ICES-[2026]

iii. international conference on ENGINEERING SCIENCES

04-06 SEPTEMBER 2026 | KONYA TÜRKİYE | IN-PERSON & ONLINE

ABSTRACT BOOK

EDITORS
Prof. Dr. Bayram AKDEMİR
Assoc. Prof. Dr. Perihan Hazel KAYA

KONYA TECHNICAL UNIVERSITY 1970

İKSAD INSTITUTE

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Institute of Economic Development and Social Research

Konya Technical University

III. International Conference on Engineering Sciences

September 04 – 06, 2026/ Konya, Türkiye

ABSTRACTS BOOK

EDITORS
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adapted by Mariam Rasulan

CONGRESS ID I
SCIENTIFIC & REVIEW COMMITTEE II
PHOTO GALLERY III
PROGRAM IV
CONTENT V
ABSTRACTS VI
ACADEMIC INCENTIVE VII

CONGRESS ID

CONGRESS TITLE
III. International Conference on Engineering Sciences

DATE and PLACE
September 4 – 6, 2026 / Konya, Türkiye

ORGANIZATION
IKSAD-Institute of Economic Development and Social Research
Konya Technical University

PARTICIPATION
Keynote & Invited

EVALUATION PROCESS
All applications have undergone a double-blind peer review process

GRAND TOTAL – ALL FILES

ACCEPTED PAPERS	TÜRKIYE	OTHER COUNTRIES
189	91	98
across 1 file(s)	48%	52%

BREAKDOWN BY COUNTRY

Türkiye	91	Latvia	1
Nigeria	21	Russia	1
Morocco	17	France	1
India	12	Iran	1
Pakistan	10	Indonesia	1
Algeria	7	Ethiopia	1
Vietnam	6	Lebanon	1
Malaysia	5	Oman	1
Georgia	2	Bangladesh	1
Ukraine	2	Poland	1
Republic of Korea	1	Colombia	1
Iraq	1	Singapore	1
Albania	1	Brazil	1

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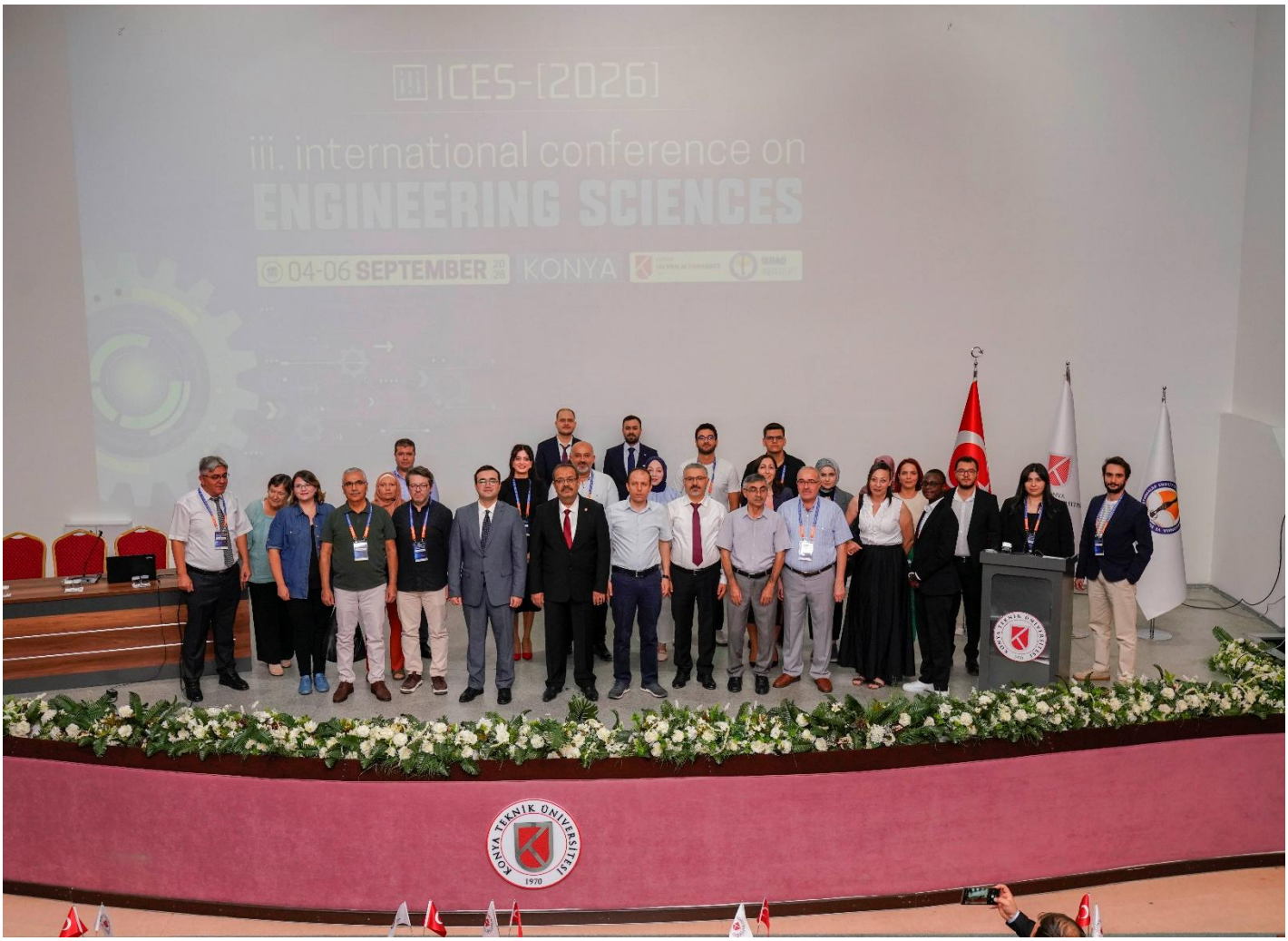






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GELİŞİMİN ÖNCÜSÜ
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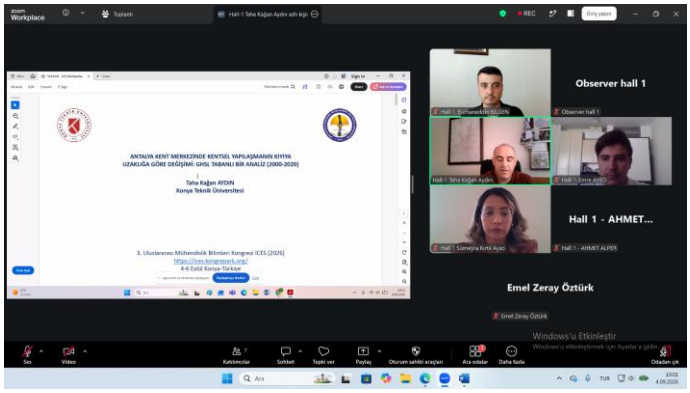
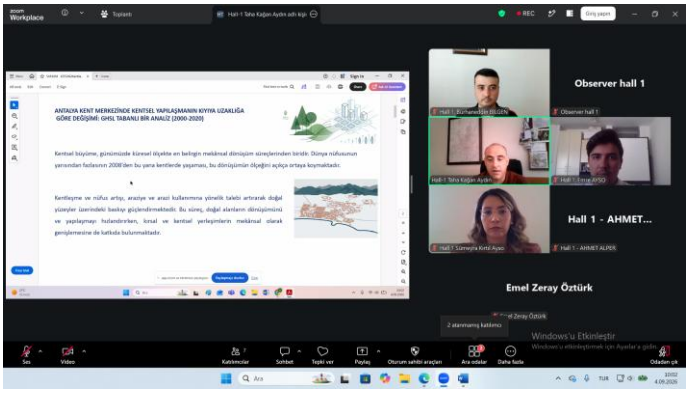

ANTALYA KENT MERKEZİNDE KENTSEL YAPILAŞMANIN KIYIYA UZAKLIĞA GÖRE DEĞİŞİMİ: GHSL TABANLI BİR ANALİZ (2000-2020)
Taha Kağan AYDIN
Konya Teknik Üniversitesi
Observer hall 1
Hall 1 - AHMET...
Emel Zeray Öztürk


ANTALYA KENT MERKEZİNDE KENTSEL YAPILAŞMANIN KIYIYA UZAKLIĞA GÖRE DEĞİŞİMİ: GHSL TABANLI BİR ANALİZ (2000-2020)
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Hall 1 - AHMET...
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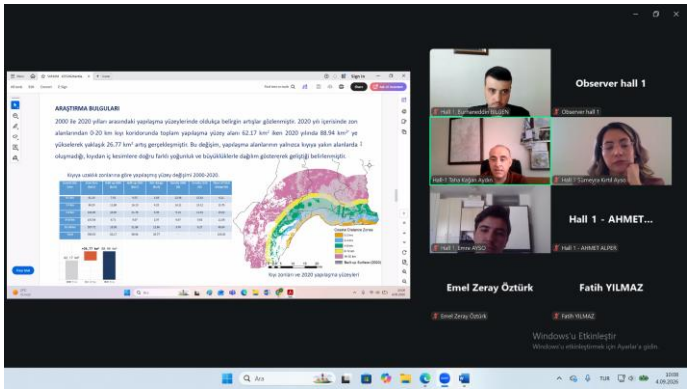
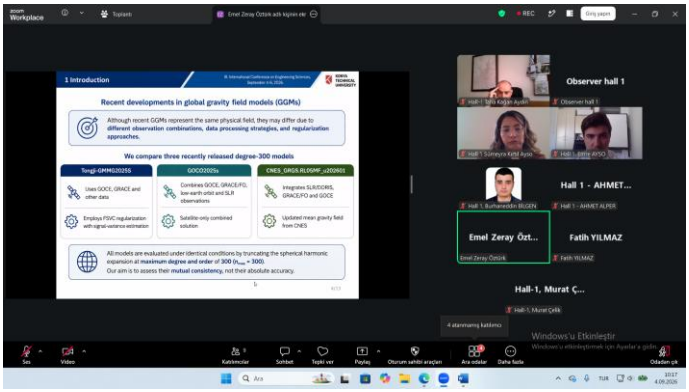
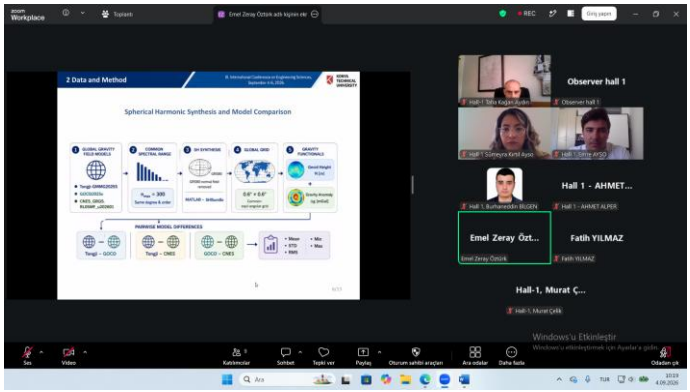
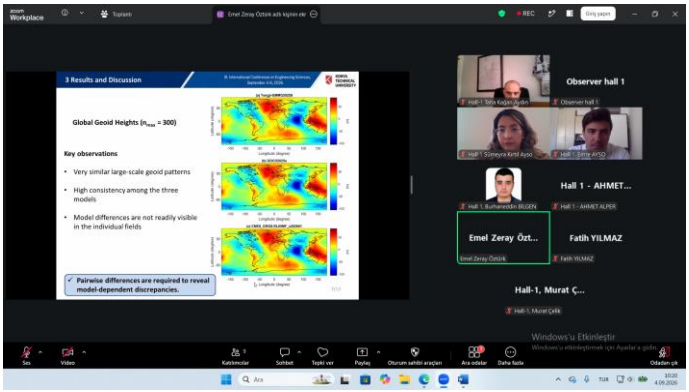
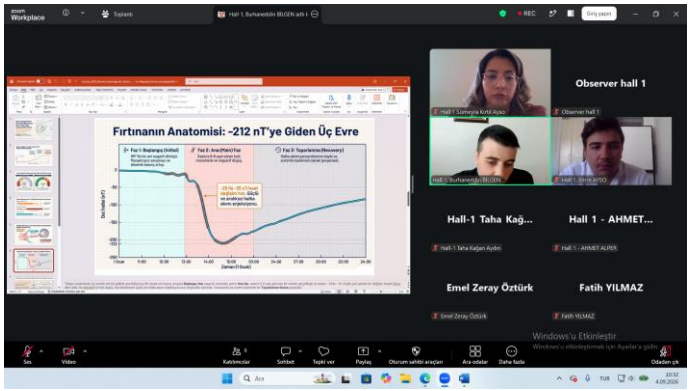
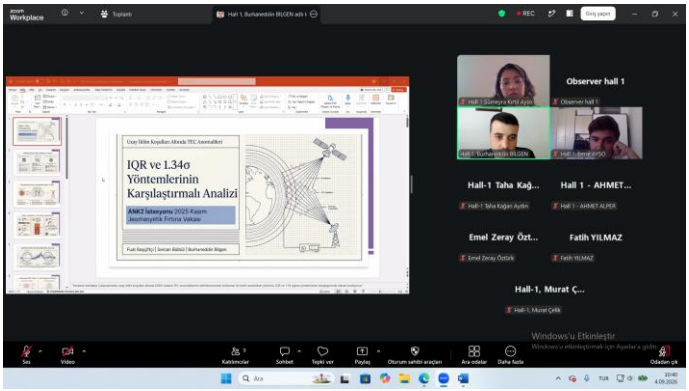

ARAŞTIRMA BULGULARI
Observer hall 1
Hall 1 - AHMET...
Emel Zeray Öztürk
Fatih YILMAZ


1 Introduction
Recent developments in global gravity field models (GGMs)
We compare three recently released degree-300 models
Observer hall 1
Hall 1 - AHMET...
Emel Zeray Özt...
Fatih YILMAZ
Hall-1, Murat Ç...


2 Data and Method
Spherical Harmonic Synthesis and Model Comparison
Observer hall 1
Hall 1 - AHMET...
Emel Zeray Özt...
Fatih YILMAZ
Hall-1, Murat Ç...


3 Results and Discussion
Global Geoid Heights (n_max = 300)
Key observations
Very similar large-scale geoid patterns
High consistency among the three models
Model differences are not readily visible in the individual fields
Pairwise differences are required to reveal model-dependent discrepancies.
Observer hall 1
Hall 1 - AHMET...
Emel Zeray Özt...
Fatih YILMAZ
Hall-1, Murat Ç...


Fırtınanın Anatomisi: -212 nT'ye Giden Üç Evre
Observer hall 1
Hall-1 Taha Kağ...
Hall 1 - AHMET...
Emel Zeray Öztürk
Fatih YILMAZ


IQR ve 1.34σ Yöntemlerinin Karşılaştırmalı Analizi
Observer hall 1
Hall-1 Taha Kağ...
Hall 1 - AHMET...
Emel Zeray Özt...
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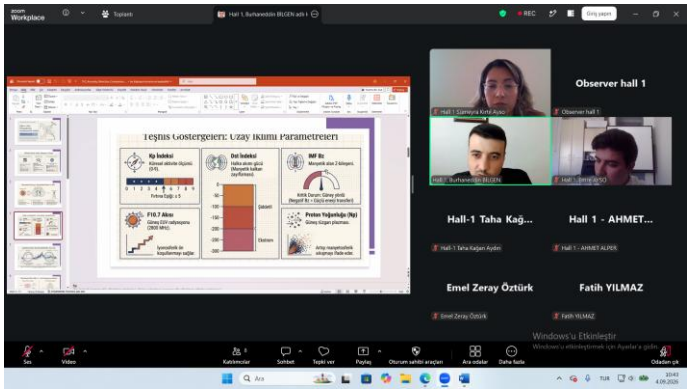
Hall-1, Murat Ç...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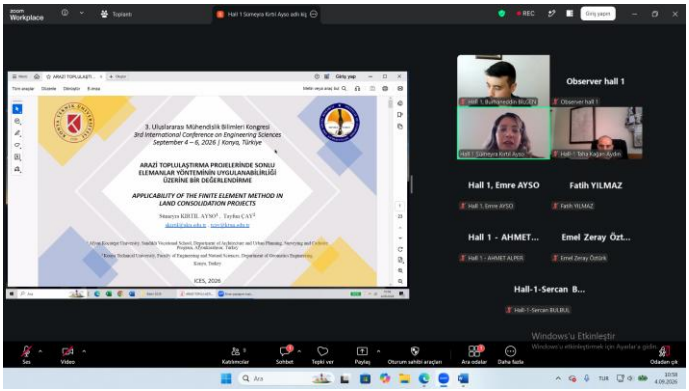
3. Uluslararası Mühendislik Bilimleri Kongresi
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September 4 – 6, 2026 | Konya, Türkiye
ARAZİ TOPLULAŞTIRMA PROJELERİNDE SONLU ELEMANLAR YÖNTEMİNİN UYGULANABİLİRLİĞİ ÜZERİNE BİR DEĞERLENDİRME
APPLICABILITY OF THE FINITE ELEMENT METHOD IN LAND CONSOLIDATION PROJECTS
ICES, 2026
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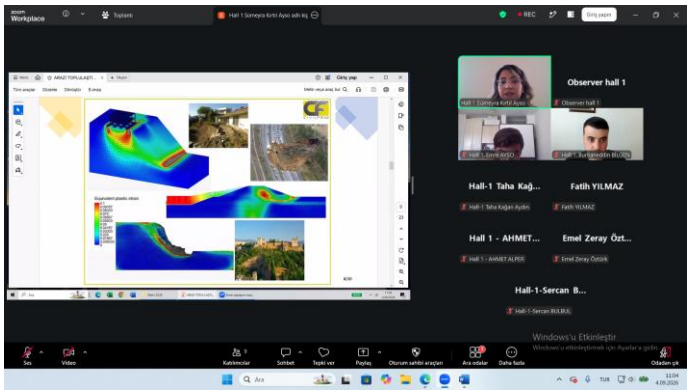
Hall 1, Emre AYSO
Fatih YILMAZ
Hall 1 - AHMET...
Emel Zeray Özt...
Hall-1-Sercan B...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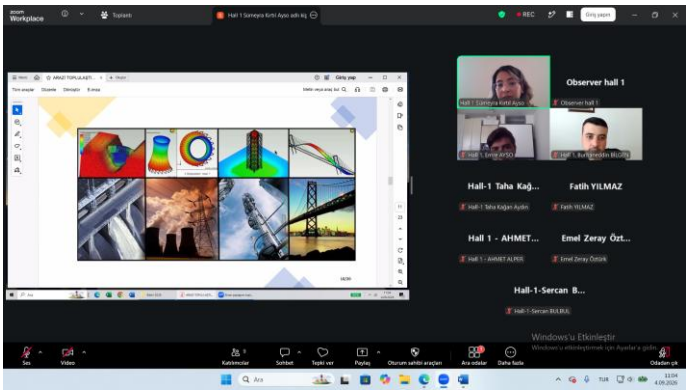
Fatih YILMAZ
Hall 1 - AHMET...
Emel Zeray Özt...
Hall-1-Sercan B...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Hall-1 Taha Kağ...
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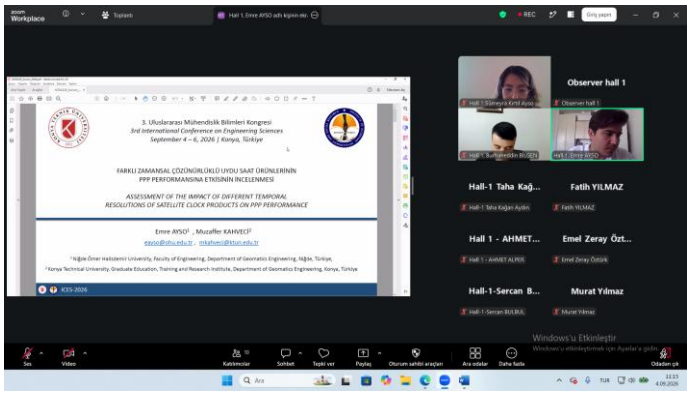
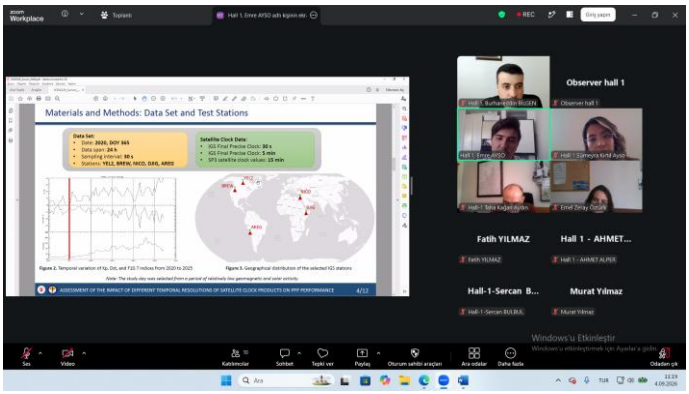
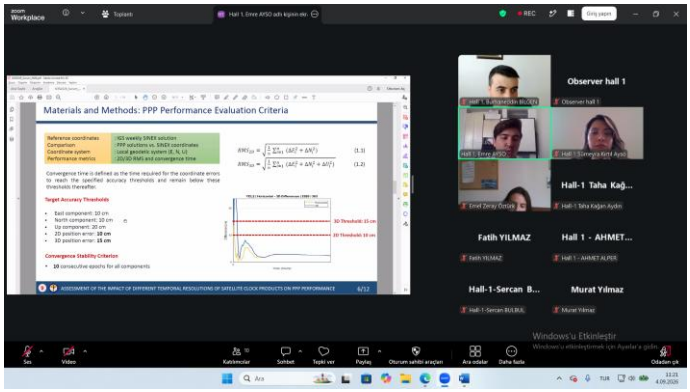
Hall 1 - AHMET...
Emel Zeray Özt...
Hall-1-Sercan B...


3. Uluslararası Mühendislik Bilimleri Kongresi
3rd International Conference on Engineering Sciences
September 4 – 6, 2026 | Konya, Türkiye
FARKLI ZAMANSAL ÇÖZÜNÜRLÜKLÜ UYDU SAAT ÜRÜNLERİNİN PPP PERFORMANSINA ETKİSİNİN İNCELENMESİ
ASSESSMENT OF THE IMPACT OF DIFFERENT TEMPORAL RESOLUTIONS OF SATELLITE CLOCK PRODUCTS ON PPP PERFORMANCE
Observer hall 1
Hall-1 Taha Kağ...
Fatih YILMAZ
Hall 1 - AHMET...
Emel Zeray Özt...
Hall-1-Sercan B...
Murat Yılmaz


Materials and Methods: Data Set and Test Stations
Observer hall 1
Fatih YILMAZ
Hall 1 - AHMET...
Hall-1-Sercan B...
Murat Yılmaz


Materials and Methods: PPP Performance Evaluation Criteria
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Hall-1 Taha Kağ...
Fatih YILMAZ
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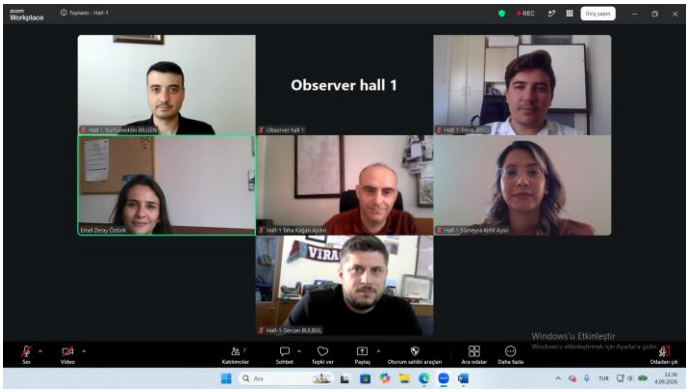
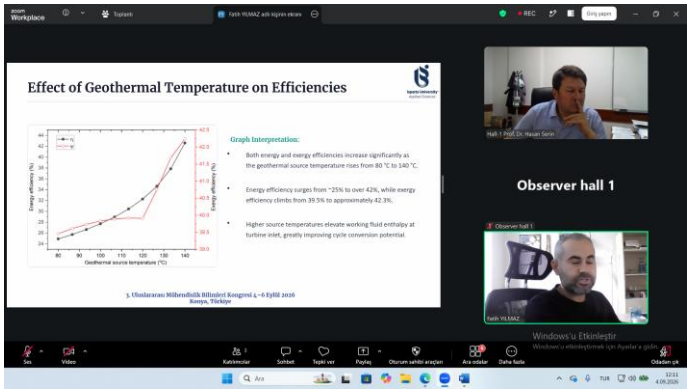
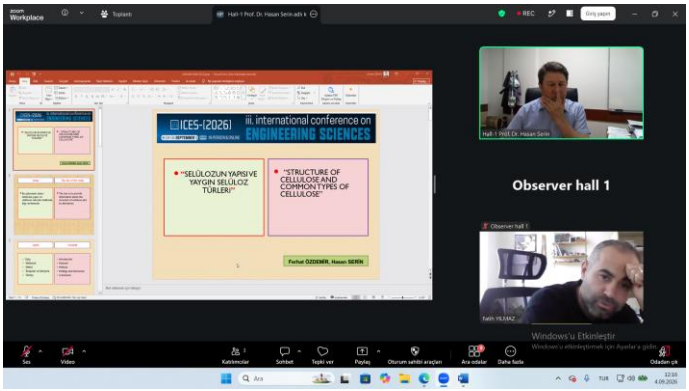
Hall-1-Sercan B...
Murat Yılmaz


Observer hall 1


Effect of Geothermal Temperature on Efficiencies
Graph Interpretation:
Observer hall 1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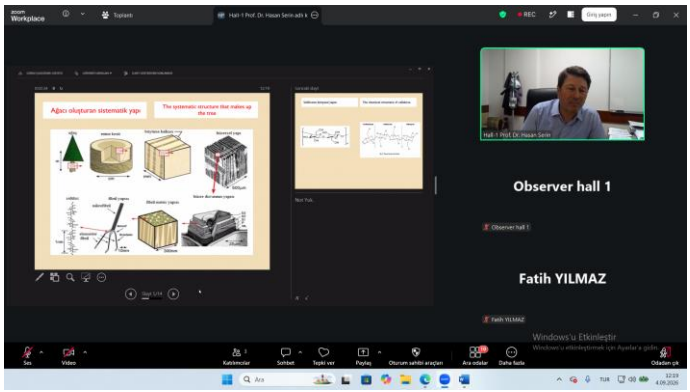
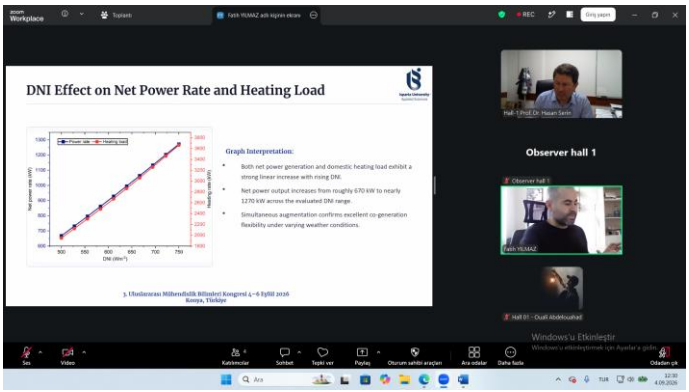
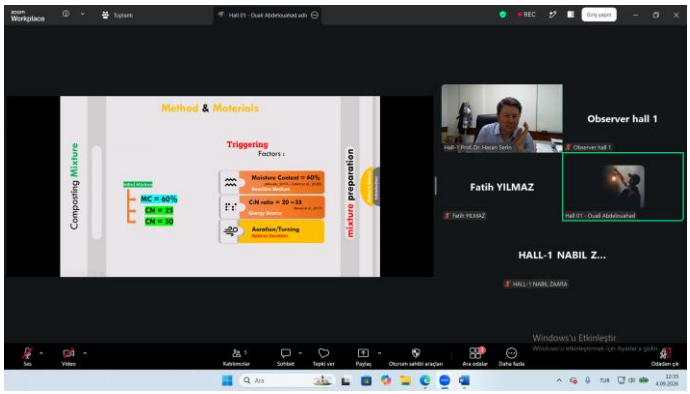
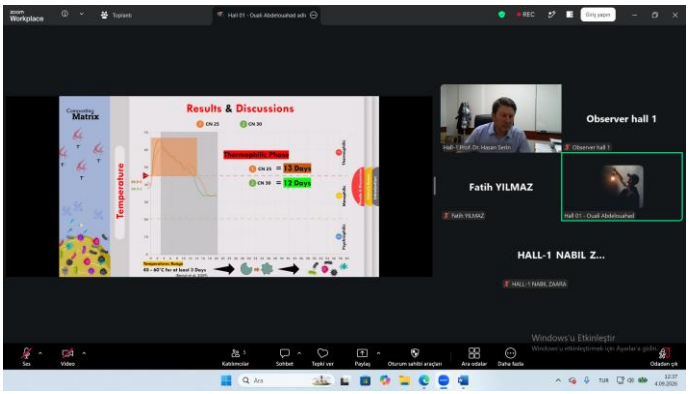
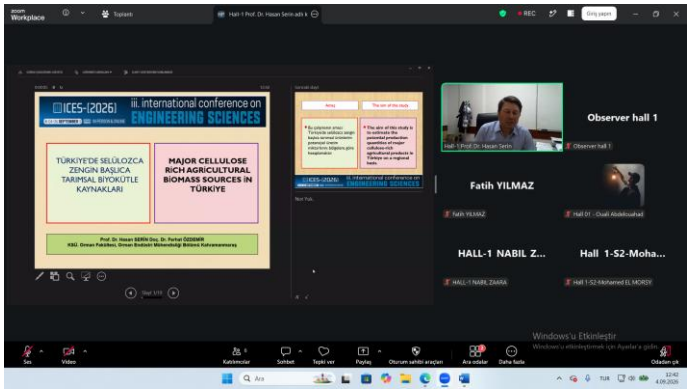
"SELÜLOZUN YAPISIVE YAYGIN SELÜLOZ TÜRLERİ"
"STRUCTURE OF CELLULOSE AND COMMON TYPES OF CELLULOSE"
Observer hall 1


Observer hall 1
Fatih YILMAZ


DNI Effect on Net Power Rate and Heating Load
Graph Interpretation:
Observer hall 1


Method & Materials
Triggering Factors :
Composting Mixture
mixture preparation
Observer hall 1
Fatih YILMAZ
HALL-1 NABIL Z...


Results & Discussions
Thermophilic Phase
Observer hall 1
Fatih YILMAZ
HALL-1 NABIL Z...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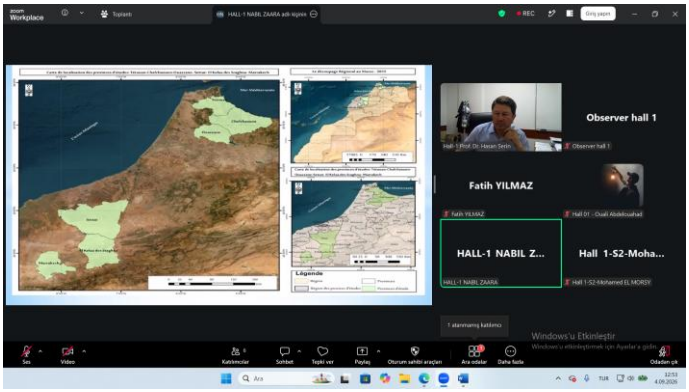
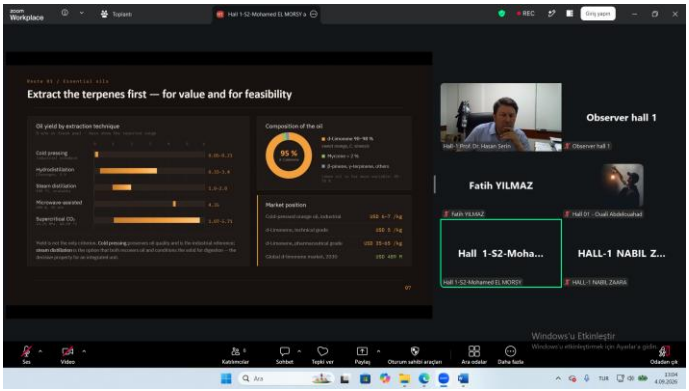
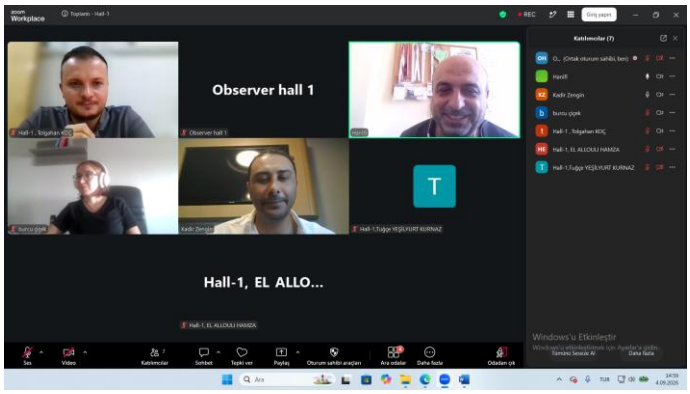
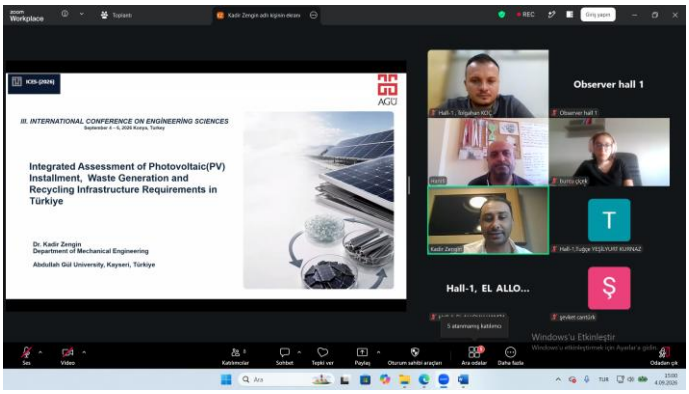
TÜRKİYE'DE SELÜLOZCA ZENGİN BAŞLICA TARIMSAL BİYOKÜTLE KAYNAKLARI
MAJOR CELLULOSE RICH AGRICULTURAL BIOMASS SOURCES IN TÜRKİYE
Observer hall 1
Fatih YILMAZ
HALL-1 NABIL Z...
Hall 1-S2-Moha...


Observer hall 1
Fatih YILMAZ
HALL-1 NABIL Z...
Hall 1-S2-Moha...

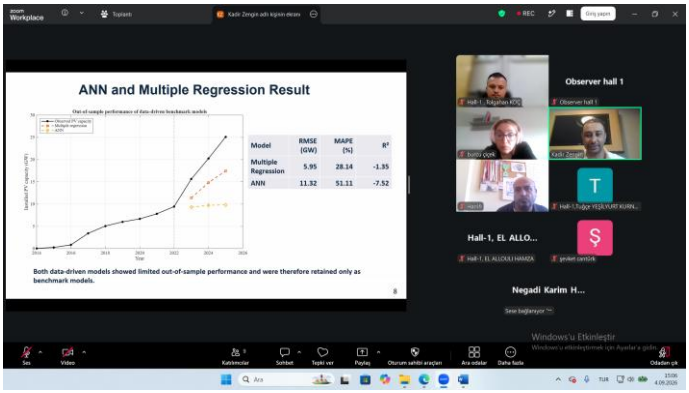

Résultats
1- La teneur en huile par apport à la matière fraiche et sèche
a- Par apport à la matière fraiche
C=Chaouen, K=Kelaa des Sraghna, M=Marrakech, O=Ouezzane, S=Settat, T=Tétouan
Observer hall 1
Fatih YILMAZ
HALL-1 NABIL Z...
Hall 1-S2-Moha...

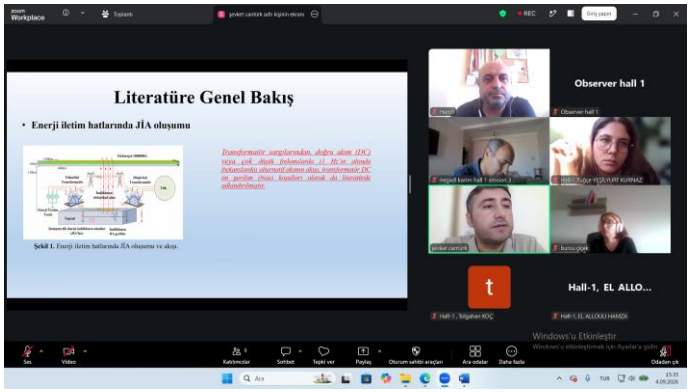

Extract the terpenes first — for value and for feasibility
Observer hall 1
Fatih YILMAZ
Hall 1-S2-Moha...
HALL-1 NABIL Z...

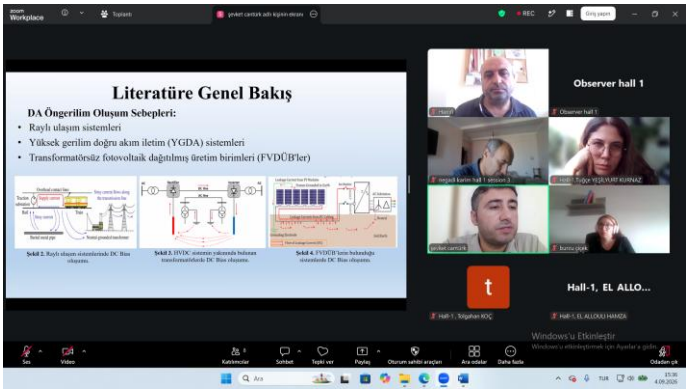

Observer hall 1
Hall-1, EL ALLO...

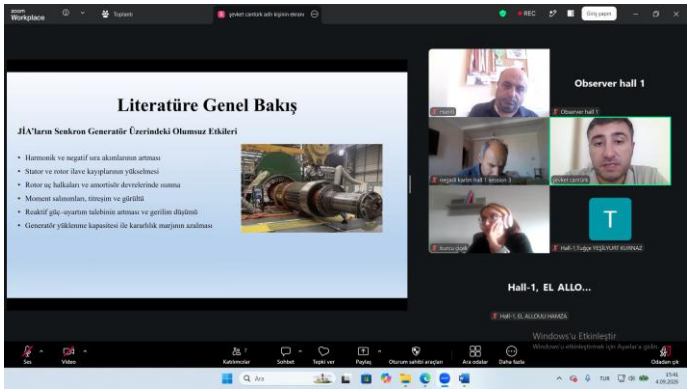

III. INTERNATIONAL CONFERENCE ON ENGINEERING SCIENCES
Integrated Assessment of Photovoltaic(PV) Installment, Waste Generation and Recycling Infrastructure Requirements in Türkiye
Dr. Kadir Zengin
Department of Mechanical Engineering
Abdullah Gül University, Kayseri, Türkiye
Observer hall 1
Hall-1, EL ALLO...

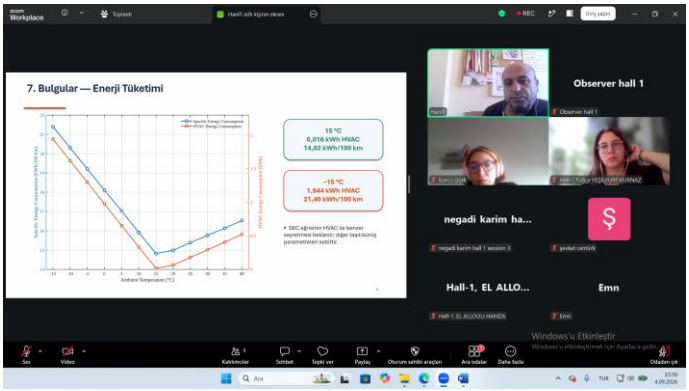

Global Electrical Energy Outlook by Resource
Global electricity generation and renewable generation by source, 2015-2025
Observer hall 1
Hall-1, EL ALLO...

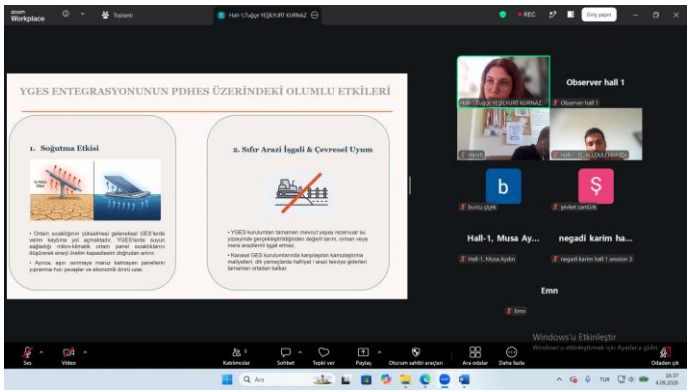

ANN and Multiple Regression Result
Model RMSE (GW) MAPE (%) R²
Multiple Regression 5.95 28.14 -1.35
ANN 11.32 51.11 -7.52
Both data-driven models showed limited out-of-sample performance and were therefore retained only as benchmark models.
Observer hall 1
Hall-1, EL ALLO...
Negadi Karim H...

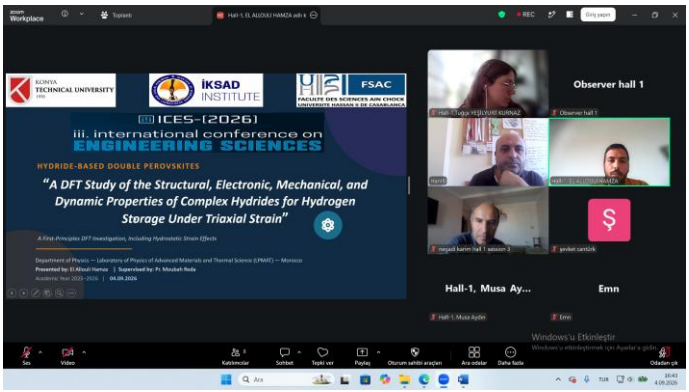

Literatüre Genel Bakış
• Enerji iletim hatlarında JİA oluşumu
Observer hall 1
Hall-1, EL ALLO...

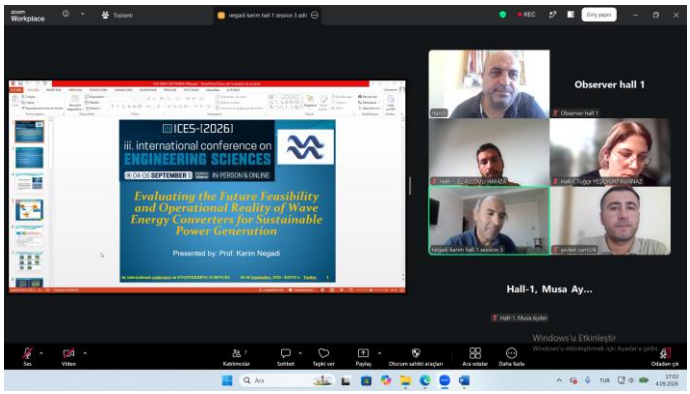

Literatüre Genel Bakış
DA Öngerilim Oluşum Sebepleri:
• Raylı ulaşım sistemleri
• Yüksek gerilim doğru akım iletim (YGDA) sistemleri
• Transformatörsüz fotovoltaik dağıtılmış üretim birimleri (FVDÜB'ler)
Observer hall 1
Hall-1, EL ALLO...

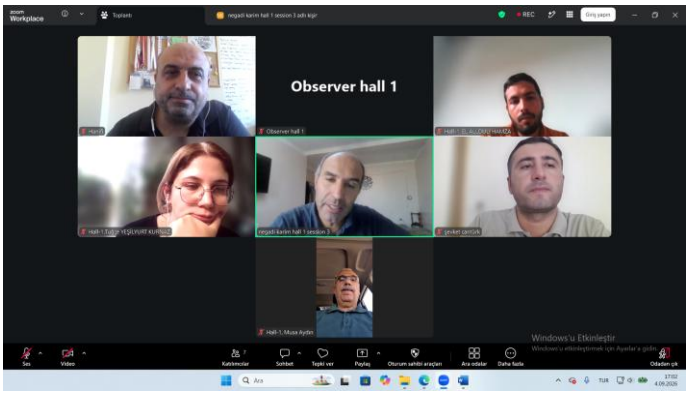

Literatüre Genel Bakış
JİA'ların Senkron Generatör Üzerindeki Olumsuz Etkileri
• Harmonik ve negatif sıra akımlarının artması
• Stator ve rotor ilave kayıplarının yükselmesi
• Rotor uç halkaları ve amortisör devrelerinde ısınma
• Moment salınımları, titreşim ve gürültü
• Reaktif güç–uyarım talebinin artması ve gerilim düşümü
• Generatör yüklenme kapasitesi ile kararlılık marjının azalması
Observer hall 1
Hall-1, EL ALLOU...

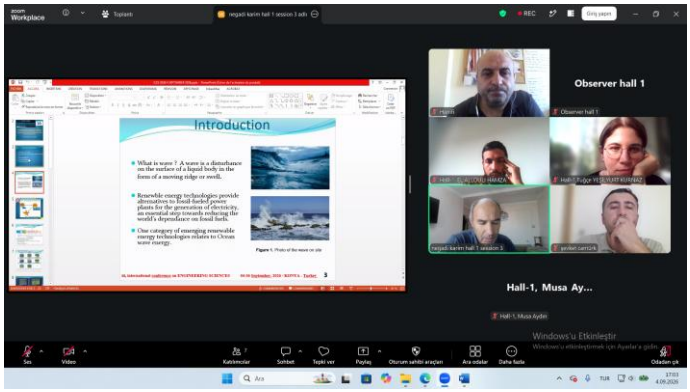

7. Bulgular — Enerji Tüketimi
15 °C
0,016 kWh HVAC
14,82 kWh/100 km
−15 °C
1,944 kWh HVAC
21,40 kWh/100 km
Observer hall 1
negadi karim ha...
Hall-1, EL ALLOU...
Emn

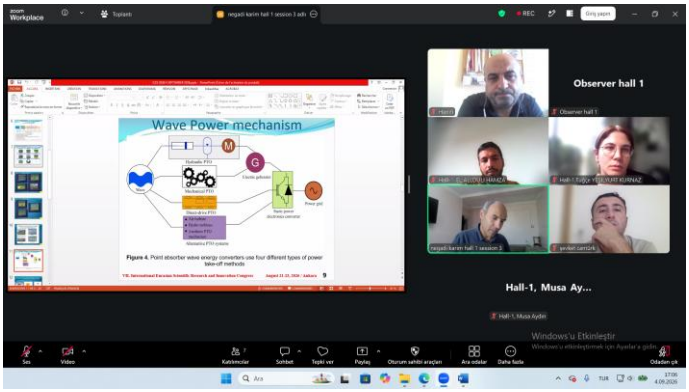

YGES ENTEGRASYONUNUN PDHES ÜZERİNDEKİ OLUMLU ETKİLERİ
1. Soğutma Etkisi
2. Sıfır Arazi İşgali & Çevresel Uyum
Observer hall 1
Hall-1, Musa Ay...
negadi karim ha...
Emn

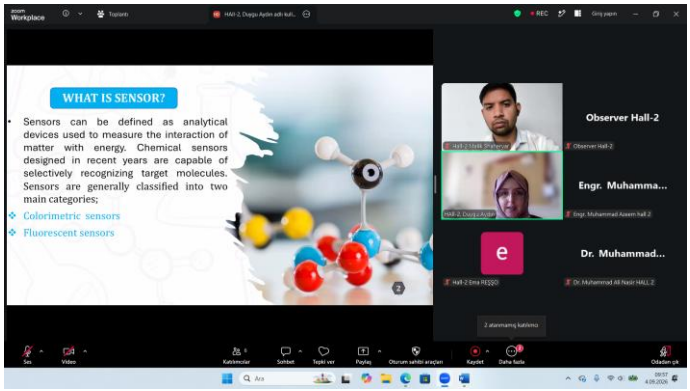

KONYA TECHNICAL UNIVERSITY
İKSAD INSTITUTE
FSAC
ICES-[2026]
iii. international conference on
ENGINEERING SCIENCES
HYDRIDE-BASED DOUBLE PEROVSKITES
"A DFT Study of the Structural, Electronic, Mechanical, and Dynamic Properties of Complex Hydrides for Hydrogen Storage Under Triaxial Strain"
Observer hall 1
Hall-1, Musa Ay...
Emn

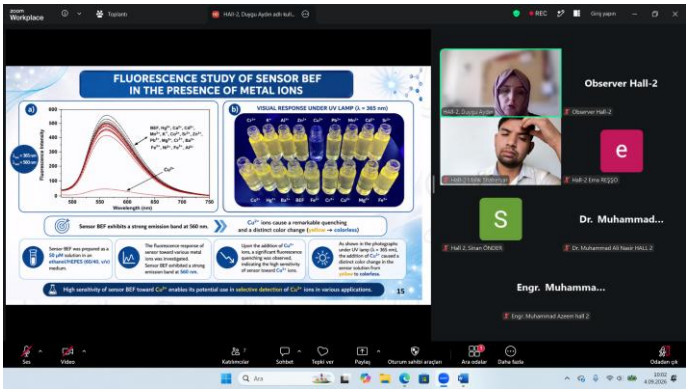

ICES-[2026]
iii. international conference on
ENGINEERING SCIENCES
04-06 SEPTEMBER IN-PERSON & ONLINE
Evaluating the Future Feasibility and Operational Reality of Wave Energy Converters for Sustainable Power Generation
Presented by: Prof. Karim Negadi
Observer hall 1
Hall-1, Musa Ay...

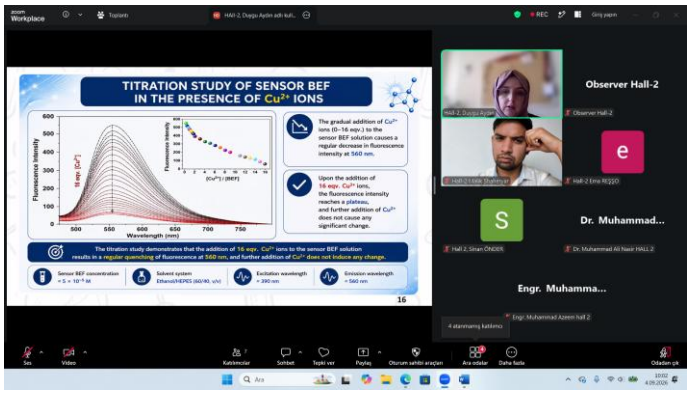

Observer hall 1

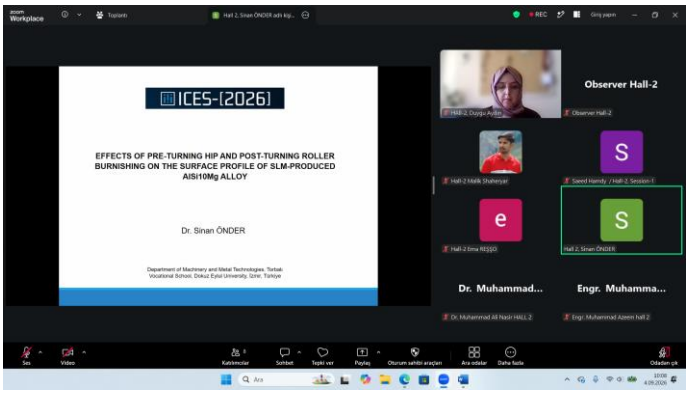

Introduction
What is wave ? A wave is a disturbance on the surface of a liquid body in the form of a moving ridge or swell.
Renewable energy technologies provide alternatives to fossil-fueled power plants for the generation of electricity, an essential step towards reducing the world's dependence on fossil fuels.
One category of emerging renewable energy technologies relates to Ocean wave energy.
Observer hall 1
Hall-1, Musa Ay...

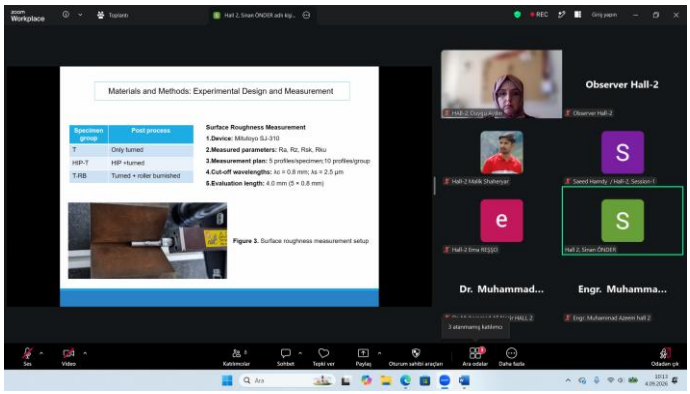

Wave Power mechanism
Observer hall 1
Hall-1, Musa Ay...

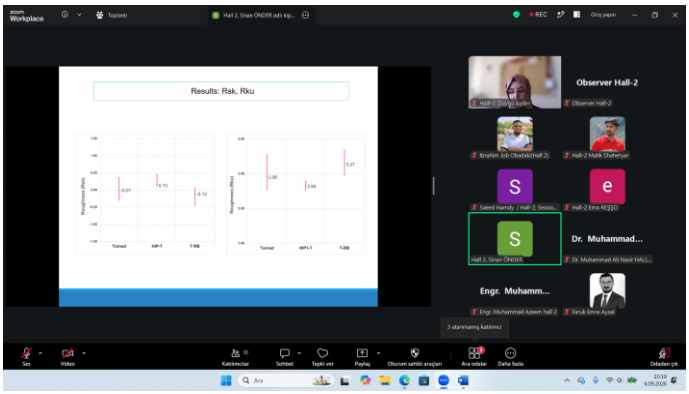

WHAT IS SENSOR?
Sensors can be defined as analytical devices used to measure the interaction of matter with energy. Chemical sensors designed in recent years are capable of selectively recognizing target molecules. Sensors are generally classified into two main categories;
Colorimetric sensors
Fluorescent sensors
Observer Hall-2
Engr. Muhamma...
Dr. Muhammad...

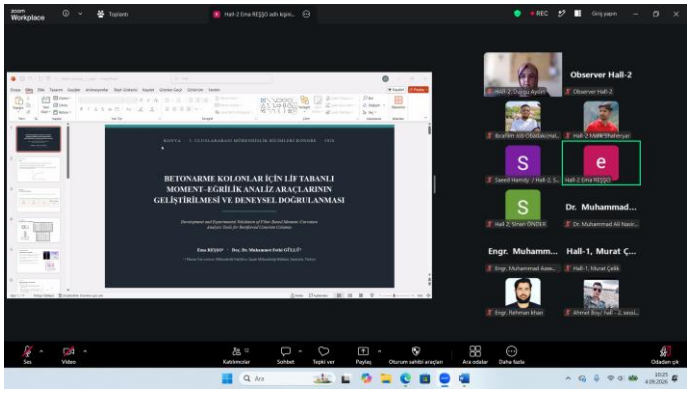

FLUORESCENCE STUDY OF SENSOR BEF IN THE PRESENCE OF METAL IONS
VISUAL RESPONSE UNDER UV LAMP (λ = 365 nm)
Sensor BEF exhibits a strong emission band at 560 nm.
High sensitivity of sensor BEF toward Cu2+ enables its potential use in selective detection of Cu2+ ions in various applications.
Observer Hall-2
Dr. Muhammad...
Engr. Muhamma...

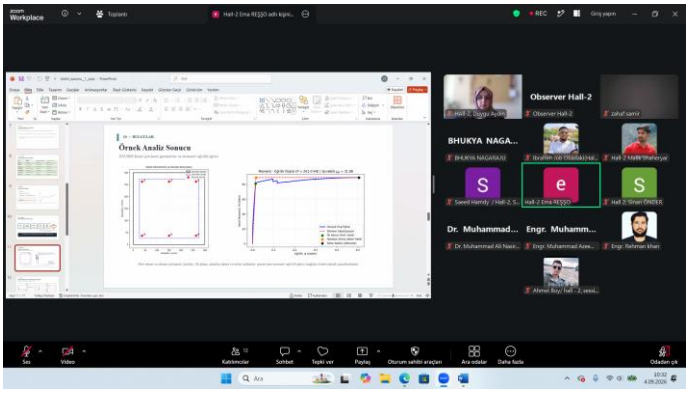

TITRATION STUDY OF SENSOR BEF IN THE PRESENCE OF Cu2+ IONS
The gradual addition of Cu2+ ions (0–16 equ.) to the sensor BEF solution causes a regular decrease in fluorescence intensity at 560 nm.
Upon the addition of 16 equ. Cu2+ ions, the fluorescence intensity reaches a plateau, and further addition of Cu2+ does not cause any significant change.
The titration study demonstrates that the addition of 16 equ. Cu2+ ions to the sensor BEF solution results in a regular quenching of fluorescence at 560 nm, and further addition of Cu2+ does not induce any change.
Observer Hall-2
Dr. Muhammad...
Engr. Muhamma...

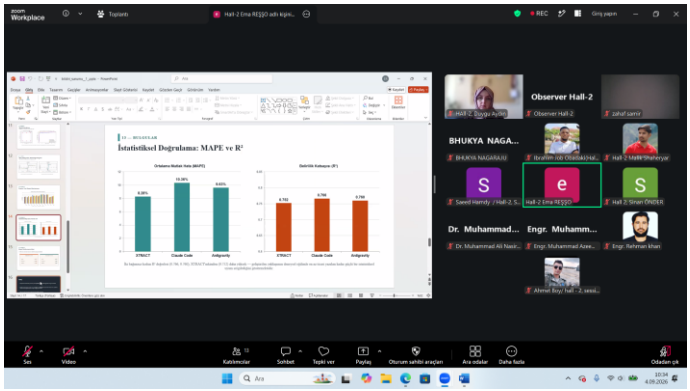

ICES-[2026]
EFFECTS OF PRE-TURNING HIP AND POST-TURNING ROLLER BURNISHING ON THE SURFACE PROFILE OF SLM-PRODUCED AISi10Mg ALLOY
Dr. Sinan ÖNDER
Observer Hall-2
Dr. Muhammad...
Engr. Muhamma...

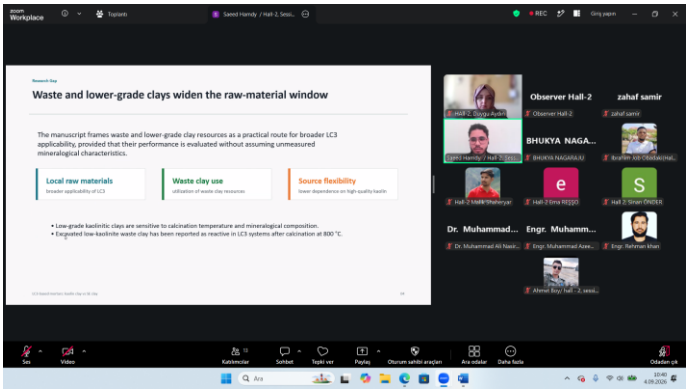

Materials and Methods: Experimental Design and Measurement
Surface Roughness Measurement
1.Device: Mitutoyo SJ-310
2.Measured parameters: Ra, Rz, Rsk, Rku
3.Measurement plan: 5 profiles/specimen,10 profiles/group
4.Cut-off wavelengths: λc = 0.8 mm; λs = 2.5 μm
5.Evaluation length: 4.0 mm (5 × 0.8 mm)
Figure 3. Surface roughness measurement setup
Observer Hall-2
Dr. Muhammad...
Engr. Muhamma...

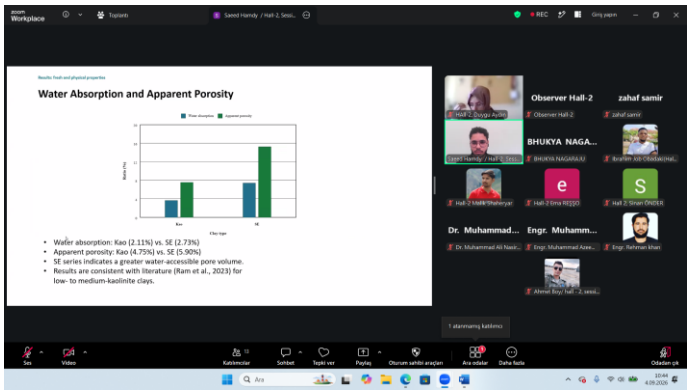

Results: Rsk, Rku
Observer Hall-2
Dr. Muhammad...
Engr. Muhamm...

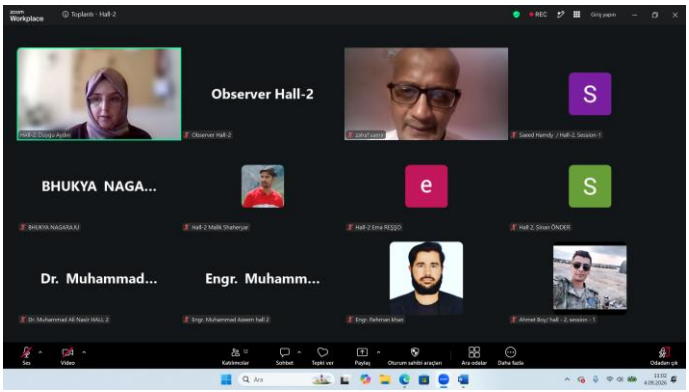

BETONARME KOLONLAR İÇİN LİF TABANLI MOMENT–EĞRİLİK ANALİZ ARAÇLARININ GELİŞTİRİLMESİ VE DENEYSEL DOĞRULANMASI
Observer Hall-2
Dr. Muhammad...
Engr. Muhamm...
Hall-1, Murat Ç...

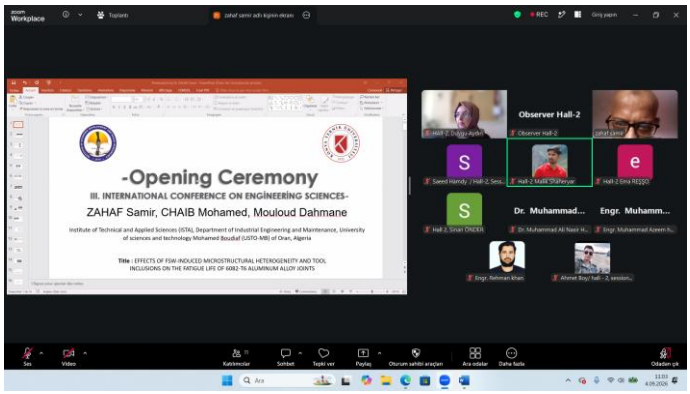

Örnek Analiz Sonucu
Observer Hall-2
BHUKYA NAGA...
Dr. Muhammad...
Engr. Muhamm...

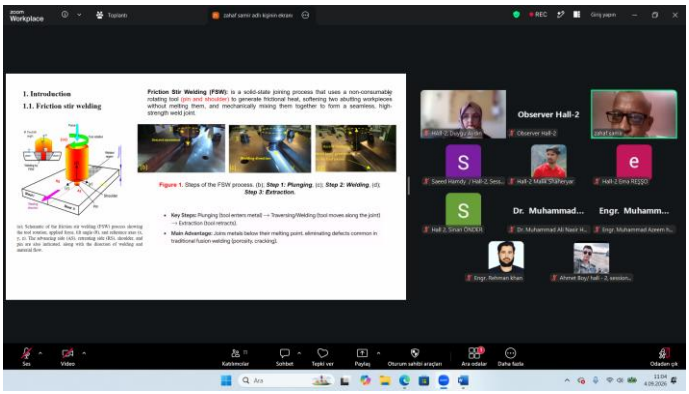

Observer Hall-2
İstatistiksel Doğrulama: MAPE ve R²
BHUKYA NAGA...
Dr. Muhammad...
Engr. Muhamm...

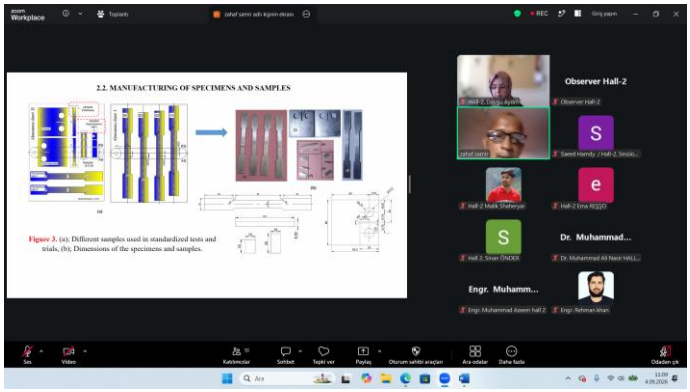

Waste and lower-grade clays widen the raw-material window
Local raw materials
Waste clay use
Source flexibility
Observer Hall-2
zahaf samir
BHUKYA NAGA...
Dr. Muhammad...
Engr. Muhamm...

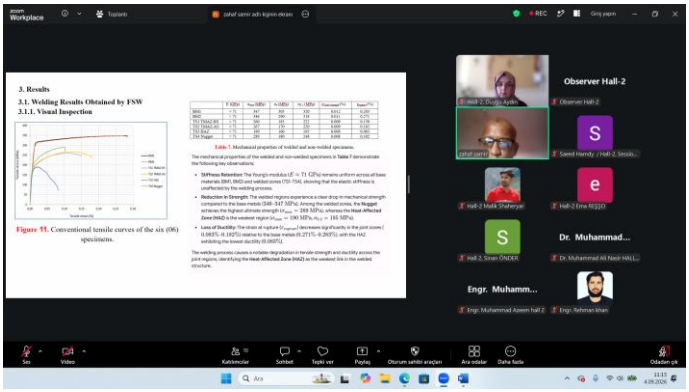

Water Absorption and Apparent Porosity
Water absorption: Kao (2.11%) vs. SE (2.73%)
Apparent porosity: Kao (4.75%) vs. SE (5.90%)
SE series indicates a greater water-accessible pore volume.
Results are consistent with literature (Ram et al., 2023) for low- to medium-kaolinite clays.
Observer Hall-2
zahaf samir
BHUKYA NAGA...
Dr. Muhammad...
Engr. Muhamm...

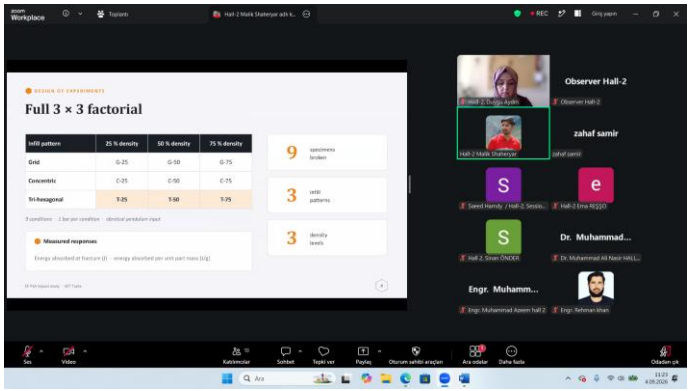

Observer Hall-2
BHUKYA NAGA...
Dr. Muhammad...
Engr. Muhamm...

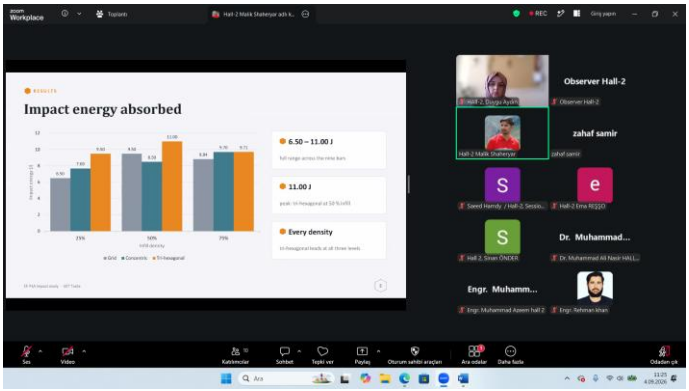

-Opening Ceremony
III. INTERNATIONAL CONFERENCE ON ENGINEERING SCIENCES-
ZAHAF Samir, CHAIB Mohamed, Mouloud Dahmane
Observer Hall-2
Dr. Muhammad...
Engr. Muhamm...


1. Introduction
1.1. Friction stir welding
Observer Hall-2
Dr. Muhammad...
Engr. Muhamm...

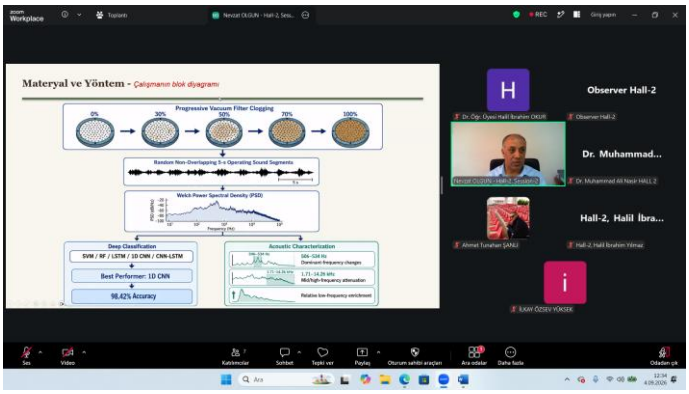

2.2. MANUFACTURING OF SPECIMENS AND SAMPLES
Observer Hall-2
Dr. Muhammad...
Engr. Muhamm...

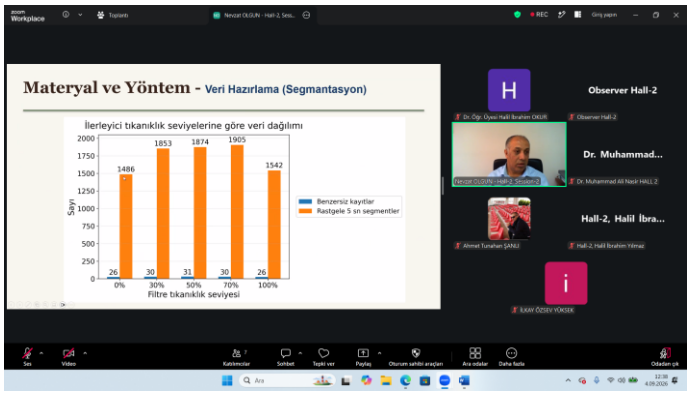

3. Results
3.1. Welding Results Obtained by FSW
3.1.1. Visual Inspection
Observer Hall-2
Dr. Muhammad...
Engr. Muhamm...

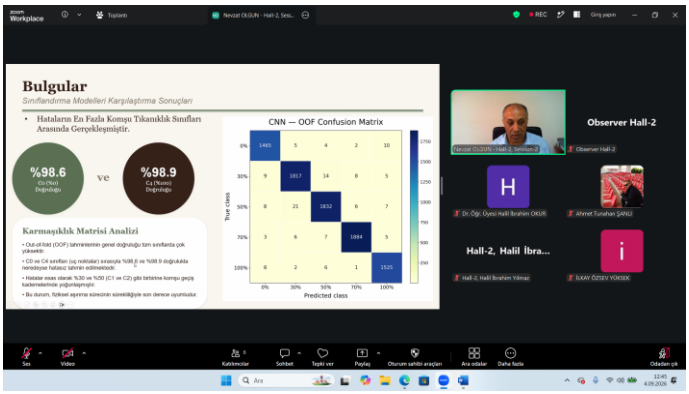

Full 3 × 3 factorial
Observer Hall-2
zahaf samir
Dr. Muhammad...
Engr. Muhamm...

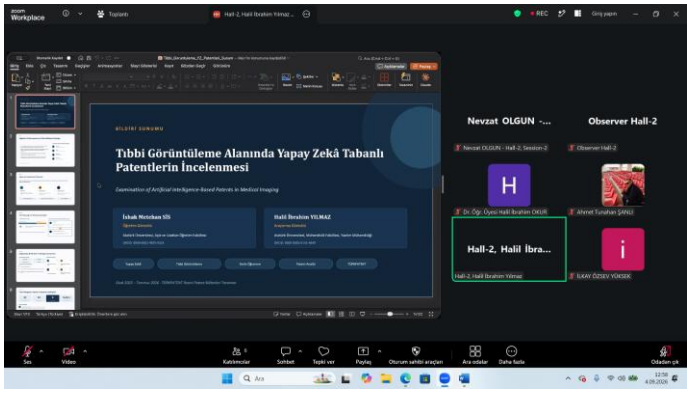

Impact energy absorbed
6.50 – 11.00 J
11.00 J
Every density
Observer Hall-2
zahaf samir
Dr. Muhammad...
Engr. Muhamm...

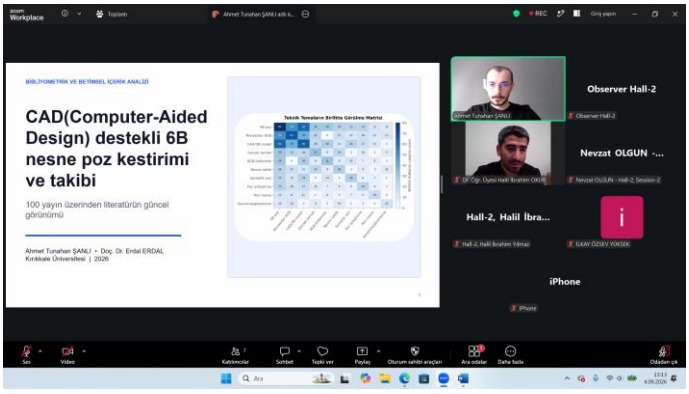

ICES-[2026]
iii. international conference on ENGINEERING SCIENCES
PROGRESİF VAKUM FİLTRESİ TIKANMASININ AKUSTİK KARAKTERİZASYONU VE DERİN SPEKTRAL SINIFLANDIRILMASI
ACOUSTIC CHARACTERIZATION and DEEP SPECTRAL CLASSIFICATION of PROGRESSIVE VACUUM FILTER CLOGGING
Dr. Öğretim Üyesi Nevzat OLGUN
Afyon Kocatepe Üniversitesi, Mühendislik Fakültesi, Yazılım Mühendisliği Bölümü
nolgun@aku.edu.tr | Afyonkarahisar, Türkiye
Observer Hall-2
Dr. Muhammad...
Hall-2, Halil İbra...
İLKAY ÖZSEV YÜKSEK

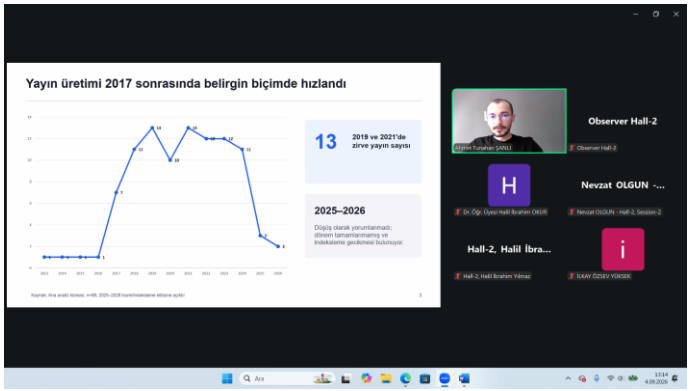

Materyal ve Yöntem - Çalışmanın blok diyagramı
Progressive Vacuum Filter Clogging
Random Non-Overlapping 5-s Operating Sound Segments
Welch Power Spectral Density (PSD)
Deep Classification
SVM / RF / LSTM / 1D CNN / CNN-LSTM
Best Performer: 1D CNN
98.42% Accuracy
Acoustic Characterization
Observer Hall-2
Dr. Muhammad...
Hall-2, Halil İbra...
İLKAY ÖZSEV YÜKSEK

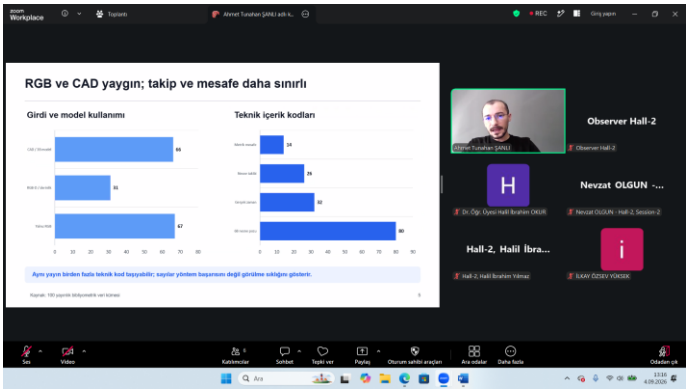

Materyal ve Yöntem - Veri Hazırlama (Segmantasyon)
İlerleyici tıkanıklık seviyelerine göre veri dağılımı
Sayı
Filtre tıkanıklık seviyesi
Benzersiz kayıtlar
Rastgele 5 sn segmentler
1486
1853
1874
1905
1542
26
30
31
30
26
0%
30%
50%
70%
100%
Observer Hall-2
Dr. Muhammad...
Hall-2, Halil İbra...
İLKAY ÖZSEV YÜKSEK

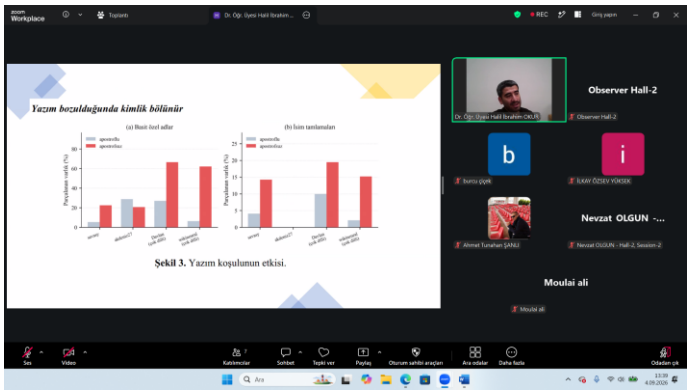

Bulgular
Sınıflandırma Modelleri Karşılaştırma Sonuçları
Hataların En Fazla Komşu Tıkanıklık Sınıfları Arasında Gerçekleşmiştir.
%98.6
%98.9
ve
Karmaşıklık Matrisi Analizi
CNN — OOF Confusion Matrix
True class
Predicted class
Observer Hall-2
Hall-2, Halil İbra...
İLKAY ÖZSEV YÜKSEK

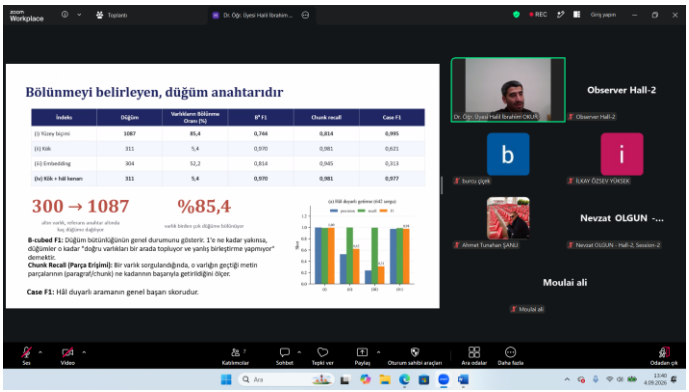

Tıbbi Görüntüleme Alanında Yapay Zekâ Tabanlı Patentlerin İncelenmesi
İshak Metehan SİS
Halil İbrahim YILMAZ
Nevzat OLGUN -...
Observer Hall-2
Hall-2, Halil İbra...
İLKAY ÖZSEV YÜKSEK


CAD(Computer-Aided Design) destekli 6B nesne poz kestirimi ve takibi
100 yayın üzerinden literatürün güncel görünümü
Ahmet Tunahan ŞANLI • Doç. Dr. Erdal ERDAL
Kırıkkale Üniversitesi | 2026
Observer Hall-2
Nevzat OLGUN -...
Hall-2, Halil İbra...
İLKAY ÖZSEV YÜKSEK
iPhone


Yayın üretimi 2017 sonrasında belirgin biçimde hızlandı
13
2019 ve 2021'de zirve yayın sayısı
2025–2026
Observer Hall-2
Nevzat OLGUN -...
Hall-2, Halil İbra...


RGB ve CAD yaygın; takip ve mesafe daha sınırlı
Girdi ve model kullanımı
Teknik içerik kodları
Observer Hall-2
Nevzat OLGUN -...
Hall-2, Halil İbra...


Yazım boşulduğunda kimlik bölünür
Şekil 3. Yazım koşulunun etkisi.
Observer Hall-2
Nevzat OLGUN -...
Moulai ali


Bölünmeyi belirleyen, düğüm anahtarıdır
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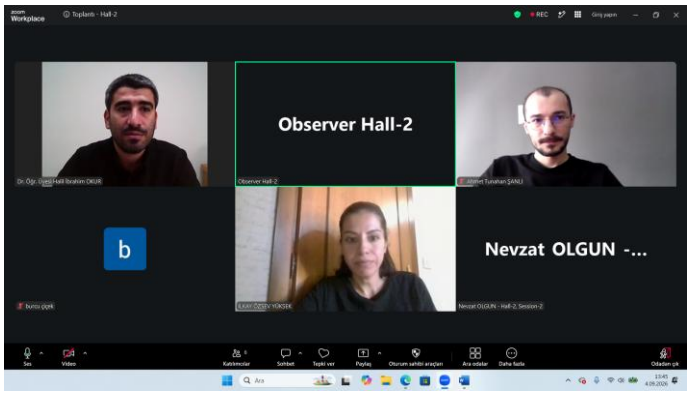
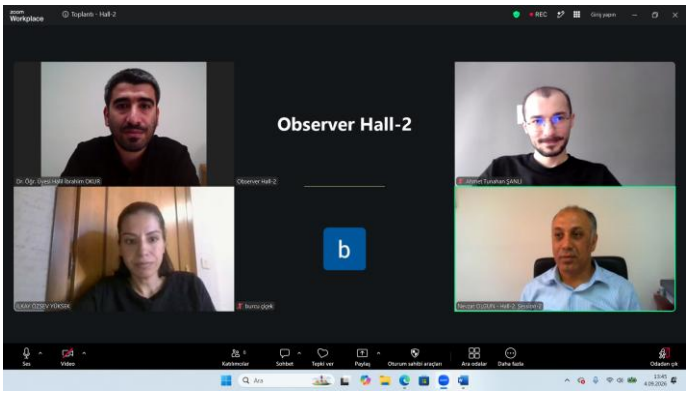
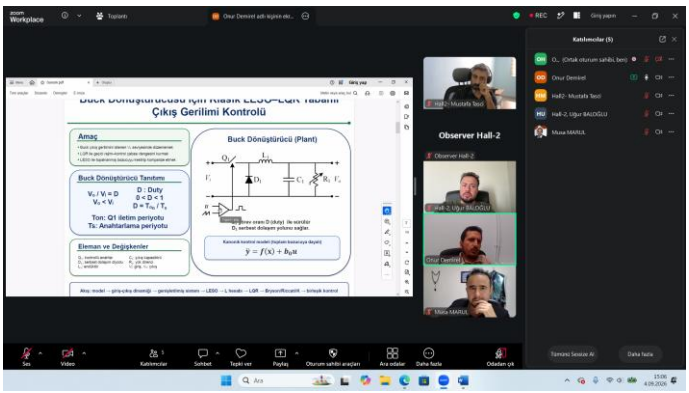
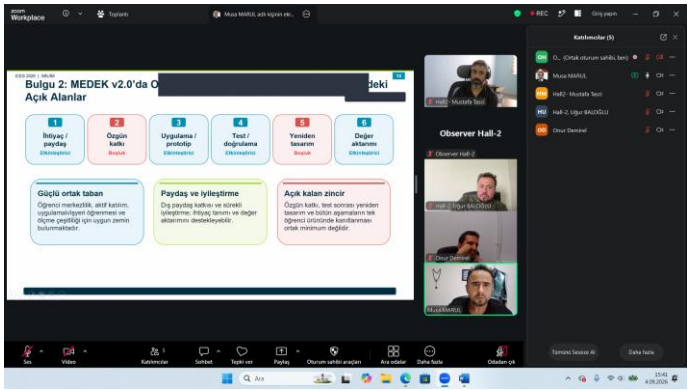
Observer Hall-2
Nevzat OLGUN -...
Moulai ali


Observer Hall-2
Nevzat OLGUN -...


Observer Hall-2


Observer Hall-2


Çıkış Gerilimi Kontrolü
Amaç
Buck Dönüştürücü (Plant)
Buck Dönüştürücü Tanıtımı
Eleman ve Değişkenler
Observer Hall-2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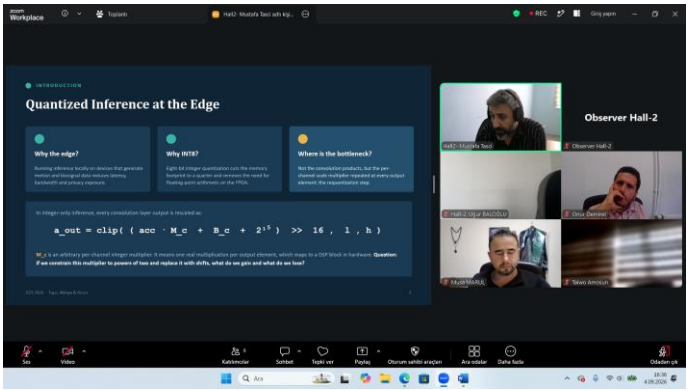
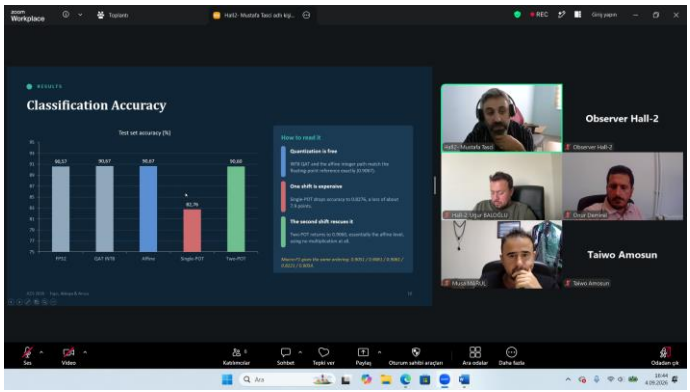
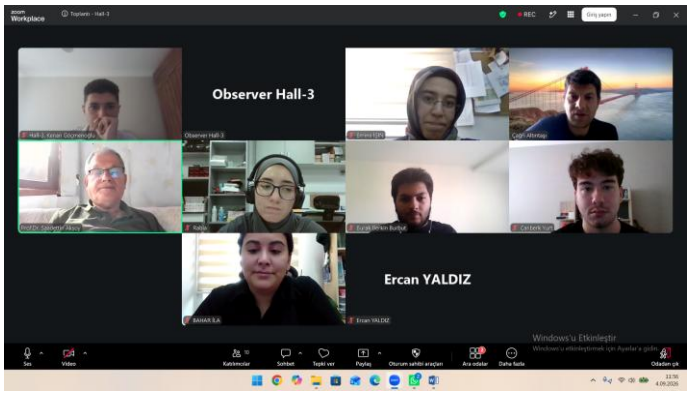
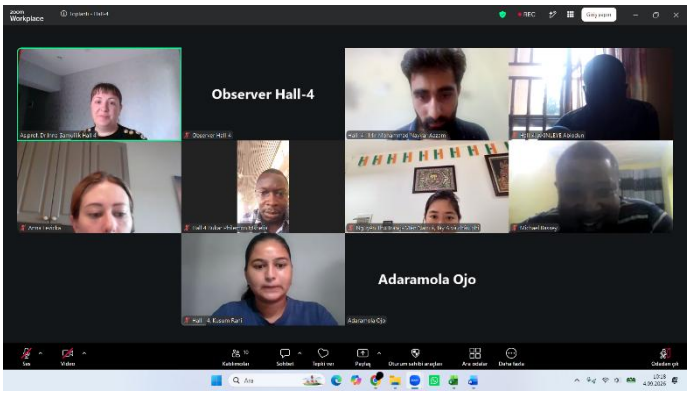
Açık Alanlar
Observer Hall-2

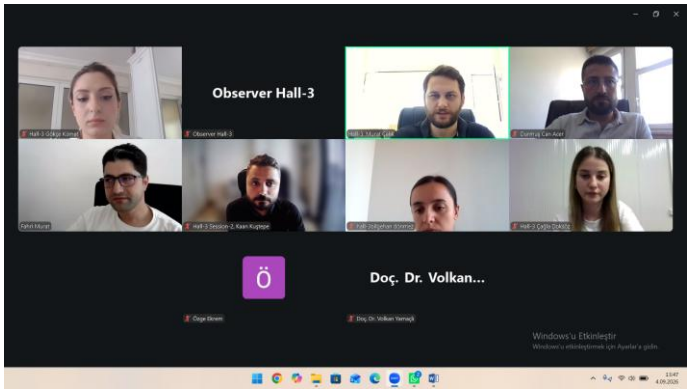

Quantized Inference at the Edge
Observer Hall-2

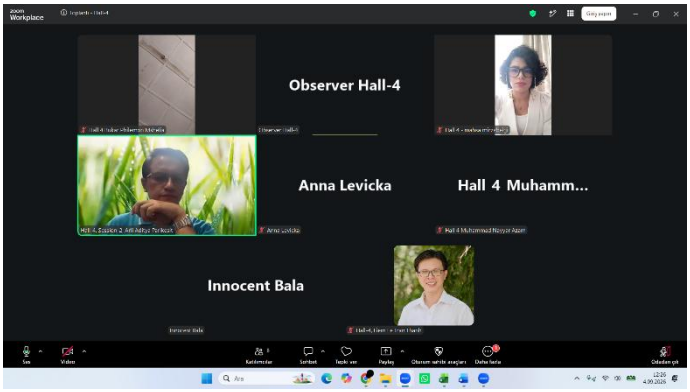

Classification Accuracy
Observer Hall-2
Taiwo Amosun


Observer Hall-2


Observer Hall-3
Ercan YALDIZ


Observer Hall-4
Adaramola Ojo


Observer Hall-3
Doç. Dr. Volkan...


Observer Hall-4
Anna Levicka
Hall 4 Muhamm...
Innocent Bala


Observer Hall-3
Hall-3 Sermin G...
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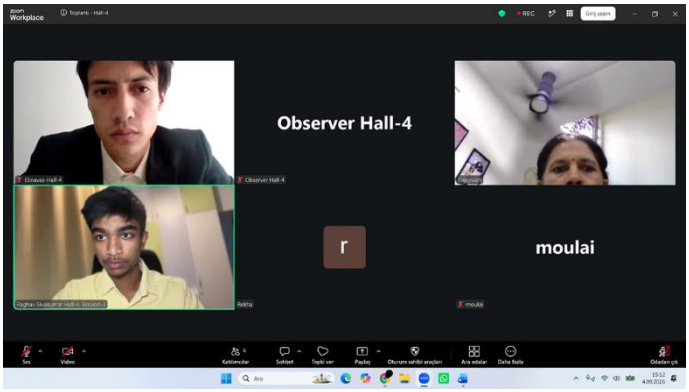
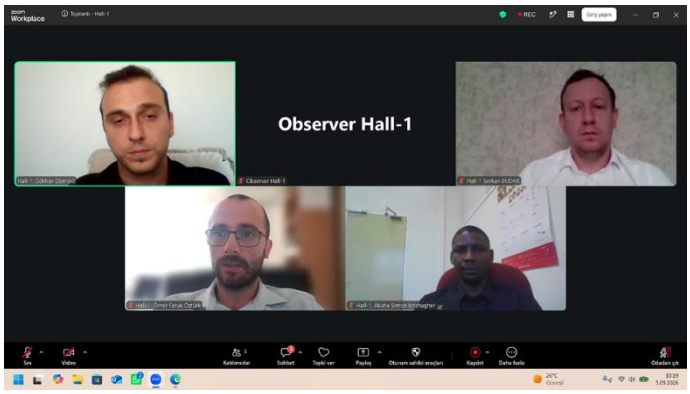
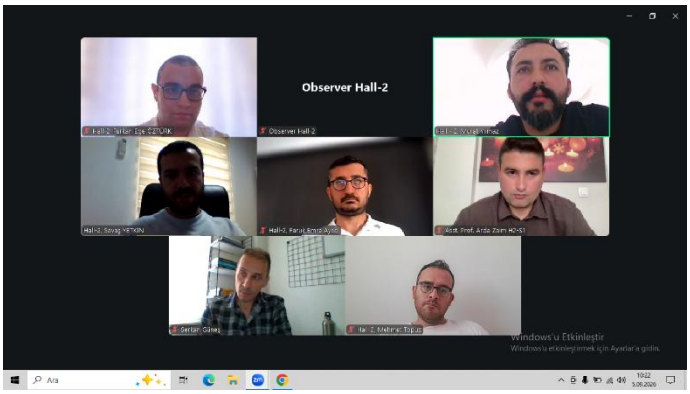
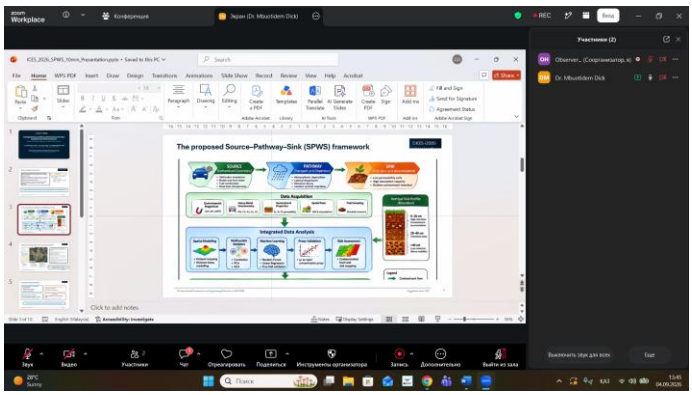
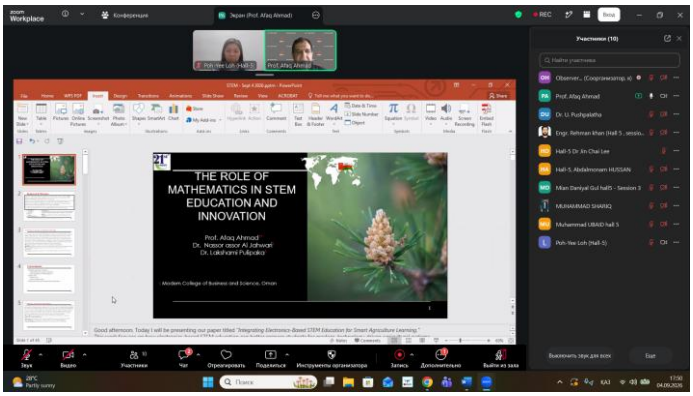

Observer Hall-4
r
moulai

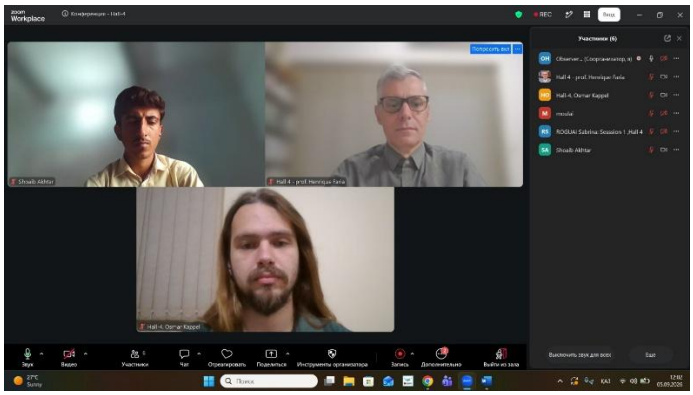

Observer Hall-1


Observer Hall-2


The proposed Source–Pathway–Sink (SPWS) framework


THE ROLE OF MATHEMATICS IN STEM EDUCATION AND INNOVATION
Prof. Afaq Ahmad
Dr. Nassor Nassor Al Jahwari
Dr. Lakshmi Pullicatu
Modern College of Business and Science, Oman


I. INTRODUCTION
Unmanned Aerial Vehicles (UAVs), commonly known as pilotless aircraft or drones, are aircraft that can operate without a human pilot onboard. They are controlled remotely by a ground operator or fly fully autonomously based on pre-programmed systems and AI (J. Gordon Leishman, 2026). Current practical applications of UAVs are no longer confined to laboratories; they are transforming the landscape of various industries (J. Gordon Leishman, 2026; L. Lakshdhar et al., 2025).



ICES-[2026]

iii. international conference on ENGINEERING SCIENCES

04-06 SEPTEMBER 2026 | KONYA TÜRKİYE | IN-PERSON & ONLINE

CONFERENCE PROGRAM



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-Opening Ceremony

III. INTERNATIONAL CONFERENCE ON ENGİNEERİNG SCIENCES-

Date: **04.09.2026**
Ankara Local Time: **11:00-12:00**
Place: **Konya Technical University**

9:00	**Start at 9:00AM**	
9:30	**Registration Start**	
11:20	**Take a photo for the conference opening ceremony.**	
11:30	**Rector's Opening Speech**	
12:00	**Lunch**	

III. INTERNATIONAL CONFERENCE ON ENGİNEERİNG SCIENCES

Prof. Dr. Bayram AKDEMİR - Konya Technical University
Dr. Atabek MOVLYANOV – General Coordinator of IKSAD Institute
Assoc. Prof. Dr. Sercan DOĞAN - Konya Chamber of Mechanical Engineers President
Vehbi KONARILI - Republic of Türkiye Ministry of Industry and Technology, Konya Provincial Director of Industry and Technology
Mustafa BÜYÜKEĞEN - Konya Chamber of Industry President
Prof. Dr. Osman Nuri ÇELİK - Konya Technical University Rector





IN-PERSON PRESENTATIONS

04.09.2026 / Hall-1

ANKARA LOCAL TIME

13 30 : 16 00

Konya Technical University

HEAD OF SESSION:

AUTHORS	AFFILIATION	TOPIC TITLE
Sezer SAĞLAM Veysel Karani YILMAZ Yusuf Tuna BİRER Rifat AKGÜL Kutluhan Emre Ahmet AVCI	KTO Karatay University, Türkiye Mercedes Benz Türk A.Ş., Aksaray, Türkiye Aksaray University, Türkiye Yıldız Technical University, Türkiye	OVERLOOKED PROCESS CONSTRAINTS IN THE TRANSFER OF NEW DESIGNS TO MASS PRODUCTION: ASSEMBLY TOOL ACCESSIBILITY AND FASTENER STANDARDISATION
Kadir ERDOĞAN Sercan YAĞMUR Sercan DOĞAN Aziz Hakan ALTUN	Çağlayan Soğutma A.Ş. Konya Technical University, Türkiye Necmettin Erbakan University, Türkiye	CFD BASED OPTIMIZATION OF AIR GUIDES FOR IMPROVING AIR CURTAIN PERFORMANCE IN OPEN REFRIGERATED DISPLAY CABINETS
Sezer SAĞLAM Veysel Karani YILMAZ Yusuf Tuna BİRER Rifat AKGÜL Ahmet AVCI	KTO Karatay University, Türkiye Mercedes Benz Türk A.Ş., Aksaray, Türkiye Aksaray University, Türkiye	COMPARISON OF ADDITIVE AND SUBTRACTIVE MANUFACTURING FOR TEMPLATES USED ON A HEAVY COMMERCIAL VEHICLE ASSEMBLY LINE IN TERMS OF COST, LEAD TIME AND MATERIAL CONSUMPTION
Veysel Karani YILMAZ Sezer SAĞLAM Yusuf Tuna BİRER Rıfat AKGÜL Ahmet AVCI	Mercedes Benz Türk A.Ş., Aksaray, Türkiye KTO Karatay University, Türkiye Aksaray University, Türkiye	REDUNDANCY DETECTION AND VISUALIZATION IN COMMERCIAL VEHICLE CONFIGURATION RULES
Recep Emre ÜNAL Osman KOCAASLAN Muharrem Hilmi AKSOY	Konya Technical University, Türkiye Selçuk University, Türkiye	NUMERICAL INVESTIGATION OF THE EFFECT OF GROOVE DEPTH ON NEAR-WAKE STRUCTURE AND DRAG OF A TRIANGULAR-GROOVED CIRCULAR CYLINDER
Erkan Caner OZKAT Tarık UNLER	Recep Tayyip Erdogan University, Türkiye Necmettin Erbakan University, Türkiye	REPORTING CONVENTIONS IN AIRCRAFT ENGINE REMAINING USEFUL LIFE PREDICTION
Mehmet Selim DEMİRTAŞ	Hitit University, Türkiye	THE REFLECTION OF DEFENCE INDUSTRY GROWTH ON PREFERENCES FOR ENGINEERING PROGRAMMES

IN-PERSON PRESENTATIONS

04.09.2026 / Hall-2

ANKARA LOCAL TIME

13 30 : 16 00

Konya Technical University

HEAD OF SESSION:

AUTHORS	AFFILIATION	TOPIC TITLE
Zeynep HABER Harun UGUZ Hüseyin HAKLI	Konya Technical University, Türkiye Necmettin Erbakan University, Türkiye	AN IMPROVED HYBRID NSGA-II ALGORITHM FOR THE REALLOCATION PROBLEM IN LAND CONSOLIDATION
Nuri KOŞTU Erkan ÜLKER	Konya Technical University, Türkiye	POST-QUANTUM CRYPTOGRAPHY (PQC): DEFENSE STRATEGIES AGAINST QUANTUM THREATS AND ALGORITHM ANALYSES
Hasan GÜLER Mehmet Veysel ÇAKIR	Kilis 7 Aralık University, Türkiye	THE IMPACT OF OPTIMAL CRITERION AND SEARCH ALGORITHM SELECTION ON ML GENERALIZATION SUCCESS IN CATEGORICAL FACTOR FDM DESIGNS
Hasan GÜLER Mehmet Veysel ÇAKIR	Kilis 7 Aralık University, Türkiye	OPTIMIZATION OF STIFFNESS-DUCTILITY TRADE-OFF IN FDM 3D PRINTING THROUGH MULTI-CRITERIA DECISION MAKING: AN APPROACH FOCUSED ON ELASTIC MODULUS AND MAXIMUM STRAIN
Kamilia KHANNOUSSI Ahmet Afşin KULAKSIZ	Konya Technical University, Türkiye	ENHANCING THE LVRT CAPABILITY OF A GRID-CONNECTED PHOTOVOLTAIC SYSTEM UNDER LINE-TO-LINE FAULT CONDITIONS USING TD3-BASED DEEP REINFORCEMENT LEARNING
Tasara Fani KARAZA Ahmet Afşin KULAKSIZ	Konya Technical University, Türkiye	ELECTROMAGNETIC INTERFERENCE (EMI) FILTER FOR ELECTRIC VEHICLES
Mehmet Kaan AKGÜN Ahmet Faruk BİREKUL Nazmiye KOPACAK	Enexus Renewable SRL, Romania Birtech Bilgi Teknolojileri, Türkiye Maltepe University, Türkiye	TECHNICAL AND REGULATORY ASSESSMENT OF FLOATING PHOTOVOLTAIC SYSTEMS IN TÜRKİYE: A CASE STUDY OF DEMİRKÖPRÜ DAM

IN-PERSON PRESENTATIONS

04.09.2026 / Hall-3

ANKARA LOCAL TIME

13 30 : 16 00

Konya Technical University

HEAD OF SESSION:

AUTHORS	AFFILIATION	TOPIC TITLE
Ayşenur ÖZLER Mehmet Ergül YEŞİLYURT İrem Sude ALTUNTAŞ Beyza GÖRGÜN Ahmet Tunahan ACAR Muhammet Zahit HARMANKAYA	Eksun Gıda, Türkiye	THE EFFECT OF CHICKPEA FLOUR ON THE TECHNOLOGICAL AND RHEOLOGICAL PROPERTIES OF WHEAT DOUGH
Öznur ATAÇ AYDIN Hüseyin ÇETİN	Meram District Directorate of Agriculture and Forestry Konya, Türkiye Selçuk University, Türkiye	BIOLOGY, DAMAGE AND CONTROL OF THE MEDITERRANEAN FRUIT FLY [*Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)]
Gulnaz DALOGLU	Eskisehir Osmangazi University, Türkiye	EVALUATION OF THE KUYUCAK AND SİVRİHİSAR (ESKISEHIR) DOLOMITES AS AGGREGATE ACCORDING TO ALCALI CARBONATE REACTIVITY
Oktay YÜKSEL Musa AYDIN	Konya Technical University, Türkiye	TECHNICAL AND ECONOMIC ANALYSIS OF DE-ICING METHODS FOR ELECTRIC POWER TRANSMISSION LINES
Utku Kaftancioglu Yagmur Nalbant Atak	Atılım University, Türkiye	ANN ASSISTED PARAMETRIC OPTIMIZATION OF HYDROGEN PRODUCTION FROM STEAM REFORMING OF METHANE, METHANOL AND ETHANOL
Yagmur Nalbant Atak	Atılım University, Türkiye	GENETIC-ALGORITHM-BASED OPTIMIZATION OF SUSTAINABLE METHANOL PRODUCTION FROM WASTEWATER-DERIVED CO_2
Murat KARACA Arif Emre KAYA	Selcuk University, Türkiye	MILLET SPECIES (Panicum spp.) CULTIVATED IN TÜRKİYE AND WEED CONTROL

IN-PERSON POSTER PRESENTATIONS

04.09.2026

ANKARA LOCAL TIME

10 00 : 16 00

Konya Technical University

AUTHORS	AFFILIATION	TOPIC TITLE
Utku Kaftancioglu	Atılım University, Türkiye	CHABOCHE INFORMED NEURAL NETWORK FOR FATIGUE LIFE PREDICTION UNDER TWO LEVEL BLOCK LOADING
Elif Şeflek	Sinop University, Türkiye	INVESTIGATION OF SMALL MODULAR REACTOR (SMR) TECHNOLOGY: NuScale Power Design
Ömer Selim Erbatur Muhammed Emir Ertanık Emre Burak Ertuş	KTO Karatay University, Türkiye	ENERGY ABSORPTION BEHAVIOR OF VINYL ESTER-FILLED LASER POWDER BED FUSION INCONEL 718 SHEET GYROID STRUCTURES

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ONLINE PRESENTATIONS

04.09.2026 / Hall-1, Session-1

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	10 ^{00} : 12 ^{00}		PASSCODE: 123456

HEAD OF SESSION: Dr. Emel Zeray Öztürk

AUTHORS	AFFILIATION	TOPIC TITLE
Taha Kağan Aydın	Konya Technical University, Türkiye	CHANGES IN URBAN BUILT-UP DEVELOPMENT BY DISTANCE FROM THE COAST IN ANTALYA CITY CENTER: A GHSL-BASED ANALYSIS (2000-2020)
Emel Zeray Öztürk	Konya Technical University, Türkiye	COMPARISON OF RECENT DEGREE-300 GLOBAL STATIC GRAVITY FIELD MODELS IN TERMS OF GEOID HEIGHTS AND GRAVITY ANOMALIES
Sercan BÜLBÜL Fuat BAŞÇİFTÇİ Burhaneddin BİLGEN	Konya Technical University, Türkiye Karamanoğlu Mehmetbey University, Türkiye Ankara Hacı Bayram Veli University, Türkiye	A COMPARATIVE ANALYSIS OF TEC ANOMALIES UNDER SPACE WEATHER CONDITIONS USING THE IQR AND 1.34σ METHODS
Sercan BÜLBÜL Fuat BAŞÇİFTÇİ Burhaneddin BİLGEN	Konya Technical University, Türkiye Karamanoğlu Mehmetbey University, Türkiye Ankara Hacı Bayram Veli University, Türkiye	MAGNETOSPHERIC ANALYSIS OF THE SEVERE GEOMAGNETIC STORM OF JANUARY 1, 2025 DURING SOLAR CYCLE 25
Sümeyra KIRTIL AYSO Tayfun ÇAY	Afyon Kocatepe University, Türkiye Konya Technical University, Türkiye	APPLICABILITY OF THE FINITE ELEMENT METHOD IN LAND CONSOLIDATION PROJECTS
Emre AYSO Muzaffer KAHVECİ	Niğde Ömer Halisdemir University, Türkiye Konya Technical University, Türkiye	ASSESSMENT OF THE IMPACT OF DIFFERENT TEMPORAL RESOLUTIONS OF SATELLITE CLOCK PRODUCTS ON PPP PERFORMANCE
Ahmet ALPER Beşir DAĞ	Batman University, Türkiye	OCCUPATIONAL HEALTH AND SAFETY PRACTICES IN WORKING AT HEIGHTS: AN EVALUATION

ONLINE PRESENTATIONS

04.09.2026 / Hall-2, Session-1

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	10 ^{00} : 12 ^{00}		PASSCODE: 123456

HEAD OF SESSION: Assoc. Prof. Dr. Duygu AYDIN

AUTHORS	AFFILIATION	TOPIC TITLE
Huseyin KUCUKBASMACI Duygu AYDIN	Karamanoğlu Mehmetbey University, Türkiye	FAST, VISUAL, AND SELECTIVE MONITORING OF Cu_2+ BY A BISPHENOL-A-BASED FLUORESCENT PROBE
Sinan ÖNDER	Dokuz Eylül University, Türkiye	EFFECTS OF PRE-TURNING HIP AND POST-TURNING ROLLER BURNISHING ON THE SURFACE PROFILE OF SLM-PRODUCED AlSi10Mg ALLOY
Ema REŞŞO Muhammet Fethi GÜLLÜ	Harran University, Türkiye	DEVELOPMENT AND EXPERIMENTAL VALIDATION OF FIBER-BASED MOMENT–CURVATURE ANALYSIS TOOLS FOR REINFORCED CONCRETE COLUMNS
Saeed Hamdy Elsaeed ABDELHADY Cenk KARAKURT Nazım Çağatay DEMİRAL Bilge EREN Ahmet BOY	Bilecik Şeyh Edebali University, Türkiye	COMPARISON OF KAOLIN CLAY AND WASTE CLAY IN LC3-BASED MORTARS IN TERMS OF MECHANICAL AND PHYSICAL PROPERTIES
Bhukya Nagaraju N .Deepa	Bharath Institute Of Higher Education And Research, India	FORMULATION AND EVALUATION OF LOPERAMIDE LIQUISOLID COMPACTS
ZAHAF SAMIR CHAIB Mohamed Mouloud Dahmane	University of Sciences and Technology of Oran, Mohamed Boudiaf, Algeria University Djillali, Liabes, Sidi Bel-Abbes, Algeria Higher National School of Hydraulics, Algeria	EFFECTS OF FSW-INDUCED MICROSTRUCTURAL HETEROGENEITY AND TOOL INCLUSIONS ON THE FATIGUE LIFE OF 6082-T6 ALUMINUM ALLOY JOINTS
Malik Shaheryar Muhammad Ali Nasir Muhammad Azeem Rehman Khan	UET Taxila, Pakistan	EFFECT OF IMPACT STRENGTH OF 3D PRINTED CARBON FIBER-REINFORCED POLYLACTIC ACID (CF-PLA) ON DIFFERENT PRINTING PARAMETERS
Aliyu Sani	Umaru Musa Yar'adua University, Nigeria	IRON ENRICHMENT AND PHASE PARTITIONING IN KATSINA KAOLIN: UNLOCKING DUAL INDUSTRIAL VALUE

ONLINE PRESENTATIONS

04.09.2026 / Hall-3, Session-1

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
10 00 : 12 00		PASSCODE: 123456	

HEAD OF SESSION: Prof. Dr. Saadettin AKSOY

AUTHORS	AFFILIATION	TOPIC TITLE
Rabia EDİS Bahar İLA Ercan YALDIZ	Konya Technical University, Türkiye	DESIGN OF 0.9 GHZ, 1.8 GHZ, AND 2.4 GHZ RF RECTIFIERS WITH MICROSTRIP AND LUMPED-ELEMENT MATCHING FOR ENERGY HARVESTING
Saadettin AKSOY	Istanbul Commerce University, Türkiye	ARTIFICIAL INTELLIGENCE-BASED OBSERVERS FOR LINEAR DYNAMIC SYSTEMS
Saadettin AKSOY Şamilislam ÖZATA Alara Betül AYHAN	Istanbul Commerce University, Türkiye	DESIGN AND IMPLEMENTATION OF A PLC-BASED LIQUID LEVEL CONTROL SYSTEM
Canberk YURT Burak Berkin BURBUT Ercan YALDIZ	Konya Technical University, Türkiye	ESP32 AND BLOCKCHAIN BASED SMART MINI CHARGING STATION: PAYMENT-VERIFIED CHARGING CONTROL WITH ERC-20 SARJ TOKEN
Cagri ALTINTASI	İzmir Democracy University, Türkiye	EFFECT OF OBSERVATION WINDOW LENGTH ON TWLS-BASED SYNCHROPHASOR ESTIMATION UNDER OUT-OF-BAND INTERFERENCE
Emine İŞİN Pinar ATAK KAFA Nurettin ÇETİNKAYA	Konya Technical University, Türkiye	EFFECT OF DIFFERENT NETTING BOUNDARIES ON BESS SIZING: AN APPLICATION TO A MULTI-FEEDER PV-CONSUMPTION PORTFOLIO
Kenan GÖÇMENOĞLU Murat UYAR	Bursa Uludağ University, Türkiye	ROBUST BEARING FAULT DIAGNOSIS UNDER NOISY CONDITIONS USING ENVELOPE ANALYSIS AND SUPPORT VECTOR MACHINES
Kenan GÖÇMENOĞLU Murat UYAR	Bursa Uludağ University, Türkiye	EVALUATING THE IMPACT OF GRID IMPEDANCE AND LOAD DYNAMICS ON POWER QUALITY: A COMPARATIVE STUDY OF DISTINCT LOAD SCENARIOS

ONLINE PRESENTATIONS

04.09.2026 / Hall-4, Session-1

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	10 ^{00} : 12 ^{00}		PASSCODE: 123456

HEAD OF SESSION: Dr. Inna Samuilik

AUTHORS	AFFILIATION	TOPIC TITLE
Mir Mohammad Nayyar Aazam Arif Billah Dar	Shri Mata Vaishno Devi University, Katra, Jammu and Kashmir, India	POLITICAL INTENT OR LEGAL OBLIGATION? ENVIRONMENTAL AGREEMENTS AND ECOLOGICAL PRESSURE IN THE G7 ECONOMIES
Kusum Rani Anju Thapa Ankita Sharma	Central University of Jammu, Jammu & Kashmir, India	ADOPTION OF E-MOBILITY AND ITS IMPACT ON COMFORT AND SAFETY OF CITIZENS
Karrar Azeez Marwah Abdulkareem Mahmood Sarah Essam Hasan Inaam Mohsin Almusawi	University of Kufa, Iraq	THE IMPACT OF INTERNAL AUDITING ON CYBERSECURITY RISKS IN BANKS
Doris Doda	Barleti University, Albania	BAYESIAN VS. FREQUENTIST LOGISTIC REGRESSION: UNCERTAINTY QUANTIFICATION FOR CLINICAL CLASSIFICATION A LAPLACE APPROXIMATION AND MCMC COMPARISON
Philemon Mshelia Bukar	Federal University Otuoke, Nigeria	DIGITAL TRANSFORMATION: A PANACEA FOR LIFELONG LEARNING IN TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING IN NIGERIA
Ojo Adaramola Awodele Oludele Akinleye Abiodun Olamilekan Adebesin, Adesoji Ademola	The Federal Polytechnic Ilaro,Ogun State, Nigeria Babcock University, Ilisan-Remo, Nigeria	DESIGN AND SIMULATION OF A MICROCONTROLLER BASED REAL TIME VITAL SIGNS MONITORING SYSTEM USING ARDUINO NANO
Gvantsa Geliashvili	Caucasus International University, Georgia	MACROECONOMIC TRAJECTORY AND INSTITUTIONAL ADAPTATION: ASSESSING POST-ASSOCIATION AGREEMENT GROWTH PATTERNS IN GEORGIA
Anna LEVICKA Inna SAMUILIK	Riga Technical University, Latvia	NONLINEAR DYNAMICS AND CHAOS IN A THREE-DIMENSIONAL FINANCIAL MODEL
Nguyen Thu Trang	Institute for South Asian, West Asian and African Studies (ISAWAAS), Vietnam	EVALUATING THE ASSOCIATION BETWEEN INTANGIBLE ASSET INVESTMENT AND ENTERPRISE PERFORMANCE: EVIDENCE FROM LISTED VIETNAMESE FIRMS

ONLINE PRESENTATIONS

04.09.2026 / Hall-5, Session-1

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
10 ^{00} : 12 ^{00}		PASSCODE: 123456	

HEAD OF SESSION: Moses Adeolu AGOI

AUTHORS	AFFILIATION	TOPIC TITLE
Luter Richard Akighirga	St Petersburg Electrotechnical University LETI, Russia	INVESTIGATION OF THE INFLUENCE OF HIGH-FREQUENCY POWER SUPPLY ONTO POWER QUALITY
Mbuotidem D. Dick Emem O. Ikpe Gabriel Abraham Bala	Akwa Ibom State Polytechnic, Nigeria Federal University Gashua, Nigeria	AN INTEGRATED SOURCE-PATHWAY-SINK FRAMEWORK FOR URBAN ROADSIDE HEAVY-METAL ASSESSMENT USING ENVIRONMENTAL MAGNETISM AND DATA-DRIVEN ANALYTICS
Mbuotidem D. Dick Emem O. Ikpe Gabriel Abraham Bala	Akwa Ibom State Polytechnic, Nigeria	AN INTEGRATED SOURCE-PATHWAY-SINK FRAMEWORK FOR URBAN ROADSIDE HEAVY-METAL ASSESSMENT USING ENVIRONMENTAL MAGNETISM AND DATA-DRIVEN ANALYTICS
Moses Adeolu AGOI Andrew Ayanfeola OKE Micheal Olayemi OLADUNJOYE Oluwanifemi Opeyemi AGOI	Lagos State University of Education, Nigeria	ARTIFICIAL INTELLIGENCE-BASED PREDICTION OF MECHANICAL, THERMAL, AND ELECTRICAL PROPERTIES OF ENGINEERING MATERIALS
Tengiz Verulava Nita Verulava	Caucasus University, Georgia Tbilisi State Medical University, Georgia	DIAGNOSTIC EFFICACY AND PRECISION OF ADVANCED MAGNETIC RESONANCE IMAGING (MRI) IN EARLY DETECTION OF MUSCULOSKELETAL -SOFT TISSUE PATHOLOGIES
Fakhira Afzal Hafeez Ullah Janjua Syed Zafar Ilyas	Islamia University Bahawalpure, Pakistan	2D IMAGING OF SKELETAL MUSCLES USING LIGHT MICROSCOPE, FT-IR SPECTROSCOPY AND UV-VISIBLE SPECTROSCOPY TECHNIQUES
P.Kishor C.Mahalakshmi G.Venu Madhav	Annamalai University, India Anurag University, India	PHASE SHIFT CARRIER-BASED PULSE WIDTH MODULATION TECHNIQUE FOR MODULAR MULTILEVEL CONVERTER IN INDUSTRIAL MOTOR DRIVE APPLICATIONS
Muhammed GÖLEÇ	Boğaziçi University, Türkiye	METROXAI-PDM: EXPLAINABLE EDGE AI FOR PREDICTIVE MAINTENANCE: A RESOURCE-AWARE STUDY USING METROPT-3
Muhammed GÖLEÇ	Boğaziçi University, Türkiye	Edge PdM: RESOURCE-ORIENTED MACHINE LEARNING FOR PREDICTIVE MAINTENANCE ON EDGE DEVICES

ONLINE PRESENTATIONS

04.09.2026 / Hall-6, Session-1

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	10 ^{00} : 12 ^{00}		PASSCODE: 123456

HEAD OF SESSION: Dr. Mourad Aloui

AUTHORS	AFFILIATION	TOPIC TITLE
Mourad Aloui Menana Elhalaoui	Sidi Mohamed Ben Abdellah University, Morocco	PREDICTION OF PYRROLOPYRIMIDINE DERIVATIVES AS NOVEL BRUTON'S TYROSINE KINASE (BTK) INHIBITORS USING QSAR MODELING, MOLECULAR DOCKING, MOLECULAR DYNAMICS, AND ADMET PROPERTIES
Oumaima Aqil Ibtissam Ballou Mohammed Chafi Saloua Jemjami	Hassan I University, Morocco	METHYLENE BLUE REMOVAL FROM WASTEWATER USING A HIGH-PERFORMANCE WASTE- DERIVED ADSORBENT
Aqsa Farooq	Ghazi University, Pakistan	A HYBRID $CdMn_2O_4$/PANI COMPOSITE ELECTROCATALYST FOR ENHANCED OXYGEN EVOLUTION REACTION
Marc Jean Médard ABADİE Bernd Karl APPELT	University of Montpellier, France	DIFFERENTIAL PHOTOCOLORIMETRY: A PAST ENGINEERING TECHNIQUE THAT REMAINS RELEVANT TODAY
Zobia Naz Alishba Muhammad Zubair	Government College University Faisalabad, Pakistan	ARYLATION OF SYMMETRIC BIS(4-BROMOPHENYL) SCHIFF BASE VIA SUZUKI COUPLING REACTION AND THEIR BIOACTIVITY PROFILING
Zobia Naz Muhammad Zubair	Government College University Faisalabad, Pakistan	SYNTHESIS OF BIOACTIVE FURAN BASED COMPOUNDS VIA SUZUKI CROSS COUPLING REACTION
Mustapha Ait Lamine	Mohammed V University in Rabat, Morocco	QUANTUM TELEPORTATION AND ENTANGLEMENT VIA QUANTUM CHANNELS IN BIMETALLIC Fe_2Cu_2 BASED ON SPIN-1/2 ISING-HEISENBERG CHAIN MODEL

ONLINE PRESENTATIONS

04.09.2026 / Hall-1, Session-2

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	12 30 : 14 30		PASSCODE: 123456

HEAD OF SESSION: Prof. Dr. Hasan SERİN

AUTHORS	AFFILIATION	TOPIC TITLE
Hasan SERİN Ferhat ÖZDEMİR	Kahramanmaraş Sütçü İmam University, Türkiye	MAJOR CELLULOSE-RICH AGRICULTURAL BIOMASS SOURCES IN TÜRKIYE
Hasan SERİN Ferhat ÖZDEMİR	Kahramanmaraş Sütçü İmam University, Türkiye	STRUCTURE OF CELLULOSE AND COMMON TYPES OF CELLULOSE
Fatih YILMAZ	Isparta University of Applied Sciences, Türkiye	MODELING AND THERMODYNAMIC INVESTIGATION OF A PARABOLIC TROUGH-DRIVEN SUPERCRITICAL BRAYTON CYCLE
Fatih YILMAZ	Isparta University of Applied Sciences, Türkiye	PERFORMANCE ANALYSIS OF A GEOTHERMAL ENERGY-ASSISTED TRANSCRITICAL RANKINE CYCLE FOR ELECTRICITY AND COOLING GENERATION
Mohamed EL MORSY Laila AFIA	Ibnou Zohr University, Morocco	VALORIZATION OF CITRUS PEELS GENERATED BY A FRUIT JUICE EXTRACTION UNIT
Kateryna Danilova	Institute of Food Resources of National Academy Agrarian Science, Ukraine	LIGNOCELLULOSIC BIOMASS AS A RAW MATERIAL FOR THE PRODUCTION OF SECOND-GENERATION BIOETHANOL
Ouali Abdelouahad Abderrazak Mabrouki Houda Boutalbi Youssouf Ouzani Fatima Hiouani Madani Djamila Chafia Tir	Mohamed Khider University, Algeria Mohamed Boudiaf University of M'Sila, Algeria	C:N RATIO OPTIMIZATION FOR DATE PALM WASTE CO-COMPOSTING UNDER HOT CLIMATIC CONDITIONS
Nabil ZAARA Amine RKHAILA Hammadi El Farissi Abdessamad Beraich Marouane AOUJI Ahmed EL YACOUBI Jamila DAHMANI Souad SKALLI Amina TOUHAMI OUAZZANI Allal DOUIRA	Ibn Tofail University, Morocco Mohammed First University, Morocco	THE INFLUENCE OF CLIMATIC FACTORS AND THE CULTIVATION SYSTEM ON THE PHYSICOCHEMICAL CHARACTERISTICS OF OLIVE OIL FROM THE MOROCCAN PICHOLINE VARIETY (Olea europaea L.) CULTIVATED IN THE NORTHERN AND CENTRAL REGION OF MOROCCO

ONLINE PRESENTATIONS

04.09.2026 / Hall-2, Session-2

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
$12^{30} : 14^{30}$		PASSCODE: 123456	

HEAD OF SESSION: Dr. Halil İbrahim OKUR

AUTHORS	AFFILIATION	TOPIC TITLE
Halil İbrahim OKUR	İskenderun Technical University, Türkiye	THE EFFECT OF INFLECTIONAL SUFFIXES ON NODE INTEGRITY IN TURKISH GRAPH-RAG SYSTEMS
Nevzat OLGUN	Afyon Kocatepe University, Türkiye	ACOUSTIC CHARACTERIZATION and DEEP SPECTRAL CLASSIFICATION of PROGRESSIVE VACUUM FILTER CLOGGING
Halil İbrahim YILMAZ İshak Metehan SİS	Atatürk University, Türkiye	ARTIFICIAL INTELLIGENCE-BASED EARLY WARNING SYSTEMS IN OPEN AND DISTANCE LEARNING: A CONCEPTUAL REVIEW AND APPLICABILITY PROPOSAL IN THE TÜRKİYE CONTEXT
İshak Metehan SİS Halil İbrahim YILMAZ	Atatürk University, Türkiye	EXAMINATION OF ARTIFICIAL INTELLIGENCE-BASED PATENTS IN MEDICAL IMAGING
Ahmet Tunahan ŞANLI Erdal ERDAL	Kırıkkale University, Türkiye	A BIBLIOMETRIC AND DESCRIPTIVE CONTENT ANALYSIS OF THE LITERATURE ON CAD-ASSISTED 6D OBJECT POSE ESTIMATION AND TRACKING
İlkay ÖZSEV YÜKSEK	Istanbul Technical University, Türkiye	WEAR EXPERIENCE, CHALLENGES, AND TEXTILE DESIGN IMPROVEMENTS IN BURN-SCAR COMPRESSION GLOVES: A USER-CENTERED CASE REPORT

ONLINE PRESENTATIONS

04.09.2026 / Hall-3, Session-2

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	12 30 : 14 30		PASSCODE: 123456

HEAD OF SESSION: Dr. Murat ÇELİK

AUTHORS	AFFILIATION	TOPIC TITLE
Bilgehan DÖNMEZ Mehmet Ali GÜVENÇ	İskenderun Technical University, Türkiye	OPTIMIZATION OF WINDING SPEED OF HOT-ROLLED STEEL COILS AND THE EFFECT OF COOLING WATER ON MECHANICAL PROPERTIES
Murat ÇELİK	Erciyes University, Türkiye	DEVELOPMENT OF ARCHITECTED MULTI-MATERIAL FILAMENTS FOR ADDITIVE MANUFACTURING
Gökçe KÜMET Fatih SELİMEFENDİGİL	Celal Bayar University, Türkiye	JET IMPINGEMENT CONVECTIVE DRYING OF POROUS OBJECT IN A CHANNEL CROSS-FLOW CONFIGURATION
Kaan KUŞTEPE Ebru SARALOĞLU GÜLER	Başkent University, Türkiye	EFFECT OF WELDING SPEED ON BENDING BEHAVIOR AND HARDNESS DISTRIBUTION OF GMAW-WELDED S235JR STEEL JOINTS
Fahri MURAT	Erzurum Technical University, Türkiye	BUILD ORIENTATION EFFECTS ON PROCESS-INDUCED STRESS AND DISTORTION IN MANDIBULAR RECONSTRUCTION PLATES
Özge EKREM Çağla DOKSÖZ Volkan YAMAÇLI	Baibars Mekatronik Havacılık Sanayi A.Ş., Türkiye Mersin University, Türkiye	STRUCTURAL DESIGN AND STATIC FINITE ELEMENT ANALYSIS OF A UAV-INTEGRATED GROUND-SUPPLIED HIGH-PRESSURE SPRAYING SYSTEM
Durmuş Can ACER Çağrı UZAY	Çukurova University, Türkiye	EFFECT OF GRAPHENE-DOPED CNT FILLER ON THE FLEXURAL PROPERTIES OF CARBON FIBER REINFORCED EPOXY COMPOSITES

ONLINE PRESENTATIONS

04.09.2026 / Hall-4, Session-2

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	12 30 : 14 30		PASSCODE: 123456

HEAD OF SESSION: Hajar Elganich

AUTHORS	AFFILIATION	TOPIC TITLE
Innocent Makoji Bala	Nasarawa State University, Nigeria	CALIFORNIA BEARING RATIO AND SUBGRADE SUITABILITY OF CALCIUM CARBIDE WASTE-STABILISED LATERITIC SOIL UNDER SOAKED AND UNSOAKED CONDITIONS AT VARYING COMPACTION ENERGIES
Shom Prakash Kushwaha Syed Misbahul Hasan Sangam Verma	Integral University, India	OXIDATIVE STRESS LINKED ANTIDIABETIC EFFECTS OF NATURAL PRODUCTS: MECHANISTIC BASIS AND CORRELATION BETWEEN ANTIOXIDANT AND ANTIDIABETIC ACTIVITIES
Hajar EL GANICH Omar Ben Lenda Omar EL RHAZOUANI Elmadani SAAD	Hassan First University, Morocco	MONTE CARLO STUDY OF MAGNETIC INTERACTIONS IN Sr_2BOsO_6 (B = Cu, Cr) DOUBLE PEROVSKITE CERAMICS
Mahsa Mirzabeigia Hooshyar Hossinib Amir Hooshang Alvandic Hyunjung Kimd	Kermanshah University of Medical Sicences, Iran	MICROPLASTICS AS VECTORS FOR HEAVY METALS AND PESTICIDES IN THE GHARESOO RIVER, IRAN: A MULTI-CONTAMINANT ASSESSMENT
Le Tran Thanh Liem Quach Duong Phuong Thao	Can Tho University, Vietnam	TECHNOLOGICAL AND ENVIRONMENTAL ASSESSMENT OF SHALLOT (ALLIUM ASCALONICUM) FARMING SYSTEMS IN CAN THO CITY, VIETNAM: ENGINEERING SOLUTIONS AND RESEARCH GAPS
Arli Aditya Parikesit	i3L University, Indonesia	ALGORITHMIC PERSPECTIVES IN BIOINFORMATICS: INTERPRETING EMERGING TRENDS IN BIOTECHNOLOGY
Gada Muleta Fanta Admasu Tantu Arba Tesfay Gebremichael Reda	Adama Science and Technology University, Ethiopia	ADSORPTION OF FLUORIDE FROM AQUEOUS SOLUTION ONTO MAGNETITE-FUNCTIONALIZED CARBON NANOTUBES (Fe_3O_4@CNTs) USING THE RESPONSE SURFACE METHODOLOGY
El Habib EL FAKIR Hayat LOUKILI Khalid ZAROUAL Brahim ACHIOU Abdellah SELLAM Younes ABROUKI	Hassan II University of Casablanca, Morocco	AN Ab-INITIO STUDY OF THE ADSORPTION OF H_2O, NaCl, AND SALT WATER ON GRAPHITE AND GRAPHENE

ONLINE PRESENTATIONS

04.09.2026 / Hall-5, Session-2

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	12 30 : 14 30		PASSCODE: 123456

HEAD OF SESSION: Violla Makhzoum

AUTHORS	AFFILIATION	TOPIC TITLE
Pushpalatha Umapathy	KCG College of Technology, Chennai, Tamilnadu, India	ENHANCING INTERVIEW SKILLS OF ENGINEERING STUDENTS THROUGH SIMULATION-BASED LEARNING
Violla Makhzoum Razan Rida Nabaa Fatima Mohammad Abboud	Islamic University of Lebanon, Lebanon	BEYOND VISIBILITY: RETHINKING DIGITAL REPUTATION AND TRUST IN THE AGE OF ARTIFICIAL INTELLIGENCE
Afaq Ahmad Nassor Al Jahwari Lakshami Pulipaka	Modern College of Business and Science, Oman	THE ROLE OF MATHEMATICS IN STEM EDUCATION AND INNOVATION
Maryem Arraji Mohamed Khalis Mohamed Chahboune	Hassan First University of Settat, Morocco Mohammed VI University of Health Sciences, Morocco	USE OF ARTIFICIAL INTELLIGENCE FOR MEDICATION ADHERENCE ASSESSMENT IN PATIENTS WITH TYPE 2 DIABETES: AN EXPLORATORY STUDY IN MOROCCO USING CHATGPT AND THE VALIDATED GENERAL MEDICATION ADHERENCE SCALE
Abdelouahed SOLTANI Abdelhak SAIDI Mohamed LAAGUIDI Bouchra BOUGARIANE	Moulay Ismail University of Meknes, Morocco	EVALUATING THE EDUCATIONAL AND GEOTOURISM POTENTIAL OF GEOSITES IN SEMI-ARID MOROCCO: THE ERRACHIDIA REGION AS A CASE STUDY

ONLINE PRESENTATIONS

04.09.2026 / Hall-6, Session-2

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
12 30 : 14 30		PASSCODE: 123456	

HEAD OF SESSION: Jebasingh Jeremiah Rajesh Jesudoss Hynes

AUTHORS	AFFILIATION	TOPIC TITLE
Abdelkrim Mebarki Mohamed Ramzi BAICHE	University of Science and Technology of Oran – Mohamed Boudiaf (USTO-MB), Algeria	A HYBRID VISION–LANGUAGE AND MACHINE LEARNING FRAMEWORK FOR AUTOMATED COGNITIVE SCREENING FROM CLOCK DRAWING TEST
Imteaz Husain Najeeb Alam Khan	University of Karachi, Pakistan	MODELING AND OPTIMIZATION OF INFORMATION DIFFUSION IN INTELLIGENT NETWORKS
Bonny McBon Akanbi Bello Muhammad	University of Abuja, Nigeria	ENHANCEMENT OF AN INTELLIGENT WEB-BASED ACADEMIC PROJECT MANAGEMENT SYSTEM WITH AUTOMATED TOPIC CLASSIFICATION AND DUPLICATE DETECTION
V. Ananthaswamy M. Shruthi	The Madura College, India	SEMI-ANALYTICAL INVESTIGATION OF A NON-LINEAR INITIAL VALUE PROBLEM IN A CANCER MODEL
Ashikur Jaman Sakib Tanzim Asad Parthib Motassin Billah Shehab	Hajee Mohammad Danesh Science and Technology University, Bangladesh	CAD-BASED DESIGN AND COMPARATIVE ASSESSMENT OF A TRANSPORTABLE LIFTING SYSTEM FOR MODERATE LOAD HANDLING
Jebasingh Jeremiah Rajesh Jesudoss Hynes	Opole University of Technology, Poland	FROM RAW ELECTROENCEPHALOGRAPHY TO AUTOMATED ACTION: FEATURE EXTRACTION FOR INTERPRETABLE MACHINE LEARNING IN BRAIN-COMPUTER INTERFACE SYSTEMS
Barira Hamisu Raji Abdullahi Egigogo Usman Abubakar Ribadu	Al-Qalam University, Nigeria	DESIGN AND IMPLEMENTATION OF AN INTEGRATED WEB APPLICATION FOR FOOD ORDERING AND CATERING TRAINING AT RAUFAZ KITCHEN, KATSINA
Akande, M. A. Omohimi, C. I Sobukola, O.P. Afolabi, W.A.O.	Federal College of Agriculture, Nigeria	PHYSICOCHEMICAL AND TEXTURAL PROPERTIES OF DEEP-FRIED CHICKEN NUGGETS AS AFFECTED BY WHEAT SUBSTITUTION WITH CORN-BRAN IN BATTER

ONLINE PRESENTATIONS

04.09.2026 / Hall-1, Session-3

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
15 00 : 17 00		PASSCODE: 123456	

HEAD OF SESSION: Dr. Hanifi KÜÇÜKSARIYILDIZ

AUTHORS	AFFILIATION	TOPIC TITLE
Tolgahan KOÇ Erhan KURT Oğuz TAŞDEMİR	Kırşehir Ahi Evran University, Türkiye	TECHNO-ECONOMIC ASSESSMENT OF AN INTEGRATED PHOTOVOLTAIC–BATTERY–HYDROGEN HYBRID ENERGY SYSTEM WITH AI-BASED ENERGY MANAGEMENT: THE CASE OF NIĞDE MUNICIPALITY
Şevket CANTÜRK Oktay KARAKAYA	Balikesir University, Türkiye	MULTI-PARAMETER ANALYSIS OF THE EFFECTS OF GICS ON A SYNCHRONOUS GENERATOR UNDER DIFFERENT OPERATING AND GRID CONDITIONS
Hanifi KÜÇÜKSARIYILDIZ	Karamanoğlu Mehmetbey University, Türkiye	EFFECT OF AMBIENT TEMPERATURE ON HVAC ENERGY CONSUMPTION AND DRIVING RANGE IN ELECTRIC VEHICLES
Kadir ZENGİN	Abdullah Gül University, Türkiye	INTEGRATED ASSESSMENT OF PHOTOVOLTAIC WASTE GENERATION AND RECYCLING INFRASTRUCTURE REQUIREMENTS IN TÜRKİYE: PROJECTIONS TO 2050
Burcu ÇİÇEK	Aksaray University, Türkiye	NUMERICAL INVESTIGATION OF A PCM-BASED THERMAL ENERGY STORAGE UNIT FOR WINTER GREENHOUSE HEATING
Tuğçe YEŞİLYURT KURNAZ Musa AYDIN	Konya Technical University, Türkiye	FLOATING PHOTOVOLTAIC INTEGRATION FOR PUMPING POWER SUPPLY IN PUMPED STORAGE HYDROPOWER PLANTS
Hamza El ALLOULI Pr. Reda MOUBAH	Hassan II University of Casablanca, Morocco	A DFT STUDY OF THE STRUCTURAL, ELECTRONIC, MECHANICAL, AND DYNAMIC PROPERTIES OF COMPLEX HYDRIDES FOR HYDROGEN STORAGE UNDER TRIAXIAL STRAIN
Karim NEGADI	University of Tiaret, Algeria	EVALUATING THE FUTURE FEASIBILITY AND OPERATIONNAL REALITY OF WAVE ENERGY CONVERTERS FOR SUSTAINABLE POWER GENERATION

ONLINE PRESENTATIONS

04.09.2026 / Hall-2, Session-3

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	15 00 : 17 00		PASSCODE: 123456

HEAD OF SESSION: Dr. Onur DEMİREL

AUTHORS	AFFILIATION	TOPIC TITLE
Onur DEMİREL	Sakarya University of Applied Sciences, Türkiye	LESO-BASED OPTIMAL VOLTAGE CONTROL OF A BUCK CONVERTER
Musa MARUL	Artvin Çoruh University, Türkiye	FROM ACCREDITATION CRITERIA TO VALIDATED INNOVATION OUTPUTS: A LEVEL-RESPONSIVE, INDUSTRY-INTEGRATED ENGINEERING EDUCATION MODEL FOR THE GENERATIVE AI ERA
Uğur BALOĞLU	Ankara University of Music and Fine Arts, Türkiye	A CONCEPTUAL COMPARISON OF STEREO WIDENING TECHNIQUES WITH RESPECT TO MONO COMPATIBILITY
Musa MARUL	Artvin Çoruh University, Türkiye	A NOVEL ARTIFICIAL-INTELLIGENCE-ASSISTED ENERGY–ASSEMBLY-MODE GRAPH AND ANT COLONY APPROACH FOR MOTION ANALYSIS OF FOUR-BAR MECHANISMS: EMG-ACMA
Mustafa TAŞCI Ahmet AKKAYA Muhammet ARUCU	Bandırma Onyedi Eylül University, Türkiye	MULTIPLIER-FREE REQUANTIZATION FOR QUANTIZED 1-D CNN INFERENCE: EVALUATION OF SINGLE- AND TWO-SHIFT SCHEMES ON FPGA
Mustafa TAŞCI Ahmet AKKAYA	Bandırma Onyedi Eylül University, Türkiye	ECG CLASSIFICATION WITH A QUANTIZED 1D-CNN ON ZYNQ-7020: EVALUATION OF THE BIT-WIDTH–DEPENDENT RESOURCE–ACCURACY TRADE-OFF
Taiwo Semiu Amosun Leo Eromina Obogai	Federal University Otuoke, Nigeria	INTEGRATION OF MECHATRONICS SYSTEMS IN SOLAR-POWERED HYDROGEN GENERATION FOR SUSTAINABLE COOKING: SAFETY, AUTOMATION, AND EFFICIENCY ANALYSIS

ONLINE PRESENTATIONS

04.09.2026 / Hall-3, Session-3

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
15 ^{00} : 17 ^{00}		PASSCODE: 123456	

HEAD OF SESSION: Sermin GÜNASLAN

AUTHORS	AFFILIATION	TOPIC TITLE
Sıla ÖZER Gözde NEREZ Sibel KAYMAK Emine ELMASLAR ÖZBAŞ Atakan ÖNGEN	Istanbul University-Cerrahpaşa, Türkiye Ankara Yildirim Beyazit University, Türkiye	EFFECT OF PHOSPHORIC ACID ACTIVATION AND PYROLYSIS TEMPERATURE ON THE STRUCTURAL EVOLUTION OF HAWTHORN POMACE-DERIVED CARBON MATERIALS
Sermin GÜNASLAN Baybars Ali FİL Zeynep Göktaş	Kastamonu University, Türkiye Balıkesir University, Türkiye	EFFECT OF OPERATING PARAMETERS ON ELECTROCHEMICAL REMOVAL OF MALACHITE GREEN DYE USING TI/IRO$_2$/RUO$_2$ ANODE AND TITANIUM CATHODE
Alper ALVER Şeyhmus KABAK Jamila MOHAMAD Ceren TEKERBAŞ Selçuk VAROL Umur GÜRDAL Serdar KÖRPE Emine BAŞTÜRK Aylin ALTINIŞIK TAGAÇ Ebru BOZACI	Aksaray University, Türkiye Kocaeli Water and Sewerage Administration General Directorate, Türkiye İzmit Waste and Residues Treatment Inc., Türkiye Knauf Insulation, Department of Process and Quality, Türkiye Dokuz Eylül University, Türkiye Ege University, Türkiye	SUSTAINABLE SEPARATION and RECOVERY OF METALWORKING OILS USING POPULUS SEED FIBERS: ADSORPTION PERFORMANCE AND REUSABİLİTY
Cansu Melis AKSU Yunus Emre ERTOŞ	Ege University, Türkiye	AN ENGINEERING PERSPECTIVE ON TRIPLE TRANSFORMATION IN SUSTAINABLE FOOD MANUFACTURING
Adem SAVAŞ	Giresun University, Türkiye	MICROPLASTIC AND NANOPLASTIC CONTAMINATION IN FOODS: CURRENT STATUS AND FUTURE PERSPECTIVES
Adem SAVAŞ	Giresun University, Türkiye	PRESENCE OF ACRYLAMIDE IN MEAT PRODUCTS: COOKING AND HEALTH RISKS
Kamala Dauda Umar Rabiu Yahayya Umar Faisal Aliyu	Umaru Musa Yar'adua University Katsina, Nigeria	TURNING WASTEWATER INTO RESOURCES: CHEMICAL ENGINEERING STRATEGIES FOR SUSTAINABLE WATER AND RESOURCE RECOVERY IN DEVELOPING ECONOMIES
Olena Bokiy	Institute of Food Recources of NAAS, Ukraine	INNOVATIONS OF THE FOOD SECTOR IN ENSURING FOOD SECURITY OF UKRAINE
Dang Hoang Thai Hien	Thai Binh Duong University, Vietnam	APPLICATION OF THE THEORY OF PLANNED BEHAVIOUR IN FOOD WASTE RESEARCH: A BIBLIOMETRIC AND SYSTEMATIC REVIEW

ONLINE PRESENTATIONS

04.09.2026 / Hall-4, Session-3

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
15 00 : 17 00		PASSCODE: 123456	

HEAD OF SESSION: Yassine Bouzid

AUTHORS	AFFILIATION	TOPIC TITLE
Lawal Mohammed Sabo Kazeem Adeyinka Salako Abbass Adebayo Adetona Abdulwaheed Adewuyi Rafiu Usman Shehu Onoduku	Federal University of Technology Minna, Nigeria	ESTIMATION OF DEPTH TO MAGNETIC BASEMENT USING SPECTRAL ANALYSIS OF HIGH-RESOLUTION AEROMAGNETIC DATA OVER LOKOJA, KOGI STATE NIGERIA
Raghav Sivakumar	United World Academy, India	THE ROLE OF ROBOTICS IN TRANSFORMING THE AUTOMOBILE INDUSTRY: ENHANCING EFFICIENCY, QUALITY, AND SAFETY
S.Rajeswari	Saranathan College of Engineering, India	MICROCONTROLLER-BASED CHARACTER DISPLAY SYSTEM
Rekha Kumari	Birla Institute of Technology Mesra, India	A REVIEW ON RECENT TRENDS, MECHANICAL AND CHEMICAL PROPERTIES AND APPLICATIONS OF BIO-COMPOSITE MATERIAL
Dilawar Hussain	Ghazi University, Pakistan	ANALYSIS AND DESIGN OF $NiCo_2O_4$ /g-CN ELECTROCATALYS VIA HYDROTHERMAL ROUTE TOWARDS ENHANCED OERPERFORMANCE
Estudiante Edgar Eduardo Navas Roberto Enrique Martinez	Universidad Nacional de Colombia, Colombia	THE PESKIN-TAKEUCHI PARAMETERS IN A NON-UNIVERSAL U(1) X SYMMETRIC MODEL
Yassine Bouzid Abdelali Grich Aicha Naboulsi Ali Elbasraoui Mamoune El Himri Abdelmajid Regti Mohammadine El Haddad	Laboratory of Analytical and Molecular Chemistry, Morocco	ENGINEERING HYBRID BIOMASS BEADS FOR DYE REMOVAL: UNRAVELING MULTILAYER ADSORPTION, DUAL-SITE ENERGETICS, AND DIFFUSION MECHANISMS ACROSS SCALES

ONLINE PRESENTATIONS

04.09.2026 / Hall-5, Session-3

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
	15 00 : 17 00		PASSCODE: 123456

HEAD OF SESSION: Trinh Thi Phuong

AUTHORS	AFFILIATION	TOPIC TITLE
Trinh Thi Phuong Le Quang Ngoc Nguyen Xuan Duy	Vietnam Academy of Social Sciences, Vietnam	CURRENT STATUS OF HOUSEHOLD WASTE MANAGEMENT IN MARINE ENVIRONMENTAL PROTECTION IN SAM SON, VIETNAM
Otegbeye-Lawal Atinuke Adenike	Science Laboratory Technology, Nigeria	AI-DRIVEN MODELLING OF IMMUNE RESPONSES FOR PERSONALIZED MEDICINE
Rehman Khan Muhammad Shariq Mian Daniyal Gul Muhammad Ubaid	Swedish College of Engineering and Technology Wah, Pakistan	EXPERIMENTAL ANALYSIS OF 3D PRINTED MATRIX UNDER TENSILE AND IMPACT LOADING
Jin Chai LEE Abdalmonam HUSSAN Muhammad ASLAM Poh-Yee LOH	UCSI University, Malaysia Wenzhou University of Technology, China Universiti Malaya, Malaysia	IMPACT OF TIME AND COST ON ENGINEERING PROJECT PERFORMANCE: A DATA-DRIVEN ANALYSIS USING PYTHON
Abdelhamid Mazouzi Mohamed Cheikh Hamdi Laouici	Innovative Mechanics Laboratory (LMI), Algeria Université de Toulouse, France University Center of El Bayadh, Algeria	UNDERSTANDING FRETTING WEAR AND TRIBOCORROSION IN HEAD-NECK TAPER JUNCTION: A REVIEW OF FINITE ELEMENT MODELING
Abderahmane Mahari Mohamed Fayçal Ameur Redouane Zitoune	novative Mechanics Laboratory (LMI), Algeria Université de Toulouse, France Nanyang Technological University, Singapore	THERMOMECHANICAL FATIGUE RESPONSE OF ADDITIVELY MANUFACTURED CARBON/ONYX COMPOSITES WITH DIRECTLY PRINTED AND DRILLED HOLES
Nguyen Thanh Cuong Mai Duc Nghia	Air Force Officer's College, Vietnam	INVESTIGATION OF THE EFFECT OF RELATIVE THICKNESS OF COMPOSITE UAV WINGS ON AERODYNAMIC PERFORMANCE USING SIMULATION METHOD

ONLINE PRESENTATIONS

04.09.2026 / Hall-6, Session-3

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
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HEAD OF SESSION:

AUTHORS	AFFILIATION	TOPIC TITLE
Tahid Nur Rahman Shahnaz Malik Samiul Sadek Mohammad Nur-E-Alam	Aviation and Aerospace University, Bangladesh Universiti Kebangsaan Malaysia, Malaysia	DESIGN AND PERFORMANCE OPTIMIZATION OF A LEAD-FREE $Cs_4CuSb_2Cl_{12}/Cs_2PtI_6$ DUAL-ABSORBER SOLAR CELL WITH ENHANCED SPECTRAL UTILIZATION
Sawaira Moeen	Government College University Lahore, Pakistan	CHITOSAN-DERIVED CARBON DOTS/POLYANILINE-NiS_2 NANOSTRUCTURE FOR ELECTROCHEMICAL WATER SPLITTING
Mouad Benaicha Mohammed Elgoual	Mohammed First University, Morocco	NUMERICAL ASSESSMENT OF HEAT EXTRACTION ENHANCEMENT IN PHOTOVOLTAIC–PHASE CHANGE MATERIAL (PV–PCM) COLLECTORS
Shahnaz Malik Sadia Mubashira Tahid Nur Rahman Samiul Sadek Mohammad Nur-E-Alam	Aviation and Aerospace University, Bangladesh Universiti Kebangsaan Malaysia, Malaysia	NUMERICAL INVESTIGATION OF INTERFACE DEFECT DENSITY AND ETL SELECTION IN BaZrS3-BASED SOLAR CELLS USING GZO, SnO_2, AND TiO_2: A SCAPS-1D STUDY
Pallab Kumar Sharker Sandrata Roy Samiul Sadek Mohammad Nur-E-Alam	Aviation and Aerospace University, Bangladesh Universiti Kebangsaan Malaysia, Malaysia	PERFORMANCE-GOVERNED DEFECT PHYSICS AND THERMAL DYNAMICS IN $AgBiS_2/CeO_x$/CuI HETEROJUNCTION SOLAR CELLS
Sandrata Roy Pallab Kumar Sharker Samiul Sadek Mohammad Nur-E-Alam	Aviation and Aerospace University, Bangladesh Universiti Kebangsaan Malaysia, Malaysia	NUMERICAL OPTIMIZATION OF FTO/TiO_2/$AgBiS_2$/Spiro-OMeTAD SOLAR CELLS: ASSESSING THICKNESS, THERMAL, AND RESISTIVE PARAMETER EFFECTS
Fadele, Noah Taiwo Afolabi, Bukola O Azeez, Adedayo Afeez Akande, Muibat Abisola	Federal College of Agriculture, Nigeria	COMPUTATION OF RELATIVE HUMIDITY AND TEMPERATURE IN A CABINET SOLAR DRYER USING SENSIBLE MATERIALS
Yassine Bouzid Aicha Naboulsi Abdelmajid Regti Mamoune El Himri Mohammadine El Haddad	Laboratory of Analytical and Molecular Chemistry, Morocco	ENGINEERING A GRAPHENE OXIDE/HUMIC ACID/ALGINATE HYDROGEL FOR EFFICIENT METHYLENE BLUE ADSORPTION: BOX-BEHNKEN OPTIMIZATION, ARTIFICIAL INTELLIGENCE, AND DFT INSIGHTS

ONLINE PRESENTATIONS

05.09.2026 / Hall-1, Session-1

	ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612
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HEAD OF SESSION: Dr. Omer Faruk Ozturk

AUTHORS	AFFILIATION	TOPIC TITLE
Muhammet Gökhan DEMİRCİ Aydın DEMİR	Sakarya University, Türkiye	INVESTIGATION OF THE EFFECT OF NONLINEAR NUMERICAL MODELING METHODS OF REINFORCED CONCRETE SHEAR WALLS ON THE NONLINEAR BEHAVIOR OF BUILDINGS
Omer Faruk Ozturk Kadir Akgol	Giresun University, Türkiye	EVALUATION OF HORIZONTAL TRAFFIC MARKINGS AT INTERSECTION APPROACHES FROM A MOTORCYCLE SAFETY PERSPECTIVE
Omer Faruk Ozturk Kadir Akgol	Giresun University, Türkiye	SPATIAL NETWORK ANALYSIS OF PEDESTRIAN ACCESSIBILITY TO EMERGENCY ASSEMBLY AREAS: A CASE STUDY OF ORTAHISAR, TRABZON
Serkan BUDAK Ali Emre OKUR Akif DURDU	Konya Technical University, Türkiye	MULTI-IMU DATA FUSION AND ATTITUDE ESTIMATION FOR UNMANNED AERIAL VEHICLES USING COMPLEMENTARY FILTERING
H. El Harouachi D;Ahoudi S. Moukannaa A.Bendahho A. El azizi M. El Gettafi M. Loutou	Mohammed Premier University, Morocco Mohammed VI Polytechnic University(UM6P), Morocco Cadi Ayyad University (UCA), Morocco	LOW-TEMPERATURE CONVERSION OF FLY ASH–PYROPHYLLITE GEOPOLYMERS INTO ZEOLITIC MATERIALS UNDER ATMOSPHERIC HUMIDIFICATION
Akuha Simon Iorshagher	Federal University Otuoke, Nigeria	PHYSICAL, MECHANICAL, DURABILITY AND MICROSTRUCTURAL PROPERTIES OF TERNARY BLENDED CONCRETE INCORPORATING MARBLE DUST AND GROUNDNUT HUSK ASH

ONLINE PRESENTATIONS

05.09.2026 / Hall-2, Session-1

ANKARA LOCAL TIME	ZOOM ID: 847 7043 0612
10 ^{00} : 12 ^{00}	PASSCODE: 123456

HEAD OF SESSION: Dr. Murat YILMAZ

AUTHORS	AFFILIATION	TOPIC TITLE
Furkan Ege ÖZTÜRK Mehmet Feyzi AKŞAHİN	Gazi University, Türkiye	HYBRID DENSE - SPARSE RETRIEVAL OPTIMIZATION FOR CROSS LANGUAGE ACADEMIC PLAGIARISM DETECTION
Savaş YETKİN Mehmet ORUÇ Mehmet TOPUZ Sedat YAYLA	Van Yuzuncu Yıl University, Türkiye	SURFACE COATING APPLICATION AND PERFORMANCE ANALYSIS TO ENHANCE CAVITATION AND CORROSION RESISTANCE IN CENTRIFUGAL PUMP IMPELLERS
Faruk Emre AYSAL	Giresun University, Türkiye	MULTI-OBJECTIVE OPTIMIZATION OF ACTIVE CAMBER CONTROL FOR A 2-DOF VEHICLE BASED ON A CAMBER-EXTENDED FIALA TIRE MODEL USING NSGA-II
Arda Zaim	Ankara Science University, Türkiye	AIRCRAFT DAMAGE IN ACCIDENTS AND SERIOUS INCIDENTS INVOLVING SINGLE-ENGINE AIRCRAFT IN TÜRKİYE
Murat YILMAZ	Osmaniye Korkut Ata University, Türkiye	SUSTAINABLE PRODUCTION OF TEA WASTE-DERIVED POROUS CARBON VIA SODIUM TETRABORATE ACTIVATION FOR SUPERCAPACITOR APPLICATIONS
Serkan GÜNEŞ Bayram ÜNAL Mürsel EKREM	Ostim Technical University, Türkiye Selçuk University, Türkiye Necmettin Erbakan University, Türkiye	ANSYS WORKBENCH-BASED COUPLED NUMERICAL INVESTIGATION OF MECHANICAL PERFORMANCE AND CO-60 GAMMA TRANSMISSION IN AUXETIC CFRP SANDWICH PANELS
Serkan GÜNEŞ Bayram ÜNAL Mürsel EKREM	Ostim Technical University, Türkiye Selçuk University, Türkiye Necmettin Erbakan University, Türkiye	INVESTIGATION OF THE ATTENUATION BEHAVIOUR OF Fe_3O_4-CONTAINING EPOXY-BASED COMPOSITES UNDER Co-60 GAMMA RADIATION USING PUBLISHED EXPERIMENTS, XCOM DATA AND AN INVERSE GEOMETRICAL DESIGN APPROACH

ONLINE PRESENTATIONS

05.09.2026 / Hall-3, Session-1

ANKARA LOCAL TIME		ZOOM ID: 847 7043 0612	
10 ^{00} : 12 ^{00}		PASSCODE: 123456	

HEAD OF SESSION: SOMNATH MAJI

AUTHORS	AFFILIATION	TOPIC TITLE
SOMNATH MAJI Sujata Dawn Ashish Das Aparna kundu Avick Kumar Dey	Maulana Abul Kalam Azad University of Technology, India Durgapur Institute of Advanced Technology and Management, Durgapur, India	A FATIGUE-AWARE GENETIC ALGORITHM FOR MULTI-SCENARIO EMERGENCY MILK DISTRIBUTION ROUTING: A CASE STUDY OF THE HOOGHLY DISTRICT
SOMNATH MAJI Meghna Chatterjee Bidipta Mukhopadhyay Saroj Patra Avick Kumar Dey	Maulana Abul Kalam Azad University of Technology, India Durgapur Institute of Advanced Technology and Management, Durgapur, India	ENHANCED TEACHING–LEARNING-BASED OPTIMIZATION FOR MULTI-PATH, MULTI-VEHICLE EMERGENCY MEDICAL DELIVERY UNDER FLOOD RISK: A CASE STUDY OF MALDA DISTRICT
Samuel Omeiza Audu Job Ibrahim Obadaki	Federal University Lokoja, Nigeria	A HYBRID FUZZY-NAÏVE BAYES LOGISTIC REGRESSION MODEL FOR ROBUST BINARY CLASSIFICATION
Job Ibrahim Obadaki Kashim Yusuf Mutalib Sadiq	Federal University Lokoja, Nigeria	FINITE DIFFERENCE MODELING AND CONVERGENCE ANALYSIS OF TWO-DIMENSIONAL REACTIVE CONTAMINANT TRANSPORT IN POROUS MEDIA
Mutalib Sadiq Jessica Mrumun Gyegwe Helen Olaronke Edogbanya Job Ibrahim Obadaki	Federal University Lokoja, Nigeria	MATHEMATICAL FORMULATION OF THE RESTRICTED THREE-BODY PROBLEM WITH DIPOLE AND OBLATENESS PERTURBATIONS
Job Ibrahim Obadaki Kashim Yusuf AUDU, Samuel Omeiza	Federal University Lokoja, Nigeria	DYNAMICS OF LASSA FEVER ON HOST AND VECTOR POPULATION
Michael BASSEY Aondona IHOM Idorenyin MARKSON	University of Uyo, Nigeria	RESPONSE SURFACE OPTIMIZATION OF TIG WELDING PARAMETERS FOR MAXIMUM TENSILE STRENGTH AND MINIMUM DILUTION

ONLINE PRESENTATIONS

05.09.2026 / Hall-4, Session-1

ANKARA LOCAL TIME	ZOOM ID: 847 7043 0612
10 00 : 12 00	PASSCODE: 123456

HEAD OF SESSION:

AUTHORS	AFFILIATION	TOPIC TITLE
Sabrina ROGUAI	Université Abbes Laghrour, Algeria	Cu-ZnO THIN FILMS FOR ENHANCED PHOTOVOTAIC PERFORMANC
Đoàn Hữu Bách	FPT Polytechnic, Vietnam	THE "KENH BONG" RELIEF-CARVING TECHNIQUE IN NORTHERN VIETNAMESE COMMUNAL HOUSE ARCHITECTURE AND ITS REINTERPRETATION IN CONTEMPORARY MATERIALS
Osmar Kappel	São Paulo State University (UNESP), Brazil	CHEMICAL KNOWLEDGE AND THE CRITICAL INTERPRETATION OF REALITY IN THE CONTEXT OF THE INFODEMIC
Boudjellel MOULAI ALI Abdelnour ZAIM	University of Relizane, Algeria University of Mascara, Algeria	MECHANICAL BEHAVIOR OF BITUMEN/HDPE COMPOSITES UNDER THREE-POINT BENDING
Mohamed EL MORSY Laila AFIA	Ibnou Zohr University, Morocco	VALORIZATION OF CITRUS PEELS GENERATED BY A FRUIT JUICE EXTRACTION UNIT
Shoaib Akhtar Ansar Rafeeq	Government Graduate College for Boys, Pakistan	FACILE FABRICATION OF ZINC ALUMINIUM SULPHIDE REDUCED GRAPHENE OXIDE NANOCOMPOSITE FOR HIGH-PERFORMANCE SUPERCAPACITOR APPLICATIONS
Saadia EL OMARI Amar HABSAOUI	Ibn Tofaïl University, Morocco	BARRIERS AND ENABLERS OF TECHNOLOGY TRANSFER: AN ANALYSIS OF INNOVATION PROJECTS ASSESSMENTS RESULTS

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CONTENT

AUTHOR(S)	TOPIC TITLE	P.No
Nabil ZAARA Amine RKHAILA Hammadi El Farissi Abdessamad Beraich Marouane AOUJI Ahmed EL YACOUBI Jamila DAHMANI Souad SKALLI Amina TOUHAMI OUAZZANI Allal DOUIRA	THE INFLUENCE OF CLIMATIC FACTORS AND THE CULTIVATION SYSTEM ON THE PHYSICOCHEMICAL CHARACTERISTICS OF OLIVE OIL FROM THE MOROCCAN PICHOLINE VARIETY (Olea europaea L.) CULTIVATED IN THE NORTHERN AND CENTRAL REGION OF MOROCCO	1
Arda ZAİM	AIRCRAFT DAMAGE IN ACCIDENTS AND SERIOUS INCIDENTS INVOLVING SINGLE-ENGINE AIRCRAFT IN TÜRKİYE	2
Öznur ATAÇ AYDIN Hüseyin ÇETİN	BIOLOGY, DAMAGE AND CONTROL OF THE MEDITERRANEAN FRUIT FLY [Ceratitis capitata (Wiedemann) (Diptera: Tephritidae)]	4
Ömer Faruk ÖZTÜRK Kadir AKGÖL	SPATIAL NETWORK ANALYSIS OF PEDESTRIAN ACCESSIBILITY TO EMERGENCY ASSEMBLY AREAS: A CASE STUDY OF ORTAHİSAR, TRABZON	6
Ema REŞŞO Muhammet Fethi GÜLLÜ	DEVELOPMENT AND EXPERIMENTAL VALIDATION OF FIBER-BASED MOMENT–CURVATURE ANALYSIS TOOLS FOR REINFORCED CONCRETE COLUMNS	8
Kadir AKGOL Omer Faruk OZTURK	EVALUATION OF HORIZONTAL TRAFFIC MARKINGS AT INTERSECTION APPROACHES FROM A MOTORCYCLE SAFETY PERSPECTIVE	10
Burcu ÇİÇEK	NUMERICAL INVESTIGATION OF A PCM-BASED THERMAL ENERGY STORAGE UNIT FOR WINTER GREENHOUSE HEATING	12
Fatih YILMAZ	PERFORMANCE ANALYSIS OF A GEOTHERMAL ENERGY-ASSISTED TRANSCRITICAL RANKINE CYCLE FOR ELECTRICITY AND COOLING GENERATION.	14
Fatih YILMAZ	MODELING AND THERMODYNAMİC INVESTIGATION OF A PARABOLIC TROUGH-DRIVEN SUPERCRİTİCAL BRAYTON CYCLE	16
Mustafa TAŞCI Ahmet AKKAYA	ECG CLASSIFICATION WITH A QUANTIZED 1D-CNN ON ZYNQ-7020: EVALUATION OF THE BIT-WIDTH–DEPENDENT RESOURCE–ACCURACY TRADE-OFF	18
Mustafa TAŞCI Ahmet AKKAYA Muhammet ARUCU	MULTIPLIER-FREE REQUANTIZATION FOR QUANTIZED 1-D CNN INFERENCE: EVALUATION OF SINGLE- AND TWO-SHIFT SCHEMES ON FPGA	20
Gulnaz DALOGLU	EVALUATION OF THE KUYUCAK AND SİVRİHİSAR (ESKISEHIR) DOLOMITES AS AGGREGATE ACCORDING TO ALCALI CARBONATE REACTIVITY	22
Furkan Ege ÖZTÜRK Mehmet Feyzi AKŞAHİN	HYBRID DENSE - SPARSE RETRIEVAL OPTIMIZATION FOR CROSS LANGUAGE ACADEMIC PLAGIARISM DETECTION	23
Ahmet ALPER Beşir DAĞ	OCCUPATIONAL HEALTH AND SAFETY PRACTICES IN WORKING AT HEIGHTS: AN EVALUATION	25
Musa MARUL	A NOVEL ARTIFICIAL-INTELLIGENCE-ASSISTED ENERGY–ASSEMBLY-MODE GRAPH AND ANT COLONY APPROACH FOR MOTION ANALYSIS OF FOUR-BAR MECHANISMS: EMG-ACMA	27

Cansu Melis AKSU *Yunus Emre ERTOŞ*	*AN ENGINEERING PERSPECTIVE ON TRIPLE TRANSFORMATION IN SUSTAINABLE FOOD MANUFACTURING*	*29*
Fakhira Afzal *Hafeez Ullah Janjua* *Syed Zafar Ilyas*	*2D IMAGING OF SKELETAL MUSCLES USING LIGHT MICROSCOPE, FT-IR SPECTROSCOPY AND UV-VISIBLE SPECTROSCOPY TECHNIQUES*	*31*
Uğur Baloğlu	*A CONCEPTUAL COMPARISON OF STEREO WIDENING TECHNIQUES WITH RESPECT TO MONO COMPATIBILITY*	*32*
Durmuş Can ACER *Çağrı UZAY*	*EFFECT OF GRAPHENE-DOPED CNT FILLER ON THE FLEXURAL PROPERTIES OF CARBON FIBER REINFORCED EPOXY COMPOSITES*	*34*
Gökçe KÜMET *Fatih SELİMEFENDİGİL*	*JET IMPINGEMENT CONVECTIVE DRYING OF POROUS OBJECT IN A CHANNEL CROSS-FLOW CONFIGURATION*	*36*
Musa MARUL	*FROM ACCREDITATION CRITERIA TO VALIDATED INNOVATION OUTPUTS: A LEVEL-RESPONSIVE, INDUSTRY-INTEGRATED ENGINEERING EDUCATION MODEL FOR THE GENERATIVE AI ERA*	*38*
Savaş YETKİN *Mehmet ORUÇ* *Mehmet TOPUZ* *Sedat YAYLA*	*SURFACE COATING APPLICATION AND PERFORMANCE ANALYSIS TO ENHANCE CAVITATION AND CORROSION RESISTANCE IN CENTRIFUGAL PUMP IMPELLERS*	*40*
Erkan Caner OZKAT *Tarık ÜNLER*	*REPORTING CONVENTIONS IN AIRCRAFT ENGINE REMAINING USEFUL LIFE PREDICTION*	*42*
Özge EKREM *Çağla DOKSÖZ* *Volkan YAMAÇLI*	*STRUCTURAL DESIGN AND STATIC FINITE ELEMENT ANALYSIS OF A UAV-INTEGRATED GROUND-SUPPLIED HIGH-PRESSURE SPRAYING SYSTEM*	*44*
İshak Metehan SİS *Halil İbrahim YILMAZ*	*EXAMINATION OF ARTIFICIAL INTELLIGENCE-BASED PATENTS IN MEDICAL IMAGING*	*46*
Alper ALVER *Şeyhmus KABAK* *Jamila MOHAMAD* *Ceren TEKERBAŞ* *Selçuk VAROL* *Umur GÜRDAL* *Serdar KÖRPE* *Emine BAŞTÜRK* *Aylin ALTINIŞIK TAGAÇ* *Ebru BOZACI*	*SUSTAINABLE SEPARATION AND RECOVERY OF METALWORKING OILS USING POPULUS SEED FIBERS: ADSORPTION PERFORMANCE AND REUSABILITY*	*48*
Mehmet Kaan AKGÜN *Ahmet Faruk BİREKUL* *Nazmiye KOPACAK*	*TECHNICAL AND REGULATORY ASSESSMENT OF FLOATING PHOTOVOLTAIC SYSTEMS IN TÜRKİYE: A CASE STUDY OF DEMİRKÖPRÜ DAM*	*50*
Yassine Bouzid *Aicha Naboulsi* *Abdelmajid Regti* *Mamoune El Himri* *Mohammadine El Haddad*	*ENGINEERING A GRAPHENE OXIDE/HUMIC ACID/ALGINATE HYDROGEL FOR EFFICIENT METHYLENE BLUE ADSORPTION: BOX-BEHNKEN OPTIMIZATION, ARTIFICIAL INTELLIGENCE, AND DFT INSIGHTS*	*52*
Aloui Mourad *Menana Elhalaoui*	*PREDICTION OF PYRROLOPYRIMIDINE DERIVATIVES AS NOVEL BRUTON'S TYROSINE KINASE (BTK) INHIBITORS USING QSAR MODELING, MOLECULAR DOCKING, MOLECULAR DYNAMICS, AND ADMET PROPERTIES*	*54*
İlkay Özsev YÜKSEK	*WEAR EXPERIENCE, CHALLENGES, AND TEXTILE DESIGN IMPROVEMENTS IN BURN-SCAR*	*55*

	COMPRESSION GLOVES: A USER-CENTERED CASE REPORT	
Sinan ÖNDER	*EFFECTS OF PRE-TURNING HIP AND POST-TURNING ROLLER BURNISHING ON THE SURFACE PROFILE OF SLM-PRODUCED AlSi10Mg ALLOY*	*56*
Yağmur Nalbant Atak	*GENETIC-ALGORITHM-BASED OPTIMIZATION OF SUSTAINABLE METHANOL PRODUCTION FROM WASTEWATER-DERIVED CO_2*	*58*
Utku Kaftancioglu *Yagmur Nalbant Atak*	*ANN ASSISTED PARAMETRIC OPTIMIZATION OF HYDROGEN PRODUCTION FROM STEAM REFORMING OF METHANE, METHANOL AND ETHANOL*	*60*
Fahri MURAT	*BUILD ORIENTATION EFFECTS ON PROCESS-INDUCED STRESS AND DISTORTION IN MANDIBULAR RECONSTRUCTION PLATES*	*62*
Ömer Selim ERBATUR *Muhammed Emir Ertanık* *Emre Burak ERTUŞ*	*ENERGY ABSORPTION BEHAVIOR OF VINYL ESTER-FILLED LASER POWDER BED FUSION INCONEL 718 SHEET GYROID STRUCTURES*	*63*
Sujata Dawn *Ashish Das* *Aparna kundu* *Avick kumar dey* *Somnath Maji*	*A FATIGUE-AWARE GENETIC ALGORITHM FOR MULTI-SCENARIO EMERGENCY MILK DISTRIBUTION ROUTING: A CASE STUDY OF THE HOOGHLY DISTRICT*	*65*
Kaan KUŞTEPE *Ebru SARALOĞLU GÜLER*	*EFFECT OF WELDING SPEED ON BENDING BEHAVIOR AND HARDNESS DISTRIBUTION OF GMAW-WELDED S235JR STEEL JOINTS*	*66*
Muhammed Göleç	*EDGE PDM: RESOURCE-DRIVEN MACHINE LEARNING FOR PREDICTIVE MAINTENANCE ON EDGE DEVICES*	*68*
Muhammed Göleç	*METROXAI-PDM: EXPLAINABLE EDGE AI FOR PREDICTIVE MAINTENANCE: A RESOURCE-AWARE STUDY USING METROPT-3*	*70*
Oktay YÜKSEL *Musa AYDIN*	*TECHNICAL AND ECONOMIC ANALYSIS OF DE-ICING METHODS FOR ELECTRIC POWER TRANSMISSION LINES*	*72*
Emre AYSO *Muzaffer KAHVECİ*	*ASSESSMENT OF THE IMPACT OF DIFFERENT TEMPORAL RESOLUTIONS OF SATELLITE CLOCK PRODUCTS ON PPP PERFORMANCE*	*74*
Sümeyra KIRTIL AYSO *Tayfun ÇAY*	*APPLICABILITY OF THE FINITE ELEMENT METHOD IN LAND CONSOLIDATION PROJECTS*	*76*
Ahmet Tunahan ŞANLI *Erdal ERDAL*	*A BIBLIOMETRIC AND DESCRIPTIVE CONTENT ANALYSIS OF THE LITERATURE ON CAD-ASSISTED 6D OBJECT POSE ESTIMATION AND TRACKING*	*78*
Gada Muleta Fanta *Admasu Tantu Arba* *Tesfay Gebremichael Reda*	*ADSORPTION OF FLUORIDE FROM AQUEOUS SOLUTION ONTO MAGNETITE-FUNCTIONALIZED CARBON NANOTUBES (Fe_3O_4@CNTs) USING THE RESPONSE SURFACE METHODOLOGY*	*80*
Nuri Koştu *Erkan Ülker*	*POST-QUANTUM CRYPTOGRAPHY (PQC): DEFENSE STRATEGIES AGAINST QUANTUM THREATS AND ALGORITHM ANALYSES*	*81*
Sercan Bülbül *Fuat Başçiftçi* *Burhaneddin Bilgen*	*MAGNETOSPHERIC ANALYSIS OF THE SEVERE GEOMAGNETIC STORM OF JANUARY 1, 2025 DURING SOLAR CYCLE 25*	*83*
Fuat Başçiftçi *Sercan Bülbül* *Burhaneddin Bilgen*	*A COMPARATIVE ANALYSIS OF TEC ANOMALIES UNDER SPACE WEATHER CONDITIONS USING THE IQR AND 1.34σ METHODS*	*84*

Taha Kağan AYDIN	*CHANGES IN URBAN BUILT-UP DEVELOPMENT BY DISTANCE FROM THE COAST IN ANTALYA CITY CENTER: A GHSL-BASED ANALYSIS (2000-2020)*	*85*
Kadir ZENGİN	*INTEGRATED ASSESSMENT OF PHOTOVOLTAIC WASTE GENERATION AND RECYCLING INFRASTRUCTURE REQUIREMENTS IN TÜRKİYE: PROJECTIONS TO 2050*	*87*
Serkan Güneş *Bayram Ünal* *Mürsel Ekrem*	*INVESTIGATION OF THE ATTENUATION BEHAVIOUR OF FE_3O_4-CONTAINING EPOXY-BASED COMPOSITES UNDER CO-60 GAMMA RADIATION USING PUBLISHED EXPERIMENTS, XCOM DATA AND AN INVERSE GEOMETRICAL DESIGN APPROACH*	*89*
Serkan Güneş *Bayram Ünal* *Mürsel Ekrem*	*ANSYS WORKBENCH-BASED COUPLED NUMERICAL INVESTIGATION OF MECHANICAL PERFORMANCE AND CO-60 GAMMA TRANSMISSION IN AUXETIC CFRP SANDWICH PANELS*	*91*
Murat ÇELİK	*DEVELOPMENT OF ARCHITECTED MULTI-MATERIAL FILAMENTS FOR ADDITIVE MANUFACTURING*	*93*
Murat UYAR *Kenan GÖÇMENOĞLU*	*EVALUATING THE IMPACT OF GRID IMPEDANCE AND LOAD DYNAMICS ON POWER QUALITY: A COMPARATIVE STUDY OF DISTINCT LOAD SCENARIOS*	*94*
Kenan GÖÇMENOĞLU *Murat UYAR*	*ROBUST BEARING FAULT DIAGNOSIS UNDER NOISY CONDITIONS USING ENVELOPE ANALYSIS AND SUPPORT VECTOR MACHINES*	*95*
Saeed Hamdy Elsaeed ABDELHADY *Cenk KARAKURT* *Nazım Çağatay DEMİRAL* *Bilge EREN* *Ahmet BOY*	*COMPARISON OF KAOLIN CLAY AND WASTE CLAY IN LC3-BASED MORTARS IN TERMS OF MECHANICAL AND PHYSICAL PROPERTIES*	*96*
Recep Emre ÜNAL *Osman KOCAASLAN* *Muharrem Hilmi AKSOY*	*NUMERICAL INVESTIGATION OF THE EFFECT OF GROOVE DEPTH ON NEAR-WAKE STRUCTURE AND DRAG OF A TRIANGULAR-GROOVED CIRCULAR CYLINDER*	*98*
Huseyin KUCUKBASMACI *Duygu AYDIN*	*FAST, VISUAL, AND SELECTIVE MONITORING OF Cu2+ BY A BISPHENOL-A-BASED FLUORESCENT PROBE*	*100*
Sermin Günaslan *Baybars Ali Fil* *Zeynep Göktaş*	*EFFECT OF OPERATING PARAMETERS ON ELECTROCHEMICAL REMOVAL OF MALACHITE GREEN DYE USING TI/IRO_2/RUO_2 ANODE AND TITANIUM CATHODE*	*102*
Murat KARACA *Arif Emre KAYA*	*MILLET SPECIES (Panicum spp.) CULTIVATED IN TÜRKİYE AND WEED CONTROL*	*104*
Hanifi KÜÇÜKSARIYILDIZ	*EFFECT OF AMBIENT TEMPERATURE ON HVAC ENERGY CONSUMPTION AND DRIVING RANGE IN ELECTRIC VEHICLES*	*106*
Kamilia KHANNOUSSI *Ahmet Afşin KULAKSIZ*	*ENHANCING THE LVRT CAPABILITY OF A GRID-CONNECTED PHOTOVOLTAIC SYSTEM UNDER LINE-TO-LINE FAULT CONDITIONS USING TD3-BASED DEEP REINFORCEMENT LEARNING*	*108*
Arli Aditya Parikesit	*ALGORITHMIC PERSPECTIVES IN BIOINFORMATICS: INTERPRETING EMERGING TRENDS IN BIOTECHNOLOGY*	*110*
Quach Duong Phuong Thao *Le Tran Thanh Liem*	*TECHNOLOGICAL AND ENVIRONMENTAL ASSESSMENT OF SHALLOT (ALLIUM ASCALONICUM) FARMING SYSTEMS IN CAN THO CITY, VIETNAM: ENGINEERING SOLUTIONS AND RESEARCH GAPS*	*111*

Veysel Karani YILMAZ *Yusuf Tuna BİRER* *Sezer SAĞLAM* *Rıfat AKGÜL* *Ahmet AVCI*	*REDUNDANCY DETECTION AND VISUALIZATION IN COMMERCIAL VEHICLE CONFIGURATION RULES*	*112*
Nita Verulava *Tengiz Verulava*	*DIAGNOSTIC EFFICACY AND PRECISION OF ADVANCED MAGNETIC RESONANCE IMAGING (MRI) IN EARLY DETECTION OF MUSCULOSKELETAL SOFT TISSUE PATHOLOGIES*	*114*
Moses Adeolu AGOI *Andrew Ayanfeola OKE* *Micheal Olayemi OLADUNJOYE* *Oluwanifemi Opeyemi AGOI*	*ARTIFICIAL INTELLIGENCE-BASED PREDICTION OF MECHANICAL, THERMAL, AND ELECTRICAL PROPERTIES OF ENGINEERING MATERIALS*	*116*
Tuğçe YEŞİLYURT KURNAZ *Musa AYDIN*	*FLOATING PHOTOVOLTAIC INTEGRATION FOR PUMPING POWER SUPPLY IN PUMPED STORAGE HYDROPOWER PLANTS*	*117*
Utku Kaftancioglu	*CHABOCHE INFORMED NEURAL NETWORK FOR FATIGUE LIFE PREDICTION UNDER TWO LEVEL BLOCK LOADING*	*119*
Imteaz Husain *Najeeb Alam Khan*	*MODELING AND OPTIMIZATION OF INFORMATION DIFFUSION IN INTELLIGENT NETWORKS*	*121*
Anna LEVICKA *Inna SAMUILIK*	*NONLINEAR DYNAMICS AND CHAOS IN A THREE-DIMENSIONAL FINANCIAL MODEL*	*122*
Karim NEGADI	*EVALUATING THE FUTURE FEASIBILITY AND OPERATIONNAL REALITY OF WAVE ENERGY CONVERTERS FOR SUSTAINABLE POWER GENERATION*	*123*
Rabia EDİS *Bahar İLA* *Ercan YALDIZ*	*DESIGN OF 0.9 GHZ, 1.8 GHZ, AND 2.4 GHZ RF RECTIFIERS WITH MICROSTRIP AND LUMPED-ELEMENT MATCHING FOR ENERGY HARVESTING*	*125*
Lawal Mohammed Sabo *Kazeem Adeyinka Salako* *Abbass Adebayo Adetona* *Abdulwaheed Adewuyi Rafiu* *Usman Shehu Onoduku*	*ESTIMATION OF DEPTH TO MAGNETIC BASEMENT USING SPECTRAL ANALYSIS OF HIGH-RESOLUTION AEROMAGNETIC DATA OVER LOKOJA, KOGI STATE NIGERIA*	*127*
Halil İbrahim YILMAZ *İshak Metehan SİS*	*ARTIFICIAL INTELLIGENCE-BASED EARLY WARNING SYSTEMS IN OPEN AND DISTANCE LEARNING: A CONCEPTUAL REVIEW AND APPLICABILITY PROPOSAL IN THE TÜRKİYE CONTEXT*	*128*
Maryem Arraji *Mohamed Khalis* *Mohamed Chahboune*	*USE OF ARTIFICIAL INTELLIGENCE FOR MEDICATION ADHERENCE ASSESSMENT IN PATIENTS WITH TYPE 2 DIABETES: AN EXPLORATORY STUDY IN MOROCCO USING ChatGPT AND THE VALIDATED GENERAL MEDICATION ADHERENCE SCALE*	*130*
Mohamed Ramzi BAICHE *Abdelkrim MEBARKI*	*A HYBRID VISION–LANGUAGE AND MACHINE LEARNING FRAMEWORK FOR AUTOMATED COGNITIVE SCREENING FROM CLOCK DRAWING TEST*	*131*
Emine İŞİN *Pınar ATAK KAFA* *Nurettin ÇETİNKAYA*	*EFFECT OF DIFFERENT NETTING BOUNDARIES ON BESS SIZING: AN APPLICATION TO A MULTI-FEEDER PV-CONSUMPTION PORTFOLIO*	*132*
Elif ŞEFLEK	*INVESTIGATION OF SMALL MODULAR REACTOR (SMR) TECHNOLOGY: NUSCALE POWER DESIGN*	*134*
Violla Makhzoum *Razan Rida Nabaa* *Fatima Mohammad Abboud*	*BEYOND VISIBILITY: RETHINKING DIGITAL REPUTATION AND TRUST IN THE AGE OF ARTIFICIAL INTELLIGENCE*	*136*

Taiwo Semiu Amosun *Leo Eromina Obogai*	*INTEGRATION OF MECHATRONICS SYSTEMS IN SOLAR-POWERED HYDROGEN GENERATION FOR SUSTAINABLE COOKING: SAFETY, AUTOMATION, AND EFFICIENCY ANALYSIS*	*137*
Sezer SAĞLAM *Veysel Karani YILMAZ* *Yusuf Tuna BİRER* *Rıfat AKGÜL* *Ahmet AVCI*	*COMPARISON OF ADDITIVE AND SUBTRACTIVE MANUFACTURING FOR TEMPLATES USED ON A HEAVY COMMERCIAL VEHICLE ASSEMBLY LINE IN TERMS OF COST, LEAD TIME AND MATERIAL CONSUMPTION*	*138*
Michael BASSEY *Aondona IHOM* *Idorenyin MARKSON*	*RESPONSE SURFACE OPTIMIZATION OF TIG WELDING PARAMETERS FOR MAXIMUM TENSILE STRENGTH AND MINIMUM DILUTION*	*140*
Abdelouahad Ouali *Abderrazak Mabrouki* *Houda Boutalbi* *Youssouf Ouzani* *Fatima Hiouani* *Djamila Madani* *Chafia Tir*	*C:N RATIO OPTIMIZATION FOR DATE PALM WASTE CO-COMPOSTING UNDER HOT CLIMATIC CONDITIONS*	*141*
Shom Prakash Kushwaha *Syed Misbahul Hasan* *Sangam Verma*	*OXIDATIVE STRESS LINKED ANTIDIABETIC EFFECTS OF NATURAL PRODUCTS: MECHANISTIC BASIS AND CORRELATION BETWEEN ANTIOXIDANT AND ANTIDIABETIC ACTIVITIES*	*142*
Tasara Fani KARAZA *Ahmet Afşin KULAKSIZ*	*ELECTROMAGNETIC INTERFERENCE (EMI) FILTER FOR ELECTRIC VEHICLES*	*143*
Akuha Simon Iorshagher	*PHYSICAL, MECHANICAL, DURABILITY AND MICROSTRUCTURAL PROPERTIES OF TERNARY BLENDED CONCRETE INCORPORATING MARBLE DUST AND GROUNDNUT HUSK ASH*	*145*
Kateryna Danilova	*LIGNOCELLULOSIC BIOMASS AS A RAW MATERIAL FOR THE PRODUCTION OF SECOND-GENERATION BIOETHANOL*	*146*
Olena BOKIY	*INNOVATIONS OF THE FOOD SECTOR IN ENSURING FOOD SECURITY OF UKRAINE*	*148*
Job Ibrahim Obadaki *Kashim Yusuf* *AUDU Samuel Omeiza*	*DYNAMICS OF LASSA FEVER ON HOST AND VECTOR POPULATION*	*150*
Mahsa Mirzabeigia *Hooshyar Hossinib* *Amir Hooshang Alvandic* *Hyunjung Kimd*	*MICROPLASTICS AS VECTORS FOR HEAVY METALS AND PESTICIDES IN THE GHARESOO RIVER, IRAN: A MULTI-CONTAMINANT ASSESSMENT*	*151*
Mutalib Sadiq *Jessica Mrumun Gyegwe* *Helen Olaronke Edogbanya* *Job Ibrahim Obadaki*	*MATHEMATICAL FORMULATION OF THE RESTRICTED THREE-BODY PROBLEM WITH DIPOLE AND OBLATENESS PERTURBATIONS*	*152*
Job Ibrahim Obadaki *Kashim Yusuf* *Mutalib Sadiq*	*FINITE DIFFERENCE MODELING AND CONVERGENCE ANALYSIS OF TWO-DIMENSIONAL REACTIVE CONTAMINANT TRANSPORT IN POROUS MEDIA*	*153*
AUDU, Samuel Omeiza *Job Ibrahim Obadaki*	*A HYBRID FUZZY-NAÏVE BAYES LOGISTIC REGRESSION MODEL FOR ROBUST BINARY CLASSIFICATION*	*154*
Hajar EL GANICH *Omar Ben Lenda* *Omar EL RHAZOUANI* *Elmadani SAAD*	*MONTE CARLO STUDY OF MAGNETIC INTERACTIONS IN Sr_2BOsO_6 (B = Cu, Cr) DOUBLE PEROVSKITE CERAMICS*	*155*
Pushpalatha Umapathy	*ENHANCING INTERVIEW SKILLS OF ENGINEERING STUDENTS THROUGH SIMULATION-BASED LEARNING*	*156*

Afaq AHMAD *Nassor AL JAHWARI* *Lakshmi PULIPAKA*	*THE ROLE OF MATHEMATICS IN STEM EDUCATION AND INNOVATION*	*157*
Kamala Dauda *Umar Rabiu* *Yahayya Umar* *Faisal Aliyu*	*TURNING WASTEWATER INTO RESOURCES: CHEMICAL ENGINEERING STRATEGIES FOR SUSTAINABLE WATER AND RESOURCE RECOVERY IN DEVELOPING ECONOMIES*	*158*
Canberk YURT *Burak Berkin BURBUT* *Ercan YALDIZ*	*ESP32 AND BLOCKCHAIN BASED SMART MINI CHARGING STATION: PAYMENT-VERIFIED CHARGING CONTROL WITH ERC-20 SARJ TOKEN*	*159*
Awodele Oludele *Ojo Adaramola Ojo Jayeola* *Akinleye Abiodun Olamilekan* *Adebesin, Adesoji Ademola*	*DESIGN AND SIMULATION OF A MICROCONTROLLER BASED REAL TIME VITAL SIGNS MONITORING SYSTEM USING ARDUINO NANO*	*161*
BUKAR, Philemon Mshelia	*DIGITAL TRANSFORMATION: A PANACEA FOR LIFELONG LEARNING IN TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING IN NIGERIA.*	*162*
Meghna Chatterjee *Bidipta Mukhopadhyay* *Saroj Patra* *Avick Kumar Dey* *Somnath Maji*	*ENHANCED TEACHING–LEARNING-BASED OPTIMIZATION FOR MULTI-PATH, MULTI-VEHICLE EMERGENCY MEDICAL DELIVERY UNDER FLOOD RISK: A CASE STUDY OF MALDA DISTRICT*	*163*
Şevket CANTÜRK *Oktay KARAKAYA*	*MULTI-PARAMETER ANALYSIS OF THE EFFECTS OF GICS ON A SYNCHRONOUS GENERATOR UNDER DIFFERENT OPERATING AND GRID CONDITIONS*	*164*
Muhammet Gökhan DEMİRCİ *Aydın DEMİR*	*INVESTIGATION OF THE EFFECT OF NONLINEAR NUMERICAL MODELING METHODS OF REINFORCED CONCRETE SHEAR WALLS ON THE NONLINEAR BEHAVIOR OF BUILDINGS*	*166*
Cagri ALTINTASI	*EFFECT OF OBSERVATION WINDOW LENGTH ON TWLS-BASED SYNCHROPHASOR ESTIMATION UNDER OUT-OF-BAND INTERFERENCE*	*168*
Ayşenur ÖZLER *Mehmet Ergül YEŞİLYURT* *İrem Sude ALTUNTAŞ* *Beyza GÖRGÜN* *Ahmet Tunahan ACAR* *Muhammet Zahit HARMANKAYA*	*THE EFFECT OF CHICKPEA FLOUR ON THE TECHNOLOGICAL AND RHEOLOGICAL PROPERTIES OF WHEAT DOUGH*	*170*
Innocent Makoji Bala	*CALIFORNIA BEARING RATIO AND SUBGRADE SUITABILITY OF CALCIUM CARBIDE WASTE-STABILISED LATERITIC SOIL UNDER SOAKED AND UNSOAKED CONDITIONS AT VARYING COMPACTION ENERGIES*	*172*
Malik Shaheryar *Muhammad Ali Nasir* *Muhammad Azeem* *Rehman Khan*	*EFFECT OF IMPACT STRENGTH OF 3D PRINTED CARBON FIBER-REINFORCED POLYLACTIC ACID (CF-PLA) ON DIFFERENT PRINTING PARAMETERS*	*173*
El Habib EL FAKIR *Hayat LOUKILI* *Khalid ZAROUAL* *Brahim ACHIOU* *Abdellah SELLAM* *Younes ABROUKI*	*AN Ab-INITIO STUDY OF THE ADSORPTION OF H2O, NaCl, AND SALT WATER ON GRAPHITE AND GRAPHENE*	*174*
Aliyu Sani *Shamsu Muhammad Aliyu*	*IRON ENRICHMENT AND PHASE PARTITIONING IN KATSINA KAOLIN: UNLOCKING DUAL INDUSTRIAL VALUE*	*175*

Onur DEMİREL	*LESO-BASED OPTIMAL VOLTAGE CONTROL OF A BUCK CONVERTER*	*176*
Sıla ÖZER *Gözde NEREZ* *Sibel KAYMAK* *Emine ELMASLAR ÖZBAŞ* *Atakan ÖNGEN*	*EFFECT OF PHOSPHORIC ACID ACTIVATION AND PYROLYSIS TEMPERATURE ON THE STRUCTURAL EVOLUTION OF HAWTHORN POMACE-DERIVED CARBON MATERIALS*	*178*
Sercan YAGMUR *Sercan DOGAN* *Kadir ERDOGAN* *Aziz Hakan ALTUN*	*CFD BASED OPTIMIZATION OF AIR GUIDES FOR IMPROVING AIR CURTAIN PERFORMANCE IN OPEN REFRIGERATED DISPLAY CABINETS*	*180*
Doris Doda	*BAYESIAN VS. FREQUENTIST LOGISTIC REGRESSION: UNCERTAINTY QUANTIFICATION FOR CLINICAL CLASSIFICATION A LAPLACE APPROXIMATION AND MCMC COMPARISON*	*182*
Mohamed EL MORSY *Laila AFIA*	*VALORIZATION OF CITRUS PEELS GENERATED BY A FRUIT JUICE EXTRACTION UNIT*	*183*
Serkan BUDAK *Ali Emre OKUR* *Akif DURDU*	*MULTI-IMU DATA FUSION AND ATTITUDE ESTIMATION FOR UNMANNED AERIAL VEHICLES USING COMPLEMENTARY FILTERING*	*184*
KARRAR ABDULELLAH AZEEZ *MARWAH ABDULKAREEM MAHMOOD* *SARAH ESSAM HASAN* *INAAM MOHSIN ALMUSAWI*	*THE IMPACT OF INTERNAL AUDITING ON CYBERSECURITY RISKS IN BANKS*	*186*
Nevzat OLGUN	*ACOUSTIC CHARACTERIZATION and DEEP SPECTRAL CLASSIFICATION of PROGRESSIVE VACUUM FILTER CLOGGING*	*187*
Faruk Emre Aysal	*MULTI-OBJECTIVE OPTIMIZATION OF ACTIVE CAMBER CONTROL FOR A 2-DOF VEHICLE BASED ON A CAMBER-EXTENDED FIALA TIRE MODEL USING NSGA-II*	*189*
Mbuotidem D. Dick *Emem O. Ikpe* *Gabriel Abraham Bala*	*AN INTEGRATED SOURCE-PATHWAY-SINK FRAMEWORK FOR URBAN ROADSIDE HEAVY-METAL ASSESSMENT USING ENVIRONMENTAL MAGNETISM AND DATA-DRIVEN ANALYTICS*	*191*
Tolgahan KOÇ *Erhan KURT* *Oğuz TAŞDEMİR*	*TECHNO-ECONOMIC ASSESSMENT OF AN INTEGRATED PHOTOVOLTAIC–BATTERY–HYDROGEN HYBRID ENERGY SYSTEM WITH AI-BASED ENERGY MANAGEMENT: THE CASE OF NİĞDE MUNICIPALITY*	*192*
Emel ZERAY ÖZTÜRK	*COMPARISON OF RECENT DEGREE-300 GLOBAL STATIC GRAVITY FIELD MODELS IN TERMS OF GEOID HEIGHTS AND GRAVITY ANOMALIES*	*194*
Sezer SAĞLAM *Veysel Karani YILMAZ* *Yusuf Tuna BİRER* *Rıfat AKGÜL* *Kutlıhan Taha Emre* *Ahmet AVCI*	*OVERLOOKED PROCESS CONSTRAINTS IN THE TRANSFER OF NEW DESIGNS TO MASS PRODUCTION: ASSEMBLY TOOL ACCESSIBILITY AND FASTENER STANDARDISATION*	*196*
H. El Harouachi *D;Ahoudi* *S. Moukannaa* *A.Bendahho* *A. El azizi* *M. El Gettafi* *M. Loutou*	*LOW-TEMPERATURE CONVERSION OF FLY ASH–PYROPHYLLITE GEOPOLYMERS INTO ZEOLITIC MATERIALS UNDER ATMOSPHERIC HUMIDIFICATION*	*199*

Mbuotidem D. Dick *Emem O. Ikpe* *Gabriel Abraham Bala*	*AN INTEGRATED SOURCE-PATHWAY-SINK FRAMEWORK FOR URBAN ROADSIDE HEAVY-METAL ASSESSMENT USING ENVIRONMENTAL MAGNETISM AND DATA-DRIVEN ANALYTICS*	*200*
Akighirga Luter Richard	*INVESTIGATION OF THE INFLUENCE OF HIGH-FREQUENCY POWER SUPPLY ONTO POWER QUALITY*	*201*
Kusum Rani *Anju Thapa* *Ankita Sharma*	*ADOPTION OF E-MOBILITY AND ITS IMPACT ON COMFORT AND SAFETY OF CITIZENS*	*202*
Zeynep HABER *Harun UGUZ* *Huseyin HAKLI*	*AN IMPROVED HYBRID NSGA-II ALGORITHM FOR THE REALLOCATION PROBLEM IN LAND CONSOLIDATION*	*203*
Halil İbrahim OKUR	*THE EFFECT OF INFLECTIONAL SUFFIXES ON NODE INTEGRITY IN TURKISH GRAPH-RAG SYSTEMS*	*205*
Bilgehan DÖNMEZ *Mehmet Ali GÜVENÇ*	*OPTIMIZATION OF WINDING SPEED OF HOT-ROLLED STEEL COILS AND THE EFFECT OF COOLING WATER ON MECHANICAL PROPERTIES*	*207*
Ferhat ÖZDEMİR *Hasan SERİN*	*STRUCTURE OF CELLULOSE AND COMMON TYPES OF CELLULOSE*	*209*
Ferhat ÖZDEMİR *Hasan SERİN*	*MAJOR CELLULOSE-RICH AGRICULTURAL BIOMASS SOURCES IN TÜRKIYE*	*211*
Saadettin AKSOY *Şamilislam Özata* *Alara Betül Ayhan*	*DESIGN AND IMPLEMENTATION OF A PLC-BASED LIQUID LEVEL CONTROL SYSTEM*	*213*
Saadettin AKSOY	*ARTIFICIAL INTELLIGENCE-BASED OBSERVERS FOR LINEAR DYNAMIC SYSTEMS*	*215*
Hasan GÜLER *Mehmet Veysel ÇAKIR*	*OPTIMIZATION OF STIFFNESS-DUCTILITY TRADE-OFF IN FDM 3D PRINTING THROUGH MULTI-CRITERIA DECISION MAKING: AN APPROACH FOCUSED ON ELASTIC MODULUS AND MAXIMUM STRAIN*	*217*
Mehmet Veysel ÇAKIR *Hasan GÜLER*	*THE IMPACT OF OPTIMAL CRITERION AND SEARCH ALGORITHM SELECTION ON ML GENERALIZATION SUCCESS IN CATEGORICAL FACTOR FDM DESIGNS*	*219*
ZAHAF Samir *CHAIB Mohamed* *Mouloud Dahmane*	*EFFECTS OF FSW-INDUCED MICROSTRUCTURAL HETEROGENEITY AND TOOL INCLUSIONS ON THE FATIGUE LIFE OF 6082-T6 ALUMINUM ALLOY JOINTS*	*221*
Tahid Nur Rahman *Shahnaz Malik* *Samiul Sadek* *Mohammad Nur-E-Alam*	*DESIGN AND PERFORMANCE OPTIMIZATION OF A LEAD-FREE $Cs_4CuSb_2Cl_{12}/Cs_2PtI_6$ DUAL-ABSORBER SOLAR CELL WITH ENHANCED SPECTRAL UTILIZATION*	*222*
Mir Mohammad Nayyar Aazam *Arif Billah Dar*	*POLITICAL INTENT OR LEGAL OBLIGATION? ENVIRONMENTAL AGREEMENTS AND ECOLOGICAL PRESSURE IN THE G7 ECONOMIES.*	*223*
BHUKYA NAGARAJU *N.DEEPA*	*FORMULATION AND EVALUATION OF LOPERAMIDE LIQUISOLID COMPACTS*	*224*
Murat YILMAZ	*SUSTAINABLE PRODUCTION OF TEA WASTE-DERIVED POROUS CARBON VIA SODIUM TETRABORATE ACTIVATION FOR SUPERCAPACITOR APPLICATIONS*	*225*
Mehmet Selim DEMİRTAŞ	*THE REFLECTION OF DEFENCE INDUSTRY GROWTH ON PREFERENCES FOR ENGINEERING PROGRAMMES*	*227*
GVANTSA GELIASHVILI	*MACROECONOMIC TRAJECTORY AND INSTITUTIONAL ADAPTATION: ASSESSING POST-ASSOCIATION AGREEMENT GROWTH PATTERNS IN GEORGIA*	*229*

REHMAN KHAN MUHAMMAD SHARIQ MIAN DANIYAL GUL MUHAMMAD UBAID	*EXPERIMENTAL ANALYSIS OF 3D PRINTED MATRIX UNDER TENSILE AND IMPACT LOADING*	*230*
Jin Chai LEE Abdalmonam HUSSAN Muhammad ASLAM Poh-Yee LOH	*IMPACT OF TIME AND COST ON ENGINEERING PROJECT PERFORMANCE: A DATA-DRIVEN ANALYSIS USING PYTHON*	*231*
Sawaira Moeen	*CHITOSAN-DERIVED CARBON DOTS/POLYANILINE-NIS2 NANOSTRUCTURE FOR ELECTROCHEMICAL WATER SPLITTING*	*232*
Nguyen Thu Trang	*EVALUATING THE ASSOCIATION BETWEEN INTANGIBLE ASSET INVESTMENT AND ENTERPRISE PERFORMANCE: EVIDENCE FROM LISTED VIETNAMESE FIRMS*	*233*
Abdelhamid Mazouzi Mohamed Cheikh Hamdi Laouici	*UNDERSTANDING FRETTING WEAR AND TRIBOCORROSION IN HEAD-NECK TAPER JUNCTION: A REVIEW OF FINITE ELEMENT MODELING*	*234*
Mohammed El Goual Mouad Benaicha	*NUMERICAL ASSESSMENT OF HEAT EXTRACTION ENHANCEMENT IN PHOTOVOLTAIC–PHASE CHANGE MATERIAL (PV–PCM) COLLECTORS*	*235*
Nguyen Thanh Cuong Mai Duc Nghia	*INVESTIGATION OF THE EFFECT OF RELATIVE THICKNESS OF COMPOSITE UAV WINGS ON AERODYNAMIC PERFORMANCE USING SIMULATION METHODS*	*236*
Shahnaz Malik Sadia Mubashira Tahid Nur Rahman Samiul Sadek Mohammad Nur-E-Alam	*NUMERICAL INVESTIGATION OF INTERFACE DEFECT DENSITY AND ETL SELECTION IN BaZrS3-BASED SOLAR CELLS USING GZO, SnO2, AND TiO2: A SCAPS-1D STUDY*	*237*
Adem Savaş	*MICROPLASTIC AND NANOPLASTIC CONTAMINATION IN FOODS: CURRENT STATUS AND FUTURE PERSPECTIVES*	*238*
Adem Savaş	*PRESENCE OF ACRYLAMIDE IN MEAT PRODUCTS: COOKING AND HEALTH RISKS*	*240*
Pallab Kumar Sharker Sandrata Roy Samiul Sadek Mohammad Nur-E-Alam	*PERFORMANCE-GOVERNED DEFECT PHYSICS AND THERMAL DYNAMICS IN $AGBIS_2/CEO_X/CUI$ HETEROJUNCTION SOLAR CELLS*	*242*
Abderahmane Mahari Mohamed Fayçal Ameur Redouane Zitoune	*THERMOMECHANICAL FATIGUE RESPONSE OF ADDITIVELY MANUFACTURED CARBON/ONYX COMPOSITES WITH DIRECTLY PRINTED AND DRILLED HOLES*	*243*
Akande M. A. Omohimi C. I Sobukola O.P. Afolabi W.A.O.	*PHYSICOCHEMICAL AND TEXTURAL PROPERTIES OF DEEP-FRIED CHICKEN NUGGETS AS AFFECTED BY WHEAT SUBSTITUTION WITH CORN-BRAN IN BATTER*	*244*
Sandrata Roy Pallab Kumar Sharker Samiul Sadek Mohammad Nur-E-Alam	*NUMERICAL OPTIMIZATION OF FTO/TiO_2/$AgBiS_2$/Spiro-OMeTAD SOLAR CELLS: ASSESSING THICKNESS, THERMAL, AND RESISTIVE PARAMETER EFFECTS*	*245*
Fadele Noah Taiwo Afolabi Bukola O. Azeez Adedayo Afeez Akande Muibat Abisola	*COMPUTATION OF RELATIVE HUMIDITY AND TEMPERATURE IN A CABINET SOLAR DRYER USING SENSIBLE MATERIALS*	*246*

Nguyen Thu Trang	*EVALUATING THE ASSOCIATION BETWEEN INTANGIBLE ASSET INVESTMENT AND ENTERPRISE PERFORMANCE: EVIDENCE FROM LISTED VIETNAMESE FIRMS*	*247*
P.Kishor *C.Mahalakshmi* *G.Venu Madhav*	*PHASE SHIFT CARRIER-BASED PULSE WIDTH MODULATION TECHNIQUE FOR MODULAR MULTILEVEL CONVERTER IN INDUSTRIAL MOTOR DRIVE APPLICATIONS*	*248*
Oumaima Aqil *Ibtissam Ballou* *Mohammed Chafi* *Saloua Jemjami*	*METHYLENE BLUE REMOVAL FROM WASTEWATER USING A HIGH-PERFORMANCE WASTE-DERIVED ADSORBENT*	*249*
Aqsa Farooq	*A HYBRID $CdMn_2O_4$/PANI COMPOSITE ELECTROCATALYST FOR ENHANCED OXYGEN EVOLUTION REACTION*	*250*
Marc Jean Médard ABADİE *Bernd Karl APPELT*	*DIFFERENTIAL PHOTOCOLORIMETRY: A PAST ENGINEERING TECHNIQUE THAT REMAINS RELEVANT TODAY*	*251*
Zobia Naz *Alishba* *Muhammad Zubair*	*ARYLATION OF SYMMETRIC BIS(4-BROMOPHENYL) SCHIFF BASE VIA SUZUKI COUPLING REACTION AND THEIR BIOACTIVITY PROFILING*	*252*
Zobia Naz *Muhammad Zubair*	*SYNTHESIS OF BIOACTIVE FURAN BASED COMPOUNDS VIA SUZUKI CROSS COUPLING REACTION*	*254*
Mustapha Ait Lamine	*QUANTUM TELEPORTATION AND ENTANGLEMENT VIA QUANTUM CHANNELS IN BIMETALLIC Fe2Cu2 BASED ON SPIN-1/2 ISING-HEISENBERG CHAIN MODEL*	*256*
Abdelouahed SOLTANI *Abdelhak SAIDI* *Mohamed LAAGUIDI* *Bouchra BOUGARIANE*	*EVALUATING THE EDUCATIONAL AND GEOTOURISM POTENTIAL OF GEOSITES IN SEMI-ARID MOROCCO: THE ERRACHIDIA REGION AS A CASE STUDY*	*257*
Bonny McBon *Akanbi Bello Muhammad*	*ENHANCEMENT OF AN INTELLIGENT WEB-BASED ACADEMIC PROJECT MANAGEMENT SYSTEM WITH AUTOMATED TOPIC CLASSIFICATION AND DUPLICATE DETECTION*	*258*
V. Ananthaswamy *M. Shruthi*	*SEMI-ANALYTICAL INVESTIGATION OF A NON-LINEAR INITIAL VALUE PROBLEM IN A CANCER MODEL*	*259*
Ashikur Jaman Sakib *Tanzim Asad Parthib* *Motassin Billah Shehab*	*CAD-BASED DESIGN AND COMPARATIVE ASSESSMENT OF A TRANSPORTABLE LIFTING SYSTEM FOR MODERATE LOAD HANDLING*	*260*
Jebasingh Jeremiah Rajesh *Jesudoss Hynes*	*FROM RAW ELECTROENCEPHALOGRAPHY TO AUTOMATED ACTION: FEATURE EXTRACTION FOR INTERPRETABLE MACHINE LEARNING IN BRAIN-COMPUTER INTERFACE SYSTEMS*	*261*
Barira Hamisu *Raji Abdullahi Egigogo* *Usman Abubakar Ribadu*	*DESIGN AND IMPLEMENTATION OF AN INTEGRATED WEB APPLICATION FOR FOOD ORDERING AND CATERING TRAINING AT RAUFAZ KITCHEN, KATSINA*	*262*
Hamza El ALLOULI *Pr. Reda MOUBAH*	*A DFT STUDY OF THE STRUCTURAL, ELECTRONIC, MECHANICAL, AND DYNAMIC PROPERTIES OF COMPLEX HYDRIDES FOR HYDROGEN STORAGE UNDER TRIAXIAL STRAIN*	*263*
Dang Hoang Thai Hien	*APPLICATION OF THE THEORY OF PLANNED BEHAVIOUR IN FOOD WASTE RESEARCH: A BIBLIOMETRIC AND SYSTEMATIC REVIEW*	*264*

Raghav Sivakumar	*THE ROLE OF ROBOTICS IN TRANSFORMING THE AUTOMOBILE INDUSTRY: ENHANCING EFFICIENCY, QUALITY, AND SAFETY.*	*265*
S. Rajeswari	*MICROCONTROLLER-BASED CHARACTER DISPLAY SYSTEM*	*266*
Rekha Kumari	*A REVIEW ON RECENT TRENDS, MECHANICAL AND CHEMICAL PROPERTIES AND APPLICATIONS OF BIO-COMPOSITE MATERIAL*	*267*
Dilawar Hussain	*ANALYSIS AND DESIGN OF NiCo2O4/g-CN ELECTROCATALYS VIA HYDROTHERMAL ROUTE TOWARDS ENHANCED OERPERFORMANCE.*	*268*
Estudiante Edgar Eduardo Navas *Roberto Enrique Martinez*	*THE PESKIN-TAKEUCHI PARAMETERS IN A NON-UNIVERSAL U(1)X SYMMETRIC MODEL*	*269*
Trinh Thi Phuong *Le Quang Ngoc* *Nguyen Xuan Duy*	*CURRENT STATUS OF HOUSEHOLD WASTE MANAGEMENT IN MARINE ENVIRONMENTAL PROTECTION IN SAM SON, VIETNAM*	*270*
Otegbeye-Lawal Atinuke Adenike	*AI-DRIVEN MODELLING OF IMMUNE RESPONSES FOR PERSONALIZED MEDICINE*	*271*
Yassine Bouzid *Abdelali Grich* *Aicha Naboulsi* *Ali Elbasraoui* *Mamoune El Himri* *Abdelmajid Regti* *Mohammadine El Haddad*	*ENGINEERING HYBRID BIOMASS BEADS FOR DYE REMOVAL: UNRAVELING MULTILAYER ADSORPTION, DUAL-SITE ENERGETICS, AND DIFFUSION MECHANISMS ACROSS SCALES*	*272*
Sabrina ROGUAI	*Cu-ZnO THIN FILMS FOR ENHANCED PHOTOVOTAIC PERFORMANC*	*273*
Đoàn Hữu Bách	*THE "KENH BONG" RELIEF-CARVING TECHNIQUE IN NORTHERN VIETNAMESE COMMUNAL HOUSE ARCHITECTURE AND ITS REINTERPRETATION IN CONTEMPORARY MATERIALS*	*274*
Osmar Kappel	*CHEMICAL KNOWLEDGE AND THE CRITICAL INTERPRETATION OF REALITY IN THE CONTEXT OF THE INFODEMIC*	*275*
Boudjellel MOULAI ALI *Abdelnour ZAIM*	*MECHANICAL BEHAVIOR OF BITUMEN/HDPE COMPOSITES UNDER THREE-POINT BENDING*	*276*
Shoaib Akhtar *Ansar Rafeeq*	*FACILE FABRICATION OF ZINC ALUMINIUM SULPHIDE REDUCED GRAPHENE OXIDE NANOCOMPOSITE FOR HIGH-PERFORMANCE SUPERCAPACITOR APPLICATIONS*	*277*
Saadia EL OMARI *Amar HABSAOUI*	*BARRIERS AND ENABLERS OF TECHNOLOGY TRANSFER: AN ANALYSIS OF INNOVATION PROJECTS ASSESSMENTS RESULTS*	*278*

THE INFLUENCE OF CLIMATIC FACTORS AND THE CULTIVATION SYSTEM ON THE PHYSICOCHEMICAL CHARACTERISTICS OF OLIVE OIL FROM THE MOROCCAN PICHOLINE VARIETY (Olea europaea L.) CULTIVATED IN THE NORTHERN AND CENTRAL REGION OF MOROCCO

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Abstract

The Moroccan olive sector is characterized by a great varietal diversity of which the *Moroccan Picholine* is the dominant variety with nearly 96% of crops. This work sets as objective the physicochemical characterization of the olive oil of the *Moroccan Picholine* variety cultivated in two large regions of Morocco, the northern region represented by three stations (Tetouan, Chaouan and Ouazzane) and the central region represented by the stations of Settat, Kelaa of Sraghna and Marrakech. In each station, we took a sample of 250 ml of olive oil to pass the physicochemical analyzes with 40 g of crushed olives from each station to determine the moisture content and the oil content compared to the fresh and dry matter. Four characters were studied, the moisture content, the oil content, the absorbance in the infrared and the chemical composition in fatty acid. The results obtained showed that the humidity rate has high values at the irrigated stations compared to the rain-fed stations. On the other hand, the oil content in relation to the fresh and dry matter is rather higher in the rain-fed stations compared to the irrigated stations. The absorbance does not show any significant difference in all the stations studied. As for the fatty acid composition, the analysis showed a significant difference between all the stations studied with the predominance of oleic acid (32.43-59.96%).

Keywords : Olive tree, *Moroccan Picholine*, moisture content, oil content, absorbance, fatty acid, regions, climate, cultivation system.

TÜRKİYE'DE TEK MOTORLU UÇAK KAZALARI VE CİDDİ OLAYLARINDA HAVA ARACI HASARLARI

AIRCRAFT DAMAGE IN ACCIDENTS AND SERIOUS INCIDENTS INVOLVING SINGLE-ENGINE AIRCRAFT IN TÜRKİYE

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Abstract

Single engine aircraft are used for a wide range of missions, including flight training, personal transportation, agricultural aviation, and firefighting. Light aircraft are widely preferred worldwide because of their relatively low acquisition and operating costs and their ability to operate from short runways. In Türkiye, these aircraft are used mainly for general aviation and flight training activities. Accidents and serious incidents occurring during such operations may cause varying levels of damage to aircraft structures and mechanical systems. Accurate determination of the type and extent of damage is essential for maintenance and repair planning. This assessment also supports decisions concerning the restoration of aircraft airworthiness. This study examines aircraft damage resulting from accidents and serious incidents involving single engine aircraft in Türkiye from 2021 to 2025. The analysis was based on 25 final investigation reports published by the Transport Safety Investigation Center. The reports covered seven accidents and eighteen serious incidents. The accidents and serious incidents were classified according to flight phase, damage severity, and affected components. Direct engine damage was distinguished from engine inspection requirements reported following propeller strikes. Most accidents and serious incidents occurred during approach, landing, and post landing ground movement. Forced landings following a loss of engine power constituted the second principal occurrence group. The landing gear, propeller, and engine were the most frequently damaged components. Concurrent damage to all three components was also identified. Damage to the wings, fuselage, and empennage was recorded in runway excursions and forced landings. Multiple systems were affected in several occurrences classified as minor damage. The number and type of damaged systems varied among occurrences assigned the same damage category. This study presents the distribution of aircraft damage by flight phase, damage severity, and affected components for single engine aircraft accidents and serious incidents in Türkiye.

Keywords: Aircraft Damage, General Aviation Accidents, Single-Engine Aircraft.

Özet

Tek motorlu uçaklar, başta uçuş eğitimi olmak üzere bireysel ulaşım, tarımsal havacılık ve yangınla mücadele gibi çeşitli görevlerde kullanılmaktadır. Özellikle hafif sınıftaki modeller, düşük satın alma ve işletme maliyetleri ile kısa pistlerden operasyon yapabilmeleri nedeniyle dünya genelinde yaygın biçimde tercih edilmektedir. Türkiye'de bu uçakların kullanımı ağırlıklı olarak genel havacılık ve uçuş eğitimi faaliyetlerinde yoğunlaşmaktadır. Bu faaliyetler sırasında meydana gelen kazalar ve ciddi olaylar, hava aracının yapısal elemanlarında ve mekanik sistemlerinde farklı düzeylerde hasara yol açabilmektedir. Hasarın türü ve kapsamının doğru belirlenmesi, bakım ve onarım planlaması açısından önemlidir. Bu değerlendirme, hava aracının yeniden uçuşa elverişliliğine ilişkin kararlara temel oluşturmaktadır. Bu çalışmada, 2021 ile 2025 yılları arasında Türkiye'de meydana gelen tek motorlu uçak kazaları ve ciddi olaylar sonucunda oluşan hava aracı hasarları incelenmiştir. Ulaşım Emniyeti İnceleme Merkezi tarafından yayımlanan 25 nihai rapor esas alınmıştır. İncelenen raporların yedisi kaza, on sekizi ciddi olaydır. Vakalar, uçuş safhası, hasar derecesi ve etkilenen bileşenler temelinde

sınıflandırılmıştır. Doğrudan motor hasarı ile pervane teması sonrası bildirilen motor kontrolü gereksinimi ayrı ele alınmıştır. Vakaların çoğu yaklaşma, iniş ve iniş sonrası yer hareketleri sırasında meydana gelmiştir. Motor gücü kaybını izleyen mecburi inişler ikinci ana vaka grubunu oluşturmuştur. İniş takımı, pervane ve motor en sık hasar gören bileşenlerdir. Bu üç bileşenin birlikte hasar gördüğü vakalar da belirlenmiştir. Kanat, gövde ve kuyruk hasarları pistten çıkma ile mecburi iniş vakalarında kaydedilmiştir. Hafif hasar sınıfındaki bazı vakalarda birden fazla sistem etkilenmiştir. Aynı hasar derecesindeki vakalarda hasar gören sistemlerin sayısı ve türü değişmiştir. Çalışma, Türkiye'deki tek motorlu uçak kazaları için bileşen düzeyinde bir hasar dağılımı sunmaktadır.

Anahtar kelimeler: Hava Aracı Hasarları, Genel Havacılık Kazaları, Tek Motorlu Uçaklar.

AKDENİZ MEYVE SİNEĞİ [*Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)]'NİN BİYOLOJİSİ, ZARARI VE MÜCADELESİ

BIOLOGY, DAMAGE AND CONTROL OF THE MEDITERRANEAN FRUIT FLY [*Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)]

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Abstract

The Mediterranean fruit fly (*Ceratitis capitata* (Wiedemann)) is a polyphagous pest distributed in many regions of the world and in our country. It is a pest with zero tolerance in external quarantine. In our country, it is a significant pest of citrus fruits, but also causes damage to apples, pears, peaches, persimmons, pomegranates, and nectarines. It has been recorded that the Mediterranean fruit fly feeds on 350 plant species from 65 different families worldwide. Adults are smaller than a housefly, and their wings have a brownish-yellowish pattern. The main damage is caused by the larvae that hatch from the eggs and feed on the fruit flesh. The softening of damaged fruits and their susceptibility to secondary infections lead to premature fruit drop, resulting in yield losses. Therefore, chemical control is frequently resorted to. Keeping pace with developing technology and changing global standards, and employing different control techniques to maintain pesticide residues below tolerance levels and ensure a clean environment, is an unavoidable necessity. Within the framework of integrated pest management, cultural measures, physical, mechanical, biological, and biotechnological control methods will be effective in reducing insecticide use in the control of the Mediterranean fruit fly. Understanding the bioecology, population changes, and damage status of *Ceratitis capitata* is crucial for effective control. Monitoring the pest through climate, soil, plant, and insect studies, as well as tracking population dynamics using tools, equipment, and machinery, will provide us with a wealth of information. In particular, traps used for insect population monitoring in biotechnological applications provide significant contributions to our understanding of this pest. Understanding this pest in all its aspects, which is economically very important (due to its inclusion in quarantine lists) and difficult to control both in our country and worldwide, will greatly contribute to minimizing the need for chemical control (due to insecticide residue problems).

Keywords: *Ceratitis capitata*, damage, control, bioecology, population change

Özet

Akdeniz Meyve Sineği (*Ceratitis capitata* (Wiedemann)) polifag bir zararlı olup dünyada ve ülkemizde birçok bölgede dağılım göstermektedir. Dış Karantinada toleransı sıfır olan bir zararlıdır. Ülkemizde özellikle turunçgillerin önemli bir zararlı olması yanında; elma, armut, şeftali, trabzon hurması, nar ve nektarinde de zarar yapmaktadır. Akdeniz meyve sineğinin dünya'da 65 farklı familyadan 350 bitki türünde beslendiği kaydedilmiştir. Erginleri bir ev sineğinden daha küçük, kanatları kahverengi sarımsı desenli yapıdadır. Asıl zararı yumurtalardan çıkan larvalar meyve etini yiyerek yapmaktadır. Zarar gören meyvelerin yumuşaması ve sekonder enfeksiyonlara açık hale gelmesi sonucunda hasattan önce dökülmesiyle verim kayıpları oluşmaktadır. Bu yüzden kimyasal mücadeleye sık sık başvurulmaktadır. Gelişen teknoloji ve değişen dünya standartlarına ayak uydurmak, ürünlerde tolerans değerlerinin altında pestisit kalıntısı ve temiz bir çevre için farklı mücadele tekniklerine başvurulması kaçınılmaz bir zorunluluktur. Entegre zararlı yönetimi kapsamında kültürel önlemler, fiziksel, mekanik, biyolojik,

biyoteknik mücadelenin yaygınlaştırılması insektisit kullanımının azaltılması açısından Akdeniz meyve sineği mücadelesinde etkili olacaktır. *Ceratitis capitata* ile etkin bir şekilde mücadele etmek için biyoekolojisinin, popülasyon değişimlerinin, zarar durumunun bilinmesi son derece önemlidir. Zararlıyla ilgili olarak yapılacak takiplerde iklim, toprak, bitki ve böcek incelemelerinin yanı sıra kullanılan alet ekipman ve teçhizatlarla da popülasyon dinamikleri izlenmesi zararlı hakkında bizlere yoğun bilgi akışı sağlayacaktır. Özellikle biyoteknik uygulamalardan böcek popülasyon takibinde kullanılan tuzaklar bu zararlı hakkında bize önemli katkılar sağlamaktadır. Ülkemizde ve dünyada ekonomik anlamda çok önemli (karantina listelerinde olması nedeniyle) ve mücadelesi zor olan bu zararlının bütün yönleriyle tanınması, kimyasal mücadeleye duyulan gereksinimin en aza indirilmesine (İnsektisit kalıntı problemlerinden dolayı) büyük katkı sağlayacaktır.

Anahtar kelimeler: *Ceratitis capitata*, zarar, mücadele , biyoekoloji, popülasyon değişimi

AFET VE ACİL DURUM TOPLANMA ALANLARINA YAYA ERİŞİLEBİLİRLİĞİN AĞ TABANLI ANALİZİ: TRABZON ORTAHİSAR ÖRNEĞİ

SPATIAL NETWORK ANALYSIS OF PEDESTRIAN ACCESSIBILITY TO EMERGENCY ASSEMBLY AREAS: A CASE STUDY OF ORTAHİSAR, TRABZON

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Abstract

The spatial distribution of disaster and emergency assembly areas is central to post-disaster planning, yet their number and size alone do not indicate how effectively residents can reach them through pedestrian networks during the critical post-disaster response period. This study evaluates network-based pedestrian accessibility to assembly areas and identifies access-disadvantaged neighborhoods with populations of at least 2,000 in Ortahisar, Trabzon. The analysis includes 276,259 residents across 33 neighborhoods and 64 assembly areas. Neighborhood populations were allocated among 15,860 residential or unspecified-use building locations in proportion to footprint area. For each building, the shortest pedestrian-network distance to the nearest assembly area was calculated and converted to access time using constant walking speeds of 0.8, 1.0, and 1.2 m/s. Accessibility was assessed as the population share able to reach an assembly area within 5, 10, 15, and 20 minutes, with population-weighted mean and median walking distances used as supplementary indicators. The population-weighted mean and median distances were 691 m and 517 m, respectively. At 1.2 m/s, 66.3%, 82.0%, and 91.2% of residents could reach the nearest assembly area within 10, 15, and 20 minutes, respectively. Reducing speed to 0.8 m/s lowered 15-minute coverage to 66.3%, demonstrating sensitivity to the walking-speed assumption. The greatest access disadvantages occurred in Çağlayan, Akyazı, and Yalıncak. In Çukurçayır, the most populous neighborhood, the median distance reached 963 m, demonstrating the need to consider accessibility jointly with the affected population. Neighborhood-level findings indicate that pedestrian accessibility is spatially uneven across Ortahisar. Estimated times represent potential access under constant speeds and an operational pedestrian network, not observed evacuation times. Joint consideration of access time and the population affected by poor access provides an objective basis for identifying planning priorities.

Keywords: Emergency assembly areas, pedestrian accessibility, GIS-based network analysis, service area analysis, disaster preparedness.

Özet

Afet ve acil durum toplanma alanlarının mekânsal dağılımı, afet sonrasında nüfusun güvenli alanlara yönlendirilmesinde belirleyici bir planlama unsurudur. Bununla birlikte, alanların sayısı ve büyüklüğü, yerleşik nüfusun mevcut yaya ulaşım ağı üzerinden bu alanlara erişim düzeyini tek başına açıklamamaktadır. Bu araştırmanın amacı, Trabzon'un Ortahisar ilçesinde nüfusu 2.000 ve üzerinde olan mahallelerde toplanma alanlarına yaya erişilebilirliği ağ tabanlı süre ölçütleriyle değerlendirmek ve erişim dezavantajının yoğunlaştığı mahalleleri belirlemektir. Çalışma, 33 mahallede yaşayan 276.259 kişi ile 64 toplanma alanını kapsamaktadır. Mahalle nüfusları, konut niteliğindeki veya kullanım türü belirtilmemiş 15.860 bina konumuna, bina taban alanlarıyla orantılı olarak dağıtılmıştır. Her bina konumundan en yakın toplanma alanına yaya ulaşım ağı üzerinden en kısa yürüme mesafesi hesaplanmıştır. Bu mesafeler 0,8, 1,0 ve 1,2 m/sn sabit yürüme hızları kullanılarak erişim süresine dönüştürülmüştür. Erişilebilirlik, 5, 10, 15 ve 20 dakikalık eşikler içinde toplanma alanına ulaşabilen nüfus oranlarıyla değerlendirilmiş; nüfus ağırlıklı ortalama ve medyan yürüme mesafeleri tamamlayıcı

göstergeler olarak kullanılmıştır. Nüfus ağırlıklı ortalama yürüme mesafesi 691 metre, medyan mesafe 517 metredir. Yürüme hızının 1,2 m/sn olduğu senaryoda nüfusun yüzde 66,3'ü 10, yüzde 82,0'si 15 ve yüzde 91,2'si 20 dakika içinde en yakın toplanma alanına erişebilmektedir. Hızın 0,8 m/sn'ye düşmesi, 15 dakikalık kapsama oranını yüzde 66,3'e indirmektedir. Erişim dezavantajının en belirgin olduğu mahalleler Çağlayan, Akyazı ve Yalıncak olarak belirlenmiştir. En yüksek nüfuslu mahalle olan Çukurçayır'da medyan yürüme mesafesinin 963 metreye ulaşması, erişim düzeyi ile etkilenen nüfus büyüklüğünün birlikte değerlendirilmesini gerekli kılmaktadır. Mahalle düzeyindeki sonuçlar, yaya erişilebilirliğinin ilçe genelinde mekânsal olarak dengeli dağılmadığını göstermektedir. Hesaplanan süreler, sabit yürüme hızları ve kullanılabilir yaya ulaşım ağı varsayımı altındaki potansiyel erişimi ifade etmekte; gerçekleşmiş tahliye sürelerini temsil etmemektedir. Bulgular, erişim süresi ile bu dezavantajdan etkilenen nüfusun birlikte değerlendirilmesinin planlama önceliklerinin belirlenmesine nesnel bir temel sağlayabileceğini göstermektedir.

Anahtar kelimeler: Acil durum toplanma alanları, yaya erişilebilirliği, mekânsal erişilebilirlik, CBS tabanlı ağ analizi, afete hazırlık.

DEVELOPMENT AND EXPERIMENTAL VALIDATION OF FIBER-BASED MOMENT–CURVATURE ANALYSIS TOOLS FOR REINFORCED CONCRETE COLUMNS

BETONARME KOLONLAR İÇİN LİF TABANLI MOMENT–EĞRİLİK ANALİZ ARAÇLARININ GELİŞTİRİLMESİ VE DENEYSEL DOĞRULANMASI

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Abstract

Accurate determination of the ductile behavior and moment-curvature response of reinforced concrete columns is essential for performance-based design and seismic safety assessment. This study develops and validates two fiber-based moment-curvature analysis tools based on the Mander models for confined and unconfined concrete, providing a reliable framework for future parametric investigations of section geometry, axial load ratio, and confinement reinforcement.

Eleven experimentally tested reinforced concrete column sections reported in the literature were examined. The specimens had axial load ratios of $N/(A_c f_{ck}) = 0.10–0.35$, concrete compressive strengths of 29–40 MPa, 6Ø14 longitudinal bars with $f_y = 484$ MPa, and transverse reinforcement with $f_{yw} = 637$ MPa. Longitudinal steel was represented by elastic, yield-plateau, and parabolic strain-hardening branches. Sections were discretized into 15 mm square fibers compatible with the XTRACT mesh, and the concrete area occupied by the reinforcing bars was excluded from the fiber mesh.

Moment-curvature analyses were conducted using two separately implemented Python tools developed with the assistance of Claude Code and Google Antigravity. After defining section geometry, material properties, and axial load, the tools calculated Mander confinement parameters, generated the two-dimensional fiber mesh, and obtained ultimate moment capacity. Results were compared with XTRACT results and experimental data using mean absolute percentage error (*MAPE*) and coefficient of determination (R^2).

Relative to the experiments, *MAPE* values were 8.28% for XTRACT, 10.36% for the Claude Code tool, and 9.63% for the Antigravity tool; corresponding R^2 values were 0.752, 0.766, and 0.760. Both tools captured the experimental trend with accuracy comparable to that of XTRACT and produced consistent results. Deviations were greater at low axial load ratios [$N/(A_c f_{ck}) \approx 0.10$], whereas all methods showed closer agreement at higher ratios [$N/(A_c f_{ck}) \approx 0.35$]. These findings support the framework's reliability for the planned parametric study.

Keywords: Moment-Curvature Analysis, Fiber Section Analysis, Mander Model, Confined Concrete, Numerical Validation

Özet

Betonarme kolonların sünek davranışının ve moment-eğrilik tepkisinin doğru bir şekilde belirlenmesi, performans temelli tasarım ve sismik güvenlik değerlendirmesi açısından hayati önem taşımaktadır. Bu çalışma, Mander sargılı ve sargısız beton modellerine dayanan iki lif tabanlı moment-eğrilik analiz aracını geliştirmeyi ve doğrulamayı; böylece kesit geometrisi, eksenel yük oranı ve sargı donatısına ilişkin gelecekteki parametrik incelemeler için güvenilir bir altyapı oluşturmayı amaçlamaktadır.

Literatürde yer alan ve deneysel olarak test edilmiş 11 adet betonarme kolon kesiti incelenmiştir. Numunelerin eksenel yük oranları $N/(A_c f_{ck})$ = 0,10–0,35, beton basınç dayanımları ise 29–40 MPa arasında değişmektedir. Numunelerde, akma dayanımı $f_y = 484$ MPa olan 6Ø14 boyuna donatı ile akma

dayanımı f_{yw} = 637 MPa olan enine donatı kullanılmıştır. Boyuna donatı, elastik, akma platosu ve parabolik pekleşme dalları ile temsil edilmiştir. Kesitler, XTRACT ağıyla uyumlu 15 mm'lik kare liflere ayrıştırılmış ve donatı çubuklarının kapladığı beton alanı lif ağından çıkarılmıştır.

Moment-eğrilik analizleri, yapay zekâ destekli programlama ortamları Claude Code ve Google Antigravity yardımıyla birbirinden bağımsız olarak geliştirilen iki Python aracı kullanılarak gerçekleştirilmiştir. Kesit geometrisi, malzeme özellikleri ve eksenel yük tanımlandıktan sonra, araçlar Mander modeline göre sargılama parametrelerini hesaplamış, iki boyutlu lif ağı oluşturmuş ve nihai moment kapasitesini belirlemiştir. Elde edilen sonuçlar, ortalama mutlak yüzde hata (MAPE) ve belirleme katsayısı (R^2) kullanılarak XTRACT sonuçlarıyla deneysel veriler karşılaştırılmıştır.

Deneysel sonuçlarla karşılaştırıldığında, *MAPE* değerleri XTRACT için %8,28, Claude Code aracı için %10,36 ve Antigravity aracı için %9,63 olarak elde edilirken, karşılık gelen R^2 değerleri sırasıyla 0,752, 0,766 ve 0,760 olarak hesaplanmıştır. Her iki araç da deneysel eğilimi XTRACT ile karşılaştırılabilir doğrulukla yakalamış ve birbiriyle tutarlı sonuçlar üretmiştir. Düşük eksenel yük oranında [$N/(A_c f_{ck}) \approx 0{,}10$] sapmalar daha büyükken, tüm yöntemler yüksek eksenel yük oranında [$N/(A_c f_{ck}) \approx 0{,}35$] deneysel sonuçlarla daha iyi uyum göstermiştir. Bu bulgular, geliştirilen araçların planlanan parametrik çalışmada kullanılabilecek düzeyde güvenilir olduğunu göstermektedir.

Anahtar Kelimeler: Moment-Eğrilik Analizi, Lif Kesit Analizi, Mander Modeli, Sargılı Beton, Sayısal Doğrulama

KAVŞAK YAKLAŞIMLARINDAKİ YATAY TRAFİK İŞARETLEMELERİNİN MOTOSİKLET GÜVENLİĞİ AÇISINDAN DEĞERLENDİRİLMESİ

EVALUATION OF HORIZONTAL TRAFFIC MARKINGS AT INTERSECTION APPROACHES FROM A MOTORCYCLE SAFETY PERSPECTIVE

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Abstract

Horizontal traffic markings are applied to road surfaces to regulate traffic flow, define lane use, and guide and warn drivers. Direction arrows assist drivers in selecting appropriate lanes and directions at intersection approaches. However, friction differences between marking materials and asphalt pavement may increase motorcyclists' risk of loss of control, particularly during braking at intersection approaches and while riding at a lean angle on horizontal curves. This study evaluates the potential effect of wide-area directional markings on the D010 Black Sea Coastal Highway on motorcycle loss-of-control risk under braking and curve-negotiation conditions. Two lanes in both directions at ten intersections were evaluated, comprising 200 horizontal directional markings, with five per lane. The General Directorate of Highways specifies 7.50-m directional markings for speeds above 60 km/h. The five markings in each lane have a cumulative length of 37.5 m and recur within the approach section 90–350 m from the intersection. Studies in the literature indicate that reduced marking-surface friction, successive markings, and braking on markings may adversely affect motorcycle dynamic stability and increase loss-of-control risk. Accordingly, braking and curve-negotiation conditions were evaluated using literature-derived friction scenarios. At a 20° lean angle, the friction demand for curve negotiation is 0.364; adding 0.20g braking increases it to 0.415. Thus, under a friction-coefficient scenario of 0.30, the marking surface cannot meet curve-negotiation demand; under 0.40, it cannot meet the combined braking and curve-negotiation demand. The findings indicate that wide-area, successive horizontal markings should be considered in motorcycle safety assessments under high-friction-demand riding conditions. The results demonstrate that evaluations of horizontal markings should consider not only visibility and guidance functions but also friction differences between markings and asphalt pavement and their location in sections requiring braking or curve negotiation.

Keywords: Skid resistance, Motorcycle dynamics, Motorcycle safety, Horizontal traffic markings,

Özet

Karayollarında trafik akışının düzenlenmesi, şerit kullanımının belirlenmesi ve sürücülere yönlendirme ve uyarıların sağlanması amacıyla yol yüzeyine yatay trafik işaretlemeleri uygulanmaktadır. Bu işaretlemeler arasında yer alan yön okları, kavşak yaklaşımlarında sürücülerin uygun şeridi seçmesine ve izleyecekleri yönü algılamasına yardımcı olmaktadır. Bununla birlikte, işaretleme malzemesinin asfalt kaplamadan farklı sürtünme özelliklerine sahip olması, motosikletler açısından kontrol kaybı riski oluşturabilmektedir. Bu risk, frenleme gereksiniminin arttığı kavşak yaklaşımlarında ve motosikletin yatış açısıyla seyrettiği yatay kurplarda belirgin hâle gelebilmektedir. Bu çalışma, D010 Karadeniz Sahil Yolu'nda kullanılan geniş yüzeyli yön işaretlemelerinin motosikletlerin frenleme ve kurp geçişi koşullarındaki kontrol kaybı riski üzerindeki potansiyel etkisini değerlendirmeyi amaçlamaktadır. Çalışma kapsamında on kavşağın her iki yönündeki ikişer şerit değerlendirilmiş ve her şeritte beş olmak üzere 200 yatay yön işaretlemesi incelenmiştir. Karayolları Genel Müdürlüğünce 60 km/sa üzerindeki hızlar için tanımlanan yön işaretlemeleri 7,50 m uzunluğundadır. Bir şeritte beş yatay işaretlemenin toplam uzunluğu 37,5 m olup, işaretlemeler kavşağa 90–350 m uzaklıktaki yaklaşım kesiminde

tekrarlanmaktadır. Literatürdeki çalışmalar, işaretleme yüzeyindeki sürtünmenin azalmasının, ardışık işaretlemelerden geçişin ve işaretleme üzerinde frenlemenin motosikletin dinamik kararlılığını olumsuz etkileyerek kontrol kaybı riskini artırabileceğini göstermektedir. Bu doğrultuda frenleme ve kurp geçişi koşulları, literatürden türetilen sürtünme senaryoları üzerinden değerlendirilmiştir. Yirmi derecelik yatış açısında kurp geçişi için gerekli sürtünme düzeyi 0,364 iken, 0,20g frenlemenin eklenmesi bu değeri 0,415'e yükseltmektedir. Buna göre 0,30 sürtünme katsayısı senaryosunda işaretleme yüzeyi kurp geçişi talebini; 0,40 senaryosunda ise frenleme ile kurp geçişinin birlikte gerçekleştiği talebi karşılayamamaktadır. Bulgular, geniş yüzeyli ve ardışık yatay işaretlemelerin yüksek tutunma gereksinimi oluşturan sürüş koşullarında motosiklet güvenliği açısından dikkate alınması gerektiğini göstermektedir. Sonuçlar, yatay işaretlemelerin değerlendirilmesinde görünürlük ve yönlendirme işlevlerinin yanı sıra işaretleme ile asfalt kaplama arasındaki sürtünme farklılığının ve işaretlemelerin frenleme veya kurp geçişi gerektiren kesimlerdeki konumlarının da dikkate alınması gerektiğini ortaya koymaktadır.

Anahtar kelimeler: Kayma direnci, Motosiklet dinamiği, Motosiklet güvenliği, Yatay trafik işaretlemeleri.

KIŞ KOŞULLARINDA SERA ISITMASI İÇİN PCM TABANLI BİR ISIL ENERJİ DEPOLAMA ÜNİTESİNİN SAYISAL OLARAK İNCELENMESİ

NUMERICAL INVESTIGATION OF A PCM-BASED THERMAL ENERGY STORAGE UNIT FOR WINTER GREENHOUSE HEATING

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Abstract

Maintaining a suitable indoor temperature during winter nights is one of the major challenges in greenhouse cultivation, particularly in regions experiencing large day–night temperature variations. Phase change materials (PCMs) can store thermal energy during the daytime and release it later as latent heat, making them suitable for supporting greenhouse heating during nighttime periods. In this study, the transient thermal behavior of a finned PCM-based thermal energy storage unit intended for greenhouse heating was numerically investigated under the winter climatic conditions of Aksaray, Türkiye. A three-dimensional transient model was developed in ANSYS Fluent, and the melting and solidification processes were simulated using the enthalpy–porosity method. The storage unit incorporated a 20 mm-thick PCM layer with solidus and liquidus temperatures of 296 K and 299 K, respectively. A solar heat input based on Aksaray meteorological data was applied for 3.6 h, followed by a nighttime discharging period. The thermal response of the storage unit was evaluated over a complete 24-hour operating cycle. The average PCM temperature, liquid fraction, and heat transfer rate from the storage unit to the surrounding environment were monitored throughout the simulation. The PCM completely melted during the daytime charging period. During the nighttime period, the stored thermal energy was gradually released to the surroundings, and the PCM completed the solidification process within the daily operating cycle. Overall, the numerical results show that the proposed finned PCM unit is capable of completing a daily charging–discharging cycle under the winter conditions considered in this study and may serve as a thermal energy storage element for greenhouse heating applications.

Keywords: Phase Change Material, Thermal Energy Storage, Greenhouse Heating, Numerical Simulation, Winter Conditions

Özet

Kış gecelerinde uygun sera iç ortam sıcaklığının korunması, özellikle gündüz ve gece sıcaklık farklarının yüksek olduğu bölgelerde sera yetiştiriciliğinde karşılaşılan önemli sorunlardan biridir. Faz değişim malzemeleri (FDM), gündüz saatlerinde depoladıkları ısıl enerjiyi gece saatlerinde gizli ısı şeklinde geri verebildikleri için sera ısıtma uygulamalarında dikkat çeken ısıl enerji depolama çözümlerinden biridir. Bu çalışmada, sera ısıtmasını desteklemek amacıyla tasarlanan kanatçıklı FDM tabanlı bir ısıl enerji depolama ünitesinin zamana bağlı ısıl davranışı, Aksaray ilinin kış iklim koşulları dikkate alınarak sayısal olarak incelenmiştir. Üç boyutlu zamana bağlı sayısal model ANSYS Fluent yazılımında oluşturulmuş, erime ve katılaşma süreçleri entalpi–porozite yöntemi kullanılarak modellenmiştir. Depolama ünitesinde katılaşma ve sıvılaşma sıcaklıkları sırasıyla 296 K ve 299 K olan 20 mm kalınlığında bir FDM tabakası kullanılmıştır. Aksaray meteorolojik verilerine dayalı güneş ısı girdisi 3.6 saat boyunca uygulanmış, ardından gece deşarj süreci modellenmiştir. Ünitenin davranışı 24 saatlik bir çalışma çevrimi boyunca değerlendirilmiştir. Simülasyon süresince ortalama FDM sıcaklığı, sıvı fraksiyonu ve depolama ünitesinden çevre ortama gerçekleşen ısı transfer hızındaki değişimler incelenmiştir. Analizler sonucunda FDM'nin gündüz şarj süresi içerisinde tamamen eridiği, gece sürecinde ise depoladığı ısıl enerjiyi çevre ortama kademeli olarak aktararak günlük çalışma çevrimi

içinde katılaşma sürecini tamamladığı belirlenmiştir. Elde edilen sonuçlar, önerilen kanatçıklı FDM ünitesinin Aksaray kış koşullarında günlük şarj–deşarj çevrimine uygun bir çalışma sergilediğini ve sera ısıtma uygulamalarında kullanılabilecek bir ısıl enerji depolama elemanı olarak değerlendirilebileceğini göstermektedir.

Anahtar Kelimeler: Faz Değişim Malzemesi, Isıl Enerji Depolama, Sera Isıtması, Sayısal Analiz, Kış Koşulları

JEOTERMAL ENERJI DESTEKLI TRANSKRITIK RANKINE ÇEVRIMININ ELEKTRIK VE SOĞUTMA ÜRETIMI IÇIN PERFORMAN ANALIZI

PERFORMANCE ANALYSIS OF A GEOTHERMAL ENERGY-ASSISTED TRANSCRITICAL RANKINE CYCLE FOR ELECTRICITY AND COOLING GENERATION.

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Abstract

Today, one of the greatest global threats facing humanity is the rapidly escalating environmental problems and the climate crisis, which demand immediate and strategic action across all sectors. In addition, the continuous depletion of fossil fuel reserves and rising energy costs necessitate a critical shift towards clean, reliable, and sustainable alternatives in the global energy landscape. In this context, geothermal energy, which holds a privileged position among renewable energy sources, stands out with its environmentally friendly, reliable, and uninterrupted nature. Integrating low- and medium-temperature geothermal potential with modern thermodynamic systems is of paramount importance in terms of increasing overall energy efficiency and converting low-grade waste heat into high-value outputs such as power and refrigeration.

This study examines an innovative integrated system powered by a low-temperature geothermal source, designed to simultaneously generate electricity and cooling through an optimized transcritical Rankine cycle integrated with an ejector subsystem. The proposed system architecture aims to maximize thermodynamic performance while focusing on the efficient utilization of low-temperature waste heat, thereby reducing thermal losses typically encountered in conventional single-generation cycles.

Detailed numerical analyses revealed that the system, operating at a constant geothermal source temperature of 120 °C, can successfully generate 1372 kW of net electricity while providing approximately 2127 kW of cooling load. Furthermore, the overall energy efficiency of the system was calculated as 14.29%, demonstrating that such integrated ejector-based configurations possess high performance potential in harnessing low-temperature renewable energy sources. This research provides a robust framework for future polygeneration plant designs, offering significant insights for engineers and researchers aiming to enhance the sustainability and thermodynamic viability of low-grade thermal energy recovery systems in modern engineering applications

Keywords: Geothermal energy, Rankine cycle, thermodynamic analysis, energy, sustainability.

Özet

Günümüzde insanlığın karşı karşıya kaldığı en büyük küresel tehditlerden biri, tüm sektörlerde acil ve stratejik eylem gerektiren, hızla tırmanan çevresel sorunlar ve iklim krizidir. Buna ek olarak, fosil yakıt rezervlerinin sürekli tükenmesi ve artan enerji maliyetleri, küresel enerji alanında temiz, güvenilir ve sürdürülebilir alternatiflere yönelmeyi zorunlu kılmaktadır. Bu bağlamda, yenilenebilir enerji kaynakları arasında ayrıcalıklı bir konuma sahip olan jeotermal enerji; çevre dostu, güvenilir ve kesintisiz yapısıyla öne çıkmaktadır. Düşük ve orta sıcaklıktaki jeotermal potansiyelin modern termodinamik sistemlerle entegre edilmesi, genel enerji verimliliğinin artırılması ve düşük kaliteli atık ısının güç ve soğutma gibi yüksek değerli çıktılara dönüştürülmesi açısından son derece önemlidir.

Bu çalışma, düşük sıcaklıklı bir jeotermal kaynakla beslenen ve bir ejektör alt sistemiyle entegre edilmiş optimize edilmiş bir transkritik Rankine çevrimi vasıtasıyla eş zamanlı elektrik ve soğutma üretmek üzere tasarlanmış yenilikçi bir entegre sistemi incelemektedir. Önerilen sistem mimarisi, geleneksel tekli

üretim çevrimlerinde tipik olarak karşılaşılan ısıl kayıpları azaltarak düşük sıcaklıklı atık ısının verimli kullanımına odaklanırken termodinamik performansı maksimize etmeyi amaçlamaktadır.

Ayrıntılı sayısal analizler, 120 °C sabit jeotermal kaynak sıcaklığında çalışan sistemin yaklaşık 2127 kW soğutma yükü sağlarken başarıyla 1372 kW net elektrik üretebildiğini ortaya koymuştur. Dahası, sistemin genel enerji verimi %14,29 olarak hesaplanmış olup, bu tür entegre ejektör tabanlı konfigürasyonların düşük sıcaklıklı yenilenebilir enerji kaynaklarından yararlanmada yüksek performans potansiyeline sahip olduğunu göstermiştir. Bu araştırma, modern mühendislik uygulamalarında düşük kaliteli ısıl enerji geri kazanım sistemlerinin sürdürülebilirliğini ve termodinamik uygulanabilirliğini artırmayı amaçlayan mühendisler ve araştırmacılar için önemli içgörüler sunarak gelecekteki çoklu üretim tesisi tasarımları için güçlü bir temel sağlamaktadır.

Anahtar kelimeler: Jeotermal enerji, Rankine cycle, termodinamik analiz, enerji, sürdürülebilirlik

PARABOLİK OLUK DESTEKLİ SÜPERKRİTİK BRAYTON GÜÇ ÇEVRİMİNİN MODELLENMESİ VE ENERJİ-EKSERJİ ANALİZ

MODELING AND THERMODYNAMİC INVESTIGATION OF A PARABOLIC TROUGH-DRIVEN SUPERCRİTİCAL BRAYTON CYCLE

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Abstract

This study presents a comprehensive thermodynamic investigation of an innovative supercritical Brayton cycle supported by parabolic trough solar collectors (PTSC), designed to substantially enhance the utilization of renewable energy resources in modern power generation. Carbon dioxide (CO_2) is utilized as the working fluid throughout the system due to its advantageous thermo-physical properties, including high density and superior heat transfer characteristics near the critical point. To optimize system efficiency and effectively manage operational parameters, the cycle architecture is meticulously configured with an intercooled dual-compressor arrangement. Furthermore, the system is engineered to simultaneously address domestic heating load requirements, thereby functioning as a high-efficiency co-generation framework.

The rigorous thermodynamic characterization and modeling of the proposed configuration are conducted using fundamental mass, energy, and exergy balance equations. The analytical results indicate that the proposed system achieves a remarkable energy efficiency of 50.49% and an exergy efficiency of 22.09%. Under the baseline evaluated operational conditions, the integrated plant is capable of generating a robust net power output of 1023 kW, demonstrating its technical viability for advanced power applications.

In the subsequent phase of the study, the parametric effects of critical operational and environmental variables—such as Direct Normal Irradiation (DNI) intensity and ambient reference temperature—on the overall system performance, total exergy destruction rates, and energy conversion efficiency are thoroughly examined. The findings demonstrate that this CO_2-based integrated system offers a robust, reliable, and environmentally friendly alternative for high-efficiency solar energy applications. Moreover, the study highlights the decisive role of identifying exergy destruction hotspots within the system components, providing valuable insights for future optimization, commercial scale-up, and advanced thermodynamic design in renewable energy systems

Keywords: Supercritical Brayton Cycle, Parabolic Trough Collector, Exergy Analysis, CO_2 Power Cycles, Solar Energy

Özet

Bu çalışma, modern güç üretiminde yenilenebilir enerji kaynaklarının kullanımını büyük ölçüde artırmak amacıyla tasarlanmış, parabolik oluklu güneş kolektörleri (PTSC) ile desteklenen yenilikçi bir süperkritik Brayton çevriminin kapsamlı bir termodinamik incelemesini sunmaktadır. Karbondioksit (CO_2), yüksek yoğunluk ve kritik nokta yakınındaki üstün ısı transferi özellikleri dahil olmak üzere avantajlı termofiziksel özellikleri nedeniyle sistem boyunca akışkan olarak kullanılmaktadır. Sistem verimliliğini optimize etmek ve operasyonel parametreleri etkin bir şekilde yönetmek için çevrim mimarisi, ara soğutmalı çift kompresörlü bir düzenlemeyle titizlikle yapılandırılmıştır. Ayrıca sistem, konut ısıtma yükü gereksinimlerini aynı anda karşılayacak şekilde tasarlanmış olup bu sayede yüksek verimli bir kojenerasyon çerçevesi olarak işlev görmektedir.Önerilen konfigürasyonun titiz termodinamik karakterizasyonu ve modellemesi, temel kütle, enerji ve ekserji denge denklemleri kullanılarak gerçekleştirilmiştir. Analitik sonuçlar, önerilen sistemin %50,49'luk dikkate değer bir enerji verimliliğine ve %22,09'luk bir ekserji verimliliğine ulaştığını göstermektedir. Değerlendirilen temel

işletme koşulları altında entegre tesis, 1023 kW net güç çıkışı üretebilecek kapasitede olup gelişmiş güç uygulamaları için teknik uygulanabilirliğini kanıtlamaktadır.Çalışmanın sonraki aşamasında; Doğrudan Normal Işıma (DNI) yoğunluğu ve ortam referans sıcaklığı gibi kritik operasyonel ve çevresel değişkenlerin genel sistem performansına, toplam ekserji yıkım oranlarına ve enerji dönüşüm verimliliğine olan parametrik etkileri kapsamlı bir şekilde incelenmiştir. Bulgular, CO_2 tabanlı bu entegre sistemin yüksek verimli güneş enerjisi uygulamaları için sağlam, güvenilir ve çevre dostu bir alternatif sunduğunu göstermektedir. Dahası, çalışma, sistem bileşenleri içindeki ekserji yıkım odaklarının belirlenmesinin genel sistem performansındaki belirleyici rolünü vurgulayarak gelecekteki optimizasyon, ticari ölçek büyütme ve yenilenebilir enerji sistemlerindeki gelişmiş termodinamik tasarım için değerli içgörüler sunmaktadır.

Anahtar kelimeler: Süperkritik Brayton Çevrimi, Parabolik Oluk Kollektör, Ekserji Analizi, CO_2 Güç Çevrimleri, Güneş Enerjisi

ZYNQ-7020 ÜZERİNDE NİCEMLENMİŞ 1B-EVRİŞİMLİ SİNİR AĞI İLE EKG SINIFLANDIRMASI: BİT-GENİŞLİĞİNE BAĞLI KAYNAK–DOĞRULUK ÖDÜNLEŞİMİNİN BİT DÜZEYİNDE DEĞERLENDİRMESİ

ECG CLASSIFICATION WITH A QUANTIZED 1D-CNN ON ZYNQ-7020: EVALUATION OF THE BIT-WIDTH–DEPENDENT RESOURCE–ACCURACY TRADE-OFF

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ÖZET

Gerçek zamanlı elektrokardiyografi (EKG) sınıflandırmasının uç (edge) cihazlarda gerçekleştirilmesi, düşük güç tüketimi ve sınırlı donanım kaynakları nedeniyle nicelenmiş modelleri ve bit düzeyinde birebir (bit-exact) çıkarım hatlarını gerektirir. Literatürde farklı model ve platformlarda çok sayıda çalışma bulunsa da, sabit bir model ve tek bir donanım platformu üzerinde bit-genişliğinin etkisinin sistematik biçimde ayrıştırılması sınırlı kalmıştır. Bu çalışma, bu boşluğu hedefleyerek sabit bir model ve tek bir donanım platformunda bit-genişliğinin doğruluk, kaynak kullanımı ve gecikme üzerindeki etkisini incelemektedir. PTB-XL veri kümesinin 100 Hz sürümünde, beş tanısal süper-sınıfa eşlenen 21.388 kayıt, tek kanal (Lead II) ve 10 saniyelik pencereler kullanılarak z-skoru normalizasyonu ile işlenmiştir. Yaklaşık 2,9 bin parametreli kompakt bir 1B-CNN modeli, nicemleme-farkında eğitim (QAT) ile INT8, INT6 ve INT4 hassasiyetlerinde eğitilmiş; ardından Zynq-7020 (PYNQ-Z1) platformu için Vitis HLS kullanılarak ap_int/ap_uint tabanlı bit düzeyinde birebir donanım hızlandırıcısına dönüştürülmüştür. Tamsayı çıkarım hattı, yeniden nicemleme ve önyargı ölçekleme dâhil olmak üzere NumPy tabanlı bit düzeyinde birebir bir referansla doğrulanmıştır. FP32 taban model 0,818 makro-AUC ve 0,595 makro-F1 elde ederken, INT8 (0,819 AUC; 0,598 F1) ve INT6 (0,816 AUC; 0,591 F1) doğruluğu korumuş, INT4 ise 0,751 AUC ile belirgin performans kaybı göstermiştir. Ayrıca, düşük hassasiyette önyargı nicemlemesinin kritik olduğu ve uygun yeniden nicemleme ile yaklaşık 6 puanlık AUC kaybının giderilebildiği gösterilmiştir. HLS sentezinde tüm modeller 50 MHz zamanlama hedefini ve 2,08 ms gecikmeyi sağlamış; DSP, LUT ve FF kullanımı büyük ölçüde sabit kalırken bit-genişliğine en duyarlı kaynağın BRAM olduğu, özellikle INT8'de blok bellek kullanımının belirgin biçimde arttığı gözlemlenmiştir. Sonuçlar, bu platformda INT6 ve INT8'in doğruluk ve donanım verimliliği açısından en uygun çalışma noktalarını sunduğunu; INT4'ün ise doğruluktaki belirgin kayıp nedeniyle yalnızca kaynak kısıtının en ön planda olduğu senaryolar için uygun olabileceğini göstermektedir.

Anahtar Kelimeler: EKG sınıflandırması, nicemleme, nicemleme-farkında eğitim, FPGA, Zynq-7020, uç yapay zekâ, yüksek seviyeli sentez (HLS).

ABSTRACT

Real-time electrocardiography (ECG) classification on edge devices, constrained by low power budgets and limited hardware resources, calls for quantized models and bit-exact inference pipelines. Although many studies address different models and platforms, the systematic isolation of bit-width effects for a fixed model on a single hardware platform remains limited. Targeting this gap, this study examines how bit-width affects accuracy, resource usage, and latency for a fixed model on a single hardware platform. Using the 100 Hz version of the PTB-XL dataset, 21,388 records mapped to five diagnostic superclasses

were processed with single-lead (Lead II) 10-second windows and per-record z-score normalization. A compact 1D-CNN with approximately 2,900 parameters was trained via quantization-aware training (QAT) at INT8, INT6, and INT4 precisions, then converted into an ap_int/ap_uint-based bit-exact hardware accelerator for the Zynq-7020 (PYNQ-Z1) platform using Vitis HLS. The integer inference pipeline, including requantization and bias scaling, was verified against a NumPy-based bit-exact reference. The FP32 baseline reached a macro-AUC of 0.818 and a macro-F1 of 0.595, while INT8 (0.819 AUC; 0.598 F1) and INT6 (0.816 AUC; 0.591 F1) preserved accuracy and INT4 (0.751 AUC) showed a clear performance drop. Bias quantization proved critical at low bit-widths: proper requantization recovered an otherwise ~6-point AUC loss. In HLS synthesis, all models met the 50 MHz timing target with 2.08 ms latency; DSP, LUT, and FF usage remained largely constant, whereas BRAM was the resource most sensitive to bit-width, with block-memory usage increasing markedly at INT8. The results indicate that INT6 and INT8 offer the most favorable operating points in terms of accuracy and hardware efficiency on this platform, whereas INT4 is advisable only when aggressive compression is required.

Keywords: ECG classification, quantization, quantization-aware training, FPGA, Zynq-7020, edge AI, high-level synthesis (HLS).

NİCEMLENMİŞ 1B EVRİŞİMLİ SİNİR AĞI ÇIKARIMINDA ÇARPANSIZ YENİDEN ÖLÇEKLEME: TEK VE İKİ KAYDIRMALI ŞEMALARIN FPGA ÜZERİNDE DEĞERLENDİRİLMESİ

MULTIPLIER-FREE REQUANTIZATION FOR QUANTIZED 1-D CNN INFERENCE: EVALUATION OF SINGLE- AND TWO-SHIFT SCHEMES ON FPGA

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ÖZET

Derin öğrenme modellerinin kenar (edge) donanımlarında dağıtımı, tamsayı-temelli (integer-only) çıkarımı ve buna bağlı yeniden ölçekleme (requantization) adımını gerektirir. Yeniden ölçekleme, evrişim biriktiricisini (accumulator) çıkış aktivasyon ölçeğine taşıyan, kanal başına bir çarpma işlemi içerir ve bu çarpmalar FPGA gerçeklemelerinde sınırlı sayıdaki DSP bloklarını tüketir. Bu çalışmada, yeniden ölçekleme çarpanının 2'nin kuvvetlerine kısıtlanarak çarpansız (multiplier-free) gerçeklendiği iki şema incelenmiştir: tek 2'nin kuvveti (tek kaydırma) ve iki 2'nin kuvvetinin toplamı (iki kaydırma ve bir toplama). Üç şema (affine çarpan, tek-POT ve iki-POT) tek değişkenli bir tasarım kapsamında, ortak bir nicelenmiş 1B evrişimli sinir ağı ve UCI HAR insan aktivite tanıma veri kümesi (128 örneklik pencereler, 9 kanal, altı sınıf, denek-bağımsız bölme) üzerinde karşılaştırılmıştır. Model, eğitim-farkında niceleme ile INT8'e nicelenmiş; tüm şemalar ortak bir tamsayı yeniden ölçekleme formülü altında ifade edilmiş ve yalnızca kanal başına çarpanın seçimiyle farklılaştırılmıştır. Bu ortak formül sayesinde, tamsayı golden referans ile Yüksek Seviye Sentez (HLS) çekirdeği arasındaki bit-tam (bit-exact) eşdeğerlik yapı gereği korunmuş ve C-benzetimiyle doğrulanmıştır. Bulgular, tek kaydırmalı şemanın ölçek yaklaşım hatasının artması (evrişim katmanlarında ortalama yaklaşık %18-20) nedeniyle doğruluğu belirgin biçimde düşürdüğünü (0,907'den 0,828'e), iki 2'nin kuvvetinin toplamının ise bu hatayı yaklaşık %2-3'e indirerek doğruluğu affine referansa (0,906) yakın tuttuğunu ve bunu herhangi bir çarpma gerektirmeden sağladığını göstermektedir. Donanım açısından ise, paylaşımlı (ardışık düzenlenmemiş) bu gerçeklemede çarpansız şemaların DSP kazancı sınırlı kalmış (71'e karşı 68 DSP) ve gecikme artmıştır (0,76 ms'ye karşı 1,26 ms); çünkü yeniden ölçekleme çarpanı birkaç DSP bloğuna amorti olmakta, kanal başına değişken kaydırmalar ise ek çevrim getirmektedir. Üç şema da yaklaşık 70 MHz'lik hedef saat frekansını karşılamaktadır. Sonuç olarak, çarpansız yeniden ölçeklemenin donanım avantajı tasarım biçimine bağlıdır ve beklenen DSP kazancının, her yeniden ölçekleme çarpanının ayrı bir DSP'ye eşlendiği tam-açılmış veya ardışık düzenli veri yolu tasarımlarında ortaya çıkacağı değerlendirilmektedir.

Anahtar Kelimeler: FPGA, niceleme, yeniden ölçekleme, çarpansız aritmetik, 1B-CNN, Yüksek Seviye Sentez.

ABSTRACT

Deploying deep learning models on edge hardware requires integer-only inference and an associated requantization step. Requantization contains a per-channel multiplication that maps the convolution accumulator onto the output activation scale, and these multiplications consume the limited number of DSP blocks in FPGA implementations. This study investigates two schemes in which the requantization multiplier is constrained to powers of two and therefore realized without any multiplication: a single power of two (one shift) and a sum of two powers of two (two shifts and one addition). Three schemes (affine multiplier, single-POT, and two-POT) are compared as a single-variable design on a common quantized 1-D convolutional neural network and the UCI HAR human activity recognition dataset (128-sample windows, 9 channels, six classes, subject-independent split). The model is quantized to INT8 with quantization-aware training, and all schemes are expressed under a common integer requantization formula, differing only in how the per-channel multiplier is chosen. Owing to this shared formula, bit-exact equivalence between the integer golden reference and the High-Level Synthesis (HLS) kernel is preserved by construction and confirmed by C-simulation. The results show that the single-shift scheme noticeably lowers accuracy (from 0.907 to 0.828) because the scale-approximation error grows to roughly 18-20% on average across the convolution layers, whereas the sum of two powers of two reduces this error to about 2-3% and keeps accuracy close to the affine reference (0.906) without any multiplication. On the hardware side, however, in this resource-shared (non-pipelined) implementation the multiplier-free schemes yield only a marginal DSP saving (71 versus 68 DSPs) and a higher latency (0.76 ms versus 1.26 ms), because the requantization multiplier is amortized over several outputs while the per-channel variable shifts add cycles. All three schemes meet the target clock frequency of about 70 MHz. Consequently, the hardware benefit of multiplier-free requantization is design-dependent, and the expected DSP saving is anticipated in fully unrolled or pipelined datapaths where each requantization multiplier maps to a dedicated DSP.

Keywords: FPGA, quantization, requantization, multiplier-free arithmetic, 1-D CNN, High-Level Synthesis.

EVALUATION OF THE KUYUCAK AND SİVRİHİSAR (ESKISEHIR) DOLOMITES AS AGGREGATE ACCORDING TO ALCALI CARBONATE REACTIVITY

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Abstract

Dolomite is generally used in construction and building as fine and coarse aggregates in the cement and mortar. In the aftermath of the Great Maraş earthquake on February 6, 2023, dolomite-containing aggregates were found in many buildings. The type of aggregate effects importance in concrete strength. Therefore, the Sivrihisar dolomite-added aggregates and the Kuyucak dolomitic limestone-added aggregates were investigated for aggregate reactivity as cement aggregates in this study. The AAR-5 test (rapid preliminary screening test for carbonate aggregates) was applied to the 6 mortar samples to determine the alkali quality of these aggregates. The six mortar bars were prepared in a 40x40x160 mm mold and the length change values were measured for 14 days. The scanning electron microscopy and the energy dispersive spectroscopy (SEM-EDX) tests were done for 6 mortar samples. According to the variance analysis, elemental minerals of 6 mortar samples have different effects from each other. The Silisium element is the minimum (3.80 %) and the carbon element is the maximum amount (20.86 %) compared to other samples. Thus, carbon and silisium elements can affect the length change amount. Also, when the 1.no. and 6. no samples's lengths increase according to days, the others have a negative trend according to days according to regression analysis. The maximum length change rate is 0.555% on the 3rd day and a positive mean relationship (0.027%) has on 14th day. It is determined that Kuyucak and Sivrihisar dolomite rocks don't cause alkali-carbonate reactivity. Therefore, they can be evaluated for different aggregate groups in construction materials.

Keywords: Dolomite, aggregate, alcali carbonate reaction, microscopic characterization

ÇAPRAZ DİLDE AKADEMİK İNTİHAL TESPİTİ İÇİN HİBRİT YOĞUN - SEYREK ERİŞİM OPTİMİZASYONU

HYBRID DENSE - SPARSE RETRIEVAL OPTIMIZATION FOR CROSS LANGUAGE ACADEMIC PLAGIARISM DETECTION

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Abstract

This study proposes a dual arm hybrid cross language retrieval architecture that combines semantic and lexical features to identify similarities between Turkish and English academic documents. In critical areas such as cross language plagiarism detection, multilingual retrieval, and duplicate content identification, balancing the preservation of interlingual semantic similarity with the capture of specialized terminology presents a significant problem. To overcome this problem, the proposed system combines a XLM-RoBERTa based dense retrieval and a BM25 based sparse retrieval. In the dense retrieval, texts are converted into 768 dimensional dense vectors using multilingual XLM-RoBERTa and Cosine Similarity is calculated using the FAISS library. In the sparse retrieval, statistical scores are generated using the BM25 algorithm after morphological analysis, tokenization, and stop word removal steps specific to Turkish and English languages. Independent scores obtained from both arms are tested using Weighted Combination, Reciprocal Rank Fusion (RRF) and Maximum Score methods. Experimental studies conducted on a dataset of 4,850 chunks consisting of 500 randomly selected English articles and their Turkish translations from open source arXiv dataset (cs.AI category) showed that the most successful result was obtained with the weighted combination method. In this study, where the documents were divided into 500 character chunks with the first 100 characters overlapping, 200 evaluation queries (100 cross language, 100 monolingual) were used. The highest performance was achieved with an optimum parameter of $\alpha = 0.7$, which gives more weight to dense retrieval, with an 85% success rate at P@5 and an MRR score of 0.82. This hybrid approach provided a 7% performance increase compared to dense retrieval alone and a 13% increase compared to sparse retrieval alone. Furthermore, the hybrid system reduced the performance difference between monolingual and cross language retrieval from 12% in sparse retrieval alone to 6%. In conclusion, the proposed hybrid system significantly improves cross lingual retrieval performance by preserving semantic relationships between languages while also increasing the accuracy of matching common technical terms.

Keywords: Natural Language Processing, Information Retrieval, Hybrid Retrieval, Cross-Lingual Similarity, FAISS, BM25, XLM-RoBERTa

Özet

Bu çalışma, Türkçe ve İngilizce akademik belgeler arasındaki benzerliği tespit etmek amacıyla semantik ve sözcüksel özellikleri birleştiren çift kollu bir hibrit çapraz dil erişim mimarisi önermektedir. Çapraz dil intihal tespiti, çok dilli erişim ve tekrarlı içerik tanımlama gibi kritik alanlarda diller arası anlamsal benzerliğin korunması ile özel terminolojinin yakalanması arasındaki dengeyi kurmak büyük bir zorluktur. Bu zorluğu aşmak için önerilen sistem; XLM-RoBERTa tabanlı yoğun erişim kolu ve BM25 tabanlı seyrek erişim kolunu bir araya getirmektedir. Yoğun erişimde, çok dilli XLM-RoBERTa modeli

kullanılarak metinler 768 boyutlu yoğun vektörlere dönüştürülmekte ve FAISS kütüphanesi üzerinde Kosinüs Benzerliği hesaplanmaktadır. Seyrek erişimde ise Türkçe ve İngilizce dillere özgü morfolojik analiz, tokenizasyon ve etkisiz kelime temizliği adımlarının ardından BM25 algoritması ile istatistiksel skorlar üretilmektedir. İki koldan elde edilen bağımsız skorlar; Ağırlıklı Kombinasyon, Ters Sıra Birleştirme (RRF) ve Maksimum Skor yöntemleriyle denenmiştir. Açık kaynak arXiv veri setinden (cs.AI kategorisi) elde edilen rastgele 500 İngilizce makale ve bunların Türkçe çevirilerinden oluşan 4.850 parçalık bir veri seti üzerinde yapılan deneysel çalışmalarda, en başarılı sonucun ağırlıklı kombinasyon yöntemiyle elde edildiği gözlemlenmiştir. Belgelerin ilk 100 karakteri örtüşmeli olarak, 500 karakterlik parçalara bölündüğü bu çalışmada, 200 değerlendirme sorgusu (100 çapraz dil, 100 tek dil) kullanılmıştır. En yüksek performans, yoğun erişime daha fazla ağırlık veren optimum $\alpha = 0,7$ parametresi ile P@5 değerinde %85 başarı oranı ve 0,82 MRR skoru ile yakalanmıştır. Bu hibrit yaklaşım, sadece yoğun erişime kıyasla %7, sadece seyrek erişime kıyasla ise %13 performans artışı sağlamıştır. Ayrıca hibrit sistem, tek dilli ve çapraz dilli erişim arasındaki performans farkını sadece seyrek erişimdeki %12 seviyesinden %6'ya düşürmüştür. Sonuç olarak önerilen hibrit sistem, diller arası anlamsal ilişkileri korurken ortak teknik terimlerin eşleşme hassasiyetini de artırarak çapraz dilli erişim başarımını önemli ölçüde yükseltmektedir.

Anahtar Kelimeler: Doğal Dil İşleme, Bilgi Erişimi, Hibrit Erişim, Çapraz Dil Benzerliği, FAISS, BM25, XLM-RoBERTa

YÜKSEKTE ÇALIŞMALARDA İŞ SAĞLIĞI VE GÜVENLİĞİ UYGULAMALARININ DEĞERLENDİRİLMESİ

OCCUPATIONAL HEALTH AND SAFETY PRACTICES IN WORKING AT HEIGHTS: AN EVALUATION

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Abstract

Work at height is one of the most critical occupational activities in terms of occupational health and safety (OHS due to the risk of falls and other serious hazards. Falls from height can result in severe injuries, permanent disabilities, and fatalities. Therefore, identifying hazards in advance, assessing risks, and implementing appropriate preventive measures are essential for ensuring worker safety. The main objective of this study is to evaluate the occupational health and safety hazards and risks associated with work at height and to identify effective practices for preventing accidents caused by falls.

Within the scope of the study, the concept and scope of work at height and the main areas where such activities are performed were examined. Technical, physical, environmental, individual, and organizational risk factors contributing to accidents were evaluated. National legislation and international regulations concerning work at height were also examined, with particular attention given to the responsibilities of employers and employees. The hierarchy of controls was evaluated as a fundamental approach to risk management, emphasizing hazard elimination, collective protective measures, and the appropriate use of personal protective equipment. In addition, the importance of personnel selection, professional competence, occupational safety training, pre-work planning, periodic equipment inspections, and effective workplace supervision was assessed.

The study concluded that a significant proportion of accidents related to work at height can be prevented through effective occupational health and safety practices. Comprehensive risk assessment, appropriate collective protection systems, continuous training, proper equipment selection, regular supervision, and the development of a strong safety culture are considered essential for reducing the risk of falls from height and improving workplace safety.

Keywords: Work at Height, Occupational Health and Safety, Falls from Height, Risk Assessment, Collective Protection, Personal Protective Equipment.

Özet

Yüksekte gerçekleştirilen çalışmalar, düşme riski ve diğer ciddi tehlikeler nedeniyle iş sağlığı ve güvenliği (İSG) açısından en kritik çalışma faaliyetlerinden biridir. Yüksekten düşmeler; ciddi yaralanmalara, kalıcı iş göremezliğe ve ölümlere neden olabilmektedir. Bu nedenle tehlikelerin önceden belirlenmesi, risklerin değerlendirilmesi ve uygun önleyici tedbirlerin uygulanması, çalışanların güvenliğinin sağlanması açısından büyük önem taşımaktadır. Bu çalışmanın temel amacı, yüksekte çalışmalarda karşılaşılan iş sağlığı ve güvenliği tehlike ve risklerini değerlendirmek ve yüksekten düşme kaynaklı kazaların önlenmesine yönelik etkili uygulamaları ortaya koymaktır.

Çalışma kapsamında yüksekte çalışma kavramı ve kapsamı ile bu tür çalışmaların gerçekleştirildiği başlıca çalışma alanları incelenmiştir. Kazalara neden olabilecek teknik, fiziksel, çevresel, bireysel ve

organizasyonel risk faktörleri değerlendirilmiştir. Ayrıca yüksekte çalışmalara ilişkin ulusal mevzuat ve uluslararası düzenlemeler incelenmiş ve özellikle işveren ile çalışanların sorumlulukları ele alınmıştır. Risk yönetiminde temel bir yaklaşım olarak risk kontrol hiyerarşisi değerlendirilmiş; tehlikenin ortadan kaldırılması, toplu koruma önlemlerine öncelik verilmesi ve kişisel koruyucu donanımların uygun şekilde kullanılması üzerinde durulmuştur. Bunun yanında personel seçimi, mesleki yeterlilik, iş sağlığı ve güvenliği eğitimleri, çalışma öncesi planlama, ekipmanların periyodik kontrolleri ve etkin saha denetiminin önemi değerlendirilmiştir.

Çalışma sonucunda, yüksekte çalışma ile ilişkili kazaların önemli bir bölümünün etkili iş sağlığı ve güvenliği uygulamalarıyla önlenebileceği sonucuna ulaşılmıştır. Kapsamlı risk değerlendirmesi, uygun toplu koruma sistemleri, sürekli eğitim, doğru ekipman seçimi, düzenli denetim ve güçlü bir güvenlik kültürünün oluşturulmasının yüksekten düşme risklerinin azaltılması ve çalışma ortamı güvenliğinin geliştirilmesi açısından temel unsurlar olduğu değerlendirilmiştir.

Anahtar kelimeler: Yüksekte Çalışma, İş Sağlığı ve Güvenliği, Yüksekten Düşme, Risk Değerlendirmesi, Toplu Koruma, Kişisel Koruyucu Donanım.

YAPAY ZEKÂ DESTEKLİ DÖRT ÇUBUK MEKANİZMALARININ HAREKET ANALİZİ İÇİN ENERJİ–MONTAJ MODU GRAFİĞİ VE KARINCA KOLONİSİ TABANLI YENİ BİR YAKLAŞIM: EMG-ACMA

A NOVEL ARTIFICIAL-INTELLIGENCE-ASSISTED ENERGY–ASSEMBLY-MODE GRAPH AND ANT COLONY APPROACH FOR MOTION ANALYSIS OF FOUR-BAR MECHANISMS: EMG-ACMA

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ÖZET

Dört çubuk mekanizmalarının hareket analizi, sürekli durum değişkenlerine dayalı klasik sayısal integrasyon yöntemleriyle gerçekleştirilmektedir. Bununla birlikte montaj modu, hareket yönü ve enerji bakımından uygulanabilirlik gibi ayrık fiziksel durumların aynı çözüm sürecinde ele alınması sınırlı kalmaktadır. Bu çalışmada, mekanizma hareketini fiziksel olarak uygulanabilir bir durum-yolu problemi biçiminde yeniden formüle eden Enerji–Mod Çizgesi Karınca Kolonisi Hareket Analizi (EMG-ACMA) yöntemi önerilmiştir. Yöntemde, her açısal adımda mekanizmanın enerji düzeyi, montaj modu ve hareket yönüyle tanımlanan olası durumları düğümlerle; bu durumlar arasındaki izinli fiziksel geçişleri ise kenarlarla temsil eden katmanlı bir enerji–mod çizgesi oluşturulmuştur. Klasik kinematik ve dinamik denklemlerden türetilen fiziksel kısıtlar bu çizgeye aktarılmış; uygulanabilir hareket yolu, sıra tabanlı feromon güncellemesine sahip Karınca Kolonisi Optimizasyonu kullanılarak araştırılmıştır. Bu bütünleşik temsil, fiziksel kısıtların çözüm üretimi sırasında doğrudan uygulanmasını sağlayarak fizik dışı aday yolların daha araştırma aşamasında elenmesine olanak tanımaktadır. Yöntem, enerji korunumlu dinamik rejim ile dış tahrikli–disipatif dinamik rejimde doğrulanmıştır. Enerji korunumlu rejimde, açısal adım küçüldükçe DOP853 referans çözümüne göre hatanın düzenli biçimde azaldığı belirlenmiştir. Dış tahrikli–disipatif dinamik rejimde, 42–71 aralığındaki PCG64 tohumları kullanılarak 30 bağımsız ACO koşusu gerçekleştirilmiş; elde edilen çözümler, dinamik programlamayla belirlenen kesin çizge minimumu ve DOP853 referans çözümü üzerinden doğrulanmıştır. En iyi ACO çözümünün maliyeti $6{,}636938\times10^{-5}$ olarak hesaplanmış ve bu değer dinamik programlama minimumunun yalnızca %4,328 üzerinde gerçekleşmiştir. Bulgular, EMG-ACMA'nın önceden optimum yol bilgisine gereksinim duymadan düşük maliyetli ve fiziksel olarak uygulanabilir hareket yolları üretebildiğini göstermiştir. Sonuç olarak EMG-ACMA, mekanizmanın sürekli ve ayrık fiziksel durumlarını açıkça tanımlanmış düğüm ve geçişler üzerinden birlikte değerlendiren; klasik hareket denklemlerini korurken çözüm uzayını sürü zekâsıyla araştıran yeni bir fizik bilgili hibrit hareket analizi çerçevesi sunmaktadır.

Anahtar kelimeler: Dört çubuk mekanizması, Hareket analizi, Karınca kolonisi optimizasyonu, Sürü zekâsı.

ABSTRACT

Motion analysis of four-bar mechanisms is performed using numerical integration of continuous state variables. However, assembly mode, motion direction, and energetic admissibility are discrete states seldom handled within a unified solution process. This study proposes Energy–Mode Graph Ant Colony Motion Analysis (EMG-ACMA), which reformulates mechanism motion as a physically admissible state-path problem. At each angular step, a layered energy–mode graph is constructed: nodes represent states defined by energy level, assembly mode, and motion direction, whereas edges represent permitted transitions. Physical constraints derived from kinematic and dynamic equations are embedded in the graph, and the admissible motion path is searched using Ant Colony Optimization with rank-based pheromone updating. This representation enforces physical constraints during solution generation,

allowing nonphysical candidates to be eliminated during the search. The method is validated under energy-conservative and externally driven dissipative dynamic regimes. In the energy-conservative regime, the error relative to the DOP853 reference solution decreases systematically as the angular increment is refined. In the externally driven dissipative regime, 30 independent ACO runs are performed using PCG64 seeds 42–71; the solutions are verified against the exact graph minimum obtained by dynamic programming and the DOP853 reference solution. The best ACO solution yields a cost of 6.636938×10^{-5}, only 4.328% above the dynamic-programming minimum. The results show that EMG-ACMA can generate low-cost, physically admissible motion paths without prior knowledge of the optimal path. Overall, EMG-ACMA provides a new physics-informed hybrid framework that jointly evaluates continuous and discrete physical states through explicitly defined nodes and transitions, preserves the classical equations of motion, and explores the solution space using swarm intelligence.

Keywords: Four-bar mechanism, Motion analysis, Ant colony optimization, Swarm intelligence.

SÜRDÜRÜLEBİLİR GIDA SANAYİNDE ÜÇÜZ DÖNÜŞÜMÜN MÜHENDİSLİK PERSPEKTİFİYLE DEĞERLENDİRİLMESİ

AN ENGINEERING PERSPECTIVE ON TRIPLE TRANSFORMATION IN SUSTAINABLE FOOD MANUFACTURING

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Abstract

Food production systems are facing new performance requirements driven not only by traditional engineering objectives, such as food safety, product quality, process control, and resource efficiency, but also by climate change, digitalization, and sustainability-oriented regulations. Beyond reducing carbon emissions, improving energy and water efficiency, promoting circular production practices, sustainable food systems require integrated management of environmental, digital and socio-technical components, including real-time data management, traceability, workforce development, occupational health and safety, and organizational compliance.

In recent years, this holistic transformation has increasingly been discussed in the international literature under the concept of triple transformation. However, the concept has been addressed mainly from sustainable development and the social science perspectives, while its implications, production systems, and particularly the food industry remain limited.

This study aims to contribute to the literature by providing one of the pioneering engineering-based evaluations of the triple transformation approach in the food industry. The recent development of the concept and research trends were examined, and the findings were discussed through a holistic engineering perspective. The evaluation addresses resource efficiency, life cycle assessment, carbon and water management; Industry 4.0 applications, artificial intelligence-assisted production, digital product passport and data-driven traceability systems; together with occupational health and safety, technical competency development, just transition, human rights, responsible supply chain practices, and corporate governance.

The study is expected to contribute to the reinterpretation of the triple transformation concept within engineering applications in the food industry and to support future research on integrated sustainable production system.

Keywords: Sustainability, Food industry, Triple transformation, Green transformation, Digitalization tansformation

Özet

Gıda sanayinde üretim sistemleri; gıda güvenliği, ürün kalitesi, proses kontrolü ve kaynak verimliliği gibi geleneksel mühendislik hedeflerinin yanı sıra iklim değişikliği, dijitalleşme ve sürdürülebilirlik odaklı düzenlemelerin de etkisiyle yeni performans gereklilikleriyle karşı karşıyadır. Karbon emisyonlarının azaltılması, enerji ve su verimliliğinin iyileştirilmesi, döngüsel üretim uygulamalarının yaygınlaştırılması, gerçek zamanlı veri yönetimi ve izlenebilirliğin yanı sıra, bu dönüşümü destekleyecek teknik insan kaynağının geliştirilmesi, iş sağlığı ve güvenliğinin yaygınlaştırılması ve

kurumsal uyum mekanizmalarının geliştirilmesi, gıda üretim sistemlerinin çevresel, dijital ve sosyo-teknik bileşenlerinin bütünleşik olarak yönetilmesini gerektirmektedir.

Son yıllarda bu bütüncül dönüşüm süreci uluslararası literatürde üçüz dönüşüm kavramı kapsamında giderek daha fazla tartışılmaktadır. Ancak kavramın mevcut kullanımının büyük ölçüde sürdürülebilir kalkınma ve sosyal bilimler ekseninde şekillendiği; üretim sistemleri, mühendislik uygulamaları ve özellikle gıda sanayine yönelik değerlendirmelerin ise sınırlı olduğu görülmektedir.

Bu çalışma, üçüz dönüşüm yaklaşımını gıda sanayinin mühendislik perspektifinden değerlendiren öncü çalışmalardan olmayı ve literatüre katkı sunmayı amaçlamaktadır. Bu doğrultuda kavramın güncel literatürdeki gelişimi ve araştırma eğilimleri incelenmiş ve elde edilen bulgular ışığında çevresel, dijital ve sosyo-teknik bileşenler bütüncül bir mühendislik yaklaşımıyla tartışılmıştır. Değerlendirme; çevresel boyutta kaynak verimliliği, yaşam döngüsü değerlendirmesi, karbon ve su yönetimi; dijital boyutta Endüstri 4.0 uygulamaları, yapay zekâ destekli üretim, dijital ürün pasaportu ve veri odaklı izlenebilirlik sistemleri; sosyo-teknik boyutta ise çalışan sağlığı ve güvenliği, teknik yetkinlik geliştirilmesi, adil geçiş, insan hakları, sorumlu tedarik zinciri uygulamaları ve kurumsal yönetişim ekseninde gerçekleştirilmiştir.

Çalışmanın, üçüz dönüşüm kavramının gıda sanayindeki mühendislik uygulamaları bağlamında yeniden yorumlanmasına katkı sağlaması, sürdürülebilir üretim sistemlerinin yalnızca çevresel ve teknolojik göstergeler üzerinden değil, insan faktörünü de içeren bütünleşik bir sistem yaklaşımıyla değerlendirilmesine yönelik akademik tartışmalara katkı sunması beklenmektedir.

Anahtar kelimeler: Sürdürülebilirlik, Gıda Sanayi, Üçüz Dönüşüm, Yeşil Dönüşüm, Dijital Dönüşüm

2D IMAGING OF SKELETAL MUSCLES USING LIGHT MICROSCOPE, FT-IR SPECTROSCOPY AND UV-VISIBLE SPECTROSCOPY TECHNIQUES

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ABSTRACT

This research presents a diagnosis of muscles using a light microscope, Fourier transform – Infrared (FT-IR) and UV-visible spectroscopy. Skeletal muscle images are acquired with these three different techniques. Diseased and normal muscles are differentiated, and the results of these techniques are compared. Microscopy results are based on the physical limitations of the optics that are solvable. The active control of illumination sources can also be adapted for chip-scale microscopy imaging. This approach is fully capable of working with cell cultures, which can significantly improve cell/bacteria culture experiments. In FT-IR, a decision is made based on processing the spectral data using various computational algorithms. Such images are constructed from spectra and objective reflection underlying the health status of the analysed sample. In a UV-visible spectrophotometer, a decision is made on the basis of an acute response that is characterised by the appearance of abnormally strong muscle contractions, including movements. From our results, we can set an order to define the sensitivity of the technique for skeletal muscle investigation. Overall, our three methods are useful and produce almost true results. This study will be helpful in the field of medicine to diagnose different diseases in living animals.

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STEREO GENIŞLETME TEKNIKLERININ MONO UYUMLULUK AÇISINDAN KAVRAMSAL KARŞILAŞTIRMASI

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ÖZET

Stereo genişliğin artırılması çağdaş müzik prodüksiyonlarında sık kullanılan yöntemlerden biridir. Ancak mono downmix alındığında ortaya çıkan spektral ve tonal denge değişimleri, uygulamada çoğunlukla genel bir mono uyumluluk riski olarak değerlendirilmekte ve yöntemler arasında ayrım gözetilmemektedir. Denetim çoğunlukla kanallar arası korelasyon katsayısının izlenmesiyle sınırlı kalmakta, ancak bu ölçüt farklı yöntemlerin ürettiği değişimleri ayırmaya yetmemektedir. Oysa farklı genişletme yöntemleri mono uyumluluğu aynı mekanizmayla etkilememektedir. Bu bildiri, yaygın genişletme yaklaşımlarını sinyal işleme temelleri ile stereo görüntüleme, faz ilişkileri ve mono toplama çalışmalarına dayanarak karşılaştırmalı biçimde incelemektedir. Karşılaştırmada mono değişimin spektral dağılımı, zamansal kararlılığı, öngörülebilirliği, işlenen sinyalin niteliğine bağımlılığı ve frekans alanında sınırlandırılabilirliği ele alınmaktadır. Kanallar arası gecikmeye dayalı genişletme, doğrusal ve zamanla değişmeyen bir işlem olduğundan tek bir aktarım fonksiyonuyla tanımlanabilmekte; mono toplamada genlik yanıtında $1/\tau$ aralıklı ve konumu gecikme süresinden hesaplanabilen periyodik comb filtering çentikleri oluşmaktadır. Pitch shifting temelli yaklaşımlar zamanla değişen işlemler olduğundan sabit bir aktarım fonksiyonuyla betimlenememekte, kanallar arasındaki küçük frekans farkları destrüktif girişim örüntüsünü zaman içinde kaydırarak beating davranışına yol açmaktadır. Doubling yaklaşımlarında gecikme ve modülasyon kaynaklı bu davranışlar iç içe geçmektedir. Mid/Side (M/S) işlemede mekanizma matris dönüşümünün doğrudan sonucudur. Mono downmix sadece mid bilgisini içerdiğinden side bileşeni ortadan kalkmakta; değişim comb filtering türü bir iptalden ziyade, stereo sürümde güçlendirilmiş side bilgisinin kaybına bağlı tını ve denge farklılaşması biçiminde görülmektedir. Etkinin niteliği sinyalin M/S enerji dağılımına bağlıdır. Bulgular, mono uyumluluğun tek türden bir problem olmadığını; farklı genişletme yöntemlerinin etkinin büyüklüğü yanında oluşum mekanizması, zamansal davranışı ve spektral örüntüsü bakımından da ayrıldığını göstermektedir. Önerilen çerçeve, yöntem seçimini "hangi yöntem daha güvenlidir?" sorusundan çıkararak, yayın ve dağıtım bağlamı ile kabul edilebilir mono değişim türü doğrultusunda bilinçli bir prodüksiyon kararına dönüştürmeyi amaçlamaktadır. Ayrıca nicel doğrulama gerektiren değişkenleri sonraki deneysel çalışmalar için ortaya koymaktadır.

Anahtar kelimeler: Ses mühendisliği, stereo genişletme, mono uyumluluk, comb filtering, Mid/Side işleme, aktarım fonksiyonu

A CONCEPTUAL COMPARISON OF STEREO WIDENING TECHNIQUES WITH RESPECT TO MONO COMPATIBILITY

ABSTRACT

Increasing stereo width is one of the methods frequently employed in contemporary music production. However, the changes in spectral and tonal balance that arise when a mono downmix is taken are, in practice, generally treated as a single, undifferentiated mono compatibility risk, and no distinction is made between methods. Monitoring is for the most part limited to observing the interchannel correlation coefficient, yet this criterion is not sufficient to distinguish the changes produced by different methods. In fact, different widening methods do not affect mono compatibility through the same mechanism. This paper examines common widening approaches comparatively, drawing on signal processing fundamentals together with the literature on stereo imaging, phase relationships and mono summation. The comparison addresses the spectral distribution of the mono change, its temporal stability, its

predictability, its dependence on the character of the processed signal, and the extent to which it can be constrained in the frequency domain. Widening based on interchannel delay is a linear and time-invariant operation and can therefore be described by a single transfer function; under mono summation, periodic comb filtering notches are formed in the magnitude response, spaced at intervals of $1/\tau$ and located at positions that can be calculated from the delay time. Pitch shifting based approaches are time-varying operations and cannot be characterised by a fixed transfer function; the small frequency differences between the channels shift the destructive interference pattern over time and give rise to beating behaviour. In doubling approaches, the delay-induced and modulation-induced behaviours are intertwined. In Mid/Side (M/S) processing, the mechanism is a direct consequence of the matrix transformation. Since the mono downmix contains only the mid information, the side component is eliminated; the change appears not as a cancellation of the comb filtering type, but as a differentiation in timbre and balance resulting from the loss of the side information that was reinforced in the stereo version. The nature of the effect depends on the M/S energy distribution of the signal. The findings indicate that mono compatibility is not a problem of a single kind, and that widening methods differ not only in the magnitude of the effect but also in its mechanism of formation, its temporal behaviour and its spectral pattern. The proposed framework aims to move method selection away from the question of "which method is safer?" and to reformulate it as an informed production decision guided by the broadcast and distribution context and by the type of mono change deemed acceptable. It also sets out the variables requiring quantitative verification for subsequent experimental studies.

Keywords: Audio engineering, stereo widening, mono compatibility, comb filtering, Mid/Side processing, transfer function

EFFECT OF GRAPHENE-DOPED CNT FILLER ON THE FLEXURAL PROPERTIES OF CARBON FIBER REINFORCED EPOXY COMPOSITES

GRAFEN KATKILI CNT DOLGU MADDESİNİN KARBON ELYAF TAKVİYELİ EPOKSİ KOMPOZİTLERİN EĞİLME ÖZELLİKLERİ ÜZERİNDEKİ ETKİSİ

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ABSTRACT

In this study, the effect of a hybrid nano-filler consisting of multi-walled carbon nanotubes (MWCNTs) doped with 32 wt.% graphene nanopowder on the flexural properties of unidirectional carbon fiber reinforced polymer (CFRP) composites was investigated. Three composite configurations were produced to evaluate the synergistic effect of 1D and 2D carbon nanostructures. These included two modified CFRP configurations containing 0.5% and 1.5% by weight of hybrid nanoparticles relative to the epoxy matrix, and a neat CFRP control configuration. The matrix system comprised MGS L160 laminating epoxy resin and MGS H160 hardener mixed at a 100:25 weight ratio. The nanocomposite matrices were prepared using ultrasonic homogenization in an ice bath to ensure homogeneous distribution. The composite laminates were produced using a hand-lay-up technique followed by the vacuum bagging method. Quasi-static three-point bending tests were conducted to determine the maximum bending force and flexural strength. Tests were carried in accordance with the ASTM D7264 standard using an Instron 8801 universal testing machine. The experimental results indicate that the optimal incorporation of CNTs with 0.5 wt.% graphene doped CNTs significantly enhances mechanical performance, increasing the average flexural strength by 14.6% compared to the neat control group. However, increasing the filler content by 1.5 wt.% resulted in a relative decrease in flexural properties, primarily due to the agglomeration of nanoparticles. Force-displacement and comparative stress-strain curves revealed that the hybrid nanofiller effectively delayed matrix-dominated progressive failure mechanisms and shifted the structural behavior to a more gradual damage propagation. Overall, the optimal addition of graphene-doped CNTs forms a robust, interconnected multi-dimensional network where 1D MWCNTs act as nanoscale bridges across micro cracks and 2D graphene nanoplatelets deflect crack propagation. This synergistic hybrid network significantly enhances the load-bearing capacity and structural flexibility of CFRP laminates.

Keywords: Carbon fiber reinforced polymer (CFRP), Graphene-carbon nanotube hybrid nanofiller, Synergistic effect, Flexural properties, Polymer nanocomposites.

ÖZET

Bu çalışmada, ağırlıkça %32 grafen nanopartikül katkılı çok duvarlı karbon nanotüplerden (ÇDKNT) oluşan hibrit bir nano-dolgunun, tek yönlü karbon fiber takviyeli polimer (KFTP) kompozitlerin eğilme özellikleri üzerindeki etkisi araştırılmıştır. Bir boyutlu (1B) ve iki boyutlu (2B) karbon nanoyapıların sinerjik etkisini değerlendirmek amacıyla üç farklı kompozit konfigürasyonu üretilmiştir. Bu konfigürasyonlar, epoksi matrisine göre ağırlıkça %0,5 ve %1,5 oranında hibrit nanopartikül içeren iki

adet modifiye edilmiş KFTP yapısını ve katkısız bir KFTP kontrol grubunu içermektedir. Matris sistemi, ağırlıkça 100:25 oranında karıştırılan MGS L160 laminasyon epoksi reçinesi ve MGS H160 sertleştiricisinden oluşturulmuştur. Nanokompozit matrisler homojen bir dağılım sağlamak amacıyla buz banyosunda ultrasonik homojenizasyon yöntemi kullanılarak hazırlanmıştır. Kompozit laminatlar el yatırması tekniğini takiben vakum torbalama yöntemiyle üretilmiştir. Maksimum eğilme kuvvetini ve eğilme mukavemetini belirlemek amacıyla yarı-statik üç nokta eğilme testleri gerçekleştirilmiştir. Testler bir Instron 8801 üniversal test cihazı kullanılarak ASTM D7264 standardına uygun olarak yürütülmüştür. Deneysel sonuçlar ağırlıkça %0,5 grafen katkılı ÇDKNT'lerin optimum şekilde matrise dahil edilmesinin mekanik performansı önemli ölçüde artırdığını ve ortalama eğilme mukavemetini katkısız kontrol grubuna kıyasla %14,6 oranında yükselttiğini göstermektedir. Ancak dolgu içeriğinin ağırlıkça %1,5'e çıkarılması, temel olarak nanopartiküllerin aglomerasyonu (kümelenmesi) nedeniyle eğilme özelliklerinde nispi bir düşüşe yol açmıştır. Kuvvet-yer değiştirme ve karşılaştırmalı gerilme-şekil değiştirme eğrileri, hibrit nano-dolgunun matris kaynaklı ilerleyici hasar mekanizmalarını etkili bir şekilde geciktirdiğini ve yapısal davranışı daha kademeli bir hasar ilerlemesine kaydırdığını ortaya koymuştur. Genel olarak, grafen katkılı ÇDKNT'lerin optimum seviyede eklenmesi 1B KFTP'lerin mikro çatlakları köprülediği, 2B grafen nanoplakaların ise çatlak ilerlemesini saptırdığı güçlü ve birbiriyle bağlantılı çok boyutlu bir ağ oluşturmaktadır. Bu sinerjik hibrit ağ KFPT laminatların yük taşıma kapasitesini ve yapısal esnekliğini önemli ölçüde artırmaktadır.

Anahtar kelimeler: Karbon fiber takviyeli polimer, Grafen-karbon nanotüp hibrit nano-dolgu, Sinerjik etki, Eğilme özellikleri, Polimer nanokompozitler.

KANAL İÇİ ÇAPRAZ AKIŞ KONFİGÜRASYONUNDA GÖZENEKLİ BİR NESNENİN ÇARPAN JETLE TAŞINIMLI KURUTULMASI

JET IMPINGEMENT CONVECTIVE DRYING OF POROUS OBJECT IN A CHANNEL CROSS-FLOW CONFIGURATION

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Abstract

Drying processes are critical in industry due to their high energy consumption. Therefore, improving drying efficiency is important for achieving energy savings. The simultaneous occurrence of heat and mass transfer in convective drying makes moisture transfer particularly complex in porous media. While thermal and concentration boundary layers formed on the surface in conventional channel flow can negatively affect the drying rate, impinging jets can enhance local heat and mass transfer by altering the surface flow. In this study, the effect of a hybrid system combining channel flow and impinging jets on the drying performance of a moist porous material was numerically investigated. The analyses were performed using COMSOL Multiphysics at a constant air temperature of 343.15 K for 180 minutes. The initial liquid water saturation (S_l) was set to 0.70. System performance was evaluated using three configurations: combined jet-channel flow, channel flow only, and jet flow only. In the combined model, the channel Reynolds number (Re_c) was set to 100, 200, and 300, while the jet Reynolds number (Re_j) was set to 25 and 100. The results showed that increasing both Reynolds numbers decreased the final water saturation, with the channel Reynolds number having a dominant effect on moisture removal. Increasing the channel flow enhanced drying by providing continuous convection over the porous surface. In the jet-only configuration, backflow (circulation) zones hindered moisture removal, resulting in the highest final saturation values. The highest drying performance was obtained with the combined configuration at the maximum channel and jet Reynolds numbers. Under this condition, liquid water saturation decreased to 0.52055 after 180 minutes, corresponding to a 25.6% reduction from the initial value. Overall, the results demonstrated that the optimum combination of channel and jet flows significantly enhances moisture removal during drying.

Keywords: Convective drying, Porous object, Jet impingement, Reynolds number, Liquid saturation**.**

Özet

Kurutma işlemleri, yüksek enerji tüketimi nedeniyle endüstride kritik bir yere sahiptir. Bu nedenle kurutma veriminin artırılması, doğrudan enerji tasarrufu sağlanması açısından büyük önem taşımaktadır. Taşınımla kurutma sürecinde ısı ve kütle transferinin eş zamanlı gerçekleşmesi, özellikle gözenekli ortamlarda nem iletimini günden güne karmaşık bir hale getirmektedir. Geleneksel kanal akışlı sistemlerde yüzeyde meydana gelen termal ve konsantrasyon sınır tabakaları kurutma hızını olumsuz etkilerken, çarpan jet uygulamaları yüzey akışını değiştirerek yerel ısı ve kütle transferini belirgin şekilde artırabilmektedir.

Bu çalışmada, kanal akışı ile çarpan jetlerin birlikte kullanıldığı karma bir sistemin, nemli gözenekli bir malzemenin kurutma performansı üzerindeki etkisi sayısal olarak incelenmiştir. Analizler COMSOL Multiphysics programı ile 343,15 K sabit hava sıcaklığında ve 180 dakikalık kurutma süresi esas

alınarak gerçekleştirilmiştir. Çalışmada başlangıç sıvı su doygunluğu (S_l) 0,70 olarak kabul edilmiştir. Sistem performansı, birleşik jet-kanal akışı, sadece kanal akışı ve sadece jet akışı olmak üzere üç farklı konfigürasyon üzerinden karşılaştırmalı olarak ele alınmıştır. Birleşik modelde kanal Reynolds sayısı (Re_c) 100, 200 ve 300; jet Reynolds (Re_j) sayısı ise 25 ve 100 değerlerinde tutulmuştur.

Elde edilen veriler, her iki Reynolds sayısındaki artışın nihai su doygunluğunu düşürdüğünü, ancak nem uzaklaştırma üzerinde kanal Reynolds sayısının baskın bir rol oynadığını göstermiştir. Kanal akışının artırılması, gözenekli yüzey boyunca kesintisiz bir taşınım sağlayarak kurutmayı olumlu yönde etkilemiştir. Sadece jet akışı kullanılan durumda ise oluşan geri akış (sirkülasyon) bölgeleri nemin sistemden atılmasını zorlaştırarak en yüksek nihai doygunluk değerlerinin ortaya çıkmasına neden olmuştur. En yüksek kurutma performansına, hem kanal hem de jet Reynolds sayısının maksimum olduğu birleşik konfigürasyonda ulaşılmıştır. Bu koşulda 180 dakika sonunda sıvı su doygunluğu 0,52055 seviyesine gerilemiş olup, başlangıç değerine göre %25,6'lık bir iyileşme elde edilmiştir. Sonuç olarak, kanal ve jet akışlarının optimum kombinasyonunun kurutma süreçlerinde nem giderimini belirgin ölçüde artırdığı tespit edilmiştir.

Anahtar kelimeler: Konvektif kurutma, Gözenekli cisim, Çarpan jet hava akışı, Reynolds sayısı, Sıvı su doygunluğu.

AKREDİTASYON ÖLÇÜTLERİNDEN DOĞRULANMIŞ İNOVASYON ÜRÜNÜNE: ÜRETKEN YAPAY ZEKÂ ÇAĞINDA DÜZEYE DUYARLI, SANAYİYLE BÜTÜNLEŞİK BİR MÜHENDİSLİK EĞİTİMİ MODELİ

FROM ACCREDITATION CRITERIA TO VALIDATED INNOVATION OUTPUTS: A LEVEL-RESPONSIVE, INDUSTRY-INTEGRATED ENGINEERING EDUCATION MODEL FOR THE GENERATIVE AI ERA

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ÖZET

Üretken yapay zekâ (ÜYZ), rutin bilgi üretimini hızlandırırken mühendislik eğitiminin değerini doğru cevabı yeniden üretmekten gerçek bir gereksinimi güvenli, etik ve doğrulanabilir bir inovasyon çıktısına dönüştürmeye taşımaktadır. Bu çalışma, MÜDEK Sürüm 3.1 ile MEDEK Önlisans Program Ölçütleri v2.0'ın programlar üstü ortak hükümlerini düzey-duyarlı bir doküman analiziyle incelemektedir. Tasarım bilimi yaklaşımı kapsamında resmî hükümler, gereksinim ve paydaşların belirlenmesiyle başlayan; özgün teknik seçeneklerin geliştirilmesi, prototipleme ya da uygulama ve deneysel doğrulamayla ilerleyen; geribildirim doğrultusunda yeniden tasarım ve üretilen değerin sanayiye ya da topluma aktarılmasıyla tamamlanan altı aşamalı bir inovasyon yaşam döngüsüne göre incelenmiştir. Hükümler 'doğrudan', 'etkinleştirici' ve 'operasyonel boşluk' olarak sınıflandırılmış; canlı icra, ölçüm, yineleme ve gerçek paydaş doğrulaması ayrıca sınanmıştır. Disipline ve programa özgü ölçütler kapsam dışıdır. Bulgular, MÜDEK'in gereksinim ve paydaşların belirlenmesine, özgün teknik seçeneklerin geliştirilmesine ve deneysel doğrulamaya doğrudan dayanak sağladığını; prototipleme ya da uygulama ile üretilen değerin sanayiye veya topluma aktarılmasını ise etkinleştirdiğini göstermektedir. Bununla birlikte, geribildirim sonrasında yeniden tasarım ve uçtan uca ürün kanıtı açık ortak asgari koşullar olarak tanımlanmamıştır. MEDEK'in ortak tabanı öğrenci merkezlilik, uygulamalı/işyeri öğrenmesi, paydaş katılımı ve sürekli iyileştirme için elverişli dayanaklar sunmakta; ancak özgün katkı, test–yeniden tasarım ve doğrulanmış ürün zincirini programlar üstü ortak yükümlülük olarak kurmamaktadır. Önerilen Sanayiyle Bütünleşik Uygulamalı İnovasyon Modeli (SBUİM), uygulamalı sınavı, etik ÜYZ doğrulamasını, prototiplemeyi, sanayi geribildirimini, eğitimcinin özerkliğini, psikolojik güvenliğini ve düzeye göre farklılaştırılmış teknik performans ile sorumluluk beklentilerini tek yaşam döngüsünde birleştirmektedir. Uygulama öncesi değerlendirme sürecinin izlenebilirliği sağlanmış; bu değerlendirme iç tutarlılık, uygulanabilirlik ve yan etki kontrolüyle sınırlandırılmıştır. Nedensel etki iddiası kurulmamış, çok kurumlu pilot için sınanabilir önermeler geliştirilmiştir.

Anahtar kelimeler: üretken yapay zekâ, mühendislik eğitimi, mühendislik akreditasyonu, inovasyon yaşam döngüsü

ABSTRACT

Generative artificial intelligence (GenAI) is shifting the value of engineering education from reproducing answers toward converting authentic needs into safe, ethical, and verifiable innovation outputs. This study conducts a level-sensitive document analysis of the programme-neutral provisions in MÜDEK Criteria v3.1 and MEDEK Associate Degree Programme Criteria v2.0. Within a design-science approach, the official provisions were examined using a six-stage innovation lifecycle that begins with defining needs and stakeholders; progresses through developing original technical alternatives, prototyping or implementation, and experimental verification; and concludes with feedback-driven redesign and the transfer of value to industry or society. Each provision was classified as direct, enabling, or an operational gap and was further examined for live execution, measurement,

iteration, and authentic stakeholder validation. Discipline- and programme-specific criteria were excluded. MÜDEK directly supports the definition of needs and stakeholders, the development of original technical alternatives, and experimental verification; it provides enabling foundations for prototyping or implementation and the transfer of value to industry or society. However, feedback-driven redesign and end-to-end product evidence are not established as explicit common minima. MEDEK's common baseline supports student-centred education, applied or workplace learning, stakeholder participation, and continuous improvement, yet it does not establish original contribution, test–redesign, and a validated innovation output as a programme-neutral chain. The proposed Industry-Integrated Applied Innovation Model combines hands-on assessment, ethical GenAI verification, prototyping, industry feedback, faculty autonomy, psychological safety, and level-differentiated expectations for technical performance and responsibility within one lifecycle. Ex ante evaluation addresses traceability, internal consistency, feasibility, and side effects without claiming causal effectiveness; testable propositions are specified for a multi-institutional pilot.

Keywords: generative artificial intelligence, engineering education, engineering accreditation, innovation lifecycle

SANTRİFÜJ POMPA ÇARKLARINDA KAVİTASYON VE KOROZYON DİRENCİNİ ARTIRMAYA YÖNELİK YÜZEY KAPLAMA UYGULAMASI VE PERFORMANS ANALİZİ

SURFACE COATING APPLICATION AND PERFORMANCE ANALYSIS TO ENHANCE CAVITATION AND CORROSION RESISTANCE IN CENTRIFUGAL PUMP IMPELLERS

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Abstract

One of the main factors limiting the operational performance of centrifugal pumps is cavitation. It leads to a decrease in pump efficiency, increased vibration and noise, wear on impeller surfaces, and corrosion damage. In this experimental study, the effects of an uncoated reference impeller and the Belzona 1321 Ceramic S-Metal coating on a centrifugal pump impeller were comparatively evaluated in terms of performance, cavitation, and corrosion.

This experimental study was conducted on a centrifugal pump equipped with a closed-type impeller operating at a constant rotational speed. Surface properties were determined through contact angle measurements; the contact angle value for the uncoated impeller surface was 70.32°, while this value increased to 99.87° for the surface coated with Belzona 1321. The microstructure and corrosion behavior of the coating layer were examined using scanning electron microscopy (SEM), open-circuit potential (OCP), electrochemical impedance spectroscopy (EIS), and potentiodynamic polarization (PDP) analyses. The pump impeller sample coated with Belzona 1321 exhibited higher surface resistance to cavitation and corrosion compared to the uncoated impeller sample. The impeller sample, which was a hydrophilic substrate material, acquired hydrophobic properties upon being coated with Belzona 1321. The coating layer formed a protective barrier, reducing the metal surface's direct contact with the corrosive environment and lowering the corrosion rate. Electrochemical test results showed that the coated sample exhibited a lower corrosion current density and higher polarization resistance. SEM images revealed that the Belzona 1321 coating performed successfully in terms of corrosion resistance and structural integrity.

Pump performance was evaluated based on the following parameters: total head, efficiency, suction pressure, vibration level, and net positive suction head (ENPYm). Around the hydrophobic coating's best efficiency point (BEP), it increased efficiency by approximately 6–8%, raised the manometric head, reduced vibration levels by approximately 30–35%, and improved the ENPYm value by approximately 5–9%. It was determined that the homogeneous surface structure formed by the Belzona 1321 Ceramic S-Metal coating both increased corrosion resistance and positively enhanced the performance of the centrifugal pump.

Keywords: Cavitation, Coating, Corrosion, NPSH

Özet

Santrifüj pompaların çalışma performansını sınırlandıran başlıca etkenlerden biri kavitasyondur. Pompa veriminin azalmasına, titreşim ve gürültünün artmasına, çark yüzeylerin aşınmasına ve korozyon hasarlarının oluşmasına neden olmaktadır. Bu deneysel çalışmada, kaplamasız referans çarkı ile Belzona 1321 Ceramic S-Metal kaplamasının santrifüj pompa çarkı üzerindeki etkileri performans, kavitasyon ve korozyon açısından karşılaştırmalı olarak değerlendirilmiştir..

Bu deneysel çalışma, sabit devir hızında çalışan kapalı tip çarka sahip bir santrifüj pompa üzerinde gerçekleştirilmiştir. Yüzey özellikleri temas açısı ölçümleriyle belirlenmiş ve kaplamasız çark yüzeyinin temas açı değeri 70,32°, Belzona 1321 ile kaplanan yüzeyde ise bu değerin 99,87°'ye yükselmiştir. Kaplama tabakasının mikroyapısı ve korozyon davranışı taramalı elektron mikroskobu (SEM), açık devre potansiyeli (OCP), elektrokimyasal empedans spektroskopisi (EIS) ve potansiyodinamik polarizasyon (PDP) analizleriyle incelenmiştir. Belzona 1321 ile kaplanan pompa çark numunesinin kaplamasız çark numunesine göre kavitasyon ve korozyona karşı daha yüksek yüzey dayanımı göstermiştir. Hidrofilik karakterdeki altlık malzeme olan çark numunesi, Belzona 1321 kaplaması ile kaplanarak hidrofobik özellik kazanmıştır. Kaplama tabakası koruyucu bir bariyer oluşturarak metal yüzeyin korozif ortamla doğrudan temasını azaltmış ve korozyon hızını düşürmüştür. Elektrokimyasal test sonuçlarında kaplamalı numunenin daha düşük korozyon akım yoğunluğu ve daha yüksek polarizasyon direnci sergilemiştir. SEM görüntülerinde ise, Belzona 1321 kaplamasının korozyon direnci ve yapısal bütünlük açısından başarılı performans gösterdiği belirlenmiştir.

Pompa performansı; toplam basma yüksekliği, verim, emme basıncı, titreşim seviyesi ve emmedeki mevcut net pozitif yük (ENPYm) parametreleri dikkate alınarak değerlendirilmiştir. Hidrofobik kaplamanın en iyi verim noktası(BEP) çevresinde verim değeri yaklaşık %6-8 oranında artırdığını, manometrik basma yüksekliğinde artış sağladığını, titreşim seviyesini yaklaşık %30-35 oranında azalttığını ve $ENPY_m$ değerinde ise yaklaşık %5-9 oranında iyileşme sağlamıştır. Belzona 1321 Ceramic S-Metal kaplamasının oluşturduğu homojen yüzey yapısının hem korozyon direncini artırdığını hem de santrifüj pompa performansını olumlu yönde arttırdığı belirlenmiştir.

Anahtar kelimeler: ENPY, Kavitasyon, Kaplama, Korozyon

REPORTING CONVENTIONS IN AIRCRAFT ENGINE REMAINING USEFUL LIFE PREDICTION

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ÖZET

Kalan faydalı ömür kestirimi çalışmalarında NASA C-MAPSS veri kümesi, alanyazının ortak sınama ortamı durumundadır. Bu veri kümesi üzerinde bildirilen sonuçların birbiriyle karşılaştırılmasının güç olduğu bilinmektedir. Derleme çalışmaları bu sorunu dile getirmekte, yeni kıyaslama çalışmaları ise sabit protokoller önermektedir. Ancak sorunun büyüklüğü bugüne kadar ölçülmemiştir. Bu çalışma, alanyazında eksik olan bu niceliği sağlamayı amaçlamaktadır. İki raporlama tercihi, modelleme seçimleriyle eşit statüde birer deney faktörü olarak ele alınmıştır. Bunlardan birincisi, motor sağlıklı iken eğitim hedefini sabit tutan R_early kesme değeridir. İkincisi, hatanın hangi çevrimler üzerinde ve hangi referans değere göre hesaplandığıdır. Deney, toplam 1416 motor birimi içeren dört alt kümenin tamamı üzerinde tam çarpanlı olarak kurulmuştur. Tasarımda dört kesme değeri, iki öznitelik gösterimi, dört öğrenici ve beş tohum çaprazlanmıştır. Böylece toplam 640 model bağımsız olarak eğitilmiş, her model yeniden eğitilmeden dört farklı raporlama tercihine göre puanlanmıştır. Aynı modelin bildirilen hatası bu tercihlere bağlı olarak 3,6 ile 5,9 kat arasında değişmektedir. Yaygın kullanılan kesilmiş referans altında hata varyansının %79,8 kadarı kesme değerinden, %3,4 kadarı ise öğrenici seçiminden kaynaklanmaktadır. Kesme değerinin puanlamadaki rolü kaldırıldığında dahi varyansın %42,3 kadarı bu değere bağlı kalmaktadır. Bildirilen hata, kesme değeri düştükçe her alt kümede ve her öğrenici için tekdüze azalmaktadır. Kesme değerinin 140 çevrimden 110 çevrime indirilmesi, dört öğrenici arasındaki farkın tamamından daha fazla hata azalması sağlamaktadır. Bu nedenle farklı kesme değerleriyle elde edilen sonuçlar karşılaştırılabilir değildir. Kazanan model ayrıca blokların %44,4 kadarında ölçüte, %41,2 kadarında puanlama protokolüne ve %72,5 kadarında kesme değerine göre değişmektedir. Prognostik sonuçlar; kesme değeri, puanlanan çevrim kümesi, referans değer uygulaması ve ölçüt ile birlikte bildirilmelidir. Bulgular, çevrim kesirleri düzeyinde yapılan yöntem sıralamalarının, denetlenmeyen bir ölçek üzerinde yürütüldüğünü ortaya koymaktadır.

Anahtar Kelimeler: Prognostik, Kalan faydalı ömür, Turbofan motor, C-MAPSS, Tekrarlanabilirlik

ABSTRACT

The NASA C-MAPSS data set is the common testbed of the remaining useful life literature. Results reported on it are known to be hard to compare. Reviews state the concern, and recent benchmarks prescribe fixed protocols. The size of the problem has never been measured. This study supplies that missing quantity. Two reporting conventions are treated as experimental factors of the same standing as the modelling choices. The first is the early-life cap R_early, which holds the training target constant while the engine is still healthy. The second is the set of scored cycles, together with the treatment of the ground truth. A balanced factorial experiment was run on all four subsets, holding 1416 engine units. The design crosses four caps, two feature representations, four learners and five seeds. In total 640 models were fitted independently, and each was scored under four conventions without being refitted.

The reported error of one fixed model varies by a factor of 3.6 to 5.9. Under the conventional capped ground truth the cap explains 79.8% of the variance in that error, whereas the learner explains 3.4%. Removing the scoring role of the cap still leaves 42.3% with it. The reported error falls monotonically as the cap falls, on every subset and learner. Lowering the cap from 140 to 110 cycles removes more error than the spread between the four learners. Results obtained under different caps are therefore not comparable. The winning model also changes with the metric in 44.4% of blocks, with the protocol in 41.2% and with the cap in 72.5%. Prognostic results should therefore be reported together with the cap, the scored cycles, the truth convention and the metric. A field that ranks methods by fractions of a cycle is ranking them on a scale it does not control.

Keywords: Prognostics, Remaining useful life, Turbofan engine, C-MAPSS, Reproducibility

YERDEN BESLEMELİ YÜKSEK BASINÇLI PÜSKÜRTME SİSTEMİNİN İHA ENTEGRASYONU İÇİN YAPISAL BOYUTLANDIRMA VE STATİK SONLU ELEMANLAR ANALİZİ

STRUCTURAL DESIGN AND STATIC FINITE ELEMENT ANALYSIS OF A UAV-INTEGRATED GROUND-SUPPLIED HIGH-PRESSURE SPRAYING SYSTEM

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Abstract

Cleaning high-rise building façades and surfaces that are difficult to access using conventional equipment such as ladders and platforms is generally a time-consuming and hazardous process that requires human operators to work at height. To address this challenge, an unmanned aerial vehicle (UAV)-based spraying subsystem utilizing a ground-fed hose was developed. In this study, the structural adequacy of the spray attachment kit used in the proposed system was investigated using the finite element method. The system requirements were defined as a maximum take-off weight of less than 25 kg, a hose length of approximately 100 m, a minimum operating pressure of 150 bar, and a flow rate of approximately 4 L/min. For the initial structural load case, the static weight of the 100 m hose and the water column contained within the hose, which has an internal diameter of 8 mm, was considered. The resulting vertical load was calculated as 119.94 N. The five-component spray attachment kit was modeled using 7075-T6 aluminum alloy. The material was assumed to exhibit linear-elastic and isotropic behavior, and three-dimensional solid finite elements were employed in the analysis. The generated finite element mesh consisted of 96,503 elements and 158,270 nodes. Four surfaces were defined as fixed supports, while a total vertical load of 120 N was applied to two relevant surfaces to represent the static load generated by the hose and the water column. The finite element analysis resulted in a maximum von Mises equivalent stress of 16.97 MPa, a maximum total deformation of 0.005038 mm, and a maximum equivalent elastic strain of 1.528×10^{-4}. Considering a yield strength of 505 MPa for the 7075-T6 aluminum alloy, the corresponding static factor of safety was calculated to be approximately 29.76. The results indicate that the spray attachment kit exhibits high structural stiffness and a substantial strength reserve under the investigated baseline load case representing only the static weight of the hose and the water column. However, the calculated factor of safety should not be interpreted as representing the overall safety margin of the system under all operational conditions. Jet reaction forces, dynamic loads induced by hose oscillation, wind loads, pressure transients, contact and preload conditions at mechanical joints, and fatigue effects resulting from cyclic loading were not included in the present model. Therefore, these operational and dynamic effects should be incorporated into subsequent analyses to achieve a more comprehensive structural verification of the system.

Keywords: UAV, façade cleaning, high-pressure spraying, tethered UAV, finite element analysis, 7075-T6.

Özet

Bu çalışmada, Yüksek katlı bina cepheleri ile merdiven, platform ve benzeri geleneksel ekipmanlarla erişimi zor veya güvenlik riski taşıyan yüzeylerin temizliği, günümüzde çoğunlukla insan operatörlerin yüksekte çalışmasını gerektiren, zaman alıcı ve iş güvenliği açısından riskli bir süreçtir. Bu ihtiyaç doğrultusunda, yerden beslemeli hortum kullanan bir insansız hava aracı (İHA) püskürtme alt sistemi geliştirilmiş ve bu çalışmada söz konusu sistemin püskürtme bağlantı kitinin yapısal yeterliliği sonlu elemanlar yöntemiyle incelenmiştir. Sistem gereksinimleri; 25 kg'dan düşük azami kalkış ağırlığı, yaklaşık 100 m hortum uzunluğu, en az 150 bar çalışma basıncı ve yaklaşık 4 L/dk debi sağlayacak şekilde tanımlanmıştır. Yapısal analiz kapsamında ilk yük durumu, 8 mm iç çaplı hortum ile hortum içerisindeki 100 m uzunluğundaki su kolonunun toplam statik ağırlığını temsil edecek şekilde oluşturulmuş ve bu yük 119,94 N düşey kuvvet olarak hesaplanmıştır. Beş parçadan oluşan püskürtme bağlantı kiti 7075-T6 alüminyum alaşımından modellenmiş; malzeme doğrusal-elastik ve izotropik kabul edilerek üç boyutlu katı sonlu elemanlar kullanılmıştır. Oluşturulan sonlu elemanlar ağı 96.503 eleman ve 158.270 düğümden meydana gelmektedir. Sınır koşulları kapsamında dört yüzey ankastre olarak tanımlanmış ve hortum-su kolonunun oluşturduğu yükü temsil etmek üzere ilgili iki yüzeye toplam 120 N düşey kuvvet uygulanmıştır. Sonlu elemanlar analizi sonucunda maksimum von Mises eşdeğer gerilmesi 16,97 MPa, maksimum toplam yer değiştirme 0,005038 mm ve maksimum eşdeğer elastik birim şekil değiştirme $1{,}528\times10^{-4}$ olarak elde edilmiştir. 7075-T6 alüminyum alaşımının 505 MPa akma dayanımı esas alındığında, statik emniyet katsayısı yaklaşık 29,76 olarak hesaplanmıştır. Elde edilen sonuçlar, yalnızca hortum ve içerisindeki su kolonunun statik ağırlığını temsil eden temel yük durumu altında püskürtme bağlantı kitinin yüksek rijitliğe ve önemli bir yapısal dayanım rezervine sahip olduğunu göstermektedir. Bununla birlikte, hesaplanan emniyet katsayısı sistemin tüm çalışma koşullarındaki emniyet katsayısı olarak değerlendirilmemelidir. Mevcut analiz modelinde jet reaksiyon kuvvetleri, hortum salınımından kaynaklanan dinamik yükler, rüzgâr etkileri, basınç darbeleri, bağlantı elemanları arasındaki temas ve ön yükleme koşulları ile tekrarlı yüklemelerden kaynaklanabilecek yorulma etkileri dikkate alınmamıştır. Bu nedenle, sistemin nihai yapısal doğrulaması için söz konusu dinamik ve çalışma koşullarının sonraki analiz aşamalarında modele dahil edilmesi gerekmektedir.

Anahtar kelimeler: İnsansız hava aracı, dış cephe temizliği, yüksek basınçlı püskürtme, hortumlu İHA, sonlu elemanlar analizi, 7075-T6.

TIBBİ GÖRÜNTÜLEME ALANINDA YAPAY ZEKÂ TABANLI PATENTLERİN İNCELENMESİ

EXAMINATION OF ARTIFICIAL INTELLIGENCE-BASED PATENTS IN MEDICAL IMAGING

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Abstract

In recent years, the deep integration of deep learning methods into medical image analysis has driven the rapid spread of AI-assisted diagnostic systems across fields such as radiology, pathology, and dermatology; yet how this wave of innovation is reflected at the intellectual property level in Turkey remains relatively underexplored. This study aims to identify, classify, and evaluate the clinical contributions of artificial intelligence (AI)-based patents in medical imaging published in the Official Patent Bulletins of the Turkish Patent and Trademark Office (TÜRKPATENT) between January 2025 and July 2026. The study was designed as a qualitative document analysis. Nineteen monthly issues of the Official Patent Bulletin (2025/1–2025/12 and 2026/1–2026/7) were screened in PDF format. Patent abstracts in which terms such as "artificial intelligence," "deep learning," or "machine learning" co-occurred with imaging-modality terms, including MRI, CT, X-ray, ultrasound, PET, and dermoscopy, were identified through a systematic keyword search; the resulting candidates were then manually verified against the applicant, inventor, classification code, and abstract fields, and the patents meeting the inclusion criteria were sorted into four functional categories. The screening identified a total of 22 qualifying patents: (A) Diagnostic Classification and Early Detection Systems (n=13), (B) Image Enhancement and Synthetic Image Generation (n=2), (C) Surgical/Interventional Navigation and Real-Time Image Guidance (n=5), and (D) Clinical Decision Support and Multimodal Integration Systems (n=2). Applicants included Karadeniz Technical University, the leading contributor with three patents, alongside Atatürk, Ege, Gazi, Mersin, Üsküdar, and Recep Tayyip Erdoğan universities, as well as private companies such as Turkcell, Innoway R&D, and AID Core Solutions; all records examined were still at the application stage, with none yet granted. AI-based patenting activity in medical imaging in Turkey is concentrated primarily in oncological diagnosis, neuroimaging, and dental radiography. These findings are broadly consistent with the international literature, although data on clinical validation and regulatory approval remain limited; future research would benefit from a longitudinal design that tracks patents through registration and clinical approval (e.g., Ministry of Health/CE/FDA).

Keywords: Artificial intelligence, medical imaging, deep learning, patent analysis, TÜRKPATENT

Özet

Son yıllarda derin öğrenme yöntemlerinin tıbbi görüntü analizine yoğun biçimde entegre olması, radyoloji, patoloji ve dermatoloji gibi alanlarda yapay zekâ destekli tanı sistemlerinin hızla yaygınlaşmasına yol açmıştır; ancak bu inovasyon faaliyetinin Türkiye'deki fikri mülkiyet düzeyindeki yansıması görece az araştırılmıştır. Bu çalışmanın amacı, Türk Patent ve Marka Kurumu (TÜRKPATENT) Resmi Patent Bültenlerinde Ocak 2025–Temmuz 2026 döneminde yayımlanan, tıbbi görüntüleme alanında yapay zekâ (YZ) kullanan patentleri belirlemek, sınıflandırmak ve bu patentlerin klinik katkılarını literatür bağlamında değerlendirmektir. Çalışma nitel bir doküman analizi deseninde

tasarlanmıştır. TÜRKPATENT'in 19 aylık dönemine (2025/1–2025/12 ve 2026/1–2026/7) ait Resmi Patent Bültenleri PDF formatında taranmıştır. "Yapay zekâ", "derin öğrenme" veya "makine öğrenmesi" gibi terimlerin "MR", "BT", "röntgen", "ultrason", "PET" ve "dermoskopi" gibi görüntüleme modalitesi terimleriyle birlikte geçtiği patent özetleri sistematik anahtar kelime taramasıyla tespit edilmiş; belirlenen adaylar başvuru sahibi, buluşu yapan, sınıflandırma kodu ve özet bilgileri esas alınarak elle doğrulanmış, kriterleri karşılayan patentler işlevlerine göre dört kategoriye ayrılmıştır. Tarama sonucunda toplam 22 patent belirlenmiştir: (A) Tanısal Sınıflandırma ve Erken Teşhis Sistemleri (n=13), (B) Görüntü İyileştirme ve Sentetik Görüntü Üretimi (n=2), (C) Cerrahi/Girişimsel Navigasyon ve Gerçek Zamanlı Görüntü Rehberliği (n=5) ve (D) Klinik Karar Destek ve Çok Modlu Entegrasyon Sistemleri (n=2). Başvuru sahipleri arasında en fazla patente sahip Karadeniz Teknik Üniversitesi (3 patent) başta olmak üzere Atatürk, Ege, Gazi, Mersin, Üsküdar ve Recep Tayyip Erdoğan üniversiteleri ile Turkcell, Innoway R&D ve AID Core Solutions gibi özel şirketler yer almaktadır; incelenen kayıtların tamamı henüz başvuru aşamasında olup tescil edilmiş patent bulunmamaktadır. Türkiye'de tıbbi görüntüleme alanında YZ tabanlı patent üretimi özellikle onkolojik tanı, nörogörüntüleme ve dental radyografi alanlarında yoğunlaşmaktadır. Bulgular uluslararası literatürle genel olarak uyumludur, ancak klinik doğrulama ve düzenleyici onay süreçlerine ilişkin veri sınırlıdır; ileride yapılacak çalışmaların patentlerin tescil ve klinik onay süreçlerini izleyen boylamsal bir tasarımla ele alınması önerilmektedir.

Anahtar Kelimeler: Yapay zekâ, tıbbi görüntüleme, derin öğrenme, patent analizi, TÜRKPATENT

POPULUS TOHUM LİFLERİ KULLANILARAK METAL İŞLEME YAĞLARININ SÜRDÜRÜLEBİLİR AYRILMASI VE GERİ KAZANIMI: ADSORPSİYON PERFORMANSI VE YENİDEN KULLANILABİLİRLİĞİ

SUSTAINABLE SEPARATION AND RECOVERY OF METALWORKING OILS USING POPULUS SEED FIBERS: ADSORPTION PERFORMANCE AND REUSABILITY

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Abstract

Waste metalworking fluids (MWFs), particularly those classified as EWC 12 01 06 and 12 01 09, are hazardous wastewater streams that are difficult to treat because of stable oil-in-water emulsions and complex surfactant formulations. This study evaluates hollow Populus seed fibers, an abundant urban biomass, as untreated biosorbents for the removal and recovery of metalworking oils. Fibers from six Populus species (*P. alba, P. angustifolia, P. canadensis, P. fremontii, P. nigra, and P. tremula*) were tested against two industrial MWF matrices under batch conditions. Equilibrium adsorption capacities

ranged from 4.99 to 187.1 g g^{-1}, with P. nigra showing the highest uptake, reaching 123.4 g g^{-1} for EWC 12 01 06 and 187.1 g g^{-1} for EWC 12 01 09. Equilibrium data were best described by the multilayer BET model (R^2 up to 0.995), whereas adsorption kinetics followed the pseudo-second-order model (R^2 = 0.924-0.999), with film diffusion contributing to mass transfer. Sorption was governed by hydrophobic surface interactions and capillary condensation within the hollow lumen. Thermodynamic analysis indicated an endothermic, entropy-driven physisorption process, with negative ΔG° values at 298 K for P. nigra. Reusability tests showed 77.5% capacity retention after ten cycles for EWC 12 01 09, corresponding to an estimated service life of 21-27 cycles before 50% capacity loss. ATR-FTIR confirmed that recovered oils remained chemically unchanged. A gate-to-gate assessment further indicated low energy demand and carbon emissions per gram of oil removed, highlighting Populus seed fibers as efficient, reusable, and circular-economy-compatible biosorbents for sustainable MWF treatment and resource recovery.

Keywords: *Populus* seed fibers; metalworking fluids; biosorption; oil recovery; circular economy; hollow fiber sorbents; capillary condensation; reusability

Özet

Atık metal işleme sıvıları (MWF'ler), özellikle EWC 12 01 06 ve 12 01 09 kodları altında sınıflandırılanlar, kararlı yağ-su emülsiyonları ve karmaşık yüzey aktif madde formülasyonları nedeniyle arıtılması güç tehlikeli atıksu akımlarını oluşturmaktadır. Bu çalışmada, bol miktarda bulunan kentsel bir biyokütle olan içi boş yapılı *Populus* tohum lifleri, metal işleme yağlarının giderimi ve geri kazanımı için herhangi bir ön işleme tabi tutulmadan biyosorbent olarak değerlendirilmiştir. Altı farklı *Populus* türünden (*P. alba, P. angustifolia, P. canadensis, P. fremontii, P. nigra ve P. tremula*) elde edilen lifler, iki farklı endüstriyel MWF matrisi kullanılarak kesikli sistem koşullarında test edilmiştir. Denge adsorpsiyon kapasiteleri 4,99-187,1 g g^{-1} arasında değişmiş, en yüksek adsorpsiyon kapasitesi *P. nigra* için elde edilerek EWC 12 01 06'da 123,4 g g^{-1} ve EWC 12 01 09'da 187,1 g g^{-1} değerlerine ulaşmıştır. Denge verileri en iyi çok tabakalı BET modeli ile açıklanırken (R^2 en yüksek 0.995), adsorpsiyon kinetiği yalancı ikinci derece modele uyum göstermiştir (R^2 = 0.924-0.999) ve film difüzyonunun kütle transferine katkıda bulunduğu belirlenmiştir. Sorpsiyonun, hidrofobik yüzey etkileşimleri ile içi boş lif lümeni içerisinde gerçekleşen kapiler yoğunlaşmanın birleşik etkisiyle kontrol edildiği ortaya konmuştur. Termodinamik analizler, sürecin endotermik ve entropi güdümlü bir fiziksel adsorpsiyon mekanizmasına sahip olduğu ve *P. nigra* için 298 K'de negatif ΔG° değerleri elde edildiğini göstermiştir. Yeniden kullanılabilirlik deneylerinde, *P. nigra* EWC 12 01 09 için on çevrim sonunda başlangıç kapasitesinin %77,5'ini korumuş ve %50 kapasite kaybına ulaşmadan önce tahmini kullanım ömrü 21-27 çevrim olarak belirlenmiştir. ATR-FTIR analizleri, geri kazanılan yağların kimyasal yapılarında herhangi bir değişiklik meydana gelmediğini doğrulamıştır. Kapıdan kapıya gerçekleştirilen değerlendirme ayrıca, giderilen yağın gramı başına düşük enerji tüketimi ve karbon emisyonu olduğunu ortaya koymuş; böylece *Populus* tohum liflerinin sürdürülebilir MWF arıtımı ve kaynak geri kazanımı için yüksek verimli, yeniden kullanılabilir ve döngüsel ekonomi ile uyumlu biyosorbentler olduğu gösterilmiştir.

Anahtar kelimeler: *Populus* tohumları; metal işleme sıvıları; biosorpsiyon; yağ geri kazanımı; döngüsel eknomi; İçi boş lifli sorbentler; kılcal yoğunlaşma; yeniden kullanılabilirlik

TECHNICAL AND REGULATORY ASSESSMENT OF FLOATING PHOTOVOLTAIC SYSTEMS IN TÜRKİYE: A CASE STUDY OF DEMİRKÖPRÜ DAM

TÜRKİYE'DE YÜZER FOTOVOLTAİK SİSTEMLERİN TEKNİK VE DÜZENLEYİCİ AÇIDAN DEĞERLENDİRİLMESİ: DEMİRKÖPRÜ BARAJI ÖRNEĞİ

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Abstract

Floating photovoltaic (FPV) systems have been recognized as a prospective renewable energy technology in recent years due to their constructional advantages, including lower land-use requirements compared with conventional photovoltaic installations, the potential for electricity generation on water surfaces, enhanced module efficiency through the natural cooling effect of water, and reduced evaporation losses from reservoir surfaces. This study considers FPV installations in Türkiye within the regulatory framework and conducts technical analyses, using the Demirköprü Dam in Manisa as a case study. In this context, a grid-connected FPV system with an installed power capacity of 5 MWp is simulated with meteorological data from the Meteonorm database in PVsyst. The system design is developed with site-specific conditions, engineering requirements, and regulatory limitations controlling the use of reservoir surfaces in Türkiye under the Renewable Energy Resource Zones (YEKA) framework, including the GES-2025 TEİAŞ grid-connection criteria, solar-based renewable energy zone allocation requirements, and associated grid-connection capacity boundaries. The PVsyst model is configured with bifacial modules and water-surface albedo to account for the additional rear-side irradiance and quantify its impact on the annual energy performance. The results show an annual electricity generation of 8,593 MWh, corresponding to a net increase of 191 MWh (2.27%) compared with a conventional monofacial module configuration. The Demirköprü Dam case study shows the potential for reservoir-based renewable energy generation in Türkiye and shows that using available reservoir surfaces can directly help national sustainability objectives. In conclusion, the large-scale adoption of FPV systems in Türkiye depends not only on technical performance and economic considerations but also on optimal site selection, multidisciplinary engineering approaches, environmental impact analyses, and regulatory compliance.

Keywords: Floating Photovoltaic (FPV) Systems, Bifacial Photovoltaic Modules, Albedo Effect, PVsyst, Demirköprü Dam, Renewable Energy

Özet

Yüzer fotovoltaik (FPV) sistemler; geleneksel fotovoltaik kurulumlara kıyasla karasal alandaki arazi kullanım gereksinimlerini azaltırken su yüzeylerinde elektrik üretimine olanak sağlaması, suyun doğal soğutma etkisiyle modül verimliliğini artırması ve baraj rezervuarlarındaki buharlaşma kayıplarını azaltması gibi yapısal avantajlarıyla son yıllarda umut vadeden bir yenilenebilir enerji teknolojisi olarak ortaya çıkmıştır. Bu çalışmada, Türkiye'deki FPV kurulumları düzenleyici çerçeve kapsamında incelenmiş ve Manisa'da yer alan Demirköprü Barajı ölçeğinde teknik analizler gerçekleştirilmiştir. Bu bağlamda, Meteonorm veri tabanından alınan meteorolojik veri seti kullanılarak 5 MWp kurulu güç

kapasitesine sahip şebeke bağlantılı bir FPV sistemi PVsyst yazılımı aracılığıyla modellenmiştir. Sistem tasarımında sahaya özgü koşullar, mühendislik kriterleri ve Türkiye'deki rezervuar yüzeylerinin kullanımına dair düzenleyici kısıtlar bütünleşmiş bir yaklaşımla ve özellikle yenilenebilir enerji kaynak alanı (YEKA) modeli GES-2025 TEİAŞ bağlantı görüşleri ile güneş enerjisine dayalı yenilenebilir enerji kaynak alanları ve bağlantı kapasitelerinin tahsisine ilişkin düzenleyici kısıtlamalar dikkate alınarak geliştirilmiştir. Geleneksel tek yüzeyli fotovoltaik panellerin ötesine geçilerek, çift yüzeyli fotovoltaik modül teknolojisinin ve albedo (yansıtma) etkisinin modele dâhil edildiği simülasyonda, yıllık enerji üretimi 8.593 MWh düzeyine ulaşmış ve geleneksel tek yüzeyli modül konfigürasyonuna kıyasla yıllık enerji üretiminde 191 MWh (%2,27) net artış elde edilmiştir. Elde edilen sayısal bulgular, çift yüzeyli modül mimarisinin ve albedo etkisinin FPV sistemlerinin performansına olumlu katkı sağladığını göstermektedir. Demirköprü Barajı vaka çalışması, Türkiye'deki rezervuar tabanlı yenilenebilir enerji potansiyelini uygulamalı bir model üzerinden ortaya koymaktadır. Su yüzeylerinin temiz enerji üretiminde yenilikçi bir alternatif olduğunu destekleyen bu çalışma, mevcut rezervuar yüzeylerinin kullanımının ulusal sürdürülebilirlik hedeflerine doğrudan katkı sağlayabileceğine işaret etmektedir. Sonuç olarak, Türkiye'deki FPV sistemlerinin yaygınlaşmasının teknik performans ve ekonomik değerlendirmelerin yanı sıra optimum saha seçimine, çok disiplinli mühendislik yaklaşımlarına, çevresel etkilerin değerlendirilmesine ve düzenleyici mevzuat altyapısına uyuma da bağlı olduğu saptanmıştır.

Anahtar kelimeler: Yüzer Fotovoltaik (FPV) Sistemler, Çift Yüzeyli Fotovoltaik Modüller, Albedo Etkisi, PVsyst, Demirköprü Barajı, Yenilenebilir Enerji

VERIMLI METILEN MAVISI ADSORPSIYONU IÇIN GRAFEN OKSIT/HUMIK ASIT/ALJINAT HIDROJELININ GELISTIRILMESI : BOX-BEHNKEN OPTIMIZASYONU, YAPAY ZEKA VE DFT ANALIZLERI

ENGINEERING A GRAPHENE OXIDE/HUMIC ACID/ALGINATE HYDROGEL FOR EFFICIENT METHYLENE BLUE ADSORPTION: BOX-BEHNKEN OPTIMIZATION, ARTIFICIAL INTELLIGENCE, AND DFT INSIGHTS

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Abstract

The discharge of wastewater containing dyes into the environment is a major global problem that must be addressed due to its negative impact on both aquatic flora and fauna and on humans. This research describes the design of a new type of hydrogel, called a graphene oxide/humic acid/alginate (GO/HA/ALG) hydrogel composite, capable of effectively removing methylene blue (MB). The composition of the composite was determined using the Box-Behnken design of experiments, and the optimal amounts of the components were established at 0.15 g of GO, 0.1 g of HA, and 2 g of ALG; the predicted MB removal efficiency for this composition was 96.58%. The structure and other properties of the composite were examined using XRD, FTIR, and SEM/EDX methods, and zeta potential measurements showed that the composite had formed successfully and contained numerous oxygen-containing functional groups. The optimized material exhibited a maximum adsorption capacity of 185.2 mg g^{-1}, significantly outperforming pristine graphene oxide due to the synergistic contribution of graphene oxide, humic acid, and alginate. An Artificial Neural Network (ANN) model accurately predicted the adsorption efficiency under various operating conditions, while Density Functional Theory (DFT) calculations provided molecular-level insights into the adsorption mechanism. Electrostatic attraction, hydrogen bonding, and π-π interactions were identified as the main driving forces for MB adsorption. These findings demonstrate that the GO/HA/ALG composite is a highly efficient, sustainable, and easily recoverable adsorbent with promising potential for wastewater treatment.

Keywords: GO/HA/ALG composite, Methylene blue, Adsorption, Artificial Neural Network, Density Functional Theory, Experimental design.

Özet

Boyar madde içeren atık suların çevreye deşarj edilmesi, sucul ekosistemler ve insan sağlığı üzerindeki olumsuz etkileri nedeniyle önemli bir küresel çevre sorunu oluşturmaktadır. Bu çalışmada, metilen mavisinin (MB) sulu çözeltilerden etkili bir şekilde giderilmesi amacıyla grafen oksit/humik asit/aljinat (GO/HA/ALG) esaslı yeni bir hidrojel kompozit adsorban geliştirilmiştir. Kompozitin bileşimi Box–Behnken deney tasarımı kullanılarak optimize edilmiş ve optimum bileşimin 0.15 g GO, 0.10 g HA ve 2.0 g ALG içerdiği belirlenmiştir. Bu bileşim için tahmin edilen MB giderim verimi %96.58 olarak elde edilmiştir. Optimize edilen kompozitin yapısal ve fizikokimyasal özellikleri XRD, FTIR ve SEM/EDX analizleri ile incelenmiş, zeta potansiyeli ölçümleri ise kompozitin başarılı bir şekilde oluşturulduğunu ve yapısında çok sayıda oksijen içeren fonksiyonel grubun bulunduğunu doğrulamıştır. Optimize edilen GO/HA/ALG kompoziti 185.2 mg g^{-1} maksimum adsorpsiyon kapasitesi göstermiş ve saf grafen okside kıyasla belirgin şekilde daha yüksek adsorpsiyon performansı sergilemiştir. Bu gelişmiş performansın GO, HA ve ALG bileşenleri arasındaki sinerjik katkıdan kaynaklandığı değerlendirilmiştir. Ayrıca, Yapay Sinir Ağı (ANN) modeli, farklı çalışma koşullarında MB giderim veriminin yüksek doğrulukla tahmin edilebildiğini göstermiştir. Yoğunluk Fonksiyonel Teorisi (DFT) hesaplamaları ise adsorpsiyon mekanizmasına moleküler düzeyde ek bilgiler sağlamıştır. Sonuçlar, elektrostatik çekim, hidrojen

bağları ve π–π etkileşimlerinin MB adsorpsiyonunu yönlendiren temel mekanizmalar olduğunu göstermiştir. Genel olarak, GO/HA/ALG hidrojel kompoziti, boyar madde içeren atık suların arıtılmasında kullanılabilecek yüksek verimli, sürdürülebilir ve kolay geri kazanılabilir umut verici bir adsorban olarak değerlendirilebilir.

Anahtar kelimeler: Grafen oksit, Humik asit, Aljinat, Metilen mavisi, Adsorpsiyon, Yapay Sinir Ağı, Yoğunluk Fonksiyonel Teorisi

PREDICTION OF PYRROLOPYRIMIDINE DERIVATIVES AS NOVEL BRUTON'S TYROSINE KINASE (BTK) INHIBITORS USING QSAR MODELING, MOLECULAR DOCKING, MOLECULAR DYNAMICS, AND ADMET PROPERTIES

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ABSTRACT

In recent years, significant attention has been given to developing and discovering novel Bruton's tyrosine kinase (BTK) inhibitors, as they present an effective treatment strategy for B-cell malignancies. BTK plays a crucial role in B cell receptor (BCR)-mediated activation and proliferation by regulating downstream factors such as the NF-κB and MAP kinase pathways. To address this challenge and propose potential therapeutic options for B-cell lymphomas, researchers conducted 2D-QSAR and ADMET studies on pyrrolopyrimidine derivatives that act as inhibitors of the BCR site in cytochrome b. These studies aim to improve and identify new compounds that could serve as more potent BTK inhibitors, leading to the identification of new drug candidates in this field.

In our study, we used 2D-QSAR (including multiple linear regression, multiple nonlinear regression, and artificial neural networks), molecular docking, molecular dynamics, and ADMET properties to investigate the potential of 35 pyrrolopyrimidine derivatives as BTK inhibitors. A molecular docking study and molecular dynamics simulations of molecule 13 over a 10 ns period revealed that it forms multiple hydrogen bonds with several residues and demonstrates frequent stability throughout the simulation. Based on the results obtained from molecular modeling, we proposed six new compounds (Pred1, Pred2, Pred3, Pred4, Pred5, and Pred6) with highly significant predicted activity according to MLR models. An in silico evaluation of the predicted ADMET properties of the new candidate molecules is strongly recommended to classify these molecules as promising candidates for new anticancer agents specifically designed to target BTK inhibition.

Keywords: QSAR, Pyrrolopyrimidine, Molecular docking, Molecular dynamic, ADMET propriety, BTK inhibitors.

WEAR EXPERIENCE, CHALLENGES, AND TEXTILE DESIGN IMPROVEMENTS IN BURN-SCAR COMPRESSION GLOVES: A USER-CENTERED CASE REPORT

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ABSTRACT

Compression garments are widely used as a conservative approach in the management of hypertrophic scars following burn injuries. In hand burns, compression gloves are particularly critical because scar formation can affect not only skin appearance but also joint mobility, tactile interaction, and the performance of daily activities. However, the therapeutic effectiveness of a compression glove is strictly dependent on patient adherence and long-term usability. Factors such as garment fit, thermal and tactile comfort and overall user satisfaction directly indluence whether the garment is worn as prescribed. Despite this, subjective user experiences and expectations are often overlooked during the design and technical evaluation of medical textiles.

This study presents a user-centered case report evaluating the long-term wear experience of an individual using a compression glove during burn-scar threapy. The key textile-related parameters – including pattern fit, fabric elasticity, breathability, thermal comfort, skin-textile interaction, seam placement, and pressure distribution – from the user's perspective. Furthermore, functional challenges such as finger movement restriction, garment durability during repeated use, and daily handling difficulties are detailed.

The findings are evaluated from a textile engineering and user-centered design perspective to identify possible improvements. Enhancing anatomical fit, seamless production, localized elasticity, more comfortable fabric selection and use of 3D or 4D scanning methods are some suggested improvements. This case report shows that incorporating user feedback into medical textile design may support the development of more comfortable, practical, and effective burn-scar management products. These improvements may also contribute to better wearability and support more consistent use during long-term treatment.

Keywords: Burn scar, compression glove, medical textiles, textile comfort

SLM İLE ÜRETİLEN AlSi10Mg ALAŞIMINDA TORNALAMA ÖNCESİ HIP VE TORNALAMA SONRASI MAKARALI PARLATMANIN YÜZEY PROFİLİNE ETKİLERİ

EFFECTS OF PRE-TURNING HIP AND POST-TURNING ROLLER BURNISHING ON THE SURFACE PROFILE OF SLM-PRODUCED AlSi10Mg ALLOY

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Abstract

AlSi10Mg parts produced by selective laser melting (SLM) require post-processing owing to high, non-uniform as-built surface roughness. This study examined the effects of hot isostatic pressing (HIP) before turning and roller burnishing after turning on the surface profile. Six cylindrical specimens, each 7.4 mm in final diameter and 50 mm long, were prepared for surface-profile measurements. Two specimens were assigned to each group: T, turned; HIP-T, turned after HIP; and T-RB, roller-burnished after turning. To standardize the variable as-built surface, whose Ra was approximately 16 µm, all specimens underwent two roughing passes and one finishing pass at a constant cutting speed of 35 m/min. HIP conditions were 500 °C, 100 MPa, and 2 h, whereas roller burnishing was performed at 100 N, 1000 rpm, and 0.03 mm/rev in one pass. Five axial profiles per specimen were measured at different circumferential positions, yielding 10 profiles per group for calculation of mean Ra, Rz, Rsk, and Rku values. Compared with T, Ra in HIP-T changed from 0.63 to 0.61 µm, while Rz decreased by 11.8%, from 4.06 to 3.58 µm; Rsk increased from −0.01 to 0.13, and Rku decreased from 2.90 to 2.64. In T-RB, Ra and Rz decreased by 71.4% and 68.7%, respectively, reaching 0.18 and 1.27 µm; Rsk decreased to −0.12, while Rku increased to 3.27. In HIP-T, the slightly positive Rsk and Rku below 3 indicated a flatter surface-height distribution despite limited changes in amplitude parameters. Plastic deformation during roller burnishing suppressed surface peaks, producing a low-amplitude, slightly valley-dominated profile. Together, Rsk and Rku suggested that pronounced local valleys were retained on the flattened surface. Overall, HIP pretreatment caused limited changes in the amplitude parameters of the post-turning surface profile but could alter its statistical distribution parameters; roller burnishing affected both amplitude and statistical distribution parameters.

Keywords: Selective laser melting, AlSi10Mg, hot isostatic pressing, roller burnishing, surface profile

Özet

Seçici lazer ergitme (SLM) ile üretilen AlSi10Mg parçalar, yüksek ve homojen olmayan as-built yüzey pürüzlülüğü nedeniyle üretim sonrası işlem gerektirmektedir. Bu çalışmada, tornalama öncesinde uygulanan sıcak izostatik preslemenin (HIP) ve tornalama sonrasında uygulanan makaralı parlatmanın yüzey profiline etkileri incelenmiştir. Yüzey profili ölçümleri için son çapı 7,4 mm ve uzunluğu 50 mm olan altı silindirik numune hazırlanmıştır. Her grup ikişer numuneden oluşmuştur: T, tornalanmış; HIP-T, HIP sonrasında tornalanmış; T-RB ise tornalama sonrasında makaralı parlatılmıştır. Yaklaşık 16 µm Ra değerine sahip değişken as-built yüzeyi standartlaştırmak amacıyla tüm numunelere 35 m/dak sabit kesme hızında iki kaba ve bir finisaj pasosu uygulanmıştır. HIP işlemi 500 °C ve 100 MPa altında 2 saat gerçekleştirilirken makaralı parlatma 100 N kuvvet, 1000 dev/dak ve 0,03 mm/dev ilerlemeyle tek paso uygulanmıştır. Her numuneden farklı çevresel konumlarda eksenel doğrultuda beş profil ölçülmüş; böylece grup başına elde edilen 10 profil üzerinden ortalama Ra, Rz, Rsk ve Rku değerleri hesaplanmıştır. T grubuyla karşılaştırıldığında HIP-T grubunda Ra 0,63 µm'den 0,61 µm'ye değişirken Rz %11,8 azalarak 4,06 µm'den 3,58 µm'ye düşmüş; Rsk −0,01'den 0,13'e yükselmiş ve Rku 2,90'dan 2,64'e gerilemiştir. T-RB grubunda Ra ve Rz sırasıyla %71,4 ve %68,7 azalarak 0,18 ve 1,27 µm'ye ulaşmış; Rsk −0,12'ye düşerken Rku 3,27'ye yükselmiştir. HIP-T grubunda hafif pozitif Rsk değeri ve

Rku'nun 3'ün altında olması, genlik parametrelerindeki sınırlı değişime karşın daha yayvan bir yüzey yüksekliği dağılımına işaret etmiştir. Makaralı parlatma sırasında oluşan plastik deformasyon, yüzey tepelerini baskılayarak düşük genlikli ve hafif vadi ağırlıklı bir profil meydana getirmiştir. Rsk ve Rku'nun birlikte değerlendirilmesi, düzleştirilen yüzeyde belirgin yerel vadilerin korunduğunu düşündürmüştür. Genel olarak HIP ön işlemi, tornalama sonrası yüzey profilinin genlik parametrelerinde sınırlı değişim oluştururken istatistiksel dağılım parametrelerini değiştirebilmiş; makaralı parlatma ise hem genlik hem de istatistiksel dağılım parametrelerini etkilemiştir.

Anahtar kelimeler: Seçici lazer ergitme, AlSi10Mg, sıcak izostatik presleme, makaralı parlatma, yüzey profili

ATIKSU KAYNAKLI CO_2'DEN SÜRDÜRÜLEBİLİR METANOL ÜRETİMİNİN GENETİK ALGORİTMA TABANLI OPTİMİZASYONU

GENETIC-ALGORITHM-BASED OPTIMIZATION OF SUSTAINABLE METHANOL PRODUCTION FROM WASTEWATER-DERIVED CO_2

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Abstract

This study investigates a sustainable power-to-methanol configuration in which carbon dioxide recovered from a wastewater-treatment-related biogenic stream is combined with renewable hydrogen and converted to methanol in a membrane-reactor-based synthesis section. A self-contained MATLAB screening model was developed to couple CO_2 capture, compression, electrolytic H_2 production, methanol synthesis, product separation, heat recovery, energy and exergy balances, and annualized production cost. The investigated system considers a 100 kg h^{-1} CO_2 source, 92% capture efficiency, a 52.5 kWh kg^{-1} H_2 electrolyzer electricity demand, 50 bar reactor pressure, 5% purge, and 70% heat-recovery effectiveness. The effects of reactor temperature and H_2/CO_2 molar ratio were first evaluated parametrically, after which a real-coded genetic algorithm (GA) was applied to minimize methanol production cost within 473.15–573.15 K and H_2/CO_2=2.0–4.0 while pressure and membrane permeance were fixed at their base values. At 523.15 K, 50 bar, H_2/CO_2=3.0 and a membrane permeance of 1.0×10^{-5} mol m^{-2} s^{-1} Pa^{-1}, the model predicted 16.61 kg h^{-1} methanol production, 39.00% energy efficiency, 44.50% exergy efficiency and a production cost of 1.014 USD kg^{-1}. The GA converged to 522.84 K and H_2/CO_2=2.88, yielding 16.34 kg h^{-1} methanol, 39.05% energy efficiency, 44.56% exergy efficiency and a minimum cost of 1.0136 USD kg^{-1}. Increasing H_2/CO_2 improved methanol production, but thermodynamic performance declined beyond approximately 2.8 because the additional hydrogen demand increased electrolyzer power, compression and heating requirements. The results indicate that the base case is already close to the economic optimum and that an H_2/CO_2 range of approximately 2.8–3.0 provides a balanced thermodynamic-economic operating region rather than simply maximizing methanol output.

Keywords: CO_2 utilization, green methanol, membrane reactor, genetic algorithm, thermoeconomics

Özet

Bu çalışma, atıksu arıtımıyla ilişkili biyojenik bir akıştan geri kazanılan karbondioksitin yenilenebilir hidrojenle birleştirilerek membran reaktör tabanlı bir sentez bölümünde metanole dönüştürüldüğü sürdürülebilir bir power-to-methanol konfigürasyonunu incelemektedir. CO_2 yakalama, sıkıştırma, elektrolitik H_2 üretimi, metanol sentezi, ürün ayırma, ısı geri kazanımı, enerji ve ekserji dengeleri ile yıllıklandırılmış üretim maliyetini bütünleşik olarak değerlendirmek amacıyla bağımsız bir MATLAB tarama modeli geliştirilmiştir. İncelenen sistemde 100 kg h^{-1} CO_2 kaynağı, %92 yakalama verimi, 52,5 kWh kg^{-1} H_2 elektrolizör elektrik tüketimi, 50 bar reaktör basıncı, %5 purge oranı ve %70 ısı geri kazanım etkinliği dikkate alınmıştır. Reaktör sıcaklığı ve H_2/CO_2 molar oranının etkileri öncelikle parametrik olarak değerlendirilmiş, ardından basınç ve membran permeansı temel değerlerinde sabit tutulurken 473,15–573,15 K ve H_2/CO_2=2,0–4,0 aralıklarında metanol üretim maliyetini en aza indirmek amacıyla gerçek kodlu bir genetik algoritma (GA) uygulanmıştır. 523,15 K, 50 bar, H_2/CO_2=3,0 ve $1,0\times10^{-5}$ mol m^{-2} s^{-1} Pa^{-1} membran permeansı temel koşullarında model; 16,61 kg h^{-1} metanol üretimi, %39,00 enerji verimi, %44,50 ekserji verimi ve 1,014 USD kg^{-1} üretim maliyeti öngörmüştür. GA, 522,84 K ve H_2/CO_2=2,88 koşullarına yakınsamış ve bu noktada 16,34 kg h^{-1} metanol üretimi, %39,05 enerji verimi, %44,56 ekserji verimi ve 1,0136 USD kg^{-1} minimum maliyet elde edilmiştir. Parametrik sıcaklık taraması, yaklaşık 523 K civarında belirgin bir optimum bulunduğunu göstermiştir. H_2/CO_2 oranındaki artış metanol üretimini yükseltirken, yaklaşık 2,8 değerinin üzerinde ilave hidrojen gereksiniminin elektrolizör gücü, sıkıştırma ve ısıtma ihtiyacını artırması nedeniyle termodinamik

performans azalmıştır. Sonuçlar, temel durumun ekonomik optimuma zaten oldukça yakın olduğunu ve yaklaşık H_2/CO_2=2,8–3,0 aralığının yalnızca metanol üretimini maksimize etmek yerine dengeli bir termodinamik-ekonomik çalışma bölgesi sunduğunu göstermektedir.

Anahtar kelimeler: CO_2 kullanımı, yeşil metanol, membran reaktör, genetik algoritma, termoekonomi

METAN, METANOL VE ETANOLÜN BUHAR REFORMASYONUNDAN HİDROJEN ÜRETİMİNİN YSA DESTEKLİ PARAMETRİK OPTİMİZASYONU

ANN ASSISTED PARAMETRIC OPTIMIZATION OF HYDROGEN PRODUCTION FROM STEAM REFORMING OF METHANE, METHANOL AND ETHANOL

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Abstract

A mechanistic artificial neural network (ANN) framework was developed to compare hydrogen production from the steam reforming of methane, methanol, and ethanol and to identify favorable operating conditions. A one-dimensional, steady-state, isothermal packed-bed reactor model was solved in MATLAB. Methane reforming was described by the intrinsic Xu-Froment reaction network, including steam methane reforming, water-gas shift, and overall reforming reactions, whereas compact apparent kinetic expressions were used for the methanol and ethanol branches. Nine hundred operating points were generated by varying temperature, pressure, steam-to-carbon ratio, and catalyst-weight-to-fuel-flow ratio within fuel-specific ranges. The common feed-forward ANN used seven inputs, including three fuel one-hot variables, two hidden layers with 18 and 10 tanh neurons, and five linear outputs: hydrogen yield, fuel conversion, energy efficiency, carbon dioxide intensity, and hydrogen production rate. Standardized data were divided into 70% training, 15% validation, and 15% test subsets, and network parameters were learned using mini-batch Adam with a 0.001 learning rate and validation-based early stopping. Test R^2 values ranged from 0.99736 to 0.99900 across the five outputs. The trained ANN screened 50,000 candidate points per fuel using a normalized weighted performance score, after which each selected optimum was recalculated with the mechanistic model. The verified hydrogen yields were 0.726, 0.750, and 0.610 for methane, methanol, and ethanol, respectively. Methanol achieved the highest energy efficiency (80.6%), methane the lowest CO_2 intensity (3.42 kg CO_2/kg H_2), and ethanol the greatest absolute H_2 production (3.66 kmol/h). Range-scaled local sensitivities for temperature, pressure, and steam-to-carbon ratio were 57.1%, 39.6%, and 3.3% for methane; 74.4%, 20.6%, and 4.9% for methanol; and 14.4%, 48.0%, and 37.6% for ethanol. Thus, temperature dominated methane and methanol performance, while pressure and steam-to-carbon ratio governed ethanol more strongly. The ANN serves as a rapid optimization and sensitivity layer, with the mechanistic model retained for final verification.

Keywords: artificial neural network, steam reforming, hydrogen production, Xu-Froment kinetics, parametric optimization

Özet

Metan, metanol ve etanolün buhar reformasyonundan hidrojen üretimini karşılaştırmak ve uygun işletme koşullarını belirlemek amacıyla mekanistik model destekli bir yapay sinir ağı (YSA) çerçevesi geliştirilmiştir. Tek boyutlu, sürekli rejimli ve izotermal dolgulu yatak reaktör modeli MATLAB ortamında çözülmüştür. Metan reformasyonu; buharlı metan reformasyonu, su-gazı değişim ve toplam reformasyon reaksiyonlarını içeren Xu-Froment içsel kinetik ağıyla tanımlanırken, metanol ve etanol kollarında kompakt görünür kinetik ifadeler kullanılmıştır. Yakıta özgü aralıklarda sıcaklık, basınç, buhar/karbon oranı ve katalizör kütlesi/yakıt debisi oranı değiştirilerek toplam 900 geçerli işletme noktası oluşturulmuştur. Ortak ileri beslemeli YSA; yakıtı gösteren üç one-hot değişken dâhil yedi giriş, sırasıyla 18 ve 10 tanh nöronlu iki gizli katman ve hidrojen verimi, yakıt dönüşümü, enerji verimi, karbondioksit yoğunluğu ile hidrojen üretim hızını temsil eden beş doğrusal çıkıştan oluşmaktadır. Standartlaştırılmış veriler %70 eğitim, %15 doğrulama ve %15 test alt kümelerine ayrılmış; ağ parametreleri 0,001 öğrenme oranlı mini-batch Adam algoritması ve doğrulama tabanlı erken durdurma

kullanılarak öğrenilmiştir. Beş çıkış için test R^2 değerleri 0,99736-0,99900 aralığındadır. Eğitilen YSA, normalize edilmiş ağırlıklı performans puanıyla her yakıt için 50.000 aday noktayı taramış ve seçilen her optimum ilgili mekanistik modelle yeniden hesaplanmıştır. Fiziksel modelle doğrulanan hidrojen verimleri metan, metanol ve etanol için sırasıyla 0,726, 0,750 ve 0,610'dur. Metanol en yüksek modellenen enerji verimine (%80,6), metan en düşük modellenen CO_2 yoğunluğuna (3,42 kg CO_2/kg H_2), etanol ise en yüksek mutlak H_2 üretimine (3,66 kmol/sa) ulaşmıştır. Sıcaklık, basınç ve buhar/karbon oranı için aralıkla ölçeklendirilmiş yerel duyarlılıklar metanda sırasıyla %57,1, %39,6 ve %3,3; metanolde %74,4, %20,6 ve %4,9; etanolde %14,4, %48,0 ve %37,6'dır. Buna göre sıcaklık metan ve metanol performansında baskınken, etanolde basınç ve buhar/karbon oranı daha etkilidir. YSA hızlı bir optimizasyon ve duyarlılık katmanı olarak kullanılmış, nihai doğrulama mekanistik modelle yapılmıştır.

Anahtar kelimeler: yapay sinir ağı, buhar reformasyonu, hidrojen üretimi, Xu-Froment kinetiği, parametrik optimizasyon

BUILD ORIENTATION EFFECTS ON PROCESS-INDUCED STRESS AND DISTORTION IN MANDIBULAR RECONSTRUCTION PLATES

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ABSTRACT

Mandibular reconstruction plates produced by laser powder bed fusion (LPBF) must retain their anatomical conformity after manufacturing, cooling, separation from the build platform, and support removal. This study presents a comparative thermo-mechanical finite element investigation of build-orientation effects on a Ti-6Al-4V mandibular reconstruction plate. Four representative configurations—horizontal, vertical, standard, and diagonal—were analysed in Ansys Mechanical using the AM PBF Thermal-Structural workflow. Temperature-dependent material properties, cylindrical supports, layer-wise activation, cooling, base-plate separation, and support removal were included. The horizontal configuration showed the shortest predicted build time and the lowest maximum temperature at the final thermal evaluation step. Relative to the horizontal model, build time increased by approximately 31% for the diagonal, 54% for the standard, and 176% for the vertical configuration. Final deformation was lowest for the vertical orientation (0.79 mm), followed by the diagonal (1.14 mm), standard (1.35 mm), and horizontal (1.38 mm) configurations. Support volume was also lowest for the vertical model (849.7 mm^3) and highest for the horizontal model (2938.5 mm^3). The standard orientation produced the highest transient maximum equivalent stress, approximately 1.36 GPa, whereas the vertical configuration showed the lowest peak, approximately 1.25 GPa. No single orientation was optimal for all evaluated criteria. The horizontal and vertical configurations represented opposing advantages in thermal/manufacturing efficiency and geometrical stability, while the diagonal configuration exhibited intermediate behaviour across the main performance metrics. Because the model was not experimentally calibrated or validated, the reported values should be interpreted as comparative numerical predictions rather than machine-specific absolute outcomes. The findings highlight the need to consider thermal history, support demand, process-induced stress, and post-removal distortion together when selecting LPBF build orientation for anatomically shaped mandibular reconstruction plates.

Keywords: Additive manufacturing; build orientation; finite element analysis; mandibular reconstruction plate; process-induced stress; Ti-6Al-4V

VİNİLESTER DOLGULU LAZER TOZ YATAĞI ERGİTME INCONEL 718 SHEET GYROID YAPILARIN ENERJİ ABSORPSİYONU DAVRANIŞI

ENERGY ABSORPTION BEHAVIOR OF VINYL ESTER-FILLED LASER POWDER BED FUSION INCONEL 718 SHEET GYROID STRUCTURES

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Abstract

The primary objective of this study is to experimentally investigate the effects of infiltrating Inconel 718 Sheet Gyroid cellular structures, manufactured via laser powder bed fusion (L-PBF) additive manufacturing, with a vinyl ester-based thermoset polymer matrix on their quasi-static compressive behavior and energy absorption performance. Accordingly, Sheet Gyroid geometries with a unit cell size of 4.2 mm and nominal overall dimensions of 12.6 × 12.6 × 12.6 mm were designed at two target relative densities: 18% and 36%. Standard solution annealing and two-stage aging heat treatments were applied to the as-built L-PBF specimens to ensure microstructural and mechanical stability. Following surface cleaning and chemical preparation, vacuum-assisted vinyl ester polymer infiltration was carried out within the metallic porous skeletons. Both unfilled and polymer-filled hybrid specimens were prepared for each relative density group, alongside fully dense Inconel 718 control specimens as a baseline. Quasi-static compression tests were performed at room temperature at a constant crosshead speed of 1 mm/min. Mechanical performance was comprehensively evaluated using peak force, total energy absorption (EA) calculated from the area under the force–displacement curves, and specific energy absorption (SEA) normalized by specimen mass. The results revealed that the mechanical contribution of the vinyl ester filling is strongly dependent on the relative density of the metallic skeleton. At 60% engineering strain, the highest EA and SEA values were achieved in the 36% relative density vinyl ester-filled specimen (36VE) at 431.71 J and 59.79 J/g, respectively. This superior performance stems from the synergistic interplay between the intrinsic stiffness of the metallic Gyroid walls and the hydrostatic constraint provided by the polymer phase against lateral deformation. In conclusion, vinyl ester-reinforced Inconel 718 hybrid Sheet Gyroid structures present a lightweight, high-performance solution for crashworthiness and energy absorption applications in the aerospace and defense sectors.

Keywords: Inconel 718, LP-BF, Sheet Gyroid, TPMS, vinyl ester, energy absorption

Özet

Bu çalışmanın temel amacı, eklemeli imalat teknolojilerinden lazer toz yatağında ergitme (LP-BF) yöntemiyle üretilen Inconel 718 Sheet Gyroid hücresel yapıların vinilester esaslı termoset polimer matris ile infiltre edilmesinin, yarı-statik basma davranışı ve enerji absorpsiyon performansı üzerindeki etkilerini deneysel olarak araştırmaktır. Bu doğrultuda, 4,2 mm birim hücre boyutuna ve 12,6 × 12,6 × 12,6 mm nominal dış boyutlara sahip Sheet Gyroid geometrileri, %18 ve %36 olmak üzere iki farklı hedef bağıl yoğunlukta tasarlanmıştır. L-PBF prosesi ile imal edilen numunelerin mikroyapısal ve mekanik kararlılığını sağlamak adına standart çözeltiye alma ve çift kademeli yaşlandırma ısıl işlemleri uygulanmıştır. Yüzey temizliği ve kimyasal hazırlık süreçlerinin ardından metalik gözenekli iskelet

içerisine vakum destekli vinilester polimer infiltrasyonu gerçekleştirilmiştir. Her bağıl yoğunluk grubu için boş ve polimer dolgulu hibrit numuneler hazırlanmış, ayrıca referans amacıyla tam dolu Inconel 718 kontrol numunesi kullanılmıştır. Basma testleri oda sıcaklığında 1 mm/dak sabit çene hızında gerçekleştirilmiştir. Mekanik performans; tepe kuvveti, kuvvet–yer değiştirme eğrileri altındaki integrasyonla bulunan toplam enerji absorpsiyonu (EA) ve kütleye normalize edilen özgül enerji absorpsiyonu (SEA) parametreleri üzerinden kapsamlı biçimde değerlendirilmiştir. Elde edilen bulgular, vinilester dolgusunun sağladığı mekanik katkının metalik iskeletin bağıl yoğunluğuyla doğrudan ilişkili olduğunu göstermiştir. %60 mühendislik şekil değiştirmesi seviyesinde en yüksek EA ve SEA değerleri, sırasıyla 431,71 J ve 59,79 J/g ile %36 bağıl yoğunluklu vinilester dolgulu numunede (36VE) elde edilmiştir. Bu üstün performans, metalik Gyroid çeperlerin rijitliği ile polimer fazın basma altındaki yanal deformasyonu kısıtlayıcı hidrostatik destek mekanizmasının sinerjisinden kaynaklanmaktadır. Sonuç olarak, vinilester takviyeli Inconel 718 hibrit Sheet Gyroid yapıların, yüksek mukavemet ve üstün darbe sönümleme gerektiren havacılık ve savunma sanayii uygulamalarında hafif ve güvenilir bir mühendislik çözümü sunduğu belirlenmiştir.

Anahtar kelimeler: Inconel 718, LP-BF, Sheet Gyroid, TPMS, vinilester, enerji absorpsiyonu

A FATIGUE-AWARE GENETIC ALGORITHM FOR MULTI-SCENARIO EMERGENCY MILK DISTRIBUTION ROUTING: A CASE STUDY OF THE HOOGHLY DISTRICT

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Abstract

Timely distribution of perishable emergency supplies such as milk to peri-urban and rural health and relief centres is a routing problem in which driver fatigue, delivery urgency, and vehicle capacity interact in ways that classical distance-only formulations fail to capture. Existing routing approaches typically treat distance, urgency, and operational constraints as loosely coupled terms, overlooking the compounding effect of fatigue on route quality. This paper proposes a fatigue-aware genetic algorithm (GA) for a single-vehicle emergency milk distribution problem over a realistic 20-node instance built from real settlements of the Hooghly district, West Bengal, India, using geographic (haversine) inter-node distances. The model couples an exponentially decaying fatigue accumulator with urgency-weighted lateness and waiting penalties inside a single scalar objective, capturing the interaction between driver condition, delivery timeliness, and vehicle capacity. The problem is solved with an elitist GA combining ordered crossover with a fatigue-biased adaptive mutation operator, whose mutation probability rises with route fatigue, favouring exploration away from fatiguing tours. Four scenarios, namely normal, high-fatigue, strict-emergency, and long-horizon, are evaluated to reflect distinct regimes a relief coordinator may face. The GA is statistically validated against a random-search baseline of identical evaluation budget over twelve runs with paired seeds. The GA achieves a 24.2% lower mean objective value than random search, confirmed statistically significant by a Wilcoxon signed-rank test ($p < 0.001$) with a large effect size. Route distances across scenarios range from 223.47 km to 272.17 km, reflecting trade-offs from each scenario's penalty structure. All source code, input data, and figures used to generate the results are released for full reproducibility.

Keywords: Genetic algorithm · vehicle routing problem · driver fatigue · emergency logistics · metaheuristics · Hooghly district.

EFFECT OF WELDING SPEED ON BENDING BEHAVIOR AND HARDNESS DISTRIBUTION OF GMAW-WELDED S235JR STEEL JOINTS

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Abstract

Welded joints are extensively utilized in the fabrication of metallic structures, and welding process parameters can significantly influence the mechanical properties of these joints. Among these parameters, welding speed is particularly important because it alters the heat input per unit length, thereby affecting the properties of both the weld metal and the heat-affected zone. This study examines the impact of varying welding speeds on the bending behavior and hardness distribution of S235JR structural steel during gas metal arc welding, aiming to identify optimal welding conditions for mechanical performance. An automation-supported linear motion welding platform was employed to ensure controlled and repeatable welding processes. S235JR specimens were joined using ER70S-6 filler wire, with welding current and arc voltage maintained constant across three different welding speeds. Three specimens were prepared for each welding condition. The mechanical behavior of the welded specimens was evaluated using three-point bending tests, while Rockwell B hardness measurements were conducted on the weld metal, heat-affected zone, and base metal. The results indicate that the average bending performance at the lowest welding speed was 10.15% and 12.08% higher than at medium and high welding speeds, respectively. Additionally, the hardness of the heat-affected zone was 19.08% higher at the lowest welding speed compared to the medium welding speed, and 25.77% higher than at the high welding speed. In contrast, weld-metal hardness did not exhibit significant variation with welding speed. These findings demonstrate that welding speed has a substantial effect on the bending performance and heat-affected zone properties of S235JR welded joints under automated welding conditions.

Keywords: S235JR steel, GMAW, Welding speed, Three-point bending

Özet

Kaynaklı birleştirmeler, metalik yapıların imalatında yaygın olarak kullanılmakta olup, kaynak işlem parametreleri bu birleştirmelerin mekanik özelliklerini önemli ölçüde etkileyebilmektedir. Bu parametreler arasında kaynak hızı özellikle önemlidir; çünkü birim uzunluk başına ısı girdisini değiştirerek hem kaynak metalinin hem de ısıdan etkilenmiş bölgenin özelliklerini etkilemektedir. Bu çalışma, S235JR yapı çeliğinin gazaltı ark kaynağı ile birleştirilmesinde farklı kaynak hızlarının eğme davranışı ve sertlik dağılımı üzerindeki etkisini incelemekte ve mekanik performans açısından uygun kaynak koşullarının belirlenmesini amaçlamaktadır. Kaynak işlemlerinin kontrollü ve tekrarlanabilir şekilde gerçekleştirilebilmesi amacıyla otomasyon destekli doğrusal hareket sağlayan bir kaynak platformu kullanılmıştır. S235JR numuneler ER70S-6 ilave tel kullanılarak birleştirilmiş; kaynak akımı ve ark gerilimi sabit tutulurken üç farklı kaynak hızı uygulanmıştır. Her bir kaynak koşulu için üç numune hazırlanmıştır. Kaynaklı numunelerin mekanik davranışı üç nokta eğme testleri ile değerlendirilirken, kaynak metali, ısıdan etkilenmiş bölge ve ana metalde Rockwell B sertlik ölçümleri gerçekleştirilmiştir. Sonuçlar, en düşük kaynak hızındaki ortalama eğme performansının orta ve yüksek kaynak hızlarına kıyasla sırasıyla %10,15 ve %12,08 daha yüksek olduğunu göstermiştir. Ayrıca, en düşük kaynak hızında ısıdan etkilenmiş bölgenin sertliği, orta kaynak hızına göre %19,08 ve yüksek kaynak hızına göre %25,77 daha yüksek bulunmuştur. Buna karşılık, kaynak metali sertliğinde kaynak

hızına bağlı anlamlı bir değişim gözlenmemiştir. Bu bulgular, otomasyon destekli kaynak koşullarında kaynak hızının S235JR kaynaklı birleştirmelerin eğme performansı ve ısıdan etkilenmiş bölge özellikleri üzerinde önemli bir etkiye sahip olduğunu göstermektedir.

Anahtar kelimeler: S235JR çeliği, GMAW, Kaynak hızı, Üç nokta eğme

EDGEPDM: EDGE CİHAZLARINDA PREDICTIVE MAINTANANCE İÇİN KAYNAK ODAKLI MAKİNE ÖĞRENİMİ

EDGE PDM: RESOURCE-DRIVEN MACHINE LEARNING FOR PREDICTIVE MAINTENANCE ON EDGE DEVICES

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Abstract

Predictive Maintenance, a popular application in recent times, aims to optimize production by predicting potential equipment failures in industrial production lines using machine learning (ML)-based models. While many ML-based approaches achieve high prediction performance, they present practical challenges such as edge device deployment, latency, energy consumption, memory usage, and computational capacity. Since edge devices are frequently used in Predictive Maintenance applications, it is important to consider these challenges when designing applications. A review of the literature reveals that there are very few studies comparing different ML models in predictive maintenance not only in terms of prediction accuracy but also in terms of resource consumption. This article introduces EdgePdM, an experimental framework for evaluating resource-oriented ML models for edge-based predictive maintenance. Experiments were conducted using the AI4I 2020 predictive maintenance dataset, a public dataset, on Decision Tree, Random Forest, LightGBM, and XGBoost classifiers. Furthermore, the models were deployed on a Raspberry Pi platform to simulate a real edge environment and profiled in terms of inference latency and energy per inference. The impact of model complexity on practical applicability was specifically addressed, particularly in edge platforms with limited computational and energy resources. This identified key trade-offs between high-performance models with high deployment costs and lighter alternatives. Furthermore, a composite Edge Efficiency Score was introduced to measure the balance between prediction performance and deployment cost. The proposed methodology aims to identify models that provide high fault detection capability while meeting the operational constraints of industrial Edge AI systems. The goal is for the findings and the proposed framework to guide the selection of optimized ML models for real-time and energy-sensitive predictive maintenance applications.

Keywords: Predictive Maintenance, Edge AI, Machine Learning, Raspberry Pi, Energy Efficiency, Inference Latency, Resource-Aware Computing, AI4I 2020.

Özet

Son zamanların populer uygulamalarından Predictive Maintanance, makine öğrenmesi (ML) tabanlı modelleri kullanarak endüstriyel üretim hattalarında potansiyel ekipman arızalarını önceden tahmin ederek üretim optimizasyonu sağlamayı hedefler. Birçok ML tabanlı yaklaşım yüksek tahmin performansı elde etmesine rağmen pratikte edge cihazları dağıtım, gecikme, enerji tüketimi, bellek kullanımı ve hesaplama kapasitesi gibi challengeları beraberinde getirir. Edge cihazları, Predictive Maintanance uygulamarında sıklıkla kullanıldıgı için uygulamaların tasarlanırken bu challengelarında dikkate alınması önemlidir. Literatür incelendiğinde predictive maintanance çalışmalarında farklı ML modellerinin tahmin doğruluğu karşılaştırması dışında kaynak tüketimi açısından da karşılaştıran çok az çalışma vardır. Bu makale, edge tabanlı tahmine dayalı bakım için kaynak odaklı ML modellerini değerlendirmek üzere deneysel bir çerçeve olan EdgePdM tanıtır. Public bir dataset olan AI4I 2020

tahmine dayalı bakım veri kümesi kullanılarak Karar Ağacı, Rastgele Orman, LightGBM ve XGBoost sınıflandırıcıları üzerinde deneyler gerçekleştirildi. Ayrıca modeller gerçek bir edge ortamını modelleyebilmek için Raspberry Pi platformuna dağıtılarak çıkarım gecikmesi ve çıkarım başına enerji açısından profillendirildi. Özellikle sınırlı hesaplama ve enerji kaynaklarına sahip edge platformlarında model karmaşıklığının pratik uygulanabilirlik üzerindeki etkisi ele alındı. Böylece, yüksek dağıtım maliyetli yüksek başarım oranına sahip modeller ile daha hafif alternatifler arasındaki temel ödünleşimler tespit edilir. Ayrıca, tahmin performansı ve dağıtım maliyeti arası dengeyi ölçmek için bileşik bir Uç Verimlilik Puanı tanıtılıldı. Önerilen metodoloji endüstriyel Uç Yapay Zeka sistemlerinin operasyonel kısıtlamalarını karşılarken yüksek arıza tespit yeteneği sağlayan modelleri belirlemeyi amaçlar. Elde edilen bulgular ile önerilen çerçevenin gerçek zamanlı ve enerji duyarlı predictive maintenance uygulamaları için optimize ML modellerinin seçimine yönelik yol gösterici olması hedeflenir.

Anahtar kelimeler: Tahmine Dayalı Bakım, Uç Yapay Zeka, Makine Öğrenimi, Raspberry Pi, Enerji Verimliliği, Çıkarım Gecikmesi, Kaynak Bilinçli Hesaplama, AI4I 2020.

METROXAI-PDM: EXPLAINABLE EDGE AI FOR PREDICTIVE MAINTENANCE: A RESOURCE-AWARE STUDY USING METROPT-3

METROXAI-PDM: EXPLAINABLE EDGE AI FOR PREDICTIVE MAINTENANCE: A RESOURCE-AWARE STUDY USING METROPT-3

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Abstract

One topic that has attracted attention in academia and the private sector in recent years is predictive maintenance (PdM), which involves applications based on the detection of potential equipment failures. PdM applications generally operate by training artificial intelligence (AI) models using data collected from production lines via sensors. These models are not yet fully effective for low-processing-power Internet of Things (IoT) and edge devices used in Industry 4.0 environments, as they typically require high processing power and storage capacity (due to the high volume of data processed). This is because IoT and edge devices often present challenges such as resource constraints and insufficient storage capacity. Considering these challenges, this paper proposes MetroXAI-PdM, an explainable Edge AI framework for PdM using a public dataset, MetroPT-3. MetroXAI-PdM uses operational sensor measurements collected from a metro air production unit to train light machine learning (ML) models and perform failure and anomaly prediction. In evaluating performance results, in addition to traditional prediction performance metrics, SHAP-based explainability was used to identify the sensor variables that make the strongest contribution to model decisions and to provide both global and local interpretations of predicted anomalies. The reason for using SHAP-based explainability is that it successfully demonstrates quantitatively how much and in what direction each feature contributes to a prediction. Furthermore, the impact of explainability (generating SHAP explanations) on computational cost was examined to observe its practicality for edge environments. In this way, the balance between prediction performance, interpretability, inference delay, and energy efficiency is investigated. The findings show that MetroXAI-PdM offers an integrated PdM approach that not only provides high prediction performance but also explains model decisions and can be evaluated for applicability in resource-constrained edge environments.

Keywords: Explainable AI, Edge AI, predictive maintenance, MetroPT-3, SHAP, machine learning, anomaly detection, endpoint computing.

Özet

Son yıllarda akademi ve özel sektörde dikkaleri üzerine çeken konulardan biriside potansiyel ekipman arızalarının tespitine dayalı uygulamaları içeren predictive maintanancedır (PdM). PdM uygulamaları genellikle, üretim bandlarından sensörler vasıtasıyla toplanan verilerin, yapay zeka (AI) modellerini eğitmesine dayalı olarak çalışır. Bu modeller, genellikle yüksek işlem gücü ve depolama kapasitesi (yüksek veri işlendiği için) gerektirdiği için Industry 4.0 ortamlarında kullanılan düşük işlem güçlü Internet of Things (IoT) ve edge devicelar için henüz tam olarak efektif değildir. Çünkü, IoT ve edge cihazlar genellikle kaynak kısıtlılığı ve depomama kapasitesi gibi challengeları içerir. Bu paper, bu challengelarıda göz önüne alarak public bir veriseti MetroPT-3 kullanarak PdM için açıklanabilir bir Uç Yapay Zeka çerçevesi olan MetroXAI-PdM'yi önerir. MetroXAI-PdM, metro hava üretim ünitesinden toplanan operasyonel sensör ölçümlerini hafif makine öğrenimi (ML) modellerini eğitmek için kullanır ve arıza ve anomali tahmini gerçekleştirir. Performans sonucları değerlendirilirken geleneksel tahmin

performans ölçümlerine ek olarak model kararları için en güçlü katkıyı veren sensör değişkenlerini belirlemek ve tahmin edilen anomalilerin hem küresel hem de yerel yorumlarını sağlamak için SHAP tabanlı açıklanabilirlik kullanıldı. SHAP tabanlı açıklanabilirlik kullanılmasının sebebi bir tahminine hangi özelliğin ne kadar ve hangi yönde katkı yaptığını nicel olarak başarılı bir şekilde göstermesidir. Ayrıca açıklanabilirliğin (SHAP açıklamalarını üretmek) hesaplama maliyeti üzerindeki etkisi incelenerek edge ortamlar için ne kadar pratik oldugu gözlemlendi. Bu şekilde, tahmin performansı, yorumlanabilirlik, çıkarım gecikmesi ve enerji verimliliği arası denge incelenir. Elde edilen bulgular, MetroXAI-PdM'nin yalnızca yüksek tahmin performansı sağlayan değil, aynı zamanda model kararlarını açıklayabilen ve kaynak kısıtlı edge ortamlarında uygulanabilirliği değerlendirilebilen bütünleşik bir PdM yaklaşımı sunduğunu göstermektedir.

Anahtar kelimeler: Açıklanabilir Yapay Zeka, Uç Nokta Yapay Zekası, tahmine dayalı bakım, MetroPT-3, SHAP, makine öğrenimi, anomali tespiti, uç nokta bilişimi.

ELEKTRİK İLETİM HATLARINDA UYGULANAN BUZ YÜKÜ TEMİZLEME YÖNTEMLERİNİN TEKNİK VE EKONOMİK AÇIDAN İNCELENMESİ

TECHNICAL AND ECONOMIC ANALYSIS OF DE-ICING METHODS FOR ELECTRIC POWER TRANSMISSION LINES

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Abstract

Ice load accumulation caused by adverse weather conditions on power transmission lines leads to severe ice formations on conductors, including rime, ice, and snow, with densities ranging from 0.05 to 0.917 g/cm³. Ice loads accumulated on conductors cause mechanical overloads, large-scale power outages, and severe grid failures in transmission lines. The first ice-load-induced collapse worldwide was recorded in the United States in 1932; in subsequent years, severe damage occurred in Italy, Canada, Russia, Chinese and Turkey. While the severe icing disaster in South China in 2008 resulted in direct economic losses of 22 billion US dollars, the grid damage in Texas, USA, in 2021 left 4.5 million consumers without power. To eliminate these adverse effects that threaten grid reliability and transmission continuity, various de-icing approaches based on thermal, mechanical, and robotic actions have been developed in the literature. Although mechanical approaches such as impact, pulley, vibration, and robotics developed in the literature are effective locally over short spans, their field deployment remains limited due to operational safety risks, terrain difficulties, and energy supply constraints of autonomous vechiles . Although electro-thermal methods based on Joule heating in conductor resistance are effective on long transmission lines, alternating current (AC) requires more power compared to direct current (DC) due to high inductive reactance and reactive power losses. In nearly all DC de-icing applications—which stand out for their high thermal efficiency free from reactive losses—the transmission line must be decommissioned and short-circuited at the line terminals, thereby interrupting energy transfer to consumers and entailing certain economic drawbacks. This study aims to technically and economically compare the advantages and disadvantages of existing de-icing methods in the literature. Furthermore, this study aims to establish an applicable technical and academic infrastructure and highlight areas for future development to prevent ice-load-induced collapses in power transmission lines.

Keywords: Power transmission lines, Ice load, AC-DC Joule heating, Mechanical de-icing methods.

Özet

Enerji iletim hatlarında olumsuz hava koşulları sebebiyle meydana gelen buz yükü birikimi iletkenler üzerinde yoğunlukları 0,05 ila 0,917 g/cm³ arasında değişen kırağı, buz ve kar tabanlı ciddi buz yükü oluşumlarına neden olmaktadır. İletkenler üzerinde biriken buz yükleri iletim hatlarında mekanik aşırı yüklenmelere, geniş ölçekli enerji kesintilerine ve ciddi şebeke arızalarına yol açmaktadır. Dünya genelinde buz yükü kaynaklı ilk yıkım 1932'de ABD'de kaydedilmiş; Daha sonraki yıllarda, İtalya, Kanada, Rusya, Çin ve Japonya Türkiye de ciddi hasarlar meydana gelmiştir. 2008 yılında Güney Çin'de yaşanan yoğun buzlanma felaketi 22 milyar ABD doları doğrudan ekonomik kayba yol açarken, 2021'de ABD'nin Teksas eyaletinde meydana gelen şebeke hasarı 4,5 milyon tüketiciyi enerjisiz bırakmıştır. Şebeke güvenilirliğini ve iletim sürekliliğini tehdit eden bu olumsuz etkileri bertaraf etmek amacıyla literatürde termal, mekanik ve robotik etkiye dayalı olarak çeşitli buz temizleme yaklaşımları

geliştirilmiştir. Literatürde geliştirilen darbe, kasnak, titreşim ve robotik mekanik yaklaşımlar anlık olarak kısa mesafeli alanlarda etkili olsa da operasyonel güvenlik riskleri, arazi zorlukları ve otonom platformların enerji besleme kısıtları nedeniyle sahada sınırlı kalmaktadır. İletken direncinde oluşan Joule ısısına dayalı termal elektrik yöntemler uzun iletim hatlarında etkili olsa da alternatif akım (AC), yüksek endüktif reaktans ve reaktif güç kayıpları sebebiyle doğru akıma (DC) kıyasla daha fazla güç talep etmektedir. Reaktif kayıplardan arındırılmış yüksek termal verimliliğiyle öne çıkan DC buz eritme uygulamalarının hemen hemen tamamında ise iletim hattı devre dışı bırakılıp hat sonları kısa devre edilerek tüketicilere olan enerji transferi kesilmesi ve ekonomik olarak bazı sorunları barındırmaktadır. Bu çalışmada, buz yükünün temizlenmesi üzerine literatürde bulunan yöntemlerin avantaj ve dezavantajlarının teknik ve ekonomik açıdan karşılaştırılması amaçlanmıştır. Ayrıca bu çalışma, enerji iletim hatlarında buz yükü kaynaklı yıkımların önlenmesine yönelik uygulanabilir teknik ve akademik bir altyapı oluşturmayı ve gelişim alanlarını ortaya koymayı hedeflemiştir.

Anahtar kelimeler: Enerji iletim hatları, Buz yükü, AC-DC Joule ısıtma, Mekanik buz temizleme yöntemleri.

FARKLI ZAMANSAL ÇÖZÜNÜRLÜKLÜ UYDU SAAT ÜRÜNLERİNİN PPP PERFORMANSINA ETKİSİNİN İNCELENMESİ

ASSESSMENT OF THE IMPACT OF DIFFERENT TEMPORAL RESOLUTIONS OF SATELLITE CLOCK PRODUCTS ON PPP PERFORMANCE

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Abstract

In Precise Point Positioning (PPP), correcting satellite clock offsets using high-accuracy products is critical to solution reliability. Since satellite clock products are provided at different temporal resolutions, their effects on PPP positioning accuracy and convergence performance require investigation. This study examines the effects of satellite clock products with different sampling intervals on the positioning accuracy and convergence time of static PPP solutions. The analysis used 24-hour GNSS observations from five International GNSS Service (IGS) stations, YEL2, NICO, BREW, DJIG, and AREG, distributed across different geographical regions on day of year 365 of 2020, when ionospheric irregularities were relatively low. In all scenarios, the same precise orbit product was used with satellite clock information at three temporal resolutions. IGS final precise clock products with 30-s and 5-min sampling intervals were compared with satellite clock values provided at 15-min intervals in the IGS final precise ephemeris file. Satellite clock values at signal transmission time were obtained by first-order linear interpolation, and performance was evaluated using horizontal (2D) and three-dimensional (3D) RMS values and convergence times. Across the five stations, the 2D and 3D RMS values were 1.65 and 2.65 cm for the 30-s product, 2.36 and 3.57 cm for the 5-min product, and 2.47 and 4.33 cm for the 15-min values, respectively. Mean 2D convergence times were 5.3, 19.3, and 52.7 min, while mean 3D convergence times were 4.8, 28.6, and 71.6 min, respectively. Compared with the 15-min clock values, the 30-s product improved mean 2D and 3D RMS values by approximately 33% and 39% and reduced 2D and 3D convergence times by approximately 90% and 93%, respectively.

Keywords: Precise Point Positioning (PPP), Satellite clock products, Temporal resolution, Convergence time, Positioning accuracy

Özet

Hassas Nokta Konum Belirleme (Precise Point Positioning, PPP) tekniğinde uydu saat kayıklıklarının yüksek doğruluklu ürünlerle düzeltilmesi, PPP çözümünün güvenirliği açısından kritik öneme sahiptir. Uydu saat ürünlerinin farklı zamansal çözünürlüklerde (örn. 30 sn, 5 dk, 15 dk. vb.) sunulması, bu ürünlerin PPP doğruluğu ve yakınsama performansı üzerindeki etkisinin araştırılmasını önemli hâle getirmektedir. Bu çalışmada, farklı örnekleme aralıklarına sahip uydu saat ürünlerinin statik PPP çözümlerinin konum doğruluğu ve yakınsama süresi üzerindeki etkisi araştırılmıştır. Uygulamada, farklı coğrafi bölgelere dağılmış YEL2, NICO, BREW, DJIG ve AREG olmak üzere beş IGS (International GNSS Service) istasyonunun, iyonosferik düzensizliklerin görece düşük olduğu 2020 yılının 365. gününe ait 24 saatlik GNSS gözlem verileri kullanılmıştır. Tüm senaryolarda aynı hassas yörünge ürünü kullanılarak üç farklı çözünürlükteki saat bilgisiyle PPP çözümleri gerçekleştirilmiştir. Bu kapsamda, 30 saniye ve 5 dakika örnekleme aralıklı IGS sonuç (final) hassas saat ürünleri ile IGS sonuç hassas efemeris dosyasında 15 dakika aralıklarla verilen uydu saat değerleri karşılaştırılmıştır. Tüm çözümlerde

sinyal iletim zamanına karşılık gelen uydu saat değerleri birinci dereceden doğrusal enterpolasyonla belirlenmiş, çözüm performansı yatay (2D) ve üç boyutlu (3D) RMS ile yakınsama süreleri üzerinden değerlendirilmiştir. Beş istasyon birlikte değerlendirildiğinde, 30 saniyelik saat ürünü için 2D ve 3D RMS değerleri sırasıyla 1.65 cm ve 2.65 cm, 5 dakikalık ürün için 2.36 cm ve 3.57 cm, 15 dakikalık saat değerleri için ise 2.47 cm ve 4.33 cm olarak belirlenmiştir. Ortalama 2D yakınsama süresi sırasıyla 5.3, 19.3 ve 52.7 dakika; ortalama 3D yakınsama süresi ise 4.8, 28.6 ve 71.6 dakika olarak hesaplanmıştır. Sonuçlar, 30 saniye örnekleme aralıklı uydu saat ürününün, 15 dakikalık saat değerlerine kıyasla ortalama 2D ve 3D RMS değerlerinde sırasıyla yaklaşık %33 ve %39 iyileşme sağladığını; 2D ve 3D yakınsama sürelerini ise yaklaşık %90 ve %93 oranında azalttığını göstermektedir.

Anahtar kelimeler: Hassas Nokta Konum Belirleme (PPP), Uydu saat ürünleri, Zamansal çözünürlük, Yakınsama süresi, Konum doğruluğu

ARAZİ TOPLULAŞTIRMA PROJELERİNDE SONLU ELEMANLAR YÖNTEMİNİN UYGULANABİLİRLİĞİ ÜZERİNE BİR DEĞERLENDİRME

APPLICABILITY OF THE FINITE ELEMENT METHOD IN LAND CONSOLIDATION PROJECTS

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Abstract

Land consolidation is a multidimensional planning process aimed at improving the efficient and sustainable use of agricultural land through the rearrangement of fragmented parcels and the integrated planning of rural infrastructure. However, land consolidation projects involve several technical and engineering challenges, particularly in parcel reallocation, road and irrigation infrastructure planning, soil stability, drainage, erosion control, and the management of complex topographic conditions. This study evaluates the applicability of the Finite Element Method (FEM) as a numerical modelling approach for addressing such engineering problems in land consolidation projects. Within this framework, the potential integration of FEM into land consolidation processes was examined through scenario-based applications involving different topographic and soil conditions. Proposed scenarios include parcel and soil deformation analysis using linear elasticity, irrigation and rainfall flow modelling, soil moisture transfer, slope stability assessment based on the Mohr–Coulomb criterion, time-dependent settlement analysis of rural roads, and coupled simulations incorporating soil, water, and infrastructure interactions. The potential for automating data exchange between open-source GIS platforms such as QGIS and FEM software such as COMSOL or ANSYS using Python was also evaluated. The assessment indicates that FEM has considerable potential to support engineering-based decision-making, particularly in identifying areas susceptible to deformation, settlement, excessive moisture, erosion, and slope instability before the implementation of land consolidation plans. Furthermore, the integration of FEM outputs with GIS-based spatial data may contribute to the development of more comprehensive decision-support systems for parcel reallocation and rural infrastructure planning. Future studies should validate the proposed framework using real project data and different topographic conditions.

Keywords: Land Consolidation, Finite Element Method (FEM), Geographic Information Systems (GIS), Numerical Modelling, Soil Stability, Rural Infrastructure

Özet

Arazi toplulaştırması, parçalı tarım arazilerinin yeniden düzenlenmesi ve kırsal altyapının bütünleşik biçimde planlanması yoluyla tarım arazilerinin etkin ve sürdürülebilir kullanımını geliştirmeyi amaçlayan çok boyutlu bir planlama sürecidir. Bununla birlikte, arazi toplulaştırma projeleri; özellikle parsel dağıtımı, yol ve sulama altyapısının planlanması, zemin stabilitesi, drenaj, erozyon kontrolü ve karmaşık topoğrafik koşulların yönetimi açısından çeşitli teknik ve mühendislik güçlükleri içermektedir. Bu çalışmada, arazi toplulaştırma projelerinde karşılaşılan bu tür mühendislik problemlerinin çözümünde sayısal bir modelleme yaklaşımı olarak Sonlu Elemanlar Yönteminin (SEY) uygulanabilirliği değerlendirilmiştir. Bu kapsamda, SEY'in arazi toplulaştırma süreçlerine entegrasyonu, farklı topoğrafik ve zemin koşullarını içeren senaryo temelli uygulamalar üzerinden

incelenmiştir. Önerilen senaryolar; lineer elastisite kullanılarak parsel ve zemin deformasyon analizini, sulama ve yağış suyu akış modellemesini, toprak nem transferini, Mohr-Coulomb kriterine dayalı şev stabilitesi değerlendirmesini, tarla içi yolların zamana bağlı oturma analizini ve zemin, su ve altyapı etkileşimlerini birlikte ele alan bağlı simülasyonları kapsamaktadır. Ayrıca farklı eğim ve zemin özelliklerine sahip alanların modellenmesiyle, SEY'in değişken topoğrafik koşullardaki potansiyel kullanım alanları değerlendirilmiştir. Python dili kullanılarak QGIS gibi açık kaynaklı CBS platformları ile COMSOL ya da ANSYS gibi SEY yazılımları arasında veri alışverişinin otomatik hâle getirilebilmesi potansiyeli değerlendirilmiştir. Yapılan değerlendirme, SEY'in arazi toplulaştırma planlarının uygulanmasından önce deformasyon, oturma, aşırı nem, erozyon ve şev stabilitesi açısından riskli bölgelerin belirlenmesinde mühendislik temelli karar verme süreçlerini destekleyebilecek önemli bir potansiyele sahip olduğunu göstermektedir. Bunun yanında, SEY çıktılarının CBS tabanlı mekânsal verilerle bütünleştirilmesi, parsel dağıtımı ve kırsal altyapı planlamasına yönelik daha kapsamlı karar destek sistemlerinin geliştirilmesine katkı sağlayabilir. Bu yaklaşım sayesinde, farklı mühendislik kriterlerinin birlikte değerlendirilmesiyle arazi düzenleme sürecinde riskli ve iyileştirme gerektiren alanların önceden belirlenmesi mümkün olabilecektir.Gelecekte yapılacak çalışmalarda, önerilen yaklaşımın gerçek proje verileri ve farklı topoğrafik koşullar kullanılarak doğrulanması önerilmektedir.

Anahtar Kelimeler: Arazi Toplulaştırması, Sonlu Elemanlar Yöntemi (SEY), Coğrafi Bilgi Sistemleri (CBS), Sayısal Modelleme, Zemin Stabilitesi, Kırsal Altyapı

CAD DESTEKLİ 6B NESNE POZ KESTİRİMİ VE TAKİBİ LİTERATÜRÜNÜN BİBLİYOMETRİK VE BETİMSEL İÇERİK ANALİZİ

A BIBLIOMETRIC AND DESCRIPTIVE CONTENT ANALYSIS OF THE LITERATURE ON CAD-ASSISTED 6D OBJECT POSE ESTIMATION AND TRACKING

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ÖZET

Bu çalışmada, CAD/3B model destekli 6B nesne poz kestirimi, nesne takibi ve monoküler metrik mesafe alanındaki akademik yayınların gelişimi bibliyometrik göstergeler ve betimsel içerik kodlarıyla incelenmiştir. IEEE Xplore/IEEE-CVF, ScienceDirect/Elsevier, SpringerLink ve ilgili birincil yayın kaynaklarından derlenen 100 çalışma; yayın yılı, kaynak, yazar, kurum, ülke, atıf, girdi türü, CAD kullanımı, yöntem ailesi, veri kümesi, gerçek zamanlı çalışma, sentetik veri, örtülme, takip ve mesafe bileşenleri bakımından kodlanmıştır. Tarihsel geometrik temeli oluşturan RANSAC ve EPnP ayrı işaretlenmiş, 98 yayın ana analiz kümesinde değerlendirilmiştir. Bulgular, yayın sayısının 2017 sonrasında belirgin biçimde arttığını; 2019 ve 2021 yıllarında on üçer, 2022 ve 2023 yıllarında on ikişer yayınla yoğunlaştığını göstermiştir. Korpusta 67 çalışma RGB, 31 çalışma RGB-D/derinlik girdisi kullanırken, 66 çalışmada CAD/3B model kullanımı belirlenmiştir. Teknik içerik kodlarına göre 80 yayın 6B poz, 32 yayın gerçek zamanlı çalışma, 26 yayın takip ve 14 yayın metrik mesafe ile ilişkilidir. RGB, CAD/3B model ve 6B poz bileşenlerinin birlikte bulunduğu 37 yayın saptanmış; bunların beşinde nesne takibi de birlikte ele alınmıştır. Savunma veya gözetleme bağlamıyla ilişkilendirilen 15 yayının 13'ü monoküler RGB, 10'u takip ve dokuzu gerçek zamanlı çalışma etiketi taşımaktadır. İncelenen dönem boyunca alanın geometrik eşleştirme ve PnP tabanlı yöntemlerden derin öğrenme, sentetik veri üretimi, render-karşılaştırma, yeni nesneye genelleme ve temel model destekli yaklaşımlara doğru çeşitlendiği görülmüştür. Ülke ve kurum bilgisi bulunan 82 kayıtta ABD, Çin, Almanya ve Birleşik Krallık öne çıkmış; yazar ve kurum dağılımı belirli araştırma grupları çevresinde yoğunlaşmıştır. Atıf verileri de alanın temel veri kümeleri, takip yöntemleri ve öğrenme tabanlı poz kestirim çalışmalarının etkisini göstermektedir. Sonuçlar, CAD destekli 6B poz, takip ve mesafe çalışmalarının yöntemsel yapısını, teknik bileşenlerin görülme sıklığını ve başlıca uygulama alanlarını bütüncül biçimde sunmaktadır.

Anahtar kelimeler: 6B nesne pozu, CAD modeli, monoküler RGB, nesne takibi, metrik mesafe, örtülme, bibliyometrik analiz.

ABSTRACT

This study examines the development of academic publications on CAD/3D-model-assisted 6D object pose estimation, object tracking, and monocular metric distance through bibliometric indicators and descriptive content codes. A corpus of 100 publications collected mainly from IEEE Xplore/IEEE-CVF, ScienceDirect/Elsevier, SpringerLink, and primary publication sources was coded by publication year, source, authorship, affiliation, country, citations, input modality, CAD use, method family, dataset, real-

time operation, synthetic data, occlusion, tracking, and distance-related components. RANSAC and EPnP, which constitute the geometric foundation, were marked separately, while 98 publications formed the main analysis set. The findings show a clear increase in publication activity after 2017, with thirteen publications in both 2019 and 2021 and twelve in both 2022 and 2023. Within the corpus, 67 studies use RGB input, 31 use RGB-D/depth, and 66 employ a CAD/3D model. According to the content codes, 80 publications address 6D pose, 32 real-time operation, 26 tracking, and 14 metric distance. The combined use of RGB, CAD/3D models, and 6D pose occurs in 37 publications; five of these also address object tracking. Among the 15 publications associated with defense or surveillance contexts, 13 use monocular RGB, 10 include tracking, and nine are coded for real-time operation. Across the reviewed period, the field diversified from geometric matching and PnP-based methods toward deep learning, synthetic data generation, render-and-compare pipelines, novel-object generalization, and foundation-model-assisted approaches. Among the 82 records with country and affiliation metadata, the United States, China, Germany, and the United Kingdom are prominent, while authorship and institutional output cluster around several research groups. Citation data further reflect the influence of benchmark datasets, tracking methods, and learning-based pose estimation studies. The results provide an integrated overview of the methodological structure, technical component frequencies, and principal application areas of CAD-assisted 6D pose, tracking, and distance research.

Keywords: 6D object pose, CAD model, monocular RGB, object tracking, metric distance, occlusion, bibliometric analysis.

ADSORPTION OF FLUORIDE FROM AQUEOUS SOLUTION ONTO MAGNETITE-FUNCTIONALIZED CARBON NANOTUBES (Fe_3O_4@CNTs) USING THE RESPONSE SURFACE METHODOLOGY

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Abstract

In recent years, the quality of water supplies has been degrading due to presences of emerging contaminates from different sources, seeking the developments of innovative materials for treatments. Among the contaminates, fluoride pollution accounts serious attention in the globe. This study focused on the sol-gel based green syntheses of magnetic iron oxide modified carbon nanotubes (Fe_3O_4@CNTs) by using *lantana camara* leaf extract for effective removal of fluoride ion from water sample. Synthesized Fe_3O_4@CNTs were characterized by XRD for structural and phase change analysis, FTIR for the surface chemistry study, UV-Vis for the formation of nanotubes and SEM for surface morphology study. Fluoride removal efficiency was evaluated by using response surface method (RSM) to determine the optimum conditions (pH 6.5, amount of Fe_3O_4@CNTs 0.35g, and shaking time 101 min, and solution temperature 40°C). Based on the optimum conditions, fluoride adsorption from a standard fluoride solution on Fe_3O_4@CNTs was better than that from real water due to co-existing ions. The Freundlich model was found to be better fitted than the Langmuir model, with R^2 values of 0.9958 and 0.9849, respectively, and maximum adsorption capacity (q_{max}) of Fe_3O_4@CNTs was found to be 12.65 mg/g. The favorable fluoride adsorption on Fe_3O_4@CNTs was shown by the dimensionless constant separation factor RL (0.09), which ranges from 0 to 1. The pseudo-second-order (R^2 = 0.99905) and pseudo-first-order (R^2 = 0.9519) values indicate that the pseudo-second-order kinetics were primarily used in the adsorption process. The desorption study showed that NaOH better performance in Fe_3O_4@CNTs regeneration, reaching its removal capacity 62% up to 5 cycles for both standard fluoride solution and real ground water. These finding suggests that Fe_3O_4@CNTs promising adsorbent for removal of targeted pollutants from the water, and contributing for the environmental redamations.

Keywords: adsorption, Fe_3O_4@CNTs, sol-gel synthesis, defluoridation, *lantana camara*, extraction.

KUANTUM SONRASI KRİPTOGRAFİ (PQC): KUANTUM TEHDİTLERİNE KARŞI SAVUNMA STRATEJİLERİ VE ALGORİTMA ANALİZLERİ

POST-QUANTUM CRYPTOGRAPHY (PQC): DEFENSE STRATEGIES AGAINST QUANTUM THREATS AND ALGORITHM ANALYSES

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Abstract

Rapid advances in quantum computing directly threaten the security of public-key cryptosystems widely used today. In particular, Shor's algorithm can solve integer factorization and discrete logarithm problems in polynomial time, weakening the long-term security of schemes such as RSA, Diffie-Hellman, and Elliptic Curve Cryptography. Similarly, Grover's algorithm provides a quadratic speedup for brute-force search against symmetric encryption and hash functions, reducing effective security margins. Therefore, migration toward cryptographic structures resistant to quantum computers has become not only a theoretical research topic but also an operational necessity.

This study examines post-quantum cryptography (PQC) from technical and mathematical perspectives. Lattice-based, code-based, and isogeny-based approaches are considered, and their security assumptions, computational costs, and practical advantages and disadvantages are comparatively discussed. The main contribution is the formulation of a simplified key encapsulation and encryption design based on the Learning With Errors (LWE) problem. Key generation, encryption, and decryption stages are expressed mathematically and evaluated with performance metrics. In addition, security level, key size, time complexity, and the role of the error distribution are analyzed within the proposed framework.

The findings indicate that lattice-based constructions stand out in the current PQC ecosystem because they provide a favorable balance among practical applicability, acceptable key sizes, and high performance. In contrast, code-based systems rely on strong security assumptions but suffer from very large public-key sizes, while isogeny-based systems require cautious consideration because of recent cryptanalytic developments despite their theoretical appeal. The study further emphasizes that secure PQC migration is not limited to algorithm selection; protocol compatibility, implementation security, cryptographic agility, and hybrid transition strategies should also be considered.

Overall, this study highlights the fundamental role of PQC in secure communication infrastructures for the quantum era and shows that LWE-based constructions provide a balanced and practically applicable direction for future secure communication systems.

Keywords: Post-Quantum Cryptography, PQC, LWE, lattice-based cryptography, Kyber

Özet

Kuantum hesaplama alanındaki hızlı ilerlemeler, günümüzde yaygın biçimde kullanılan açık anahtarlı kriptosistemlerin güvenliğini doğrudan tehdit etmektedir. Özellikle Shor algoritmasının tamsayı çarpanlara ayırma ve ayrık logaritma problemlerini polinomsal zamanda çözebilmesi, RSA, Diffie-Hellman ve Eliptik Eğri Kriptografisi gibi şemaların uzun vadede güvenliğini zayıflatmaktadır. Benzer şekilde Grover algoritması, simetrik şifreleme ve karma fonksiyonları üzerinde karekök seviyesinde hızlanma sağlayarak güvenlik marjlarını düşürmektedir. Bu nedenle, kuantum bilgisayarlara karşı dayanıklı yeni kriptografik yapılara geçiş, yalnızca teorik bir araştırma konusu değil, aynı zamanda operasyonel bir zorunluluk hâline gelmiştir.

Bu çalışmada kuantum sonrası kriptografi (Post-Quantum Cryptography, PQC) literatürü teknik ve matematiksel bir bakış açısıyla incelenmektedir. Lattice-tabanlı, kod-tabanlı ve izojeni-tabanlı yaklaşımlar temel alınarak her bir aile için güvenlik dayanakları, hesaplama maliyetleri ve uygulama ölçeğindeki avantaj-dezavantaj dengeleri tartışılmaktadır. Çalışmanın ana katkısı, Learning With Errors (LWE) problemine dayalı bir anahtar kapsülleme ve şifreleme tasarımının ayrıntılı biçimde formüle edilmesi; anahtar üretimi, şifreleme ve çözme aşamalarının matematiksel ifadelerle verilmesi ve performans metrikleriyle birlikte değerlendirilmesidir. Ayrıca önerilen çerçeve için güvenlik seviyesi, anahtar boyutu, zaman karmaşıklığı ve hata dağılımının rolü analitik olarak incelenmiştir.

Elde edilen bulgular, lattice-tabanlı yapıların özellikle pratik uygulanabilirlik, kabul edilebilir anahtar boyutu ve yüksek performans dengesi bakımından güncel PQC ekosisteminde öne çıktığını göstermektedir. Buna karşılık kod-tabanlı sistemlerin güçlü güvenlik varsayımlarına rağmen büyük anahtar boyutu sorununa sahip olduğu; izojeni-tabanlı sistemlerin ise teorik olarak ilgi çekici olmasına rağmen son yıllardaki kriptanalitik gelişmeler nedeniyle daha dikkatli ele alınması gerektiği görülmektedir. Bunun yanında, güvenli bir PQC geçişinin yalnızca algoritma seçimiyle sınırlı olmadığı; protokol uyumluluğu, uygulama güvenliği, kriptografik çeviklik ve hibrit geçiş stratejilerinin de birlikte değerlendirilmesi gerektiği vurgulanmaktadır.

Son tahlilde bu çalışma, kuantum çağında güvenli haberleşme altyapılarının tasarımında PQC'nin temel rolünü ortaya koymakta ve LWE-tabanlı yapıların gelecekteki güvenli iletişim sistemleri için dengeli ve uygulanabilir bir yaklaşım sunduğunu göstermektedir.

Anahtar kelimeler: Kuantum Sonrası Kriptografi, PQC, LWE, lattice-tabanlı kriptografi, Kyber

MAGNETOSPHERIC ANALYSIS OF THE SEVERE GEOMAGNETIC STORM OF JANUARY 1, 2025 DURING SOLAR CYCLE 25

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ABSTRACT

As Solar Cycle 25 approaches its maximum, increasing solar activity has been associated with a higher occurrence of intense geomagnetic storms driven by coronal mass ejections (CMEs). In this study, geomagnetic activity from 17 December 2024 to 16 January 2025 was investigated, with particular emphasis on the most intense event observed on 1 January 2025. The magnetospheric characteristics and driving mechanisms of this event were analyzed using hourly Dst, 3-hourly Kp, the total interplanetary magnetic field (IMF) magnitude, the GSM Bz component, and proton density (Np). Storm intensity and evolutionary phases were determined by evaluating temporal variations in geomagnetic indices together with associated solar wind and IMF conditions. The results show that the minimum Dst reached −212 nT, while the maximum Kp reached 8, indicating a very intense geomagnetic storm corresponding to the G4 level in the NOAA classification. The total IMF magnitude increased to approximately 24 nT, whereas the IMF Bz component decreased to nearly −20 nT and remained southward for several hours. These conditions indicate enhanced magnetic reconnection at the dayside magnetopause and efficient solar wind–magnetosphere energy transfer. Proton density increased to approximately 10 cm^{-3}, consistent with enhanced dynamic pressure associated with the compressed region ahead of the CME. Furthermore, the rapid decrease in Dst over approximately 6–8 h indicates the development of a strong ring current and the impulsive nature of the storm main phase. The simultaneous occurrence of enhanced IMF magnitude, strong southward Bz, increased proton density, and rapid Dst depression supports a CME-driven origin. Overall, the 1 January 2025 storm exhibits the characteristic features of an impulsive, CME-driven, and very intense geomagnetic storm. These findings contribute to the characterization of strong CME-related magnetospheric disturbances during Solar Cycle 25.

Keywords*: Geomagnetic Storm, Dst, IMF Bz, Solar Cycle 25, CME*

A COMPARATIVE ANALYSIS OF TEC ANOMALIES UNDER SPACE WEATHER CONDITIONS USING THE IQR AND 1.34σ METHODS

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ABSTRACT

In this study, ionospheric Total Electron Content (TEC) data obtained from the ANK2 GNSS station were analyzed for the period from 28 October to 27 November 2025 to investigate ionospheric anomalies under varying space weather conditions. Two statistical thresholding approaches, the Interquartile Range (IQR) and the 1.34σ method, were employed to identify and comparatively evaluate TEC anomalies. The detected anomalies were examined in relation to key space weather parameters, including the geomagnetic indices Dst and Kp, the interplanetary magnetic field (IMF) Bz component, proton density, and the solar radio flux index F10.7. During the study period, the most pronounced ionospheric disturbance occurred on 12 November, coinciding with a severe geomagnetic storm characterized by a Dst value below −200 nT and a Kp value of approximately 8. On the same date, the IMF Bz component decreased to approximately −30 nT, indicating strong southward magnetic field conditions and enhanced magnetosphere–ionosphere coupling, while proton density increased to approximately 25–30 cm^{-3}. A pronounced positive TEC anomaly was simultaneously observed by both statistical methods. The results indicate that the IQR method identified a relatively limited number of statistically significant deviations and demonstrated greater robustness against background variability and extreme values. In contrast, the 1.34σ method detected a larger number of lower-amplitude deviations, particularly during moderate geomagnetic activity and the storm recovery phase, indicating higher sensitivity to small-scale ionospheric variability. Although both methods provided consistent anomaly detection during the most intense geomagnetic disturbance, the IQR method exhibited a more conservative and reliable thresholding performance for operational applications. The findings demonstrate the potential of GNSS-derived TEC observations for monitoring ionospheric responses to space weather disturbances.

Keywords: Total Electron Content (TEC); Space Weather Conditions; Geomagnetic Storm; IQR - 1.34σ Method; IMF Bz; Dst Index; Kp Index; Ionospheric Anomaly

ANTALYA KENT MERKEZİNDE KENTSEL YAPILAŞMANIN KIYIYA UZAKLIĞA GÖRE DEĞİŞİMİ: GHSL TABANLI BİR ANALİZ (2000-2020)

CHANGES IN URBAN BUILT-UP DEVELOPMENT BY DISTANCE FROM THE COAST IN ANTALYA CITY CENTER: A GHSL-BASED ANALYSIS (2000-2020)

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Abstract

As in many parts of the world, urbanization in Turkey, increasing in coastal areas and expanding inland, can lead to increased pressure on natural areas, changes in ecosystems, and make coastal cities more vulnerable to environmental problems. In particular, changes in land use due to increasing population and tourism activities cause rapid spatial transformations in coastal cities. This study aims to spatially evaluate the changes in building surface area in Antalya city center between 2000 and 2020, based on distance from the coast. The study area was determined as the central districts of Muratpaşa, Kepez, Konyaltı, Döşemealtı, and Aksu. Analyses were carried out over five zones: 0-2, 2-4, 4-8, 8-10, and 10-20 km from the coastline. GHS-Built-S data, provided as part of the Global Human Settlement Layer (GHSL), were used to quantify built-up surface areas, while Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) data were used to assess topographic conditions. To minimize the impact of steep and mountainous areas, cells with an average slope exceeding 20° were excluded from the evaluation. The findings show that the built-up surface area in the 0-20 km coastal corridor increased from 62.17 km^2 in 2000 to 88.94 km^2 in 2020. The highest built-up density was found in the 2-4 km zone at 19.12%. The largest share of the total net increase in built-up surface occurred in the 10-20 km zone, accounting for 48.04%. The results reveal that areas close to the coast maintain high building density, while the absolute increase in built-up surface area is more pronounced in inland areas. This study offers a useful approach in terms of monitoring spatial development in coastal cities and supporting sustainable planning processes by evaluating the change in building density based on distance from the coast and taking into account topographical limitations.

Keywords: Coastal urbanization, GHSL, Built-up surface change, Coastal distance analysis.

Özet

Dünyanın birçok bölgesinde olduğu gibi Türkiye'de kıyı bölgelerinde artan ve iç kesimlere doğru genişleyen kentleşme, doğal alanlar üzerindeki baskının artmasına, ekosistemlerin değişmesine ve kıyı kentlerinin çevresel sorunlara karşı daha hassas bir yapıya dönüşmesine neden olabilmektedir. Özellikle artan nüfus ve turizm faaliyetleri nedeniyle arazi kullanımındaki değişimler kıyı kentlerindeki hızlı mekânsal dönüşümlerin oluşmasına sebep olmaktadır. Bu çalışma, Antalya kent merkezinde 2000-2020 yılları arasında meydana gelen yapılaşma yüzey değişimini kıyıya olan uzaklık temelinde mekânsal açıdan değerlendirmeyi amaçlamaktadır. Çalışma alanı olarak Muratpaşa, Kepez, Konyaltı, Döşemealtı ve Aksu merkez ilçeleri belirlenmiştir. Analizler, kıyı çizgisinden itibaren 0-2, 2-4, 4-8, 8-10 ve 10-20 km olmak üzere beş farklı zon üzerinden gerçekleştirilmiştir. Yapılaşma yüzeylerinin belirlenmesinde Global Human Settlement Layer (GHSL) kapsamında sunulan GHS-Built-S verileri, topoğrafik koşulların değerlendirilmesinde ise SRTM Sayısal Yükseklik Modeli (DEM) verileri kullanılmıştır. Bölgedeki dik ve dağlık alanların analiz üzerindeki etkisini azaltmak amacıyla ortalama eğimi 20°'nin üzerinde olan hücreler değerlendirme dışında tutulmuştur. Bulgular, 0-20 km kıyı koridorunda yapılaşmış yüzey alanının 2000 yılında 62.17 km2'den 2020 yılında 88.94 km2'ye yükseldiğini göstermektedir. En yüksek yapılaşma yoğunluğu %19.12 ile 2-4 km zonunda tespit edilirken, toplam net yapılaşma artışının en büyük payı %48.04 ile 10-20km zonunda tespit edilmiştir. Sonuçlar kıyıya

yakın kesimlerin yüksek yapılaşma yoğunluğunu koruduğunu, buna karşılık mutlak yapılaşma artışının mekânsal olarak daha iç kesimlerde belirginleştiğini ortaya koymaktadır. Çalışma, kıyıya uzaklık temelinde yapılaşma değişiminin değerlendirilmesi ve topoğrafik sınırlandırmaların dikkate alınması yoluyla, kıyı kentlerindeki mekânsal gelişimin izlenmesine ve sürdürülebilir planlama süreçlerinin desteklenmesine katkı sağlaması açısından faydalı bir yaklaşım sunmaktadır.

Anahtar kelimeler: Kıyı kentleşmesi, GHSL, Yapılaşmış yüzey değişimi, kıyıya uzaklık analizi

TÜRKİYE'DE FOTOVOLTAİK ATIK OLUŞUMU VE GERİ DÖNÜŞÜM ALTYAPISI İHTİYACININ BÜTÜNLEŞİK DEĞERLENDİRİLMESİ: 2050 YILINA KADAR ÖNGÖRÜLER

INTEGRATED ASSESSMENT OF PHOTOVOLTAIC WASTE GENERATION AND RECYCLING INFRASTRUCTURE REQUIREMENTS IN TÜRKİYE: PROJECTIONS TO 2050

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Abstract

The rapid expansion of photovoltaic (PV) installations in Türkiye has become an important component of the country's transition towards a more diversified and renewable electricity generation system. According to official data, Türkiye's total installed electricity generation capacity increased from 69.5 GW in 2014 to 125.41 GW by April 2026, representing an increase of approximately 80%. More remarkably, installed solar PV capacity increased from only 40.2 MW to 26,769 MW over the same period, reaching approximately 666 times its 2014 level. This unprecedented growth is expected to generate a substantial end-of-life (EoL) PV waste stream in the coming decades, creating an increasing need for long-term waste-management and recycling-infrastructure planning. This study develops an integrated framework to project PV installed capacity, estimate EoL PV module waste generation, and assess future recycling infrastructure requirements in Türkiye up to 2050. Historical PV installed-capacity data covering 2014–2026 are used as the basis for long-term forecasting. Multiple regression and artificial neural network (ANN) models are developed in MATLAB to project future PV capacity up to 2050. Model performance is evaluated using statistical indicators, and the resulting capacity projections are converted into annual PV installations. These annual installations are then combined with 20- and 25-year module lifetime scenarios to estimate annual and cumulative EoL PV waste. Finally, projected annual waste quantities are used to determine the recycling capacity and corresponding number of recycling facilities required to manage Türkiye's future PV waste stream. The analysis provides a long-term perspective on the transition from rapid PV deployment to large-scale EoL waste generation and identifies periods when recycling demand is expected to accelerate. By directly linking PV deployment, waste generation, and recycling requirements, the proposed framework extends conventional PV waste forecasting towards infrastructure-oriented planning and provides a quantitative basis for proactive and sustainable circular PV waste-management strategies in Türkiye.

Keywords: Photovoltaic waste; End-of-life PV modules; Solar energy; Waste forecasting; Artificial neural network; Türkiye.

Özet

Türkiye'de fotovoltaik (PV) sistemlerin hızlı yaygınlaşması, ülkenin daha çeşitli ve yenilenebilir kaynaklara dayalı bir elektrik üretim sistemine geçişinin önemli bileşenlerinden biri hâline gelmiştir. Resmî verilere göre, Türkiye'nin toplam elektrik kurulu gücü 2014 yılında 69,5 GW iken Nisan 2026 itibarıyla 125,41 GW'a ulaşmış ve yaklaşık %80 artış göstermiştir. Daha dikkat çekici olarak, güneş PV kurulu gücü aynı dönemde yalnızca 40,2 MW'tan 26.769 MW'a yükselerek 2014 seviyesinin yaklaşık 666 katına ulaşmıştır. Bu benzeri görülmemiş büyümenin, önümüzdeki yıllarda önemli miktarda kullanım ömrünü tamamlamış (EoL) PV atığı oluşturması ve uzun vadeli atık yönetimi ile geri dönüşüm altyapısı planlamasına duyulan ihtiyacı artırması beklenmektedir. Bu çalışmada, Türkiye'de 2050 yılına kadar PV kurulu gücünü tahmin etmek, ömrünü tamamlamış PV modülü atık miktarını belirlemek ve gelecekte ihtiyaç duyulacak geri dönüşüm altyapısını değerlendirmek amacıyla bütünleşik bir yaklaşım geliştirilmektedir. 2014–2026 dönemine ait geçmiş PV kurulu güç verileri uzun dönemli tahminlerin

temelini oluşturmaktadır. Gelecekteki PV kurulu gücünün 2050 yılına kadar öngörülmesi amacıyla MATLAB ortamında çoklu regresyon ve yapay sinir ağı (YSA) modelleri geliştirilmektedir. Modellerin performansı istatistiksel göstergeler kullanılarak değerlendirilmekte ve elde edilen kapasite projeksiyonları yıllık PV kurulum miktarlarına dönüştürülmektedir. Bu değerler, 20 ve 25 yıllık modül ömrü senaryoları ile birleştirilerek yıllık ve kümülatif EoL PV atık miktarları tahmin edilmektedir. Son aşamada, yıllık atık miktarları kullanılarak gerekli geri dönüşüm kapasitesi ve Türkiye'nin gelecekteki PV atık akışını yönetmek için ihtiyaç duyulacak geri dönüşüm tesisi sayısı belirlenmektedir. Analiz, hızlı PV kurulumundan büyük ölçekli EoL atık oluşumuna geçişi uzun vadeli olarak ortaya koymakta ve geri dönüşüm talebinin hızlanmasının beklendiği dönemleri belirlemektedir. PV kurulumunu, atık oluşumunu ve geri dönüşüm gereksinimlerini doğrudan ilişkilendiren bu yaklaşım, geleneksel PV atık tahminlerinin ötesine geçerek altyapı odaklı planlama için nicel bir temel sunmaktadır.

Anahtar Kelimeler: Fotovoltaik atık; Kullanım ömrünü tamamlamış PV modülleri; Güneş enerjisi; Atık tahmini; Yapay sinir ağı; Türkiye.

FE_3O_4 İÇEREN EPOKSİ ESASLI KOMPOZİTLERİN CO-60 GAMA RADYASYONU ALTINDAKİ ZAYIFLATMA DAVRANIŞININ LİTERATÜR DENEYLERİ, XCOM VERİLERİ VE TERS GEOMETRİK TASARIM YAKLAŞIMIYLA İNCELENMESİ

INVESTIGATION OF THE ATTENUATION BEHAVIOUR OF FE_3O_4-CONTAINING EPOXY-BASED COMPOSITES UNDER CO-60 GAMMA RADIATION USING PUBLISHED EXPERIMENTS, XCOM DATA AND AN INVERSE GEOMETRICAL DESIGN APPROACH

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ÖZET

Bu çalışmada, Fe_3O_4 içeren epoksi esaslı kompozitlerin yüksek enerjili gama radyasyonu altındaki davranışı; NIST-XCOM tabanlı teorik hesaplamalar ile literatürde yayımlanmış deneysel ve Monte Carlo sonuçlarının birlikte değerlendirilmesi yoluyla incelenmiştir. Çalışmanın temel amacı, magnetit içeren epoksi kompozitlerin yalnızca klasik bir radyasyon zırhlama malzemesi olarak değil, değişken kalınlıklı pasif bir radyasyon alanı modülatörü olarak da kullanılabilirliğini belirlemektir. Saf epoksi ile ağırlıkça %5, %10 ve %15 (wt.%) Fe_3O_4 içeren kompozisyonlar için Co-60 fotonlarının temsilî ortalama enerjisi olan 1,25 MeV'de kütle ve lineer zayıflatma katsayıları hesaplanmıştır. Saf epoksinin kütle zayıflatma katsayısı 0,06031 cm^2/g, Fe_3O_4'ün ise 0,05446 cm^2/g olarak bulunmuştur. Fe_3O_4 miktarı arttıkça kompozitin teorik yoğunluğu 1,210 g/cm^3'ten 1,367 g/cm^3'e yükselmiş ve buna bağlı olarak lineer zayıflatma katsayısı 0,07298 cm^{-1}'den 0,08125 cm^{-1}'e çıkmıştır. Bu değişim yaklaşık %11,3'lük bir artışa karşılık gelmektedir. Yayımlanmış epoksi/metal oksit deneyleri ile yapılan karşılaştırma, bu artışın benzer yoğunluk aralığındaki deneysel sonuçlarla aynı büyüklük mertebesinde olduğunu göstermiştir. Ağırlıkça %15 Fe_3O_4/epoksi kompoziti için yarı değer kalınlığı (HVL) 8,53 cm olarak hesaplanmış; %10, %20 ve %30 kontrollü foton azalımı için ise sırasıyla yaklaşık 1,30, 2,75 ve 4,39 cm kompozit kalınlığı gerektiği belirlenmiştir. Elde edilen sonuçlar, düşük ve orta düzeyde Fe_3O_4 içeren epoksi kompozitlerin Co-60 enerji bölgesinde ince ve yüksek performanslı zırhlardan ziyade, santimetre ölçekli ve değişken kalınlıklı pasif gama alanı modülatörleri olarak daha anlamlı bir mühendislik potansiyeli taşıdığını ortaya koymaktadır.

Anahtar Kelimeler: Fe_3O_4, Epoksi, Co-60, gama radyasyonu, XCOM, Magnetit, Lineer zayıflatma katsayısı, Ters tasarım, Pasif radyasyon modülasyonu.

ABSTRACT

This study investigates the high-energy gamma-ray attenuation behaviour of Fe_3O_4-containing epoxy composites by combining NIST-XCOM-based theoretical calculations with published experimental and Monte Carlo results. The main objective is to assess the suitability of magnetite-filled epoxy not only as a conventional shielding material but also as a variable-thickness passive radiation-field modulator. Pure epoxy and composites containing 5, 10, and 15 wt.% Fe_3O_4 were analysed at 1.25 MeV, taken as a representative mean energy for the two principal Co-60 gamma lines. The calculated mass attenuation coefficients of pure epoxy and Fe_3O_4 were 0.06031 and 0.05446 cm^2/g, respectively. Increasing the Fe_3O_4 fraction increased the theoretical composite density from 1.210 to 1.367 g/cm^3 and consequently

increased the linear attenuation coefficient from 0.07298 to 0.08125 cm^{-1}, corresponding to an improvement of approximately 11.3%. Comparison with published epoxy/metal-oxide experiments showed that this increase is of the same order of magnitude as experimentally reported values for composites within a similar density range. For the 15 wt.% Fe_3O_4/epoxy system, the half-value layer was calculated as 8.53 cm, while approximately 1.30, 2.75, and 4.39 cm thicknesses were required to achieve 10%, 20%, and 30% photon attenuation, respectively. The results indicate that low-to-moderate magnetite-loaded epoxy composites are more suitable as centimetre-scale, variable-thickness passive gamma-field modulators than as thin high-performance Co-60 shielding materials.

Keywords: Fe_3O_4, Epoxy, Co-60, gamma radiation, XCOM, Magnetite, Linear attenuation coefficient, Inverse design, Passive radiation modulation.

ANSYS WORKBENCH TABANLI AUXETİC CFRP SANDVİÇ PANELLERDE MEKANİK PERFORMANS VE CO-60 GAMA TRANSMİSYONUNUN BİRLEŞİK SAYISAL İNCELENMESİ

ANSYS WORKBENCH-BASED COUPLED NUMERICAL INVESTIGATION OF MECHANICAL PERFORMANCE AND CO-60 GAMMA TRANSMISSION IN AUXETIC CFRP SANDWICH PANELS

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ÖZET

Bu çalışmada, havacılık yapılarında yüksek özgül rijitlik ve düşük kütle nedeniyle yaygın olarak kullanılan karbon fiber takviyeli epoksi (CFRP) yüzey tabakaları ile re-entrant Auxetic CFRP çekirdekten oluşan sandviç paneller için ANSYS Workbench merkezli çok ölçekli bir sayısal tasarım çerçevesi geliştirilmiş olup Re-entrant hücre geometrisinin neden olduğu yerel alan yoğunluğu dağılımının, gama ışını zayıflatma performansı üzerindeki etkisi incelenmiştir. Çalışmanın özgün amacı, negatif Poisson oranlı hücresel mimarinin yapısal rijitlik üzerindeki etkisini Co-60 gama fotonlarının pasif transmisyonuyla aynı geometrik tasarım uzayında birlikte değerlendirmektir. Referans panel 300×300 mm boyutlarında, 15 mm çekirdek yüksekliğinde ve her iki tarafta 0,8 mm kalınlığında [0/45/−45/90]s T700/epoksi laminatlardan oluşturulmuştur. Re-entrant hücre için L=10 mm, H=12 mm, β=20° ve t=0,4–0,8 mm parametreleri kullanılmıştır. Literatür tabanlı homojenizasyon bağıntıları ile bağıl yoğunluk 0,0794–0,1588; etkin ν21 yaklaşık −0,33; G13 861,8–1723,6 MPa ve G23 455,5–911,1 MPa aralığında hesaplanmıştır. Bağımsız Mindlin-Reissner FE benchmark çözümünde 0,1 MPa düzgün yayılı basınç altında maksimum merkez deplasmanı t=0,4, 0,6 ve 0,8 mm için sırasıyla 0,274, 0,244 ve 0,229 mm olarak elde edilmiş; maksimum gerilme esaslı kullanım indeksi tüm tasarımlarda 0,07'nin altında kalmıştır. Aynı tasarımlarda alan kütlesi 4,47'den 6,37 kg/m²'ye yükselirken, 1,25 MeV temsili Co-60 enerjisindeki teorik foton azalması %2,57'den %3,64'e çıkmıştır. Sonuçlar, hücre duvar kalınlığının iki katına çıkarılmasının panel deplasmanını yaklaşık %16,5 azaltmasına karşın gama zayıflatma kazanımını yalnızca yaklaşık 1,08 yüzde puanı artırdığını göstermektedir. Böylece Auxetic mimarinin temel katkısının yüksek enerjili gama fotonları için yapısal-içsel bir zırhlama mekanizması olmaktan çok, mekanik rijitlik ve yerel birim alan kütlesini ortak bir geometrik tasarım problemi altında programlayabilmek olduğu ortaya konmuştur. Elde edilen eğilimler, Auxetic kompozitlerin enerji sönümleme ve darbe performansına ilişkin güncel çalışmalar ile karbon/epoksi sistemlerin radyasyon zayıflatma literatürüyle karşılaştırılmıştır.

Anahtar Kelimeler: Auxetic yapı; CFRP; Re-entrant bal peteği; ANSYS Workbench; Material Designer; ACP; Co-60; XCOM; Gama transmisyonu.

ABSTRACT

This study develops an ANSYS Workbench-centred multiscale numerical design framework for sandwich panels consisting of carbon-fibre-reinforced epoxy (CFRP) face sheets and a re-entrant auxetic CFRP core. The main objective is to evaluate structural stiffness and passive Co-60 gamma-ray

transmission within a common geometric design space. The reference panel is 300×300 mm with a 15 mm core and 0.8 mm [0/45/−45/90]s T700/epoxy laminates on both sides. A re-entrant unit cell with L=10 mm, H=12 mm, β=20° and wall thickness t=0.4–0.8 mm is considered. Literature-based homogenisation gives relative densities of 0.0794–0.1588, an effective ν21 of approximately −0.33, G13 of 861.8–1723.6 MPa and G23 of 455.5–911.1 MPa. An independent Mindlin-Reissner FE benchmark under a uniform pressure of 0.1 MPa predicts maximum deflections of 0.274, 0.244 and 0.229 mm for t=0.4, 0.6 and 0.8 mm, respectively. The maximum-stress utilisation index remains below 0.07. In parallel, the areal mass increases from 4.47 to 6.37 kg/m², whereas the theoretical photon attenuation at the representative Co-60 energy of 1.25 MeV increases only from 2.57% to 3.64%. These findings show that doubling the cell-wall thickness decreases structural deflection by about 16.5%, while the gamma attenuation gain is limited to about 1.08 percentage points. Therefore, the main multifunctional value of the auxetic architecture is not an intrinsic enhancement of high-energy gamma shielding, but the ability to geometrically programme structural stiffness and local areal density. The obtained trends are discussed against recent literature on auxetic composite sandwich structures and radiation attenuation of carbon/epoxy composites.

Keywords: Auxetic Structure; CFRP; Re-entrant Honeycomb; ANSYS Workbench; Material Designer; ACP; Co-60; XCOM; Gamma Transmission.

DEVELOPMENT OF ARCHITECTED MULTI-MATERIAL FILAMENTS FOR ADDITIVE MANUFACTURING

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Abstract

Architected multi-material filaments provide a promising approach for combining polymers with substantially different mechanical characteristics within a single filament through controlled spatial organization. Unlike conventional polymer blends, this approach enables the constituent materials to remain as distinct phases, offering an additional means of tailoring the behaviour of additively manufactured structures. In this study, an architected filament consisting of recycled polyethylene terephthalate (rPET) and thermoplastic polyurethane (TPU) was developed for additive manufacturing using a co-extrusion approach. A hierarchical configuration was employed to spatially organize the two constituent polymers, with rPET forming the outer phase and TPU forming the inner phase. The initial development and characterization of the produced filament focused on verifying the formation and consistency of the designed architecture. Cross-sectional imaging and optical microscopy were used to examine the distribution, continuity, and interface between the constituent phases. The produced filament was subsequently processed using fused filament fabrication to evaluate its printability and to determine whether the designed architecture could be retained during deposition. Optical microscopy of the printed structures was used to examine the resulting internal morphology and the arrangement of the constituent phases within the fabricated parts. Preliminary tensile testing was performed to provide an initial assessment of the mechanical response of the printed structures. The morphological observations confirmed the formation of the intended multi-material architecture in the produced filament and its preservation following additive manufacturing. Together with the preliminary tensile results, these findings demonstrate the feasibility of producing and processing architected rPET/TPU filaments and provide a basis for further investigation of their mechanical and functional performance.

Keywords: Additive Manufacturing, FDM, FFF, Mechanical Characterisation, Polymers

EVALUATING THE IMPACT OF GRID IMPEDANCE AND LOAD DYNAMICS ON POWER QUALITY: A COMPARATIVE STUDY OF DISTINCT LOAD SCENARIOS

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Abstract

The widespread application of uncontrolled three-phase diode bridge rectifiers in industrial electronics introduces significant non-linear characteristics to the electrical grid, directly leading to severe power quality (PQ) degradation. This paper presents a comprehensive comparative study evaluating the impact of varying load dynamics and grid impedance on PQ parameters, primarily focusing on grid-side current harmonics. Utilizing MATLAB/Simulink, three distinct operational scenarios are modeled and systematically analyzed. The first scenario establishes a theoretical baseline by evaluating the rectifier connected to a purely resistive (R) load, providing an unfiltered continuous-conduction baseline. The second scenario introduces a capacitive element, forming an RC load to simulate typical DC-link voltage smoothing requirements. The simulation of this configuration shows a drastic degradation in PQ, characterized by narrow, high-peak non-sinusoidal input currents and significantly elevated Total Harmonic Distortion (THD). To bridge the gap between ideal simulations and practical applications, the third scenario incorporates line impedance (source inductance and resistance) into the RC-loaded system to represent realistic utility grid conditions. The comparative analysis reveals a crucial dynamic: while the capacitive DC-link load severely distorts the AC current profile, the inherent line impedance acts as a natural low-pass filter. This impedance limits the rate of change of current (di/dt) and consequently attenuates higher-order harmonic components, partially restoring the grid current waveform. By examining the Fast Fourier Transform (FFT) and RMS measurements integrated within the Simulink models, this study quantifies the critical relationship between load characteristics and source parameters. Ultimately, the findings emphasize that accurate PQ assessment in industrial rectifier systems requires accounting for grid impedance, as simplified ideal-source models fail to capture the inherent harmonic-suppression dynamics of real-world electrical networks.

Keywords: Power Quality, Total Harmonic Distortion (THD), Three-Phase Rectifier, Grid Impedance, Fast Fourier Transform (FFT)

ROBUST BEARING FAULT DIAGNOSIS UNDER NOISY CONDITIONS USING ENVELOPE ANALYSIS AND SUPPORT VECTOR MACHINES

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Abstract

The continuous and safe operation of rotating machinery is critical to the efficiency and reliability of industrial production processes. Bearing faults are among the most common mechanical failures that can lead to unscheduled downtime and substantial economic losses when not detected in a timely and accurate manner. Although vibration signals are widely used in fault diagnosis, severe background noise in industrial environments poses significant challenges to identifying fault-specific characteristic frequency components. While machine learning algorithms offer effective solutions for automated diagnosis, the classification performance of the models fundamentally depends on the quality and robustness of the applied signal preprocessing techniques. In this study, the direct effects of different preprocessing techniques on the classification performance of a Support Vector Machine (SVM) model for bearing fault diagnosis are comprehensively examined. Fast Fourier Transform (FFT), Short-Time Fourier Transform (STFT), Cepstrum analysis, and envelope analysis were applied together to process vibration data across the frequency domain. To simulate harsh industrial conditions and evaluate model robustness, different levels of artificial noise were synthetically added to the raw vibration signals. The SVM model was trained and tested separately using feature sets with and without envelope analysis under different noise levels. The obtained model classification accuracy metrics were comparatively analyzed. The findings demonstrate that Envelope-analysis-supported preprocessing significantly enhances model accuracy, especially in high-noise scenarios, by accentuating masked weak periodic fault impulses. Additionally, the multidimensional feature representations provided by STFT, Cepstrum, and FFT analyses further enhance the model's generalization capability and classification performance. This research clearly demonstrates the critical role of envelope analysis in improving the fault-diagnostic accuracy and noise tolerance of machine learning models in bearing condition-monitoring systems.

Keywords: Bearing Fault Diagnosis, Envelope Analysis, Support Vector Machine (SVM), Cepstrum Analysis, Short-Time Fourier Transform

COMPARISON OF KAOLIN CLAY AND WASTE CLAY IN LC3-BASED MORTARS IN TERMS OF MECHANICAL AND PHYSICAL PROPERTIES

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ABSTRACT

The development of alternative binders in the cement industry has increased the importance of low-clinker systems such as limestone calcined clay cement (LC3). Reducing clinker content is a key strategy for lowering the environmental impact of cement-based materials; however, the practical application of LC3 strongly depends on the availability and performance of suitable calcined clay sources. Although high-quality metakaolin can provide favorable reactivity, such materials may not always be economically or regionally accessible. Therefore, evaluating locally available lower-grade and waste clays is important for expanding the applicability of LC3 technology. This study compares kaolin clay and a lower-grade waste clay, designated as SE clay in this study, in terms of the fresh, mechanical, and physical properties of LC3-based mortars. The SE clay was obtained from Termal Seramik in Bilecik, Türkiye. The binder composition was kept constant at 55% cement, 30% calcined clay, and 15% limestone, while both clays were calcined at 800 °C for 1 h. Mortar mixtures were prepared with a constant water-to-binder ratio of 0.50, and 50 × 50 × 50 mm cubic specimens were produced. Flow diameter, compressive strength, ultrasonic pulse velocity, water absorption, apparent porosity, and dry bulk density were evaluated. Flow diameters were 18 cm for the Kao series and 16 cm for the SE series, indicating lower flowability of the SE mixture. At 28 days, compressive strengths were 47.08 MPa and 36.32 MPa for the Kao and SE series, respectively. The SE series showed higher water absorption and apparent porosity, whereas ultrasonic pulse velocity values were similar at approximately 3.85 and 3.83 km/s. Overall, the Kao series exhibited higher compressive strength and lower water absorption and apparent porosity than the SE series, although the SE series still achieved a 28-day compressive strength of 36.32 MPa despite its higher water-accessible porosity.

Keywords: LC3, calcined clay, kaolin, waste clay, compressive strength, apparent porosity

ÖZET

Çimento endüstrisinde alternatif bağlayıcıların geliştirilmesi, kireçtaşı kalsine kil çimentosu (LC3) gibi düşük klinker içerikli sistemlerin önemini artırmıştır. Klinker içeriğinin azaltılması, çimento esaslı malzemelerin çevresel etkisini düşürmek için temel bir stratejidir; ancak LC3 sistemlerinin pratik uygulaması, uygun kalsine kil kaynaklarının bulunabilirliğine ve performansına büyük ölçüde bağlıdır.

Yüksek kaliteli metakaolin olumlu reaktivite sağlayabilse de bu tür malzemeler her zaman ekonomik veya bölgesel olarak erişilebilir olmayabilir. Bu nedenle, yerel olarak temin edilebilen daha düşük kaliteli ve atık killerin değerlendirilmesi, LC3 teknolojisinin uygulanabilirliğini genişletmek açısından önemlidir. Bu çalışmada, kaolin kili ve bu çalışmada SE kili olarak adlandırılan daha düşük kaliteli bir atık kil, LC3 esaslı harçların taze hal, mekanik ve fiziksel özellikleri açısından karşılaştırılmıştır. SE kili, Türkiye Bilecik'te bulunan Termal Seramik'ten temin edilmiştir. Bağlayıcı bileşimi %55 çimento, %30 kalsine kil ve %15 kireçtaşı olarak sabit tutulmuş; her iki kil 800 °C'de 1 saat süreyle kalsine edilmiştir. Harç karışımları 0,50 sabit su/bağlayıcı oranı ile hazırlanmış ve 50 × 50 × 50 mm boyutlarında küp numuneler üretilmiştir. Yayılma çapı, basınç dayanımı, ultrases geçiş hızı, su emme, görünür porozite ve kuru hacimsel yoğunluk değerlendirilmiştir. Yayılma çapları Kao serisi için 18 cm, SE serisi için 16 cm olup SE karışımının daha düşük akıcılık gösterdiğini ortaya koymuştur. 28 günde basınç dayanımları Kao ve SE serileri için sırasıyla 47,08 MPa ve 36,32 MPa'dır. SE serisi daha yüksek su emme ve görünür porozite göstermiş, buna karşılık ultrases geçiş hızı değerleri yaklaşık 3,85 ve 3,83 km/s ile benzer bulunmuştur. Genel olarak Kao serisi, SE serisine kıyasla daha yüksek basınç dayanımı ile daha düşük su emme ve görünür porozite sergilemiş; ancak SE serisi daha yüksek suya erişilebilir porozitesine rağmen 28 günde 36,32 MPa basınç dayanımına ulaşmıştır.

Anahtar kelimeler: LC3, kalsine kil, kaolin, atık kil, basınç dayanımı, görünür porozite

ÜÇGEN OLUKLU DAİRESEL BİR SİLİNDİRDE OLUK DERİNLİĞİNİN YAKIN İZ BÖLGESİ YAPISI VE SÜRÜKLEME ÜZERİNDEKİ ETKİSİNİN SAYISAL OLARAK İNCELENMESİ

NUMERICAL INVESTIGATION OF THE EFFECT OF GROOVE DEPTH ON NEAR-WAKE STRUCTURE AND DRAG OF A TRIANGULAR-GROOVED CIRCULAR CYLINDER

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Abstract

Vortex shedding behind bluff bodies causes energy losses, structural vibration, and fatigue damage in structures such as chimneys, bridge piers, offshore platform piles, and heat exchanger tube bundles. Passive surface modifications, including grooves, perforations, porous coatings, and dimples, alter separation behavior and shear-layer interaction without requiring external energy input. Groove geometry is therefore a practical parameter for controlling near-wake structure and reducing aerodynamic loading. This study examines groove depth as the governing parameter for near-wake development, surface pressure distribution, and drag behavior of a circular cylinder with twenty-four equally spaced circumferential grooves (15° angular spacing, groove width w = 4 mm, outer diameter D = 50 mm). Four configurations with radial groove depth ratios of h/D = 0.01, 0.02, 0.04, and 0.06 are analyzed at Re = 12,500 using two-dimensional Unsteady Reynolds-Averaged Navier Stokes simulations with the SST k–ω turbulence model. Mean velocity fields show a progressive contraction of the near-wake region as groove depth increases: the elongated wake core at h/D = 0.01 gives way to a shorter, more compact recirculation region at h/D = 0.06. Streamline topology confirms this through systematic shifts in the closure length and focal-point position of the recirculation bubble, while the saddle point stays on the wake centerline in all cases. Pressure coefficient distributions show little sensitivity to groove depth at the stagnation point, but the minimum pressure coefficient decreases in magnitude and base suction weakens as depth increases, pointing to a smaller pressure-related drag contribution. These wake and pressure trends are linked to the resulting drag coefficient and vortex shedding frequency to assess radial groove depth as a passive drag-control parameter for slotted cylinders.

Keywords: Drag Reduction, Grooved Cylinder, Passive Flow Control, Pressure Coefficient, Wake Structure.

Özet

Geniş cisimlerin arkasında meydana gelen girdap saçılması, bacalar, köprü ayakları, açık deniz platform kazıkları ve ısı değiştirici boru demetleri gibi yapılarda enerji kayıplarına, yapısal titreşimlere ve yorulma hasarına neden olmaktadır. Oluklar, delikli yüzeyler, gözenekli kaplamalar ve çukurcuklar gibi pasif yüzey modifikasyonları, herhangi bir harici enerji girdisi gerektirmeden akış ayrılma davranışını

ve kayma tabakası etkileşimini değiştirebilmektedir. Bu nedenle oluk geometrisi, yakın iz bölgesi yapısının kontrol edilmesi ve aerodinamik yüklerin azaltılması açısından pratik bir parametre olarak öne çıkmaktadır. Bu çalışmada, çevresel doğrultuda eşit aralıklarla yerleştirilmiş yirmi dört adet oluğa sahip (15° açısal aralık, oluk genişliği w = 4 mm, dış çap D = 50 mm) dairesel bir silindirin yakın iz bölgesi gelişimi, yüzey basınç dağılımı ve sürükleme davranışı üzerindeki etkisi belirleyici parametre olarak oluk derinliği açısından incelenmiştir. Radyal oluk derinliği oranları h/D = 0,01, 0,02, 0,04 ve 0,06 olan dört farklı konfigürasyon, Re = 12.500 Reynolds sayısında, SST k–ω türbülans modeli kullanılarak gerçekleştirilen iki boyutlu Zamana Bağlı Reynolds Ortalamalı Navier–Stokes (URANS) simülasyonları ile analiz edilmiştir. Ortalama hız alanları, oluk derinliği arttıkça yakın iz bölgesinin kademeli olarak daraldığını göstermektedir. h/D = 0,01 durumunda gözlenen uzamış iz bölgesi, h/D = 0,06 durumunda daha kısa ve daha kompakt bir geri dolaşım bölgesine dönüşmektedir. Akım çizgileri topolojisi, geri dolaşım kabarcığının kapanma uzunluğu ve odak noktası konumundaki sistematik değişimler aracılığıyla bu durumu doğrularken, eyer noktası tüm durumlarda iz bölgesi merkez hattı üzerinde kalmaktadır. Basınç katsayısı dağılımları, durma noktasında oluk derinliğine karşı düşük hassasiyet gösterirken, oluk derinliği arttıkça minimum basınç katsayısının mutlak değeri azalmakta ve taban bölgesindeki düşük basınç etkisi zayıflamaktadır. Bu durum, basınç kaynaklı sürükleme bileşeninin azalmasına işaret etmektedir. Bu durum, basınca bağlı sürükleme bileşeninin azaldığına işaret etmektedir. Elde edilen iz bölgesi ve basınç dağılımı eğilimleri, yarıklı silindirlerde radyal oluk derinliğinin pasif bir sürükleme kontrol parametresi olarak değerlendirilmesi amacıyla sürükleme katsayısı ve girdap saçılma frekansı sonuçlarıyla ilişkilendirilmiştir.

Anahtar kelimeler: Basınç Katsayısı, İz Bölgesi Yapısı, Oluklu Silindir, Pasif Akış Kontrolü, Sürükleme Azaltımı.

BİSFENOL-A TABANLI FLORESAN PROB İLE Cu^{2+} İYONLARININ HIZLI, GÖRSEL VE SEÇİCİ İZLENMESİ

FAST, VISUAL, AND SELECTIVE MONITORING OF Cu^{2+} BY A BISPHENOL-A-BASED FLUORESCENT PROBE

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Abstract

Copper is the third most abundant essential transition-metal nutrient in the human body, after iron and zinc. However, excessive levels of intracellular Cu^{2+} ions can lead to various health problems and have been associated with diseases, for example, Wilson's, Menkes', Alzheimer's, and Parkinson's diseases (Maheshkumar et al., 2024). Therefore, the development of sensitive methods for Cu^{2+} detection is of considerable importance. Fluorescent probes have attracted significant attention in recent years due to their high sensitivity and rapid response. In this study, a novel bisphenol A-based fluorescent sensor, BEF (4,4'-(propane-2,2-diyl)bis(2-((E)-((4-(phenylamino)phenyl)imino)methyl)phenol)), was developed and synthesized for the monitoring of Cu^{2+}, and its optical sensing properties were investigated. The sensing performance of BEF (5×10^{-5} M) toward various metal ions was investigated in an ethanol/HEPES (60:40, v/v) medium using fluorescence and UV–Vis spectroscopy. Among the tested cations, BEF exhibited a pronounced fluorescence response exclusively toward Cu^{2+} ions. Upon interaction with Cu^{2+}, the fluorescence emission of BEF at approximately 560 nm gradually decreased, which was attributed to a ligand-to-metal charge transfer (LMCT) process. Furthermore, competitive selectivity studies in the presence of various cations demonstrated the high selectivity of BEF toward Cu^{2+}. Fluorescence titration experiments revealed a detection limit of 36 nM for Cu^{2+}, while the binding constant between BEF and Cu^{2+} was determined to be 1.258×10^{7} M^{-2}. Job's method and TOF-MS analyses supported the formation of the BEF–Cu^{2+} complex with a 1:2 stoichiometric ratio. The sensor exhibited a rapid response to Cu^{2+}, reaching a stable response within approximately 1 min. Theoretical calculations further revealed significant changes in the electronic structure of the BEF–Cu^{2+} complex and indicated that complex formation enhances the thermodynamic stability of the system. Overall, these findings demonstrate that BEF is a promising fluorescent sensor for the recognition of Cu^{2+} ions, particularly for analytical applications.

Keywords: Bisphenol-A, Cu^{2+}, Fluorescent sensor, LMCT.

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Maheshkumar P., Nidhi P., Sarita K., Sateesh B., Areti S. 2024. Synthesis and characterization of a rhodamine derivative as a selective switch-on fluorescent sensor for Cu^{2+} ions in aqueous PBS buffer and living cells, *Sensors & Diagnostics.* 3 (3): 412–420, Doi: 10.1039/d3sd00291h.

Abstract

Bakır, insan vücudunda demir ve çinkodan sonra bulunan en bol üçüncü temel geçiş metali besin elementidir. Bununla birlikte, hücre içi Cu^{2+} iyonlarının aşırı düzeyleri çeşitli sağlık sorunlarına yol açabilmekte ve Wilson, Menkes, Alzheimer ve Parkinson hastalıkları gibi hastalıklarla ilişkilendirilmektedir (Maheshkumar ve ark., 2024). Bu nedenle, Cu^{2+} iyonlarının tespitine yönelik hassas yöntemlerin geliştirilmesi büyük önem taşımaktadır. Floresans problar, yüksek hassasiyetleri ve hızlı yanıt vermeleri nedeniyle son yıllarda büyük ilgi görmektedir. Bu çalışmada, Cu^{2+} iyonlarının izlenmesine yönelik yeni bir bisfenol A tabanlı floresans sensör olan BEF [4,4'-(propane-2,2-diyl)bis(2-((E)-((4-(phenylamino)phenyl)imino)methyl)phenol)] geliştirilmiş ve sentezlenmiş; optik algılama özellikleri incelenmiştir. BEF sensörünün (5×10^{-5} M) çeşitli metal iyonlarına karşı algılama performansı, etanol/HEPES (60:40, h/h) ortamında floresans ve UV-Vis spektroskopisi kullanılarak araştırılmıştır. Test edilen katyonlar arasında BEF, yalnızca Cu^{2+} iyonlarına karşı belirgin bir floresans yanıtı göstermiştir. Cu^{2+} ile etkileşim sonucunda, BEF'in yaklaşık 560 nm'deki floresans emisyon şiddeti kademeli olarak azalmış ve bu durum ligand-metal yük transferi (LMCT) süreci ile ilişkilendirilmiştir. Ayrıca, çeşitli katyonların varlığında gerçekleştirilen rekabetçi seçicilik çalışmaları, BEF'in Cu^{2+} iyonlarına karşı yüksek seçicilik gösterdiğini ortaya koymuştur. Floresans titrasyon deneyleri sonucunda BEF sensörünün Cu^{2+} için tayin limiti 36 nM olarak belirlenirken, BEF ile Cu^{2+} arasındaki bağlanma sabiti $1{,}258 \times 10^{7}$ M^{-2} olarak hesaplanmıştır. Job yöntemi ve TOF-MS analizleri, BEF–Cu^{2+} kompleksinin 1:2 stokiyometrik oranda oluştuğunu desteklemiştir. Sensör, Cu^{2+} iyonlarına karşı hızlı bir yanıt göstermiş ve yaklaşık 1 dakika içerisinde kararlı bir yanıta ulaşmıştır. Teorik hesaplamalar, BEF–Cu^{2+} kompleksinin elektronik yapısında önemli değişiklikler meydana geldiğini ve kompleks oluşumunun sistemin termodinamik kararlılığını artırdığını ortaya koymuştur. Elde edilen sonuçlar, BEF'in özellikle analitik uygulamalarda Cu^{2+} iyonlarının seçici ve hassas şekilde tanınması için umut vadeden bir floresans sensör olduğunu göstermektedir.

Anahtar Kelimeler: Bisfenol-A, Cu^{2+}, Floresans sensör, LMCT.

Teşekkür

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MALAHIT YEŞILI BOYASININ TI/IRO₂/RUO₂ ANOT VE TITANYUM KATOT KULLANILARAK ELEKTROKIMYASAL GIDERIMINDE İŞLETME PARAMETRELERININ ETKISI

EFFECT OF OPERATING PARAMETERS ON ELECTROCHEMICAL REMOVAL OF MALACHITE GREEN DYE USING TI/IRO₂/RUO₂ ANODE AND TITANIUM CATHODE

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Abstract

Malachite green is a cationic dye widely used in textiles, leather, paper, and various industrial processes, and its discharge into wastewater can cause significant environmental problems. The chemical structure of dyes and their difficulty in biodegrading necessitate the development of advanced treatment technologies in addition to traditional treatment methods. Electrochemical oxidation processes stand out among these methods due to their high oxidation capacity, ease of process control, and applicability to different pollutants. In this study, the removal of malachite green from model wastewater by electrochemical oxidation was investigated, and the effects of supporting electrolyte type and concentration on process performance were examined. In the experiments, a Ti/IrO_2/RuO_2-coated titanium electrode was used as the anode, while an uncoated titanium electrode was used as the cathode. The experiments were conducted at pH ≈ 7.00 and a current density of 1.218 mA/cm². In the first stage, NaCl, KCl, $NaNO_3$, and Na_2SO_4 were used as supporting electrolytes at a concentration of 7.5 mM, while the initial dye concentration was maintained at 100 mg/L. The highest malachite green removal efficiency was achieved with NaCl (98.753%), followed by KCl (96.288%), $NaNO_3$ (78.258%), and Na_2SO_4 (63.594%). The differences in removal performance among the electrolytes are thought to be associated with their effects on solution ionic conductivity, electrochemical reactions at the electrode surface, and the formation of oxidative species. Furthermore, NaCl was selected as the supporting electrolyte for subsequent experiments due to its high removal efficiency and relatively low energy consumption. In the second stage, the effect of NaCl concentration was investigated at 5.0, 7.5, 10.0, and 12.5 mM, while the other operating conditions were kept constant. The results indicated that electrolyte concentration affects process performance by influencing solution ionic conductivity and current transfer within the electrochemical cell. Overall, the electrochemical oxidation process using a Ti/IrO_2/RuO_2-coated titanium anode and an uncoated titanium cathode demonstrated high performance for malachite green removal. The findings also highlighted the importance of evaluating removal efficiency and energy consumption together for process optimization and sustainability.

Keywords: Malachite green; Electrochemical oxidation; Supporting electrolyte; Energy consumption, Support Electrolyte

Özet

Malahit yeşili, tekstil, deri, kâğıt ve çeşitli endüstriyel proseslerde kullanılan katyonik karakterli bir boyar madde olup, atıksulara deşarj edilmesi durumunda çevresel sorunlara neden olabilmektedir. Boyar maddelerin kimyasal yapıları ve biyolojik olarak parçalanmalarının güç olması, geleneksel arıtma yöntemlerinin yanı sıra ileri arıtma teknolojilerinin geliştirilmesini gerekli kılmaktadır. Elektrokimyasal oksidasyon prosesleri, yüksek oksidasyon kapasitesi, proses kontrolünün kolaylığı ve farklı kirleticilere

uygulanabilirliği nedeniyle bu yöntemler arasında öne çıkmaktadır. Bu çalışmada, malahit yeşili içeren model atıksuyun elektrokimyasal oksidasyon yöntemiyle giderimi araştırılmış ve proses performansı üzerinde etkili olan destek elektrolit türü ve konsantrasyonu incelenmiştir. Deneylerde anot olarak Ti/IrO_2/RuO_2 kaplı titanyum, katot olarak ise kaplanmamış titanyum elektrot kullanılmıştır. Deneyler pH≈7,00 ve 1,218 mA/cm² akım yoğunluğunda gerçekleştirilmiştir. İlk aşamada, başlangıç boya konsantrasyonu 100 mg/L ve elektrolit konsantrasyonu 7,5 mM olacak şekilde NaCl, KCl, $NaNO_3$ ve Na_2SO_4 kullanılmıştır. En yüksek malahit yeşili giderim verimi %98,753 ile NaCl kullanımında elde edilirken, bunu KCl (%96,288), $NaNO_3$ (%78,258) ve Na_2SO_4 (%63,594) takip etmiştir. Elektrolit türlerinin giderim performansındaki farklılığın; çözeltinin iyonik iletkenliği, elektrot yüzeyindeki elektrokimyasal reaksiyonlar ve oksidatif türlerin oluşumu üzerindeki etkilerinden kaynaklandığı düşünülmektedir. Ayrıca, NaCl'nin yüksek giderim verimi ve düşük enerji tüketimi sağlaması nedeniyle sonraki deneyler için destek elektrolit olarak seçilmiştir. İkinci aşamada NaCl konsantrasyonunun etkisi 5,0, 7,5, 10,0 ve 12,5 mM değerlerinde incelenmiştir. Diğer çalışma koşulları sabit tutulmuştur. Elde edilen sonuçlar, elektrolit konsantrasyonunun çözeltinin iyonik iletkenliği ve akım transferi üzerinden proses performansını etkilediğini göstermiştir. Genel olarak, Ti/IrO_2/RuO_2 anot ve titanyum katot kullanılan elektrokimyasal oksidasyon prosesinin malahit yeşili gideriminde yüksek performans gösterdiği ve giderim verimi ile enerji tüketiminin birlikte değerlendirilmesinin proses optimizasyonu ve sürdürülebilirliği açısından önemli olduğu sonucuna varılmıştır.

Anahtar kelimeler: Malahit yeşili; Elektrokimyasal oksidasyon; Destek elektrolit; Enerji tüketimi, Destek Elektrolit

TÜRKİYE'DE TARIMI YAPILAN DARI TÜRLERİ (*Panicum* spp.) VE YABANCI OT MÜCADELESİ

MILLET SPECIES (Panicum spp.) CULTIVATED IN TÜRKİYE AND WEED CONTROL

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Abstract

Grains are a staple food for a large portion of the world's population. Both in developed and developing countries, a significant portion of the protein and mineral requirements necessary for human nutrition are met directly from grains or grain products. It is believed that climate change, drought, population growth, and many other factors currently being experienced will pose a major threat to agricultural production and food security worldwide in the future, and that people living in arid and semi-arid regions will be most severely affected by this negative situation. For this reason, crops that can be grown in arid and semi-arid conditions are becoming increasingly important, and research on drought-resistant crops is increasing day by day. Millet is one of the most important drought-resistant plants. Furthermore, compared to major cereals, they are notable for their resistance to diseases and pests, their short growing season, and their productivity in drought-prone conditions. The most widely cultivated species worldwide are Panicum miliaceum L. (millet) and Panicum italicum L. (Italian millet). The direct damage caused by weeds to cereals stems from their competition with the crop plant for essential mineral nutrients, water, light, and living space. Product losses increase, especially when weeds that germinate and develop early are present. Scientific studies on chemical control of millet are being conducted worldwide, and there are licensed herbicides. However, no such studies have been conducted in our country, and there are no licensed plant protection products. One of the most widely used herbicides in millet cultivation areas around the world and in our country is 2,4-D. In our country, 2,4-D, known as ester, has been recorded as not causing phytotoxicity in plants when used at the appropriate time, as shown in studies conducted around the world, and as showing a positive increase in grain and stalk yield.

Keywords: Millet, *Panicum* spp., Weed, Management, Türkiye.

Özet

Tahıllar dünya nüfusunun büyük bir bölümünün temel gıda maddesidir. Hem gelişmiş ülkelerde hem de gelişmekte olan ülkelerde insan beslenmesinde gerekli olan protein ve mineral ihtiyacının önemli bir kısmı direk tahıllardan veya tahıl ürünlerinden karşılanmaktadır. Günümüzde yaşanan iklim değişiklikleri, kuraklık, nüfus artışı vb. birçok etkenlerin tarımsal üretim ve gıda güvenliği açısından gelecekte bütün dünyada büyük tehdit oluşturacağı ve bu olumsuz durumdan özellikle kurak ve yarı kurak bölgelerde yaşayan insanların en yüksek düzeyde etkileneceği düşünülmektedir. Bu nedenle kurak ve yarı kurak şartlarda yetişebilen ürünler her geçen gün biraz daha önem kazanmakta ve kurak şartlara dayanıklı ürünlerle ilgili araştırmalar her geçen gün artmaktadır. Darılar, kuraklığa dayanıklı bitkilerden en önemlilerinden birisidir. Ayrıca, önemli tahıllarla kıyaslandığında hastalık ve zararlılara dayanıklılığı, kısa yetiştirme mevsimine sahip olması ve kuraklık sorunu olan koşullardaki verimliliği ile dikkat çekmektedirler. Dünya genelinde en fazla yetiştiriciliği yapılan türler; *Panicum miliaceum* L(Arnavut darısı), *Panicum italicum* L. (İtalya kirpi darı) dır. Yabancı otların tahıllara doğrudan zararları, kültür bitkisi için gerekli olan mineral besin maddeleri, su, ışık ve yaşama yerine ortak olmalarından doğmaktadır. Özellikle erken çimlenip gelişen yabancı otların bulunması durumunda, ürün kayıpları artmaktadır. Dünyada darı da kimyasal mücadele ile ilgili bilimsel çalışmalar yapılıyor olup

ruhsatlandırılmış herbisitler vardır. Ancak ülkemizde böyle bir çalışma olmayıp ruhsatlandırılmış bir bitki koruma ürünü bulunmamaktadır. Dünyada ve ülkemizde darı tarımı yapılan alanlarda en çok kullanılan herbisitlerden birisi 2,4-D dir. Ülkemizde ester olarak bilinen 2,4-D; kullanımı ve dünyada yapılan çalışmalarda uygun zamanda kullanıldığı takdirde hem bitkide fitotoksisite oluşturmamakta hem de dane ve sap veriminde olumlu artış gösterdiği kaydedilmiştir.

Anahtar kelimeler: Darı, *Panicum* spp., Yabancı ot, Mücadele, Türkiye.

ORTAM SICAKLIĞININ ELEKTRİKLİ TAŞITLARDA HVAC ENERJİ TÜKETİMİ VE SÜRÜŞ MENZİLİNE ETKİSİ

EFFECT OF AMBIENT TEMPERATURE ON HVAC ENERGY CONSUMPTION AND DRIVING RANGE IN ELECTRIC VEHICLES

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Abstract

In electric vehicles, heating, ventilation, and air conditioning (HVAC) systems can increase energy consumption and reduce driving range depending on ambient temperature. This study investigates the effects of ambient temperature on HVAC energy consumption, specific energy consumption, and estimated driving range. A MATLAB-based REVM-60 model incorporating vehicle longitudinal dynamics, resistance forces, electric motor, battery, and regenerative braking was used in the analysis. Simulations were performed using a C-segment reference electric vehicle and the WLTP driving cycle. Ambient temperature was varied from -15 °C to +40 °C in 5 °C increments, with a target cabin temperature of 22 °C. A PTC heater was employed at low temperatures, while an air conditioning system was activated at high temperatures.

Under the reference condition of 20 °C, HVAC energy consumption, specific energy consumption, and estimated driving range were 0 kWh, 14.76 kWh/100 km, and 406.5 km, respectively. As the ambient temperature decreased to -15 °C, HVAC energy consumption increased to 1.944 kWh. Consequently, specific energy consumption increased to 21.40 kWh/100 km, while the estimated driving range decreased to 280.4 km. Under this condition, the range loss relative to the reference temperature was 31.0%. At 40 °C, HVAC energy consumption, specific energy consumption, and estimated driving range were 0.521 kWh, 16.53 kWh/100 km, and 363.0 km, respectively, with a range loss of 10.7%.

The results demonstrated that low temperatures have a more pronounced effect on vehicle energy consumption and driving range than high temperatures. The primary reason for this difference is the high HVAC energy demand associated with PTC heating under cold conditions. The findings indicate that ambient temperature-dependent HVAC energy demand should be considered when evaluating the energy and range performance of electric vehicles.

Keywords: Electric Vehicle, HVAC, Ambient Temperature, Energy Consumption, Driving Range.

Özet

Elektrikli taşıtlarda ısıtma, havalandırma ve iklimlendirme (HVAC) sistemleri, dış ortam sıcaklığına bağlı olarak enerji tüketimini artırmakta ve sürüş menzilini azaltmaktadır. Bu çalışmada, dış ortam sıcaklığının HVAC enerji tüketimi, özgül enerji tüketimi ve tahmini sürüş menzili üzerindeki etkisi incelenmiştir. Bu analizlerde, taşıt boylamsal dinamiği, direnç kuvvetleri, elektrik motoru, batarya ve rejeneratif frenleme bileşenlerini içeren MATLAB tabanlı REVM-60 modeli kullanılmıştır. Simülasyonlar, C-segmenti bir referans elektrikli taşıt ve WLTP sürüş çevrimi kullanılarak gerçekleştirilmiştir. Dış ortam sıcaklığı -15 °C ile +40 °C arasında 5 °C aralıklarla değiştirilmiştir. Hedef kabin sıcaklığı 22 °C olarak belirlenmiştir. Düşük sıcaklıklarda PTC ısıtıcı, yüksek sıcaklıklarda ise klima sistemi kullanılmıştır.

Referans koşul olarak belirlenen 20 °C'de HVAC enerji tüketimi 0 kWh, özgül enerji tüketimi 14.76 kWh/100 km ve tahmini sürüş menzili 406.5 km'dir. Ortam sıcaklığının -15 °C'ye düşmesiyle HVAC enerji tüketimi 1.944 kWh'ye yükselmiştir. Buna bağlı olarak, özgül enerji tüketimi 21.40 kWh/100

km’ye çıkmış ve tahmini sürüş menzili 280.4 km’ye gerilemiştir. Bu koşulda referans sıcaklığa göre menzil kaybı %31.0’dır. Ortam sıcaklığının 40 °C’ye yükselmesiyle HVAC enerji tüketimi 0.521 kWh, özgül enerji tüketimi 16.53 kWh/100 km ve tahmini sürüş menzili 363.0 km olarak belirlenmiştir. Bu koşulda menzil kaybı %10.7 olarak hesaplanmıştır.

Sonuçlar, düşük sıcaklıkların taşıt enerji tüketimi ve menzili üzerinde yüksek sıcaklıklara göre daha belirgin bir etkiye sahip olduğunu göstermiştir. Bu farkın temel nedeni, düşük sıcaklıklarda PTC ısıtma sisteminin oluşturduğu yüksek HVAC enerji talebidir. Bulgular, dış ortam sıcaklığına bağlı HVAC yükünün elektrikli taşıtların enerji ve menzil performansının değerlendirilmesinde dikkate alınması gerektiğini göstermektedir.

Anahtar kelimeler: Elektrikli Taşıt, HVAC, Dış Ortam Sıcaklığı, Enerji Tüketimi, Sürüş Menzili.

TD3 TABANLI DERIN PEKISTIRMELI ÖGRENME KULLANILARAK HATLAR ARASI ARIZA KOSULLARINDA ŞEBEKE BAGLANTILI BIR FOTOVOLTAIK SISTEMIN LVRT YETENEGININ GELISTIRILMESI

ENHANCING THE LVRT CAPABILITY OF A GRID-CONNECTED PHOTOVOLTAIC SYSTEM UNDER LINE-TO-LINE FAULT CONDITIONS USING TD3-BASED DEEP REINFORCEMENT LEARNING

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Özet

Fotovoltaik sistemlerin elektrik şebekelerine entegrasyonunun giderek artması, şebekede meydana gelen bozucu etkiler sırasında bu sistemlerin kararlılığını ve işletme sürekliliğini sağlayabilecek gelişmiş kontrol stratejilerinin geliştirilmesini gerekli kılmaktadır. Bu bozucu etkiler arasında, iki fazlı arızalar, şebekeye bağlı fotovoltaik sistemlerin performansının değerlendirilmesi açısından özellikle önemli olan asimetrik bozuculardan biridir. Simetrik bir bozucu durum oluşturan üç fazlı arızanın aksine, iki fazlı arıza gerilimlerde dengesizliğe ve negatif sıra bileşenlerinin ortaya çıkmasına neden olmakta; bu durum sistemin dinamiklerini daha karmaşık hâle getirerek güç dönüştürücüsü üzerinde ilave kısıtlamalar oluşturmaktadır. Bu bağlamda, bu çalışmada, iki fazlı bir arızaya maruz kalan şebekeye bağlı üç fazlı bir fotovoltaik sistemin Düşük Gerilimde Çalışmayı Sürdürme (Low Voltage Ride Through, LVRT) kapasitesini geliştirmek amacıyla, İkiz Gecikmeli Derin Deterministik Politika Gradyanı (Twin Delayed Deep Deterministic Policy Gradient, TD3) algoritmasına dayalı bir derin pekiştirmeli öğrenme stratejisi önerilmektedir.

İncelenen sistem MATLAB/Simulink ortamında modellenmiş ve simüle edilmiştir. TD3 tabanlı strateji, arıza süresi ve arızanın giderilmesini takip eden toparlanma süreci boyunca sistemin elektriksel durumuna bağlı olarak güç dönüştürücüsünün kontrolünü dinamik olarak uyarlamaktadır. Derin pekiştirmeli öğrenme yaklaşımının katkısını değerlendirmek amacıyla, TD3 ile elde edilen performanslar, oransal-integral (PI) düzenleyicilere dayalı geleneksel bir kontrol stratejisinin sonuçlarıyla karşılaştırılmıştır. Karşılaştırmada özellikle aktif ve reaktif güç, yükselme zamanı, yerleşme zamanı ve arızanın giderilmesinin ardından sistemin kararlı çalışma rejimine hızlı bir şekilde yeniden ulaşma kapasitesi dikkate alınmıştır.

Simülasyon sonuçları, TD3 tabanlı kontrol stratejisinin geleneksel PI kontrolüne kıyasla şebekedeki hızlı ve asimetrik değişimlere daha iyi uyum sağladığını göstermektedir. Elde edilen bulgular, derin pekiştirmeli öğrenmeye dayalı uyarlamalı bir kontrol stratejisinin, fotovoltaik sistemlerin gerçekçi asimetrik şebeke bozucuları karşısındaki LVRT kapasitesinin güçlendirilmesinde önemli bir potansiyele sahip olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Fotovoltaik sistem, LVRT, iki fazlı arıza, TD3, derin pekiştirmeli öğrenme, PI kontrolü, elektrik şebekesi.

Abstract

The increasing integration of photovoltaic (PV) systems into electrical grids necessitates the development of advanced control strategies capable of maintaining system stability and operational

continuity during grid disturbances. Among these disturbances, two-phase faults represent particularly relevant asymmetric conditions for evaluating the performance of grid-connected photovoltaic systems. Unlike three-phase faults, which constitute a symmetrical disturbance, two-phase faults lead to voltage unbalance and the emergence of negative-sequence components, thereby increasing the complexity of the system dynamics and imposing additional constraints on the power converter. In this context, this study proposes a deep reinforcement learning-based control strategy employing the Twin Delayed Deep Deterministic Policy Gradient (TD3) algorithm to enhance the Low Voltage Ride Through (LVRT) capability of a three-phase grid-connected photovoltaic system subjected to a two-phase fault.

The investigated system is modeled and simulated in the MATLAB/Simulink environment. The TD3-based strategy dynamically adapts the control of the power converter according to the electrical state of the system throughout the fault period and the subsequent recovery phase. To assess the contribution of the deep reinforcement learning approach, the performance obtained with TD3 is compared with that of a conventional control strategy based on proportional-integral (PI) regulators. The comparison focuses particularly on active and reactive power responses, rise time, settling time, and the ability of the system to rapidly restore stable operating conditions following fault clearance.

The simulation results demonstrate that the TD3-based control strategy provides improved adaptation to rapid and asymmetric grid disturbances compared with conventional PI control. The findings highlight the significant potential of an adaptive deep reinforcement learning-based control strategy for enhancing the LVRT capability of photovoltaic systems under asymmetric grid disturbances.

Keywords: Photovoltaic system, LVRT, two-phase fault, TD3, deep reinforcement learning, PI control, electrical grid.

ALGORITHMIC PERSPECTIVES IN BIOINFORMATICS: INTERPRETING EMERGING TRENDS IN BIOTECHNOLOGY

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ABSTRACT

Bioinformatics algorithms underlie much of modern life sciences research. They include methods for sequence alignment, structural modeling, statistical and machine learning analysis, and integration of large, heterogeneous datasets, and they turn raw biological measurements into results researchers can interpret and test further. This presentation looks at how these methods apply to three areas of biotechnology.CRISPR-Cas gene editing depends on computational tools at nearly every stage: guide RNA design, off-target prediction, and analysis of genome-wide screening data. These tools help researchers choose editing targets with fewer unintended effects and interpret the results of large screens more efficiently. AI-based drug discovery uses deep learning models, including generative chemistry methods and protein structure prediction tools, to identify drug targets, design candidate molecules, and estimate how strongly a molecule might bind its target. Compared to traditional discovery pipelines, these methods can narrow a large chemical search space to a smaller set of candidates worth testing in the lab, though experimental validation is still required at every step. A newer and less established application, AI-designed bacteriophages, uses similar computational methods, including sequence and structure modeling, to engineer or optimize phage genomes for use against specific bacterial targets. This work is still largely experimental, but it responds to a serious and increasingly common problem: resistance to conventional antibiotics. Across all three areas, the same class of algorithms used to analyze existing biological data is also being used to generate new candidates, whether edited genomes, drug molecules, or phage designs, for experimental testing. The presentation ends by considering what these applications require next: closer collaboration between computational and experimental researchers, more rigorous validation of algorithm-generated predictions, and continued work on reproducibility as these tools move from computational models toward laboratory and, eventually, clinical use.

Keywords: Bioinformatics algorithms, CRISPR-Cas, AI-generated drug discovery, AI-designed bacteriophages, antibiotic resistance

TECHNOLOGICAL AND ENVIRONMENTAL ASSESSMENT OF SHALLOT *(ALLIUM ASCALONICUM)* FARMING SYSTEMS IN CAN THO CITY, VIETNAM: ENGINEERING SOLUTIONS AND RESEARCH GAPS

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Abstract

This review comprehensively evaluates the engineering, bio-processing, environmental, and socio-economic dimensions of the specialized shallot (*Allium ascalonicum*) farming ecosystem in Can Tho City (Vinh Chau area), Vietnam. Resource-intensive cultivation practices extract up to 13.2 million cubic meters of groundwater per main cropping season, severely exacerbating aquifer depletion and coastal land subsidence, while heavy reliance on synthetic agrochemicals induces severe soil degradation and triggers destructive pathogen outbreaks such as *Erwinia carotovora* and *Fusarium oxysporum*. To mitigate these pressing ecological challenges, modern engineering and technological innovations are systematically examined: drip irrigation technology cuts agricultural groundwater consumption by over 40% while enhancing bulb yield and quality by 10–20%; biological preservation using shrimp-shell chitosan operationalizes a circular economy model; ultrasonic-assisted extraction (UAE) optimized via response surface methodology (RSM) yields high total phenolic content (17.28 mg GAE/g) from medicinal black shallots; and specialized plant-growth-promoting rhizobacteria (PGPR) strains (*Enterobacter ludwigii* and *Pseudomonas sp.*) successfully rehabilitate degraded Arenosols. Economically, exceptionally high commercial returns are severely constrained by extreme market price volatility, informal credit dependencies, and significant post-harvest losses. Socially, recurring crop failures drive agricultural landlessness, transforming indigenous Khmer landowners into a precarious seasonal labor force. Despite these technical advancements, critical research gaps persist, notably the absence of integrated Socio-Ecological Systems (SES) frameworks, severe microfinancial barriers hindering technology adoption, and unassessed spatial-administrative reconfigurations stemming from regional boundary management shifts. This study establishes an essential scientific foundation for interdisciplinary engineering policies and sustainable technological interventions, facilitating the systemic transition of a vulnerable agricultural zone into a smart, circular, and climate-resilient production ecosystem.

Keywords: *Allium ascalonicum*, Environmental engineering, Drip irrigation technology, Bio-processing, Groundwater depletion, Circular agriculture, Socio-Ecological Systems (SES).

TICARI ARAÇ KONFIGÜRASYON KURALLARINDA ARTIKLIK TESPITI VE GÖRSELLEŞTIRME

REDUNDANCY DETECTION AND VISUALIZATION IN COMMERCIAL VEHICLE CONFIGURATION RULES

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ÖZET

Ağır ticari araç üretiminde bir parçanın hangi araçlara monte edileceği, kod şartı adı verilen Boole ifadeleriyle tanımlanır. Bu ifadeler mühendisler tarafından elle yazılır ve ürün yelpazesi genişledikçe yeni seçenekler eklenerek büyür; zamanla, mantıksal olarak doğru olmakla birlikte kuralın seçtiği araç kümesine hiçbir katkısı olmayan alternatif dallar barındıran, uzun ve okunması güç kurallar ortaya çıkar. Bu tür artıklık kuralın davranışını değiştirmediği için fark edilmeden birikir; buna karşılık gözden geçirme süresini uzatır ve kural üzerinde değişiklik yapılırken hata olasılığını artırır. Mevcut yardımcı araçlar ise yalnızca "bu parça bu araca düşer mi" sorusunu yanıtlamakta, kuralın yapısı hakkında bilgi vermemektedir. Bu çalışmada, kod şartlarını çözümleyen ve görselleştiren bir masaüstü uygulaması sunulmaktadır. Uygulama kuralı sözdizimi ağacına dönüştürmekte, olumsuzlamaları De Morgan kurallarıyla yaprak düzeyine indirmekte, ifadeyi açık koşul satırlarına açmakta ve yutma yasasını uygulayarak hiçbir yeni araç konfigürasyonu eklemeyen dalları belirlemektedir. Sadeleştirilmiş kural,

kullanıcının alışkın olduğu özgün yazım biçimi korunarak geri verilmektedir. Kural ayrıca seri-paralel bir merdiven diyagramı olarak çizilmekte; olumsuz yazılmış kodlar ayrı bir görsel dille işaretlenmekte, her koşulun sağlanıp sağlanmadığı düz metinle açıklanmakta ve kod açıklamaları diyagram üzerinde gösterilmektedir. Uygulama, kurulum ve yönetici yetkisi gerektirmeden çevrimdışı çalışacak biçimde paketlenmiştir. Yöntem, denetimli biçimde artıklık enjekte edilmiş sentetik bir kural kümesi üzerinde sınanmıştır; enjekte edilen gereksiz dalların tamamı belirlenmiş, yapılan hiçbir sadeleştirme kuralın anlamını değiştirmemiş ve işlem süresi kural başına milisaniye düzeyinde kalmıştır. Gerçek kurallar üzerinde yapılan incelemede ise bazı kuralların alternatif dallarının bir kısmının diğerleri tarafından tümüyle kapsandığı ve kuralın seçtiği araç kümesi değişmeden önemli ölçüde kısaltılabildiği; ayrıca mevcut açılım mekanizmasının yer yer birbirinin tekrarı olan koşul satırları ürettiği görülmüştür. Yaklaşımın, kural gözden geçirme süresini kısaltarak ve kuralın yapısını görünür kılarak bakım sürecine katkı sağlaması beklenmektedir.

Anahtar kelimeler: ürün konfigürasyonu, Boole ifadeleri, kural sadeleştirme, yutma yasası, artıklık tespiti, görselleştirme, mühendislik yazılımı

ABSTRACT

In heavy commercial vehicle manufacturing, the set of vehicles a part is mounted on is defined by Boolean expressions known as code conditions. Written manually and extended as new options enter the product range, they accumulate alternative branches that are logically correct yet add no vehicle to the set the rule selects, producing long and hard-to-read rules. Because such redundancy does not alter behaviour, it goes unnoticed, yet it lengthens review time and increases the chance of error when a rule is modified. Existing tools answer only whether a part applies to a vehicle, revealing nothing about the structure of the rule. This study presents a desktop application that analyses and visualises code conditions. It converts a rule into a syntax tree, pushes negations down to the leaves using De Morgan's laws, expands the expression into explicit condition lines, and applies the absorption law to identify branches that admit no new vehicle configuration. The simplified rule is returned in the original notation the user is accustomed to. Each rule is also rendered as a series-parallel ladder diagram in which negated codes receive a distinct visual treatment and code descriptions appear beside each element, with every condition explained in plain language. The application runs offline without installation or administrator rights. The method was tested on a synthetic rule set with controlled redundancy injection; every injected branch was identified, no simplification altered the meaning of a rule, and processing time remained on the order of milliseconds per rule. Examination of real rules showed that some branches were entirely subsumed by others, allowing substantial shortening without changing the selected vehicle set, and that the existing expansion mechanism occasionally produces duplicate condition lines. The approach is expected to support rule maintenance by shortening review time and making rule structure visible.

Keywords: product configuration, Boolean expressions, rule simplification, absorption law, redundancy detection, visualization, engineering software

DIAGNOSTIC EFFICACY AND PRECISION OF ADVANCED MAGNETIC RESONANCE IMAGING (MRI) IN EARLY DETECTION OF MUSCULOSKELETAL SOFT TISSUE PATHOLOGIES

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Field of Study: Medicine / Diagnostic Radiology

Abstract

Introduction & Background Musculoskeletal disorders and soft tissue pathologies represent a leading cause of chronic pain, physical impairment, and reduced quality of life globally. Precise and early diagnosis is critical for determining appropriate therapeutic interventions and preventing long-term disability. While conventional imaging modalities, such as radiography and ultrasonography, offer baseline diagnostic value, they frequently exhibit limitations in visualizing subtle intra-articular lesions, deep soft tissue abnormalities, and early-stage inflammatory or degenerative changes. Magnetic Resonance Imaging (MRI) has emerged as the cornerstone of non-invasive musculoskeletal diagnostics due to its superior soft-tissue contrast resolution, multiplanar imaging capabilities, and absence of ionizing radiation.

Objective This study aims to evaluate the diagnostic efficacy, accuracy, and clinical impact of high-field MRI (1.5T and 3.0T) in identifying complex musculoskeletal soft tissue injuries and pathologies, comparing magnetic resonance findings with post-operative and arthroscopic outcomes.

Materials & Methods A prospective observational study was conducted involving 110 patients who presented with non-traumatic and post-traumatic persistent joint pain and soft tissue swelling between 2024 and 2025. All participants underwent high-resolution multi-sequence MRI protocols, including T1-weighted, T2-weighted, Proton Density (PD) fat-suppressed, and diffusion-weighted imaging (DWI). Imaging results were systematically analyzed for diagnostic sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) using arthroscopic visualization or surgical histopathology as the diagnostic gold standard.

Results High-field MRI demonstrated exceptional diagnostic precision across various soft tissue structures:

- **Ligamentous & Meniscal Lesions:** MRI achieved a diagnostic sensitivity of 94.8% and specificity of 92.3% for detecting anterior cruciate ligament (ACL) tears and complex meniscal degenerations.
- **Cartilage and Bone Marrow Edema:** Multi-sequence protocols allowed early detection of focal articular cartilage defects and subchondral bone marrow edema prior to structural radiographic changes.
- **Tendinopathies & Myopathies:** MRI effectively differentiated between high-grade partial muscle tears, tendinosis, and full-thickness tendon ruptures with an overall diagnostic accuracy of 95.5%.
- **Surgical Correlation:** High-field MRI findings demonstrated strong statistical concordance with surgical/arthroscopic observations ($p<0.001$).

Conclusion High-field Magnetic Resonance Imaging is an indispensable diagnostic modality for evaluating musculoskeletal and soft tissue pathologies. Its high sensitivity and specificity enable early detection of structural abnormalities, thereby facilitating timely conservative management or precise pre-operative planning. The integration of advanced MRI sequences significantly enhances diagnostic confidence and improves overall patient outcomes.

Keywords: Magnetic Resonance Imaging (MRI), musculoskeletal imaging, soft tissue pathologies

ARTIFICIAL INTELLIGENCE-BASED PREDICTION OF MECHANICAL, THERMAL, AND ELECTRICAL PROPERTIES OF ENGINEERING MATERIALS

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Abstract

The accurate prediction of mechanical, thermal, and electrical properties is fundamental to the selection, design, processing, and optimization of engineering materials for structural, energy, electronic, aerospace, automotive, and manufacturing applications. Conventional experimental characterization and high-fidelity computational techniques can provide reliable material-property information but are often associated with substantial time, cost, computational requirements, and iterative laboratory procedures. Artificial intelligence (AI), particularly machine learning (ML), provides an alternative data-driven paradigm capable of learning complex relationships among material composition, crystal structure, processing conditions, microstructural descriptors, and engineering properties. This study develops a computational AI-based framework for predicting multiple engineering-material properties using composition-, structure-, and process-related descriptors. The proposed methodology integrates data preprocessing, feature engineering, feature selection, supervised learning, hyperparameter optimization, and model interpretation. Random Forest, Support Vector Regression, Artificial Neural Network, and Extreme Gradient Boosting (XGBoost) models are comparatively evaluated using Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and coefficient of determination (R^2). The generated computational experiment indicates that ensemble and nonlinear learning models can provide strong predictive capability across the three property domains, with XGBoost producing the most consistent overall performance. The framework further demonstrates how explainable AI can identify influential material and processing variables, thereby supporting interpretable materials design. The study contributes an integrated computational pathway for accelerating material screening, reducing dependence on repeated experimental trials, and supporting data-driven engineering-material development.

Keywords: Artificial Intelligence; Electrical Properties; Machine Learning; Mechanical Properties.

POMPAJ DEPOLAMALI HİDROELEKTRİK SANTRALLERDE POMPA GÜCÜNÜN YÜZER GÜNEŞ ENERJİ SANTRALLERİNDEN KARŞILANMASI

FLOATING PHOTOVOLTAIC INTEGRATION FOR PUMPING POWER SUPPLY IN PUMPED STORAGE HYDROPOWER PLANTS

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Abstract

In mitigating supply-demand mismatches and frequency instabilities encountered during the grid integration of renewable energy sources, Pumped Storage Hydropower (PSH) plants stand out as large-scale and fast-responding energy storage solutions. In conversion projects of existing dam-type hydropower plants into PSH systems, the requirement for constructing reservoirs from scratch is eliminated; however, the substantial pumping power needed to convey water from the lower to the upper reservoir constitutes a significant operational expenditure. Supplying this pumping power via a Floating Photovoltaic (FPV) system installed on the reservoir surface provides an innovative approach by reducing the grid load and offering zero-marginal-cost energy generation when the pumping demand is fully met by the FPV system. The design of FPV systems utilizes completely idle water surfaces, thereby bypassing the land occupation challenges associated with ground-mounted PV systems, such as high land acquisition costs and extensive excavation, as well as preventing the potential destruction of existing habitats during these operations. Covering the reservoir surface with PV modules significantly reduces evaporation losses, thereby contributing to the preservation of the hydraulic water volume required by the PSH in turbining mode. Furthermore, the natural cooling effect provided by the water lowers module operating temperatures, thereby enhancing panel efficiency, while the shared utilization of existing hydropower infrastructure substantially reduces capital expenditures. In conclusion, the hybrid architecture formed by converting existing dam-type hydropower plants into PSH systems and instaling FPV systems on their reservoirs offers a innovative engineering approach that combines the storage flexibility of hydropower with the low-cost generation capability of photovoltaics. In this study, the integration of FPV systems into existing reservoirs through the conversion of hydropower plants into PSH was evaluated from various aspects and also the advantages and disadvantages offered by the system were comparatively analyzed with traditional ground-mounted PV applications.

Keywords: Pumped Storage Hydropower, Floating Photovoltaic System, Energy Storage Systems, Hybrid Energy Systems, Renewable Energy Sources.

Özet

Yenilenebilir enerji kaynaklarının şebeke entegrasyonunda karşılaşılan arz-talep uyumsuzluklarının ve frekans kararsızlıklarının giderilmesinde Pompaj Depolamalı Hidroelektrik Santraller (PDHES) büyük ölçekli ve hızlı yanıt kabiliyetli depolama çözümleri olarak öne çıkmaktadır. Mevcut baraj tipi hidroelektrik santrallerin PDHES'e dönüştürülmesi projelerinde, sıfırdan rezervuar inşası gereksinimi ortadan kalkmakta, ancak suyun alt rezervuardan üst rezervuara basılması için ihtiyaç duyulan yüksek pompa gücü ciddi bir işletme maliyeti oluşturmaktadır. Bu pompa gücünün rezervuar yüzeyine kurulacak Yüzer Güneş Enerjisi Santrali (YGES) ile karşılanması hem şebekenin yükünü azaltması hem de pompa gücünün tamamının YGES tarafından karşılanabildiği durumlarda sıfır maliyetli enerji

üretimi ile yenilikçi bir yaklaşım sunulabilmektedir. YGES'lerin tasarımında tamamen atıl su yüzeylerinin kullanılması sayesinde karasal güneş enerjisi santrallerinin gerektirdiği yüksek kamulaştırma maliyetleri, hafriyat gibi arazi işgali problemleri ve bu işlemler esnasında meydana gelebilecek mevcut habitatın tahribata uğraması ihtimalinin önüne geçilebilmektedir. Göl yüzeyinin panellerle kaplanması, buharlaşma kayıplarını ciddi oranlarda azaltarak PDHES'lerin türbinleme modunda ihtiyaç duyduğu hidrolik su kütlesinin korunmasına katkı sağlamaktadır. Ayrıca suyun sağladığı doğal soğutma etkisi, panel çalışma sıcaklıklarını düşürerek panellerde verim artışı sağlamakta ve mevcut hidroelektrik santral altyapısının ortak kullanımı ilk yatırım harcamalarını düşürmektedir. Sonuç olarak, mevcut baraj tipi hidroelektrik santrallerin PDHES'e dönüştürülmesi ve hidroelektrik santrallerin rezervuar alanına YGES kurulması ile oluşan hibrit yapı, hidroelektrik depolama esnekliği ile fotovoltaik üretimin düşük maliyetli gücünü birleştiren bir mühendislik yaklaşımı sunmaktadır. Bu çalışmada, hidroelektrik santrallerin PDHES'e dönüştürülmesiyle mevcut rezervuarlara YGES entegrasyonu farklı açılardan değerlendirilmiş olup sistemin sunduğu avantaj ve dezavantajlar geleneksel karasal GES uygulamalarıyla karşılaştırmalı olarak analiz edilmiştir.

Anahtar kelimeler: Pompaj Depolamalı Hidroelektrik Santraller, Yüzer Güneş Enerji Sistemleri, Enerji Depolama Sistemleri, Hibrit Enerji Sistemleri, Yenilenebilir Enerji Kaynakları.

İKİ SEVİYELİ BLOK YÜKLEME ALTINDA YORULMA ÖMRÜ TAHMİNİ İÇİN CHABOCHE BİLGİSİYLE DESTEKLENEN SİNİR AĞI

CHABOCHE INFORMED NEURAL NETWORK FOR FATIGUE LIFE PREDICTION UNDER TWO LEVEL BLOCK LOADING

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Abstract

Fatigue life under block loading depends on stress level, loading order, and block duration. This study evaluates a Chaboche informed neural network using rotating bending data for A37JC steel. The comparison includes an experimental S N anchored Chaboche damage curve approach, a scratch artificial neural network, and the informed network. The damage curve approach supplies a nonlinear sequence relation as a soft residual. It is treated as one possible accumulation rule. The dataset contains 48 completed two block failures in rolling and transverse orientations. Both neural models predict remaining second block life from orientation, ordered stress amplitudes, and first block cycles. They use the same small architecture, five fixed folds, three initialization seeds, and nested 100, 50, and 20 percent labelled subsets. Performance is measured by held out root mean square error in log10 cycles. At 100 percent labels, remaining life error was 0.492 for the direct model, 0.453 for the scratch network, and 0.329 for the informed network. The informed network reduced error by 27.3 percent relative to scratch and 33.1 percent relative to the direct model. The main improvement occurred for transverse high to low loading. Error decreased from 0.897 for the direct model and 0.544 for scratch to 0.393. The informed network also reduced aggregate upward curve variation by 87.5 percent. The median member spread within experimental support decreased from a factor of 4.86 to 1.97. The informed model did not provide the lowest error for every orientation and loading order. Full monotonicity and equal stress block division invariance were not imposed. The results show that a soft Chaboche constraint can improve held out prediction and stabilize fatigue response surfaces without forcing the direct accumulation rule. Other nonlinear accumulation rules can be evaluated within the same framework.

Keywords: fatigue life, block loading, Chaboche damage model, Chaboche informed neural network, nonlinear damage accumulation, physical consistency

Özet

Blok yükleme altındaki yorulma ömrü gerilme düzeyine, yükleme sırasına ve blok süresine bağlıdır. Bu çalışmada A37JC çeliğine ait döner eğmeli yorulma verileri kullanılarak Chaboche bilgisiyle desteklenen bir sinir ağı değerlendirilmiştir. Karşılaştırma, deneysel SN eğrisine dayalı Chaboche hasar eğrisi yaklaşımını, doğrudan eğitilen bir yapay sinir ağını ve Chaboche bilgisiyle desteklenen ağı kapsamaktadır. Hasar eğrisi yaklaşımı, doğrusal olmayan yük sırası bağıntısını yumuşak bir artık terimi olarak sağlamaktadır. Bu bağıntı, olası hasar birikim kurallarından biri olarak ele alınmıştır. Veri kümesi, hadde ve enine yönlerde kırılmayla tamamlanan 48 iki bloklu deneyi içermektedir. Her iki sinir ağı da yön, sıralı gerilme genlikleri ve birinci blok çevrim sayısını kullanarak ikinci blokta kalan ömrü tahmin etmektedir. Aynı küçük ağ mimarisi, sabit beş kat, üç başlangıç tohumu ve iç içe geçmiş yüzde 100, 50 ve 20 etiketli alt kümeler kullanılmıştır. Başarım, ayrılmış test verilerinde log10 çevrim cinsinden ortalama karekök hata ile ölçülmüştür. Yüzde 100 etiket düzeyinde kalan ömür hatası doğrudan model için 0,492, doğrudan eğitilen ağ için 0,453 ve Chaboche bilgisiyle desteklenen ağ için 0,329 olmuştur. Desteklenen ağ, hatayı doğrudan eğitilen ağa göre yüzde 27,3, doğrudan modele göre yüzde 33,1 azaltmıştır. Temel iyileşme enine yöndeki yüksekten düşüğe yüklemede elde edilmiştir. Hata, doğrudan model için 0,897 ve doğrudan eğitilen ağ için 0,544 iken 0,393'e düşmüştür. Desteklenen ağ ayrıca toplam yukarı yönlü eğri değişimini yüzde 87,5 azaltmıştır. Deney aralığındaki ortanca ağ üyesi saçılımı 4,86 katından 1,97 katına düşmüştür. Desteklenen model, her yön ve yükleme sırası için en düşük hatayı vermemiştir. Tam monotonluk ve eşit gerilme altında blok bölme değişmezliği

uygulanmamıştır. Sonuçlar, yumuşak bir Chaboche kısıtının doğrudan hasar birikim kuralını zorlamadan ayrılmış veride tahmini iyileştirebildiğini ve yorulma yanıt yüzeylerini kararlı hâle getirebildiğini göstermektedir. Diğer doğrusal olmayan hasar birikim kuralları aynı çerçevede değerlendirilebilir.

Anahtar kelimeler: yorulma ömrü, blok yükleme, Chaboche hasar modeli, Chaboche bilgisiyle desteklenen sinir ağı, doğrusal olmayan hasar birikimi, fiziksel tutarlılık

MODELING AND OPTIMIZATION OF INFORMATION DIFFUSION IN INTELLIGENT NETWORKS

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Abstract

The rapid and heterogeneous diffusion of information across intelligent networks has created new challenges for understanding, predicting, and regulating the spread of misleading content. While existing studies largely emphasize data-driven classification using machine learning and deep learning, these approaches often provide limited insight into the underlying dynamics of information diffusion and the intervention required to regulate its propagation. This study proposes a mathematically grounded framework for modeling and optimizing information diffusion in intelligent networks, with misinformation considered as a representative application. The proposed framework formulates information propagation as a dynamic process influenced by network connectivity, exposure, transmission, correction, and intervention mechanisms. A mathematical diffusion model is developed to characterize the evolution of information states and to establish conditions under which information propagation can either persist or decline. An optimization mechanism is subsequently introduced to determine effective intervention strategies while considering the associated control cost. The theoretical model is parameterized and evaluated using real-world fake-news data, thereby establishing a connection between the mathematical formulation and observed information-diffusion patterns. Experimental results demonstrate that parameter optimization substantially improves model agreement with the observed diffusion trajectories, reducing RMSE from 0.0192 to 0.0041 and increasing the coefficient of determination from 0.842 to 0.973. An optimal intervention mechanism is additionally developed to suppress misinformation propagation and identify influential network nodes for targeted intervention. The proposed framework provides an interpretable alternative to purely data-driven misinformation detection approaches by jointly incorporating network topology, nonlinear diffusion dynamics, parameter estimation, stability analysis, and intervention optimization. The proposed model reduced the information diffusion approximately 84.3 percent.

Keywords: Keywords: Information Diffusion; Intelligent Networks; Mathematical Modeling; Optimization; Misinformation Control.

NONLINEAR DYNAMICS AND CHAOS IN A THREE-DIMENSIONAL FINANCIAL MODEL

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Abstract

This study investigates the nonlinear dynamics of a three-dimensional financial model describing the interaction between interest rates, investment demand, and price growth. The analysis focuses on critical points, their local stability, phase portraits, Lyapunov exponents, and bifurcation behavior. For a representative parameter set, all critical points are found to be unstable, while numerical simulations reveal bounded irregular trajectories and complex attractors. The calculated Lyapunov spectrum contains a positive maximal Lyapunov exponent, confirming chaotic dynamics, and the negative sum of the exponents indicates that the system is dissipative. The corresponding Kaplan–Yorke dimension is approximately 2.33, supporting the presence of a chaotic attractor.

To investigate the influence of nonlinearities, the model is generalized by replacing the term (x^4) with (x^k), where (2 \leq k \leq 10). A detailed analysis is presented for the case (k=2). Bifurcation diagrams and Lyapunov analysis are used to examine the influence of the model parameters. Variation of the parameter (a) produces a transition from chaotic to periodic and subsequently asymptotically stable behavior. The parameter (b) generates chaotic dynamics within a relatively narrow range of small values. The parameter (c) produces the richest sequence of dynamical transitions, including periodic, chaotic, quasiperiodic, and asymptotically stable regimes. In contrast, parameter (d) has a weaker qualitative influence, with periodic behavior preserved over the tested range. These results demonstrate the strong parameter dependence of the model and provide insight into the mechanisms underlying complex and chaotic dynamics in nonlinear financial systems and may support studies of financial instability and nonlinear market behavior.

Keywords: chaos, critical points, bifurcation, chaotic attractor

EVALUATING THE FUTURE FEASIBILITY AND OPERATIONNAL REALITY OF WAVE ENERGY CONVERTERS FOR SUSTAINABLE POWER GENERATION

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Abstract

The global pursuit of carbon-neutral energy systems demands the diversification of renewable resources, yet ocean wave energy remains one of the most underutilized and technically challenging sources available. While wave energy converters (WECs) hold immense theoretical potential for future sustainable power generation, their commercial deployment continues to be constrained by a persistent gap between academic projections and field performance realities. This study presents a comprehensive comparative evaluation of the primary WEC power generation processes namely oscillating water columns, point absorbers, and overtopping devices to critically assess their techno-economic feasibility and operational readiness for mainstream grid integration. A multi-criteria decision-making framework was applied, incorporating key performance indicators such as power take-off efficiency, capacity factor, levelized cost of energy (LCOE), structural survivability, maintenance logistics, and environmental adaptability. Results indicate that while point absorbers demonstrate promising scalability and ease of deployment, oscillating water columns exhibit superior resilience and lower lifetime maintenance costs under aggressive marine conditions, though at significantly higher initial capital outlays. The analysis further reveals that the operational reality across all WEC archetypes is severely challenged by biofouling, mechanical fatigue, stochastic wave intermittency, and extreme weather survivability, which collectively inflate current LCOE projections to levels substantially higher than those of wind and photovoltaic systems. However, the findings also highlight that innovative solutions including hybrid energy storage systems, artificial intelligence-driven predictive maintenance, and advanced real-time control algorithms can effectively mitigate these barriers, transforming future feasibility from a theoretical exercise into an actionable roadmap. Ultimately, this evaluation bridges the gap between visionary expectations and tangible deployment, offering strategic recommendations for policymakers, investors, and engineers to prioritize phased, site-specific implementations that gradually de-risk WEC technologies while building operational confidence for large-scale sustainable energy integration.

Keywords: Wave Energy Converters (WECs); Renewable Energy Integration; Techno-economic Feasibility; Power Take-Off (PTO) Systems; Levelized Cost of Energy (LCOE); Operational Survivability; Sustainable Power Generation; Comparative Performance Analysis; Grid Integration; Marine Renewable Energy.

Özet

Küresel ölçekte karbon nötr enerji sistemlerine yönelik çabalar, yenilenebilir kaynakların çeşitlendirilmesini gerektirirken, okyanus dalga enerjisi mevcut kaynaklar arasında en az kullanılan ve teknik olarak en zorlu olanlardan biri olmaya devam etmektedir. Dalga enerjisi dönüştürücüler (WEC'ler) gelecekteki sürdürülebilir enerji üretimi için muazzam teorik potansiyele sahip olsa da, ticari uygulamaları akademik tahminler ile saha performansı gerçekleri arasındaki sürekli bir boşluk nedeniyle kısıtlanmaya devam etmektedir. Bu çalışma, ana WEC enerji üretim süreçleri olan salınım yapan su kolonları, nokta emiciler ve taşma cihazlarının teknik-ekonomik fizibilitesini ve ana şebeke entegrasyonu için operasyonel hazır olma durumunu eleştirel bir şekilde değerlendirmek üzere kapsamlı bir karşılaştırmalı değerlendirme sunmaktadır. Güç alma verimliliği, kapasite faktörü, seviyelendirilmiş enerji maliyeti (LCOE), yapısal dayanıklılık, bakım lojistiği ve çevresel uyarlanabilirlik gibi temel

performans göstergelerini içeren çok kriterli bir karar verme çerçevesi uygulanmıştır. Sonuçlar, nokta emicilerin umut verici ölçeklenebilirlik ve kolay kurulum gösterdiğini, salınım yapan su kolonlarının ise agresif deniz koşullarında üstün dayanıklılık ve daha düşük ömür boyu bakım maliyetleri sergilediğini, ancak önemli ölçüde daha yüksek başlangıç sermaye yatırımı gerektirdiğini göstermektedir. Analiz ayrıca, tüm rüzgar enerjisi dönüştürücü (WEC) prototiplerinde operasyonel gerçekliğin, biyolojik kirlenme, mekanik yorgunluk, rastgele dalga kesintileri ve aşırı hava koşullarına dayanıklılık gibi faktörler tarafından ciddi şekilde zorlandığını ve bunların topluca mevcut LCOE (Enerji Maliyeti) tahminlerini rüzgar ve fotovoltaik sistemlere göre önemli ölçüde daha yüksek seviyelere çıkardığını ortaya koymaktadır. Bununla birlikte, bulgular ayrıca hibrit enerji depolama sistemleri, yapay zeka destekli öngörücü bakım ve gelişmiş gerçek zamanlı kontrol algoritmaları gibi yenilikçi çözümlerin bu engelleri etkili bir şekilde azaltabileceğini ve gelecekteki uygulanabilirliği teorik bir çalışmadan eyleme geçirilebilir bir yol haritasına dönüştürebileceğini vurgulamaktadır. Sonuç olarak, bu değerlendirme, vizyoner beklentiler ile somut uygulama arasındaki boşluğu kapatarak, politika yapıcılar, yatırımcılar ve mühendisler için aşamalı, sahaya özgü uygulamaları önceliklendirmek ve büyük ölçekli sürdürülebilir enerji entegrasyonu için operasyonel güveni artırırken WEC teknolojilerini kademeli olarak riskten arındırmak için stratejik öneriler sunmaktadır.

Anahtar kelimeler: Dalga Enerjisi Dönüştürücüleri (WEC'ler); Yenilenebilir Enerji Entegrasyonu; Tekno-ekonomik Fizibilite; Güç Alma (PTO) Sistemleri; Düzleştirilmiş Enerji Maliyeti (LCOE); Operasyonel Dayanıklılık; Sürdürülebilir Güç Üretimi; Karşılaştırmalı Performans Analizi; Şebeke Entegrasyonu; Denizel Yenilenebilir Enerji.

ENERJİ HASADI İÇİN MİKROŞERİT VE TOPLU ELEMAN UYUMLAMALI 0,9 GHZ, 1,8 GHZ VE 2,4 GHZ RF DOĞRULTUCULARIN TASARIMI

DESIGN OF 0.9 GHZ, 1.8 GHZ, AND 2.4 GHZ RF RECTIFIERS WITH MICROSTRIP AND LUMPED-ELEMENT MATCHING FOR ENERGY HARVESTING

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Abstract

With the rapid expansion of the Internet of Things (IoT) ecosystem and autonomous wireless sensor networks, powering electronic devices via sustainable and batteryless solutions has become critical. Radio frequency (RF) energy harvesting offers a viable method to capture ambient electromagnetic energy and convert it into usable direct-current (DC) power, eliminating the maintenance, replacement, and disposal challenges associated with chemical batteries. This paper presents the comprehensive design, optimization, and prototype fabrication of four RF voltage doubler rectifiers operating across ubiquitous ambient communication bands: 0.9 GHz (GSM-900), 1.8 GHz (GSM-1800), and 2.4 GHz (Wi-Fi/ISM). Each rectifier is configured in a single-stage voltage doubler topology utilizing Skyworks SMS7630 zero-bias Schottky barrier diodes, selected for their ultra-low forward turn-on voltage and high sensitivity under weak ambient power conditions. Dedicated impedance matching networks are synthesized to achieve conjugate matching between the 50 Ω source and the non-linear diode load. At 2.4 GHz, two alternative matching topologies, lumped-element (LC) and distributed microstrip-line matching, are evaluated to investigate high-frequency parasitics and insertion loss. All circuits were modeled, simulated via non-linear Harmonic Balance in Keysight ADS, and physically fabricated on standard 1.6-mm-thick FR-4 substrates ($\varepsilon_r = 4.4$, $\tan\delta = 0.02$). Simulation results at a nominal incident power of -10 dBm demonstrate peak DC output voltages of 0.91 V, 0.74 V, and 0.72 V with corresponding power conversion efficiencies (PCE) of 56.5%, 54.5%, and 52.5% for the 0.9 GHz lumped, 1.8 GHz microstrip, and 2.4 GHz microstrip designs, respectively. Crucially, the 2.4 GHz microstrip matching network significantly outperforms its lumped-element counterpart (52.5% vs. 38.0% PCE) due to the mitigation of discrete component parasitic losses and Equivalent Series Resistance (ESR). The fabricated prototypes establish an effective foundation for integration with wideband ambient receiving antennas in self-sustaining IoT and wireless sensor nodes.

Keywords: RF energy harvesting, RF rectifier, Voltage doubler, Schottky diode, Impedance matching network, Power conversion efficiency (PCE), Internet of Things (IoT).

Özet

Nesnelerin İnterneti (IoT) ekosisteminin ve otonom kablosuz sensör ağlarının hızla yaygınlaşmasıyla birlikte, elektronik cihazların sürdürülebilir ve pilsiz çözümlerle beslenmesi kritik bir gereksinim haline gelmiştir. Radyo frekansı (RF) enerji hasadı, ortamdaki elektromanyetik enerjiyi toplayıp kullanılabilir doğru akım (DC) gücüne dönüştürerek kimyasal pillerin getirdiği periyodik bakım, değişim maliyetleri

ile çevresel atık sorunlarını ortadan kaldıran uygulanabilir bir yöntem sunmaktadır. Bu çalışma; yaygın ortam iletişim bantları olan 0,9 GHz (GSM-900), 1,8 GHz (GSM-1800) ve 2,4 GHz (Wi-Fi/ISM) frekanslarında çalışan dört adet RF gerilim katlayıcı doğrultucu devresinin kapsamlı tasarımını, optimizasyonunu ve prototip üretimini sunmaktadır. Her bir doğrultucu, düşük ortam gücü koşullarında ultra düşük iletim gerilimi ve yüksek doğrultma hassasiyeti sergileyen Skyworks SMS7630 sıfır kutuplamalı Schottky bariyer diyotlarına dayalı tek katlı bir gerilim katlayıcı topolojisi kullanmaktadır. 50 Ω kaynak ile doğrusal olmayan diyot yükü arasında eşlenik eşleşmeyi sağlamak amacıyla özel empedans uyumlaştırma devreleri sentezlenmiştir. 2.4 GHz'de, iki alternatif uyumlaştırma topolojisi, toplu elemanlı (LC) ve dağıtılmış mikroşerit hatlı uyumlaştırma, yüksek frekans parazitikleri ve araya girme kayıplarını incelemek üzere karşılaştırmalı olarak değerlendirilmiştir. Tüm devreler modellenmiş, Keysight ADS ortamında doğrusal olmayan Harmonik denge analizi ile benzetimleri yapılmış ve standart 1,6 mm kalınlığındaki FR-4 taban malzemesi ($\varepsilon_r = 4{,}4$, $\tan\delta = 0{,}02$) üzerinde fiziksel olarak üretilmiştir. -10 dBm'lik nominal gelen güç altındaki benzetim sonuçları; 0,9 GHz toplu elemanlı, 1,8 GHz mikroşerit ve 2,4 GHz mikroşerit tasarımlar için sırasıyla 0,91 V, 0,74 V ve 0,72 V tepe DC çıkış gerilimleri ile %56,5, %54,5 ve %52,5 güç dönüşüm verimliliği (PCE) elde edildiğini göstermektedir. Özellikle 2,4 GHz mikroşerit uyumlandırma devresi, ayrık bileşen parazitik kayıpları ve eşdeğer seri direnç (ESR) etkisini azaltması sayesinde toplu elemanlı eşdeğerine kıyasla belirgin şekilde daha yüksek performans sunmuştur (%38,0′e karşılık %52,5 PCE). Üretilen prototipler, otonom IoT ve kablosuz sensör düğümleri için geniş bantlı ortam alıcı antenleri ile entegrasyona yönelik etkili bir temel oluşturmaktadır.

Anahtar kelimeler: RF enerji hasadı, RF doğrultucu, Gerilim katlayıcı, Schottky diyot, Empedans uyumlama devresi, Güç dönüşüm verimliliği, Nesnelerin İnterneti (IoT).

ESTIMATION OF DEPTH TO MAGNETIC BASEMENT USING SPECTRAL ANALYSIS OF HIGH-RESOLUTION AEROMAGNETIC DATA OVER LOKOJA, KOGI STATE NIGERIA

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Abstract

This study estimates the depth to magnetic basement beneath Lokoja and its environs in Kogi State, North Central Nigeria, using spectral analysis of high-resolution aeromagnetic data. The study area, located between Latitudes 7°40′N and 8°00′N and Longitudes 6°30′E and 6°55′E, lies at the southern end of the Bida (Nupe) Basin, near the confluence of the Niger and Benue Rivers. Geologically, it represents a transition between the exposed Precambrian Basement Complex and the sedimentary rocks of the Lokoja sub-basin. Secondary aeromagnetic data obtained from the Nigerian Geological Survey Agency were processed using Oasis Montaj software. The total magnetic intensity data were separated into regional and residual components through polynomial fitting. The residual magnetic field was divided into overlapping square blocks and analyzed using a two dimensional Fast Fourier Transform. Radially averaged power spectra were then generated by plotting the logarithm of spectral energy against wavenumber. A two source depth model was applied to estimate the depths of magnetic bodies. The steeper, low-wavenumber spectral segment provided estimates of deeper magnetic sources interpreted as the basement, while the gentler, high wavenumber segment represented shallower sources related to near-surface or intra-sedimentary magnetic bodies, including ironstone-bearing units of the Agbaja Formation. Depth estimates from the spectral blocks were contoured to produce a basement-depth map. The results reveal a shallow, structurally complex basement, with local basement highs near the rivers Niger Benue confluence and progressive deepening toward the interior of the Lokoja sub basin. The findings will support groundwater exploration, engineering site investigations, and preliminary evaluation of ironstone and industrial mineral resources, while contributing detailed spectral depth data for the southern Bida Basin.

Keywords: Aeromagnetic data, spectral analysis, depth to basement

AÇIK VE UZAKTAN ÖĞRENME SİSTEMLERİNDE YAPAY ZEKÂ DESTEKLİ ERKEN UYARI SİSTEMLERİ: TÜRKİYE BAĞLAMINDA BİR KAVRAMSAL İNCELEME VE UYGULANABİLİRLİK ÖNERİSİ

ARTIFICIAL INTELLIGENCE-BASED EARLY WARNING SYSTEMS IN OPEN AND DISTANCE LEARNING: A CONCEPTUAL REVIEW AND APPLICABILITY PROPOSAL IN THE TÜRKİYE CONTEXT

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Abstract

This study brings together the international and national literature on artificial intelligence-supported early warning systems (EWS) based on the question of why Deceleration and failure rates in open and distance learning remain systematically high compared to formal education. In the screening conducted using the document /literature analysis method, research based on the OULAD dataset, especially a review of 61 studies covering the years 2018-2025, and a pioneering study conducted in a certificate program with 189 students in Türkiye were examined. The findings show that traditional methods such as Random Forest and Logistic Regression still give the most reliable results in structured enterprise data, while deep learning makes a significant difference only when behavioral data such as LMS are enriched. This situation reveals that a significant part of the studies studied are connected to a single institution. However, imbalance-sensitive metrics have not been adequately reported, and how to turn model outputs into concrete intervention processes has not been addressed to date. Even though there are notable examples in this field in the literature specific to Türkiye, the original study proposal of university-level open and distance learning involving hundreds of thousands of students has not been emphasized to date. This study proposes a conceptual early warning framework that focuses on the structural features of Türkiye's open and distance learning institutions such as mass enrollment number, low synchronous interaction and heterogeneous student profile based on the openness stated in the literature. The proposed study shows that the integration of student information system data with risk scoring systems can have benefits on student support and corporate decision-making processes.

Keywords: Open and distance learning, machine learning, artificial intelligence, early warning system, student success

Özet

Bu çalışma, açık ve uzaktan öğrenmede terk ve başarısızlık oranlarının örgün eğitime kıyasla neden sistematik olarak yüksek kaldığı sorusundan hareketle, yapay zekâ destekli erken uyarı sistemlerine (EWS) ilişkin uluslararası ve ulusal literatürü bir araya getirmektedir. Doküman/literatür analizi yöntemiyle yürütülen taramada, 2018-2025 yıllarını kapsayan 61 çalışmalık bir derleme başta olmak üzere, OULAD veri setine dayalı araştırmalar ve Türkiye'de 189 öğrencilik bir sertifika programında yürütülen öncü bir çalışma incelenmiştir. Bulgular, Rastgele Orman ve Lojistik Regresyon gibi geleneksel yöntemlerin yapılandırılmış kurumsal verilerde hâlâ en güvenilir sonuçları verdiğini, derin öğrenmenin ise ancak LMS gibi davranışsal veriler zenginleştiğinde belirgin bir fark yarattığını göstermektedir. Bu durum incelenen çalışmaların önemli bir kısmının tek bir kuruma bağlı olduğunu

ortaya koymaktadır. Bununla birlikte dengesizliğe duyarlı metrikler yeterince raporlanmamış ve model çıktılarının somut müdahale süreçlerine nasıl dönüşeceği günümüze kadar değinilmemiştir. Türkiye'ye özgü literatürde bu alanda kayda değer örnekler bulunsa bile üniversite düzeyi açık ve uzaktan öğrenmenin yüz binlerce öğrenciyi kapsayan özgün bir çalışma önerisi bugüne kadar vurgulanmamıştır. Bu çalışma, literatürde belirtilen açıklıktan yola çıkılarak Türk açık ve uzaktan öğrenme kurumlarının kitlesel kayıt sayısı, düşük senkron etkileşim ve heterojen öğrenci profili gibi yapısal özelliklerini merkeze alan kavramsal bir erken uyarı çerçevesi önermektedir. Önerilen çalışma, öğrenci bilgi sistemi verilerinin risk puanlama sistemleriyle entegrasyonunun öğrenci desteği ve kurumsal karar alma süreçleri üzerinde fayda sağlayabileceğini göstermektedir.

Anahtar Kelimeler: Açık ve uzaktan öğrenme, yapay zekâ, erken uyarı sistemi, öğrenci başarısı, makine öğrenmesi

USE OF ARTIFICIAL INTELLIGENCE FOR MEDICATION ADHERENCE ASSESSMENT IN PATIENTS WITH TYPE 2 DIABETES: AN EXPLORATORY STUDY IN MOROCCO USING ChatGPT AND THE VALIDATED GENERAL MEDICATION ADHERENCE SCALE

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ABSTRACT

Objectives: Medication adherence remains a major challenge in the management of type 2 diabetes (T2D), especially in middle-income countries such as Morocco. With the rapid development of artificial intelligence, large language models, including ChatGPT, may offer new opportunities for clinical research through simulated patient profiles. This study examined the feasibility of using ChatGPT to generate culturally contextualized virtual profiles of Moroccan patients with T2D and to apply the validated Moroccan Arabic dialect version of the general medication adherence scale (GMAS).

Methods: This exploratory pilot simulation study used ChatGPT-4 to generate 11 virtual profiles based on representative sociodemographic and clinical characteristics of Moroccan patients with T2D. Each profile was administered the validated Moroccan Arabic dialect version of the GMAS.

Results: Four profiles (36.4%) showed high adherence, 6 (54.5%) displayed moderate adherence, and 1 (9.1%) exhibited low adherence. Expert evaluations were consistent, with all ratings ≥3 on a 4-point scale, supporting the credibility and cultural appropriateness of the profiles. The simulated patterns reflected real-world trends, with higher adherence among profiles treated with oral antidiabetic drugs, covered by health insurance, and having shorter disease duration, and lower adherence among profiles using insulin, lacking insurance, and having longer disease duration.

Conclusion: ChatGPT generated credible, culturally adapted patient profiles that enabled application of a validated psychometric tool in a simulated environment. This rapid, low-cost approach may support exploratory research, healthcare training, and intervention design. Comparative studies using real patient data are needed to confirm validity.

Keywords: Artificial intelligence; Diabetes mellitus, type 2; Feasibility studies; Medication adherence; Morocco; Psychometrics

A HYBRID VISION–LANGUAGE AND MACHINE LEARNING FRAMEWORK FOR AUTOMATED COGNITIVE SCREENING FROM CLOCK DRAWING TEST

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Abstract

Cognitive screening remains a challenging task due to the complexity and variability of neuropsychological assessment data. The Clock Drawing Test (CDT), a widely used screening instrument, provides valuable information on visuospatial and executive functioning; however, its manual interpretation can be time-consuming and dependent on expert assessment. This work proposes HISACDT, a Hybrid Intelligent System for Automated Clock Drawing Test Cognitive Assessment, which combines vision–language models with classical machine learning for automated and interpretable cognitive screening from raw Clock Drawing Test (CDT) images. Unlike approaches relying on task-specific image processing pipelines or computationally intensive visual training, the proposed framework employs Gemini Flash as a zero-shot multimodal feature extractor to generate structured clinical subscores from raw clock drawings. These interpretable representations are subsequently analysed by complementary Random Forest and Support Vector Machine classifiers, whose probabilistic outputs are integrated through a soft-voting decision layer. The framework was evaluated on a clinical dataset of 132 Clock Drawing Test (CDT) images labelled as normal or abnormal. Gemini achieved a 100% feature extraction success rate and a standalone F1-score of 93.49%. The Random Forest classifier achieved the highest overall accuracy of 93.18%, while the Support Vector Machine (SVM) achieved the highest recall of 93.02% for abnormal cognitive patterns. The results demonstrate that structured representations extracted by a vision–language model can effectively support high-performance supervised classification without requiring task-specific visual model training. Beyond predictive performance, the proposed hybrid architecture preserves clinically interpretable decision features, this is offering a promising foundation for accessible Artificial Intelligence-assisted cognitive screening systems.

Keywords: Clock Drawing Test, Vision-Language Models, Cognitive Screening, Gemini, Machine Learning, Random Forest, Support Vector Machine

EFFECT OF DIFFERENT NETTING BOUNDARIES ON BESS SIZING: AN APPLICATION TO A MULTI-FEEDER PV-CONSUMPTION PORTFOLIO

FARKLI MAHSUPLAŞMA SINIRLARININ BESS BOYUTLANDIRMASINA ETKİSİ: ÇOK FİDERLİ BİR GES-TÜKETİM PORTFÖYÜ UYGULAMASI

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Abstract

This study examines how the netting boundary — the technical calculation boundary determining which generation and consumption feeders are evaluated together — affects the power and energy capacity of a battery energy storage system (BESS). The system comprises three photovoltaic (PV) plant feeders and four consumption feeders. Half-hourly active power measurements from 2 January 2023 to 30 November 2025 were used, covering the 703 days with complete simultaneous records for all feeders.

Three approaches were compared: a dedicated BESS per feeder (S1), a shared BESS for the PV and consumption groups (S2), and a single shared BESS for all feeders (S3). Capacities were determined from the 2023 data at a design percentile of 95% and applied unchanged to 2024 and 2025. The total requirement of 2.237 MW and 14.297 MWh in S1 fell to 1.934 MW and 12.582 MWh in S2, and to 1.673 MW and 11.541 MWh in S3, so S3 required 25.21% less power and 19.28% less energy capacity than S1. Aggregation did not reduce the two proportionally: the energy-to-power ratio was higher at system than at feeder level.

The energy not supplied during tracking, plus that needed to restore the state of charge (SoC) to its initial level at each block end, was expressed as a fraction of the total absolute energy requested from the battery. The resulting energy fulfillment ratio of S3 was 99.29% in 2024 and 98.83% in 2025, with SoC remaining between 10% and 90% throughout. The largest terminal-to-initial SoC deviation was 0.0649 p.u. in 2024 and 0.1181 p.u. in 2025, exceeding the 0.05 p.u. acceptance limit in at least one uninterrupted block in both years. Joint evaluation therefore lowers BESS capacity requirements, but the end-of-block energy balance requires separate examination. Network constraints, BESS siting and economic feasibility were outside the scope.

Keywords: Battery energy storage system, BESS sizing, multi-feeder system, netting boundary, shared energy storage.

Özet

Bu çalışma, hangi üretim ve tüketim fiderlerinin birlikte değerlendirileceğini belirleyen teknik hesaplama sınırı olan mahsuplaşma sınırının, bir batarya enerji depolama sisteminin (BESS) güç ve enerji kapasitesini nasıl etkilediğini incelemektedir. İncelenen sistem üç güneş enerji santrali (GES) fideri ile dört tüketim fiderinden oluşmaktadır. 2 Ocak 2023 – 30 Kasım 2025 tarihleri arasında kaydedilen yarım saatlik aktif güç ölçümleri kullanılmış, tüm fiderler için eş zamanlı ve eksiksiz kayıt bulunan 703 gün değerlendirilmiştir.

Üç yaklaşım karşılaştırılmıştır: her fider için ayrı BESS (S1), GES ve tüketim grupları için paylaşımlı BESS (S2) ve tüm fiderler için tek bir paylaşımlı BESS (S3). Kapasiteler, %95 tasarım yüzdeliği ile 2023 verisinden belirlenmiş ve elde edilen değerler 2024 ile 2025 verisine değiştirilmeden uygulanmıştır. S1'de 2,237 MW ve 14,297 MWh olan toplam gereksinim, S2'de 1,934 MW ve 12,582 MWh'ye, S3'te ise 1,673 MW ve 11,541 MWh'ye düşmüştür; buna göre S3, S1'e kıyasla %25,21 daha az güç ve %19,28 daha az enerji kapasitesi gerektirmiştir. Toplulaştırma bu iki gereksinimi aynı oranda azaltmamış, enerji/güç oranı sistem seviyesinde fider seviyesine göre daha yüksek çıkmıştır.

İzleme sırasında karşılanamayan enerji ile her bloğun sonunda şarj durumunu (SoC) başlangıç seviyesine geri getirmek için gereken enerji, bataryadan talep edilen toplam mutlak enerjiye oranlanarak ifade edilmiştir. Buna göre S3'ün enerji karşılama oranı 2024'te %99,29, 2025'te %98,83 olmuş, SoC analiz boyunca %10 ile %90 arasında kalmıştır. Blok sonu ile başlangıç SoC değeri arasındaki en büyük sapma 2024'te 0,0649 p.u., 2025'te 0,1181 p.u. olarak ölçülmüş ve 0,05 p.u. kabul sınırı her iki yılda da en az bir kesintisiz veri bloğunda aşılmıştır. Dolayısıyla fiderlerin birlikte değerlendirilmesi BESS kapasite gereksinimini düşürmekte, ancak blok sonu enerji dengesinin ayrıca incelenmesi gerekmektedir. Şebeke kısıtları, BESS'in fiziksel yerleşimi ve ekonomik fizibilite çalışma kapsamı dışında tutulmuştur.

Anahtar kelimeler: Batarya enerji depolama sistemi, BESS boyutlandırması, çok fiderli sistem, mahsuplaşma sınırı, ortak enerji depolama.

INVESTIGATION OF SMALL MODULAR REACTOR (SMR) TECHNOLOGY: NUSCALE POWER DESIGN

KÜÇÜK MODÜLER REAKTÖR (SMR) TEKNOLOJİSİ: NUSCALE POWER TASARIMININ İNCELENMESİ

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Abstract

Small Modular Reactors are nuclear fission reactors generally with an electrical capacity of 300 MWe or less, which can be manufactured in factories, have a modular structure, and rely on passive safety. They stand out due to low-carbon electricity generation, flexible use opportunities, and advanced passive safety systems.

In this study, the NuScale Power Module design, an SMR example, is examined. The NuScale Power SMR is an integrated SMR design based on PWR technology. The working principle, technical characteristics, passive cooling system, safety features, advantages, and disadvantages are discussed. Natural circulation utilizes natural driving forces such as gravity, conduction, and convection, reducing dependence on active pumps and power sources.

Each NuScale module produces 250 MWt of thermal power and 77 MWe of electrical power. In the VOYGR-12 design, approximately 924 MWe of electrical power and 3,000 MWt of thermal power can be obtained with 12 modules. Thermal energy can also be used for district heating, industrial heat, hydrogen production, and seawater desalination.

In the NuScale Power SMR, safety systems utilize natural circulation, gravity, natural convection, and steam condensation without requiring electricity, external power, or operator intervention. The Emergency Core Cooling System (ECCS) ensures that the core remains covered with water and that decay heat is removed in an emergency. The components are located within a single reactor pressure vessel.

The advantages of NuScale SMR technology, such as small unit capacity, capacity increase, installation flexibility, and adaptability to electricity needs, are evaluated. Challenges such as investment costs, nuclear waste management, licensing processes, and economic feasibility are also addressed. For Türkiye, increasing electricity demand, energy security, reducing fossil fuel dependence, and diversifying low-carbon energy sources are considered. As a result, NuScale SMR technology has significant potential for Türkiye's energy system; however, its feasibility depends on technical, economic, environmental, safety, and regulatory conditions.

Keywords: Nuclear, Energy, Reactor, Small Modular Reactor (SMR), NuScale Power

Özet

Küçük Modüler Reaktörler, genellikle 300 MWe veya daha düşük elektrik kapasitesine sahip, fabrikalarda üretilebilen, modüler bir yapıya sahip ve pasif güvenliğe dayanan nükleer fisyon reaktörleridir. Düşük karbonlu elektrik üretimi, esnek kullanım olanakları ve gelişmiş pasif güvenlik sistemleri nedeniyle öne çıkmaktadır.

Bu çalışmada, bir SMR örneği olan NuScale Power Modül tasarımı incelenmiştir. NuScale Power SMR, PWR teknolojisine dayanan entegre bir SMR tasarımıdır. Çalışma prensibi, teknik özellikleri, pasif soğutma sistemi, güvenlik özellikleri, avantajları ve dezavantajları ele alınmıştır. Doğal dolaşım; aktif pompalara ve güç kaynaklarına olan bağımlılığı azaltarak yerçekimi, iletim ve taşınım gibi doğal itici kuvvetlerden yararlanır.

Her bir NuScale modülü 250 MWt termal güç ve 77 MWe elektrik gücü üretmektedir. VOYGR-12 tasarımında, 12 modül ile yaklaşık 924 MWe elektrik gücü ve 3.000 MWt termal güç elde edilebilmektedir. Termal enerji ayrıca bölgesel ısıtma, endüstriyel ısı, hidrojen üretimi ve deniz suyunun tuzdan arındırılması için de kullanılabilmektedir.

NuScale Power SMR'da güvenlik sistemleri, elektrik, harici güç veya operatör müdahalesi gerektirmeden doğal dolaşım, yerçekimi, doğal taşınım ve buhar yoğuşmasından yararlanmaktadır. Acil Durum Çekirdek Soğutma Sistemi (ECCS), bir acil durumda çekirdeğin su ile kaplı kalmasını ve bozunma ısısının uzaklaştırılmasını sağlar. Bileşenler tek bir reaktör basınç kabı içerisinde bulunmaktadır.

Küçük ünite kapasitesi, kapasite artışı, kurulum esnekliği ve elektrik ihtiyacına uyum sağlama gibi NuScale SMR teknolojisinin avantajları değerlendirilmiştir. Yatırım maliyetleri, nükleer atık yönetimi, lisanslama süreçleri ve ekonomik uygulanabilirlik gibi zorluklar da ele alınmıştır. Türkiye açısından artan elektrik talebi, enerji güvenliği, fosil yakıtlara bağımlılığın azaltılması ve düşük karbonlu enerji kaynaklarının çeşitlendirilmesi değerlendirilmektedir. Sonuç olarak, NuScale SMR teknolojisi Türkiye'nin enerji sistemi için önemli bir potansiyele sahiptir; ancak uygulanabilirliği teknik, ekonomik, çevresel, güvenlik ve düzenleyici koşullara bağlıdır.

Anahtar Kelimeler: Nükleer, Enerji, Reaktör, Küçük Modüler Reaktör SMR, NuScale

BEYOND VISIBILITY: RETHINKING DIGITAL REPUTATION AND TRUST IN THE AGE OF ARTIFICIAL INTELLIGENCE

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&

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Abstract

The rapid advancement of Artificial Intelligence (AI) is transforming the way individuals, organizations, and institutions construct, manage, and evaluate their digital reputation. In an increasingly interconnected digital environment, reputation can no longer be understood solely through visibility, online presence, or the image presented across digital platforms. Instead, the growing influence of AI-generated content, algorithmic decision-making, automated communication, and data-driven profiling has shifted the focus toward a more complex and fundamental dimension: digital trust. This study rethinks digital reputation by examining the transition from visibility-based perceptions toward trust-based reputation in the age of Artificial Intelligence. It explores how AI technologies influence the formation, amplification, and transformation of digital reputational signals, while also addressing emerging challenges related to authenticity, credibility, transparency, privacy, and algorithmic bias. The study argues that visibility alone is no longer sufficient to establish a positive and sustainable digital reputation. In an AI-driven environment, trust increasingly depends on the accuracy and authenticity of information, transparency of technological processes, ethical use of data, and the ability of individuals and organizations to maintain credibility across dynamic digital ecosystems. Accordingly, the study proposes a conceptual perspective in which digital reputation is understood as a multidimensional construct that integrates visibility, credibility, authenticity, and trust. This perspective highlights the need for individuals and organizations to move beyond managing their digital image toward strategically building and sustaining digital trust. The study contributes to the ongoing academic discussion on digital reputation and AI by emphasizing trust as a critical foundation for reputational resilience and legitimacy in an increasingly algorithmic society.

Keywords: Artificial Intelligence; Digital Reputation; Digital Trust; Online Visibility; Digital Identity; Credibility; Authenticity; Algorithmic Influence; Digital Ethics; Reputation Management.

INTEGRATION OF MECHATRONICS SYSTEMS IN SOLAR-POWERED HYDROGEN GENERATION FOR SUSTAINABLE COOKING: SAFETY, AUTOMATION, AND EFFICIENCY ANALYSIS

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Abstract

The growing demand for clean, affordable, and decentralized cooking energy has driven interest in renewable hydrogen as an alternative to LPG, firewood, and charcoal. This study investigates the integration of mechatronic systems into a solar-powered hydrogen generation platform for sustainable cooking applications. The proposed system combines photovoltaic (PV) arrays, electrolyzers, lithium-ion energy storage, and smart mechatronic control units to produce and supply hydrogen on demand. Mechatronic components including sensors, actuators, control systems, and Human-Machine Interfaces (HMI) were designed to monitor hydrogen production, regulate gas flow, and automate ignition. The platform demonstrates enhanced safety, energy efficiency, and operational reliability in off-grid settings. Experimental evaluation of energy conversion efficiency was performed from solar to hydrogen to thermal cooking output, including system response under varying irradiance and load conditions. Results reveal a hydrogen production rate of 70.97 mL/min under 20 V, 10 A DC input, rapid load-activated ignition, and solar-to-cooking efficiency of 19.2%. The solar-hydrogen cooking unit achieved a thermal efficiency of 75 percent. Safety protocols embedded in the mechatronic system prevent accidental combustion and optimize power usage. The automation reduced human intervention by 75% during 25 days of experimental testing. This research demonstrates that mechatronic- enabled, solar-powered hydrogen systems can provide a safe, automated, and efficient pathway for sustainable cooking in off-grid and energy-poor regions, contributing to energy access and climate goals. The study provides a scalable framework for integrating renewable energy, automation, and smart control in domestic cooking systems, offering a viable solution to reduce fossil fuel dependency and associated greenhouse gas emissions.

Keywords: Mechatronics, Solar energy, Hydrogen production, Water electrolysis, Automated ignition, Renewable cooking, Safety, Energy efficiency

AĞIR TİCARİ ARAÇ MONTAJ HATTINDA KULLANILAN ŞABLONLARDA EKLEMELİ ÜRETİM İLE TALAŞLI İMALATIN MALİYET, TEDARİK SÜRESİ VE MALZEME KULLANIMI AÇISINDAN KARŞILAŞTIRILMASI

COMPARISON OF ADDITIVE AND SUBTRACTIVE MANUFACTURING FOR TEMPLATES USED ON A HEAVY COMMERCIAL VEHICLE ASSEMBLY LINE IN TERMS OF COST, LEAD TIME AND MATERIAL CONSUMPTION

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ÖZET

Montaj hatlarında delik konumlarının işaretlenmesi ve delme işleminin yönlendirilmesi için kullanılan şablonlar, işletmede imalat kabiliyeti bulunmadığında dış hizmet alımıyla, döküm poliamid blokların CNC tezgâhında işlenmesiyle temin edilmektedir. Bu yol hem parça başına yüksek bir bedel doğurmakta hem de teklif alma, sipariş onayı ve sevkiyat gibi aşamalar nedeniyle aparatın hatta ulaşmasını geciktirmektedir. Sunulan çalışmada, ağır ticari araç üreten bir tesiste kullanılan on bir şablonun işletme bünyesindeki endüstriyel FDM tezgâhında ABS ile üretilmesi, aynı şablonların dış kaynaklı talaşlı imalatla temin edilmesiyle karşılaştırılmıştır.

Karşılaştırma maliyet, tedarik süresi ve malzeme kullanımı üzerinden yürütülmüştür. Maliyet modeli kurulurken işçilik her iki yola da aynı mantıkla yüklenmiş; eklemeli üretim tarafında malzemenin yanı sıra ekstrüzyon kafası, baskı tablası ve enerji tüketimi gibi benzer çalışmalarda çoğunlukla göz ardı edilen kalemler de parça başına hesaba katılmıştır. Referans yolun fiyatlandırılmasında tedarikçiden alınan bedeller kullanılmış, belgelenme düzeyi farklı olan veriler birbirinden ayrı tutulmuş ve belirsizlik duyarlılık analiziyle sınırlı hale getirilmiştir.

Eklemeli üretim şablonların tamamında daha düşük maliyetli çıkmış, toplamda yaklaşık %56'lık bir kazanım elde edilmiştir. Kazanımın malzemeden değil, dış tedarik bedelinin ortadan kalkmasından doğduğu görülmüştür. Talaşlı yolda ham poliamidin %93,7'sinin talaş olarak uzaklaştırılması gerekmektedir; ayrıca tedarikçi fiyatının tüketilen ham malzemeyle değil bitmiş parçanın hacmiyle belirlendiği, dolayısıyla malzeme kaybının bedelinin fiyat içinde ayrı bir kalem olarak görünmediği saptanmıştır. Tedarik süresindeki kısalma %90'ı aşmakta olup bu farkın önemli bir bölümü üretimden değil, teklif ve onay aşamalarındaki beklemelerden kaynaklanmaktadır. Bulgular, düşük adetli, yüksek talaş oranlı ve gevşek toleranslı aparatlarda eklemeli üretimin bir prototipleme aracı olmanın ötesinde, doğrudan üretimi destekleyen bir tedarik seçeneği oluşturduğunu ortaya koymaktadır.

Anahtar Kelimeler: Eklemeli üretim, montaj şablonu, maliyet karşılaştırması, talaşlı imalat, tedarik süresi

ABSTRACT

Templates used on assembly lines to mark hole positions and guide drilling are procured externally, by machining cast polyamide blocks on CNC equipment, wherever no in-house capability exists. This route carries a high unit price and delays the arrival of the fixture at the line, owing to stages such as obtaining quotations, order approval and shipment. The present study compares, at a heavy commercial vehicle plant, the in-house production of eleven such templates on an industrial FDM system in ABS with their procurement through outsourced subtractive manufacturing.

The comparison covers cost, lead time and material consumption. Labour was charged to both routes on the same basis; on the additive side, items commonly disregarded in comparable studies — extrusion head wear, build sheet consumption and energy use — were also accounted for per part. The reference route was priced using amounts obtained from the supplier, data of differing documentary status were kept separate, and the remaining uncertainty was bounded by a sensitivity analysis.

Additive manufacturing proved less costly for every template, yielding a saving of approximately 56% overall. This saving was found to originate not in material but in the elimination of the external procurement charge. The subtractive route would require 93.7% of the raw polyamide to be removed as chips; supplier prices were moreover shown to follow the volume of the finished part rather than the raw material consumed, so that the cost of material loss never appears as a separate item in the price. The reduction in lead time exceeds 90%, much of it stemming from waiting at the quotation and approval stages rather than from production itself. The findings indicate that for low-volume, high-chip-ratio fixtures with loose tolerances, additive manufacturing constitutes a procurement option supporting direct production rather than merely a prototyping tool.

Keywords: Additive manufacturing, assembly template, cost comparison, subtractive manufacturing, lead time

RESPONSE SURFACE OPTIMIZATION OF TIG WELDING PARAMETERS FOR MAXIMUM TENSILE STRENGTH AND MINIMUM DILUTION

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Abstract

Tungsten Inert Gas (TIG) welding is widely considered one of the best welding processes for joining thin- to medium-gauge plates, where weld quality, mechanical strength, and dilution of the weld pool with the base metal directly affect service performance. This research study applies a Response Surface Methodology (RSM) expert system to model and optimize three TIG welding parameters. The process parameters involve the welding current, arc voltage, and the welding speed, with respect to two competing responses: tensile strength, which is to be maximized, and dilution, which is to be minimized. A three-factor, three-level Box Behnken Design (BBD) was used in the study to generate a fifteen-run experimental matrix, and second-order polynomial regression models were fitted to both responses. Analysis of variance (ANOVA) confirmed that both quadratic models were highly significant, with coefficients of determination of 0.997 for tensile strength and 0.999 for dilution, and non-significant lack of fit in both cases. The results obtained from the study show that the welding current was found to be the most influential parameter for both responses, followed by welding speed and arc voltage. A desirability-based multi-response optimization identified 124 A current, 11.4 V arc voltage, and 118 mm/min welding speed as the optimum condition, predicting 512.4 MPa tensile strength and 20.5 percent dilution, with a combined desirability of 0.87. Confirmation trials agreed closely with model predictions, within 0.4 percent for tensile strength and 0.1 percent for dilution, validating the developed models for process control. The result has great significance in the construction process in modelling the TIG welding joints to ascertain its integrity.

Keywords: TIG welding; Response Surface Methodology; Box Behnken Design; tensile strength; dilution; process

C:N RATIO OPTIMIZATION FOR DATE PALM WASTE CO-COMPOSTING UNDER HOT CLIMATIC CONDITIONS

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ABSTRACT

Efficient composting of date palm waste (DPW) is constrained by its highly lignocellulosic composition, which limits microbial accessibility and delays organic matter decomposition and stabilization. The initial carbon-to-nitrogen (C) ratio is consequently an important factor governing microbial activity, degradation efficiency, and compost development. This study investigated the effects of two initial C ratios on the composting performance and stabilization of DPW co-composted with chicken litter using a low-cost, manually operated rotary drum bioreactor under hot climatic conditions. Compost mixtures were formulated using a recipe calculator to achieve target C ratios of 25 and 30, corresponding to treatments CkS25 and CkS30, with actual initial ratios of 27.2 and 31.8, respectively. An accelerated 20-day composting process was evaluated through temperature evolution, biodegradation rate, C ratio, electrical conductivity (EC), moisture loss, and germination index (GI). CkS30 exhibited greater microbial activity, reaching a maximum temperature of 64.95 °C and the highest biodegradation rate (0.512). In contrast, CkS25 maintained thermophilic conditions for a longer period (13 days) and achieved a lower final C ratio (17.2), lower EC (6.16 dS m^{-1}), and lower moisture loss. Nevertheless, both treatments showed similar GI values of approximately 57%, indicating residual phytotoxicity and incomplete compost maturity after 20 days. Overall, a higher initial C ratio close to 30 enhanced microbial activity and biodegradation, whereas the lower ratio promoted greater stabilization according to selected maturity indicators. These findings demonstrate that initial C ratio adjustment can improve DPW composting performance; however, the accelerated 20-day process was insufficient to achieve full maturity, emphasizing the importance of a subsequent curing phase before agricultural use.

Keywords: Date palm waste; Composting; Carbon-to-nitrogen ratio; Biodegradation

Preferred presentation: Oral presentation (in person)

OXIDATIVE STRESS LINKED ANTIDIABETIC EFFECTS OF NATURAL PRODUCTS: MECHANISTIC BASIS AND CORRELATION BETWEEN ANTIOXIDANT AND ANTIDIABETIC ACTIVITIES

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Abstract

Natural products continue to attract considerable interest as sources of bioactive compounds for the prevention and management of diabetes mellitus. One important aspect of their activity is the close relationship between oxidative stress and impaired glucose regulation. Excessive production of reactive oxygen species can damage pancreatic β-cells, disturb insulin signaling, promote insulin resistance, and contribute to the progression of diabetic complications. Many naturally occurring compounds, particularly flavonoids, phenolic acids, tannins, alkaloids, terpenoids, and other polyphenols, are able to reduce oxidative stress by scavenging reactive species and strengthening endogenous antioxidant defenses. These effects may help preserve β-cell function, improve insulin sensitivity, support peripheral glucose uptake, and reduce cellular damage associated with persistent hyperglycemia. At the same time, several natural products can influence glucose homeostasis more directly through inhibition of α-amylase and α-glucosidase, modulation of glucose transport, and regulation of carbohydrate and lipid metabolism. The frequent occurrence of both antioxidant and antidiabetic effects in the same natural products suggests a meaningful pharmacological connection between redox balance and glycemic control. However, antioxidant activity measured in chemical assays should not be taken as direct proof of antidiabetic efficacy. A reliable relationship can only be established by examining antioxidant parameters together with enzyme-inhibition data, cellular responses, biochemical markers, and in vivo measures of glucose regulation. Understanding this relationship more clearly may help identify multifunctional natural products and determine the extent to which control of oxidative stress contributes to their antidiabetic action. Such an integrated approach could support the rational development of natural-product-based candidates for diabetes and its associated complications.

Keywords: Natural products; Antidiabetic activity; Antioxidant activity; Oxidative stress; Diabetes mellitus; Glucose homeostasis; Phytochemicals.

ELEKTRİKLİ ARAÇLAR İÇİN ELEKTROMANYETİK GİRİŞİM (EMI) FİLTRESİ

ELECTROMAGNETIC INTERFERENCE (EMI) FILTER FOR ELECTRIC VEHICLES

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Abstract

The use of electric vehicles is gradually increasing. Globally in 2025 nearly one in four cars sold was electric. Electric vehicles are environmentally friendly mainly because they have a low carbon footprint compared to the traditional internal combustion engines. Despite these vehicles being environmentally friendly and sustainable, they introduce a significant Electromagnetic Interference (EMI) problem. Electromagnetic interference is a disturbance created by an external source that affects an electrical circuit by electromagnetic induction and electrostatic coupling. This disturbance may degrade the performance of circuits and in data paths it may cause data losses. In Electric vehicles, electromagnetic interference is mainly caused by inverters and DC-DC converters. To drive the motors, IGBTs or MOSFETs are employed, which switch on and off at high switching frequencies (pulse-width modulation: PWM). This switching on and off (dV/dt) creates unwanted harmonics and noise. Electric vehicle battery packs typically operate at 400 V or 800 V; however, since the vehicle's auxiliary systems require a 12 V supply, DC–DC converters are employed, which constitute an additional source of EMI. If this interference is not reduced or prevented it may cause wearing of motor bearing, cable overheating, insulation losses, distort proper functioning of microprocessors and affect the external environment. This paper presents the design, simulation and analysis of a low pass Common Mode Choke filter for electric vehicles using MATLAB Simscape and Simulink. This filter will be used to minimize EMI, increase the lifespan of motor bearings and keep the vehicle’s electromagnetic compatibility (EMC) within CISPR 25, ECE R10 and ISO 11452 standards. The design, analysis and simulation will show how electromagnetic interference can be reduced using a common mode choke filter.

Keywords: Electric Vehichles, EMI, EMC, PWM, Common Mode Choke Filter

Özet

Elektrikli araçların kullanımı küresel ölçekte giderek artmaktadır; 2025 yılında satılan yaklaşık her dört araçtan biri elektrikli olmuştur. Elektrikli araçlar, geleneksel içten yanmalı motorlu araçlara kıyasla düşük karbon ayak izine sahip olmaları nedeniyle başlıca çevre dostu kabul edilmektedir. Bu araçlar çevre dostu ve sürdürülebilir olmalarına rağmen, önemli bir elektromanyetik girişim (EMI) sorununu da beraberinde getirmektedir. Elektromanyetik girişim, harici bir kaynak tarafından elektromanyetik indüksiyon ve elektrostatik kuplaj yoluyla bir elektrik devresini etkileyen bir bozulmadır. Bu bozulma, devrelerin performansını düşürebilir ve veri yollarında veri kayıplarına neden olabilir. Elektrikli araçlarda elektromanyetik girişim esas olarak güç elektroniği devrelerinden, büyük ölçüde de invertörlerden ve DC-DC dönüştürücülerden kaynaklanmaktadır. Motorları sürmek için, yüksek anahtarlama frekanslarında (darbe genişlik modülasyonu: PWM) açılıp kapanan IGBT'ler veya MOSFET'ler kullanılmaktadır. Bu açma-kapama işlemi (dV/dt), istenmeyen harmonikler ve gürültü oluşturmaktadır. Elektrikli araç batarya paketleri genellikle 400V veya 800V gerilim değerine sahiptir, ancak aracın yardımcı sistemleri 12V seviyesinde bir besleme gerilimine ihtiyaç duymaktadır; bu amaçla kullanılan DC-DC dönüştürücüler de bir başka elektromanyetik girişim kaynağıdır. Bu girişim

azaltılmadığı veya önlenmediği takdirde motor rulmanlarının aşınmasına, kabloların aşırı ısınmasına, yalıtım kayıplarına, mikroişlemcilerin düzgün çalışmasının bozulmasına ve çevresel ortamın etkilenmesine neden olabilir. Bu çalışma, MATLAB Simscape ve Simulink kullanılarak elektrikli araçlar için tasarlanan bir alçak geçiren Ortak Mod Bobini (Common Mode Choke) filtresinin tasarımını, simülasyonunu ve analizini sunmaktadır. Tasarlanacak filtre, elektromanyetik girişimi en aza indirmekte, motor rulmanlarının ömrünü artırmakta ve aracın elektromanyetik uyumluluğunu (EMC) CISPR 25, ECE R10 ve ISO 11452 standartları kapsamında tutmaktadır. Tasarım, analiz ve simülasyon sonuçları, elektromanyetik girişimin bir ortak mod bobini filtresi kullanılarak nasıl azaltılabileceğini göstermektedir.

Anahtar kelimeler: Elektrikli Araçlar, EMI, EMC, PWM, Ortak Mod Filtre Bobini

PHYSICAL, MECHANICAL, DURABILITY AND MICROSTRUCTURAL PROPERTIES OF TERNARY BLENDED CONCRETE INCORPORATING MARBLE DUST AND GROUNDNUT HUSK ASH

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ABSTRACT

The construction sector's reliance on Portland cement (PC) imposes a significant carbon and energy burden, motivating the search for supplementary cementitious materials derived from industrial and agricultural residues. This study evaluated a ternary blended cement system in which PC was partially replaced with marble dust (MD), a calcite-rich stone-processing waste, and groundnut husk ash (GHA), an amorphous-silica-rich agro-waste calcined at 600 °C. MD was held constant at 5%, whereas GHA ranged from 0 to 20%, yielding total replacement levels of 0 (control), 10, 15, 20, and 25%. Raw materials, pastes, and concretes were characterised via XRF, standard consistency, setting time, soundness, workability, compressive and flexural strength, hardened density, sulfate-attack resistance, TGA/DTA, and SEM/EDAX. XRF confirmed that GHA satisfies the ASTM C618 pozzolanic oxide-sum criterion (SiO_2+Al_2O_3+Fe_2O_3 = 76.12%). The setting times and consistency increased with replacement but remained within the BS EN 197-1 limits, whereas the workability declined progressively as the replacement levels increased. The 28-day compressive strength decreased from 27.11 N/mm² (control) to 22.37 N/mm² (25% replacement); the 10% and 15% mixes (25.33-25.48 N/mm²) still met the 25 N/mm² design target. Flexural strength peaked at 10% replacement (3.67 N/mm², +5.8% over control), and hardened density satisfied BS EN 206-1 limits throughout. The loss of sulfate exposure strength increased from 1.07% to 6.62% across the entire replacement range. TGA/DTA showed Portlandite consumption (10.69→7.40%) with corresponding calcite gain, corroborated by SEM/EDAX evidence of C-S-H, ettringite, and monocarboaluminate. A 10% OPC replacement (5% MD + 5% GHA) was identified as the optimum blend, with up to 25% replacement being viable for non-structural and mass-concrete applications.

Keywords: Marble dust; Groundnut husk ash; Ternary blended cement; Sustainable construction materials; Microstructural characterisation

İKINCI NESIL BIYOETANOL ÜRETIMI IÇIN HAMMADDE OLARAK LIGNOSELÜLOZIK BIYOKÜTLE

LIGNOCELLULOSIC BIOMASS AS A RAW MATERIAL FOR THE PRODUCTION OF SECOND-GENERATION BIOETHANOL

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Abstract

In recent years, in the developed countries of the world, interest in the use of alternative fuels and chemical products from renewable plant biomass is growing against the background of a decrease in crude oil production. Biofuel is interesting precisely because of its environmental friendliness. It is a renewable source of carbon that is not released into the atmosphere and does not lead to global warming. Biofuel is one of the most real ways to free humanity from dependence on traditional fossil resources. Biofuel production is steadily increasing. Globally, it has grown from about 180,000 barrels per day in 2000 to 2.4 million barrels per day in 2025.

Lignocellulosic biomass has a high potential for the production of biofuels, such as bioethanol and other valuable substances. Currently, the traditional raw material for the production of bioethanol is the biomass of various plant crops, in particular sugar-containing - sugar cane, sugar beet; starch-containing - grain and grain waste; lignocellulosic raw material - post-harvest corn waste, green mass of sugar sorghum, wheat straw, rice, miscanthus, etc. The use of lignocellulosic raw materials as a substrate has been the focus of researchers' attention for the past two decades. Pretreatment of lignocellulosic raw materials is an important and necessary step for delignification of biomass, that is, destruction of lignin bonds to ensure the availability of cellulose and hemicellulose in further processes of enzymatic hydrolysis and fermentation for the purpose of obtaining bioethanol. Pretreatment helps to change the structure of wheat and corn straw. The cellulose content increased from 42 to 63% for wheat straw and from 30 to 57% for corn straw, but the content of residual lignin in the product remained at the level of 12%, which indicates the incomplete destruction of lignin bonds in the molecular structure, which will interfere with enzymatic hydrolysis. Conducting organosolvent delignification of explosive defibration products with a solvent based on ethyl alcohol and sulfuric acid caused almost complete destruction of lignin bonds with the formation of cellulose in a form accessible to enzymatic hydrolysis, the final lignin content was 2.06 and 2.83% for wheat and corn straw, respectively.Enzymatic hydrolysis of semi-products of explosive defibration and organosolvent delignification was carried out and the formation of reducing sugars in the form of glucose was confirmed. Their content after 24 hours increased 6 times for wheat straw and 4.65 times for corn straw. After 48 hours, the content of reducing sugars increased by 1.3 and 1.1 times, respectively. Further fermentation by yeast Saccharomyces cerevisiae of sugared wort with cellulase contributed to an increase in the yield of ethyl alcohol. Ethanol yield was 0.24 g/g biomass for wheat straw and 0.29 g/g biomass for corn waste.

Improvements in the pretreatment of lignocellulosic raw materials, especially through combinations of different processes, and advances in biotechnology aimed at creating effective enzyme preparations and yeast strains with high enzymatic activity resistant to the action of inhibitors can increase the economic efficiency of second-generation bioethanol production by 50%.

Keywords: Lignocellulosic biomass, Biofuel, Bioethanol, Pretreatment, Organosolvent delignification, Fermentation

Özet

Son yıllarda, dünyanın gelişmiş ülkelerinde, ham petrol üretimindeki azalmanın arka planında, yenilenebilir bitki biyokütlesinden alternatif yakıtların ve kimyasal ürünlerin kullanımına olan ilgi artıyor. Biyoyakıt, çevre dostu olması nedeniyle tam olarak ilgi çekicidir. Atmosfere salınmayan ve küresel ısınmaya yol açmayan yenilenebilir bir karbon kaynağıdır. Biyoyakıt, insanlığı geleneksel fosil kaynaklara bağımlılıktan kurtarmanın en gerçek yollarından biridir. Biyoyakıt üretimi giderek artıyor. Küresel olarak, 2000'de günde yaklaşık 180.000 varilden 2025'te günde 2,4 milyon varile yükseldi.

Lignoselülozik biyokütle, biyoetanol ve diğer değerli maddeler gibi biyoyakıtların üretimi için yüksek bir potansiyele sahiptir. Şu anda, biyoetanol üretimi için geleneksel hammadde, çeşitli bitki mahsullerinin biyokütlesidir, özellikle şeker içeren - şeker kamışı, şeker pancarı, nişasta içeren - tahıl ve tahıl atığı, lignoselülozik hammadde - hasat sonrası mısır atığı, yeşil şeker sorgumu kütlesi, buğday samanı, pirinç, miscanthus vb. Lignoselülozik hammaddelerin substrat olarak kullanılması, son yirmi yıldır araştırmacıların dikkatinin odak noktası olmuştur. Lignoselülozik hammaddelerin ön arıtımı, biyokütlenin delignifikasyonu, yani biyoetanol elde etmek amacıyla enzimatik hidroliz ve fermantasyonun ileriki süreçlerinde selüloz ve hemiselülozun kullanılabilirliğini sağlamak için lignin bağlarının yok edilmesi için önemli ve gerekli bir adımdır. Ön arıtma, buğday ve mısır samanının yapısını değiştirmeye yardımcı olur. Selüloz içeriği buğday samanında %42'den %63'e, mısır samanında ise %30'dan %57'ye yükseldi ancak üründeki kalıntı lignin içeriği %12 seviyesinde kaldı. Bu durum, enzimatik hidrolize müdahale edecek moleküler yapıdaki lignin bağlarının tam olarak yok edilmediğini gösterir. Patlayıcı defibrasyon ürünlerinin etil alkol ve sülfürik asit bazlı bir çözücü ile organosolvent delignifikasyonunun yapılması, enzimatik hidrolize erişilebilen bir formda selüloz oluşumu ile lignin bağlarının neredeyse tamamen yok olmasına neden oldu; nihai lignin içeriği, buğday ve mısır samanı için sırasıyla %2.06 ve %2.83 idi.Patlayıcı defibrilasyon ve organosolvent delignifikasyon yarı ürünlerinin enzimatik hidrolizi gerçekleştirildi ve glikoz formunda indirgeyici şekerlerin oluşumu doğrulandı. 24 saat sonra içerikleri buğday samanı için 6 kat, mısır samanı için ise 4,65 kat arttı. 48 saat sonra indirgeyici şeker içeriği sırasıyla 1,3 ve 1,1 kat arttı. Şekerli mayşenin selülaz ile Saccharomyces cerevisiae mayası tarafından daha fazla fermantasyonu, etil alkol veriminin artmasına katkıda bulunmuştur. Etanol verimi buğday samanı için 0,24 g/g biyokütle ve mısır atığı için 0,29 g/g biyokütle olmuştur.

Lignoselülozik hammaddelerin özellikle farklı proseslerin kombinasyonları yoluyla ön arıtılmasındaki iyileştirmeler ve etkili enzim preparatları ve inhibitörlerin etkisine dirençli yüksek enzimatik aktiviteye sahip maya suşları oluşturmayı amaçlayan biyoteknolojideki ilerlemeler, ikinci nesil biyoetanol üretiminin ekonomik verimliliğini %50 oranında artırabilir.

Anahtar kelimeler: Lignoselülozik biyokütle, Biyoyakıt, Biyoetanol, ön Arıtma, Organik solvent Delignifikasyonu, Fermantasyon

INNOVATIONS OF THE FOOD SECTOR IN ENSURING FOOD SECURITY OF UKRAINE

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Abstract

The purpose of the study is to determine the most priority areas of innovative development of the food sector in the conditions of modern challenges and opportunities of Ukraine

The food sector of Ukraine is currently developing in mutually exclusive conditions. On the one hand, the full-scale aggression of the Russian Federation disrupted production and distribution food chains and complicated the logistics of moving products. On the other hand, on the way to European integration and in the conditions of transformational changes on the way to Industry 5.0, participants of the food market apply new technical and technological and management solutions aimed at increasing the sustainability of the food system, introduce innovations in all areas of production and sales chains. Disruption of production and infrastructure, in addition to negative phenomena, gave impetus to the innovative reconstruction of production capacities and modern technological processes. The most effective today have been the implementation of international quality standards ISO, HACCP, blockchain, digitization of processes, resource saving measures. Measures of green energy and processing waste into energy were effective and necessary, in particular, wheat and corn.

Research has shown that innovations in the deep processing of products and the circular economy (FoodTech) can be identified as priorities.This will make it possible to make a transition from the export of unprocessed grain to products with high added value based on high technologies and to receive pectin, organic acids, bioplastics, biofuels, dry bard as valuable fodder. innovative high-protein food products, etc. Innovative measures to improve logistics, including export warehouses, processing of production waste into biogas and biomethane are also a priority. It is necessary to adapt and implement warehouse Industry 4.0 and 5.0, which include artificial intelligence, personalized functional nutrition, systems for monitoring and operational adjustment of all processes of the food system in real time.

Keywords: Food sector, Food Security, Innovations, Deep processing, FoodTech, Industry 5.0

KRAYNA'NIN GIDA GÜVENLİĞİNİN SAĞLANMASINDA GIDA SEKTÖRÜNDEKİ İNOVASYONLAR

Özet

Bu çalışmanın amacı, Ukrayna'nın karşı karşıya olduğu güncel zorluklar ve fırsatlar bağlamında gıda sektörünün inovatif gelişimindeki en öncelikli alanları belirlemektir.

Ukrayna gıda sektörü halihazırda birbirine zıt koşullar altında gelişmektedir. Bir yandan, Rusya Federasyonu'nun tam kapsamlı saldırganlığı gıda üretim ve dağıtım zincirlerini sekteye uğratmış ve ürünlerin lojistik hareketliliğini zorlaştırmıştır. Diğer yandan, Avrupa entegrasyonu yolunda ve Endüstri 5.0'a geçiş sürecindeki dönüşümsel değişimler kapsamında, gıda piyasası aktörleri gıda sisteminin sürdürülebilirliğini artırmaya yönelik yeni teknik, teknolojik ve yönetsel çözümler uygulamakta; üretim ve satış zincirlerinin tüm aşamalarında inovasyonları hayata geçirmektedir. Üretim ve altyapıdaki aksamalar, olumsuz etkilerinin yanı sıra, üretim kapasitelerinin ve modern teknolojik süreçlerin inovatif bir şekilde yeniden yapılandırılmasına da ivme kazandırmıştır. Günümüzde en etkili uygulamalar; ISO ve HACCP gibi uluslararası kalite standartlarının hayata geçirilmesi, blok zinciri (blockchain) teknolojisi, süreçlerin dijitalleştirilmesi ve kaynak tasarrufu önlemleri olmuştur. Özellikle buğday ve

mısır özelinde, yeşil enerji kullanımı ve atıkların enerjiye dönüştürülmesi gibi önlemler etkili ve gerekli görülmüştür.

Araştırmalar, ürünlerin ileri düzeyde işlenmesi ve döngüsel ekonomi (FoodTech) alanındaki inovasyonların öncelikli olarak ele alınabileceğini göstermiştir. Bu yaklaşım, işlenmemiş tahıl ihracatından, ileri teknolojilere dayalı yüksek katma değerli ürünlerin üretimine geçişi mümkün kılacak; ayrıca pektin, organik asitler, biyoplastikler, biyoyakıtlar ve değerli bir hayvan yemi olan kuru damıtma artığı (dry bard) gibi ürünlerin elde edilmesini sağlayacaktır. Yenilikçi yüksek proteinli gıda ürünleri vb. İhracat depoları ile üretim atıklarının biyogaz ve biyometana dönüştürülmesi dahil olmak üzere lojistiği iyileştirmeye yönelik yenilikçi önlemler de birer önceliktir. Yapay zeka, kişiselleştirilmiş fonksiyonel beslenme ve gıda sistemindeki tüm süreçlerin gerçek zamanlı izlenmesi ve operasyonel olarak ayarlanmasına yönelik sistemleri kapsayan Endüstri 4.0 ve 5.0 uygulamalarının depolama süreçlerine uyarlanması ve hayata geçirilmesi gerekmektedir.

Anahtar Kelimeler: Gıda sektörü, Gıda Güvenliği, Yenilikler, Derinlemesine işleme, FoodTech, Endüstri 5.0

DYNAMICS OF LASSA FEVER ON HOST AND VECTOR POPULATION

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Abstract

Lassa fever remains an important zoonotic disease in West Africa, especially in Nigeria. This study investigates the dynamics of a Lassa fever model within a population through a compartmental approach, specifically focusing on the host and vector populations. The study analyzes the stability of the disease-free equilibrium (DFE) and calculates the basic reproduction number (R_0) for the model. Using a system of ordinary differential equations, the model captures the interactions between different compartments and their impact on the spread of the disease. The Jacobian matrix is derived and evaluated at the DFE to determine the stability conditions. The eigenvalues of the matrix reveal that the disease-free equilibrium is locally stable when the basic reproduction number $R_0 < 1$, indicating that the disease will eventually be eradicated from the population. Conversely, when $R_0 > 1$, the DFE becomes unstable, suggesting the potential for an outbreak. Numerical simulations corroborate the theoretical findings, providing insights into the critical factors that influence disease control and eradication. The results underscore the importance of targeting specific parameters in public health interventions to reduce R_0 and achieve long-term disease control.

Keywords: Stability analysis, disease-free equilibrium (DFE), Basic reproduction number (R_0), host-vector interaction, and sensitivity analysis.

MICROPLASTICS AS VECTORS FOR HEAVY METALS AND PESTICIDES IN THE GHARESOO RIVER, IRAN: A MULTI-CONTAMINANT ASSESSMENT

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Abstract

Microplastics (MPs) have emerged as a significant global environmental concern due to their persistence, widespread distribution, and ability to act as vectors for other contaminants. This study investigates the role of MPs as carriers for heavy metals and organophosphorus and organochlorine pesticides in the Gharesoo River, Kermanshah Province, Iran, an aquatic ecosystem heavily impacted by municipal wastewater, industrial effluents, and agricultural runoff. Sampling was conducted at three stations with varying urban activities, and a total of nine samples were analyzed for 22 heavy metals, six organophosphorus pesticides, and five organochlorine pesticides using atomic absorption spectroscopy and gas chromatography-mass spectrometry (GC-MS). The results revealed the presence of all target contaminants across all samples, with iron (61,919.5 μg g^{-1}) and antimony (0.1 μg g^{-1}) representing the highest and lowest heavy metal concentrations, respectively. Among pesticides, ethion (4.6 ppb) and butachlor (0.003 ppb) exhibited the maximum and minimum levels. Spatial distribution analysis demonstrated that downstream stations, characterized by higher anthropogenic activities, contained the greatest contaminant loads, while upstream areas showed relatively lower concentrations. Strong correlations were observed between MP abundance and heavy metal and pesticide content, suggesting that MPs serve as efficient vectors for contaminant transport and accumulation in aquatic environments. The concurrent presence of MPs, heavy metals, and pesticides poses potential ecological risks and adverse impacts on aquatic organisms, with implications for bioaccumulation through the food chain. This study provides critical evidence that MPs facilitate the transport and distribution of multiple pollutants in freshwater systems, highlighting the urgent need for improved waste management strategies and stricter regulations to mitigate the ecological and health risks associated with MP contamination in vulnerable water bodies.

Keywords: Microplastics; Vector; Heavy Metals; Organophosphorus Pesticides; Organochlorine Pesticides; Adsorption

Highlights

- Heavy metals and Pesticides accumulated on MPs particles
- MPs particles can transport heavy metals and pesticides within the aquatic zone.
- MPs were dominantly found in local river.
- Local river was contaminated with MPs, heavy metals and pesticides

MATHEMATICAL FORMULATION OF THE RESTRICTED THREE-BODY PROBLEM WITH DIPOLE AND OBLATENESS PERTURBATIONS

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Abstract

Irregular shapes and non-uniform mass distributions of celestial bodies can produce gravitational effects that are not fully represented by the classical restricted three-body problem. In this work, a mathematical formulation is developed for a restricted three-body system consisting of a rotating mass-dipole primary and an oblate secondary. The larger primary is represented by two equal masses separated by a fixed distance, while the departure of the secondary from spherical symmetry is represented by an oblateness coefficient. A scaled mass parameter and a force-ratio parameter are also introduced into the model. Using a uniformly rotating barycentric frame, the kinetic and potential energies of the infinitesimal body are established, with the oblateness correction obtained from the principal moments of inertia of the secondary. The conjugate momenta and Hamiltonian are then determined, leading to the effective potential and the governing equations of motion. The mean motion is also modified to include the contribution of the oblate secondary. The formulation gives a compact dynamical model that combines the effects of dipole mass distribution and oblateness, and provides the required equations for further analysis of particle motion in irregular binary celestial systems.

FINITE DIFFERENCE MODELING AND CONVERGENCE ANALYSIS OF TWO-DIMENSIONAL REACTIVE CONTAMINANT TRANSPORT IN POROUS MEDIA

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Abstract

A finite difference formulation and convergence analysis are presented for reactive contaminant transport in a two-dimensional homogeneous saturated porous medium. Steady groundwater flow is described with the groundwater-flow equation, and the resulting flow field is coupled to an advection–dispersion–reaction equation. The transport equation is discretized by forward difference in time, central difference for advection, and central difference for dispersion. The model includes longitudinal and transverse dispersion, first-order decay, a constant-concentration inflow boundary, and specified concentration-gradient conditions. The original MATLAB simulation is retained and interpreted using dimensionless transport measures. For the reported physical parameters, the horizontal Darcy flux is approximately 5×10^{-5} m/s and the domain-scale Péclet number is about 0.05, showing that the reported test case is dispersion dominated. To verify the numerical transport scheme, a one-dimensional non-reactive limiting case is compared with the classical Ogata–Banks analytical solution. For the benchmark case, the root-mean-square error decreases from 5.145×10^{-3} at $\Delta x = 0.4$ m to 7.889×10^{-5} at $\Delta x = 0.05$ m. The observed convergence order approaches two, with values 2.024, 2.004, and 1.999 over successive grid refinements. The benchmark therefore confirms second-order grid convergence for the chosen refinement strategy. The numerical results and original figures show progressive plume spreading from the inflow boundary while the steady hydraulic-head field remains linear. The study provides a transparent finite difference modeling framework supported by analytical verification, quantitative error measures, and grid-convergence analysis for further development toward heterogeneous and field-based contaminant transport problems.

Keywords: contaminant transport; porous medium; finite difference method; Ogata–Banks solution; grid convergence; RMSE; groundwater flow

A HYBRID FUZZY-NAÏVE BAYES LOGISTIC REGRESSION MODEL FOR ROBUST BINARY CLASSIFICATION

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Abstract

A hybrid Fuzzy-Naïve Bayes Logistic Regression (FNB-LR) model is derived which combining fuzzy logic with a Naïve Bayes classifier operating on logistic regression–transformed features. The fuzzy layer handles ambiguity and partial membership of inputs, while the Naïve Bayes component provides probabilistic classification in the latent logistic space. The model formulated and algorithm is applied to a real dataset. Empirical results demonstrate that the FNB-LR model outperforms classical logistic regression, pure fuzzy logistic regression, and a standalone Naïve Bayes classifier on accuracy using F1-score, and AUC metrics.

Keywords: fuzzy logic, Naïve Bayes, logistic regression, hybrid classifier, class imbalance, binary classification.

MONTE CARLO STUDY OF MAGNETIC INTERACTIONS IN Sr_2BOsO_6 (B = Cu, Cr) DOUBLE PEROVSKITE CERAMICS

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ABSTRACT

Double perovskites are promising magnetic materials due to their complex magnetic behavior and the possibility of tuning their properties through chemical substitution. In this work, we investigate the magnetic interactions and temperature-dependent magnetic properties of Sr_2BOsO_6 double perovskites, with B = Cu and Cr, using Monte Carlo simulations within the framework of the Ising model. The exchange coupling parameters between the magnetic ions are estimated by analyzing the relationship between the internal energy and magnetization and by adjusting the model parameters to reproduce the experimentally reported magnetic transition temperatures. For Sr_2CrOsO_6, the calculated exchange interactions are $J_{Cr–Os} = -35.201$ meV, $J_{Cr–Cr} = 5.452$ meV, and $J_{Os–Os} = 14.873$ meV. In contrast, for Sr_2CuOsO_6, the corresponding values are $J_{Cu–Os} = 3.062$ meV, $J_{Cu–Cu} = -1.531$ meV, and $J_{Os–Os} = 0.742$ meV. These results reveal significant differences in both the magnitude and sign of the exchange interactions between the two compounds. The temperature dependence of the magnetization, magnetic susceptibility, internal energy, and specific heat is also investigated to characterize their magnetic behavior and identify the magnetic transition. The comparison demonstrates that replacing Cr with Cu substantially modifies the balance between the B–Os, B–B, and Os–Os exchange interactions, leading to distinct magnetic responses and transition characteristics. The results highlight the crucial role of the B-site magnetic ion in controlling the magnetic properties of Sr_2BOsO_6 double perovskites. Overall, this study demonstrates that Monte Carlo simulations based on the Ising model provide a useful theoretical framework for estimating microscopic exchange interactions and connecting them with the macroscopic magnetic properties of complex double-perovskite materials.

Keywords: Double Perovskite Sr_2CuOsO_6, Double Perovskite Sr_2CrOsO_6, Exchange interactions, Monte Carlo Simulation

ENHANCING INTERVIEW SKILLS OF ENGINEERING STUDENTS THROUGH SIMULATION-BASED LEARNING

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Abstract

The performance in interviews plays a vital role in the employability of engineering graduates. Especially, during the hiring processes the interviewee evaluate the candidates on their communication skills, technical expertise, self-confidence, problem-solving capabilities, and professional conduct. However, most of the engineering students' get anxiety and fear during interviews. This research examines the impact of simulation-based learning on enhancing interview skills among undergraduate engineering students. A mixed-methods, and quasi-experimental approach was used to investigate the changes in students' interview performance before and after a structured intervention involving simulations. The research involved 80 final-year engineering students who took part in a six-week training program that included mock interviews, role-play, panel interviews, technical interview simulations, recorded practice sessions, peer reviews, and self-reflective assessments. Data were gathered through evaluations of interview performance conducted both prior to and following the intervention. Quantitative data were evaluated using descriptive statistics and comparisons of paired samples, whereas qualitative feedback was analyzed using thematic analysis.

The results showed that after the simulation-based learning intervention, students' overall interview performance significantly improved. Participants showed increased self-assurance, enhanced professional body language, improved language proficiency and clarity of speech. Besides, they learn to reply for the technical questions and organise their responses. The results also showed that students' perceived self-efficacy had increased and interview-related anxiety had decreased. Continuous practice, exposure to real-world interview situations, feedback from peers were found to be important components of skill improvement. Qualitative results also indicated that students were able to evaluate their development and identify areas of difficulty in verbal and nonverbal communication through video-based reflection. In conclusion, simulation-based learning offers a useful experiential method for bridging the gap between expectations for employment and classroom communication instruction.

Keywords: Engineering Students, Interview Skills, Simulation-Based Learning

THE ROLE OF MATHEMATICS IN STEM EDUCATION AND INNOVATION

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Abstract

Mathematics plays a foundational role in Science, Technology, Engineering, and Mathematics (STEM), serving as a universal language and an essential framework for understanding, analyzing, and solving complex problems. This paper examines the significance of mathematics within STEM education, research, technological development, and innovation. It focuses on how mathematical concepts and skills, including logical reasoning, quantitative analysis, mathematical modeling, statistics, probability, optimization, and computational thinking, contribute to learning and problem-solving across STEM disciplines. Mathematics enables students to interpret data, construct models, identify patterns, predict outcomes, evaluate evidence, and make informed decisions in both academic and real-world contexts. The paper further explores the interdisciplinary relationship between mathematics and other STEM fields, demonstrating how mathematical methods support scientific investigation, engineering design, technological advancement, and data-driven decision-making. Particular attention is given to the importance of developing mathematical literacy and problem-solving abilities from an early stage, as these competencies provide a strong foundation for advanced STEM learning and future professional careers. The study also highlights the growing importance of mathematics in emerging areas such as artificial intelligence, machine learning, robotics, cybersecurity, and data science. Furthermore, it emphasizes the need for innovative teaching strategies that connect mathematical theory with practical applications and interdisciplinary STEM activities. By strengthening the integration of mathematics with other STEM subjects, educators can foster critical thinking, creativity, collaboration, and analytical skills among learners. The paper concludes that mathematics should not be viewed as an isolated discipline but as a central component that connects and strengthens the broader STEM ecosystem, supporting scientific discovery, technological progress, and sustainable innovation.

Keywords: Mathematics education, STEM education, Mathematical modeling, Problem solving, Computational thinking, Data analysis, Interdisciplinary learning, Mathematical reasoning, STEM innovation, Critical thinking

TURNING WASTEWATER INTO RESOURCES: CHEMICAL ENGINEERING STRATEGIES FOR SUSTAINABLE WATER AND RESOURCE RECOVERY IN DEVELOPING ECONOMIES

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Abstract

Rapid population growth, industrialization, water scarcity, and increasing wastewater generation pose significant challenges to sustainable water management, particularly in developing economies. Conventional wastewater treatment systems are primarily designed to remove contaminants and discharge treated effluent, often overlooking wastewater as a potential source of reusable water, nutrients, energy, and valuable chemical resources. This paper explores a chemical engineering approach to transforming wastewater treatment from a disposal-oriented process into an integrated water and resource recovery system. It examines advanced treatment and recovery technologies, including membrane separation, adsorption, coagulation–precipitation, advanced oxidation processes, biological conversion, anaerobic digestion, and nutrient recovery, with emphasis on their process principles and engineering requirements. Key chemical engineering considerations, including reaction kinetics, mass transfer, separation efficiency, process integration, energy consumption, process optimization, and technological scale-up, are critically discussed. The paper further evaluates technical, economic, and environmental factors influencing the adoption of wastewater resource recovery systems in developing economies, where inadequate infrastructure, high operating costs, energy demands, and limited process control remain significant barriers. Particular attention is given to the integration of locally available materials, renewable energy, and emerging treatment technologies to enhance resource recovery while reducing environmental impacts. The study highlights the potential of wastewater-derived resources to support water security, circular resource utilization, pollution reduction, and sustainable industrial development. It proposes an integrated chemical engineering framework for developing wastewater-to-resource systems that are technically feasible, economically viable, energy-efficient, and adaptable to the conditions of developing economies. Such systems can also reduce dependence on freshwater sources and conventional raw materials while creating opportunities for decentralized treatment, resource recovery, and sustainable industrial applications.

Keywords: Wastewater resource recovery; Chemical engineering; Water reuse; Nutrient recovery; Resource recovery; Sustainable development; Circular economy; Developing economies.

ESP32 VE BLOKZİNCİR TABANLI AKILLI MİNİ ŞARJ İSTASYONU: ERC-20 SARJ TOKENİ İLE ÖDEME DOĞRULAMALI ŞARJ KONTROLÜ

ESP32 AND BLOCKCHAIN BASED SMART MINI CHARGING STATION: PAYMENT-VERIFIED CHARGING CONTROL WITH ERC-20 SARJ TOKEN

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Abstract

Blockchain technology allows value to be transferred between parties without a trusted intermediary, and smart contracts make payment procedures programmable. Integrating Internet of Things (IoT) devices into this infrastructure enables payment and physical service delivery to be combined in a single autonomous system. This study presents a smart mini charging station prototype that verifies payments on the Ethereum blockchain and delivers the charging service through an ESP32 microcontroller. A payment token named SARJ has been developed in accordance with the ERC-20 standard, and has been deployed on the Sepolia test network. The user starts the payment from a decentralized application interface and signs the transaction with the MetaMask wallet. A backend service built with Python and Web3.py follows the Transfer events of the contract in real time; once a payment is confirmed on-chain, it sends an authorization command to the ESP32 through a Flask-based HTTP bridge. The architecture is also compatible with MQTT, allowing several stations to be managed from a single backend. The ESP32 then enables the charging output through a logic-level MOSFET switch, while an INA219 sensor measures line voltage, current and power. These readings appear on the local screen and on a web-based control panel. One SARJ token authorizes the normal charging profile (target 5 V, 2 A) and two SARJ tokens the fast charging profile (target 9 V, 2 A). In functional tests, the system has produced the correct decision in all thirty-five payment transactions and rejected every invalid-amount payment. The average delay from payment confirmation to backend detection was 1.59 seconds. Private keys are stored on no device, and an MFRC522-based RFID session procedure provides two-factor verification by combining physical identity with the digital payment. The study offers a low-cost, secure, and reproducible reference architecture for combining blockchain-based micropayments with embedded systems.

Keywords: Blockchain, Charging station, ERC-20, ESP32, Internet of Things, Smart contract

Özet

Blokzincir teknolojisi, güvenilir bir aracıya gerek kalmadan taraflar arasında değer transferine olanak tanımakta; akıllı sözleşmeler ise ödeme prensibinin programlanabilir biçimde tanımlanmasını sağlamaktadır. Nesnelerin İnterneti (IoT) cihazlarının bu altyapıyla bütünleştirilmesi, ödeme ile fiziksel hizmet sunumunun tek bir otonom sistemde birleştirilmesini mümkün kılmaktadır. Bu çalışmada, ödemeyi Ethereum blokzinciri üzerinde doğrulayan ve fiziksel şarj hizmetini ESP32 mikrodenetleyicisi ile sunan akıllı bir mini şarj istasyonu prototipi tasarlanmış ve gerçeklenmiştir. SARJ adlı ödeme tokeni,

ERC-20 standardına uygun olarak geliştirilmiş ve Sepolia test ağına dağıtılmıştır. Kullanıcı ödemeyi merkeziyetsiz uygulama arayüzünden başlatmakta ve işlemi MetaMask cüzdanı ile imzalamaktadır. Python ve Web3.py ile geliştirilen backend servisi, sözleşmenin Transfer olaylarını gerçek zamanlı izlemekte; ödeme zincir üzerinde onaylandığında, ESP32 birimine Flask tabanlı bir HTTP köprüsü aracılığıyla yetkilendirme komutu göndermektedir. Mimari, MQTT protokolü ile de uyumlu olduğundan birden fazla istasyonun tek bir backend üzerinden yönetilmesine imkân tanımaktadır. ESP32, lojik seviyeli bir MOSFET anahtar üzerinden şarj çıkışını etkinleştirmekte; hat üzerindeki gerilim, akım ve güç değerleri INA219 sensörü ile ölçülmektedir. Bu değerler yerel ekranda ve web tabanlı bir kontrol panelinde görüntülenmektedir. Tek SARJ token normal şarj profilini (hedef 5 V, 2 A), iki SARJ token ise hızlı şarj profilini (hedef 9 V, 2 A) yetkilendirmektedir. İşlevsel testlerde sistem, otuz beş ödeme işleminin tamamında doğru kararı üretmiş ve geçersiz tutardaki ödemelerin tümünü reddetmiştir. Ödeme onayı ile backend algılaması arasındaki gecikme ortalama 1,59 saniye olarak ölçülmüştür. Özel anahtarlar hiçbir cihazda saklanmamakta; MFRC522 tabanlı RFID oturum prosedürü, fiziksel kimlik ile dijital ödemeyi birleştirerek iki faktörlü doğrulama sağlamaktadır. Çalışma, blokzincir tabanlı mikro ödemelerin gömülü sistemlerle bütünleştirilmesine yönelik düşük maliyetli, güvenli ve tekrarlanabilir bir referans mimari sunmaktadır.

Anahtar kelimeler: Akıllı sözleşme, Blokzincir, ERC-20, ESP32, Nesnelerin interneti, Şarj istasyonu

DESIGN AND SIMULATION OF A MICROCONTROLLER BASED REAL TIME VITAL SIGNS MONITORING SYSTEM USING ARDUINO NANO

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Abstract

Continuous vital sign tracking is critical to help detect abnormal physiological states and act at the right time. In this paper, the design and simulation of a microcontroller-based real-time vital signs monitoring system with the use of an Arduino Nano microcontroller is presented. The system is designed to track the body temperature, heart rate, and respiration rate with the Arduino Nano as the main processor. The approach taken is hardware and software integration, designing and simulating the circuit in Proteus Professional and coding the embedded program in the Arduino IDE. Temperature measurements were obtained with an LM35 sensor and heart rate, and respiration rate inputs were simulated with potentiometers. The received signals were processed on the Arduino Nano and compared to some defined threshold values. A 16 × 2 LCD display of measured parameters and health status was provided for real-time monitoring and validation via Proteus Virtual Terminal. The system included both visual and audible warning indicators to warn of abnormal conditions. The green LED was lit when the reading was normal, and the red LED and buzzer sounded when the reading was abnormal, and it was displayed as an "ALERT" status. The results of the simulation were recorded as the heart rate of 60 BPM and the respiration rate of 12 BPM, and the system was properly showing a "NORMAL" status. The temperature reading of 0.00°C was found to be a limitation of the simulation with the LM35 configuration. The overall results show successful integration of physiological data acquisition, real-time processing, parameter display, serial communication, and automatic health status indication. The proposed system offers an implementable solution for continuous vital signs monitoring and validation of the implemented hardware system.

Keywords: Arduino Nano**,** Embedded Systems**,** Physiological Parameter Detection, Proteus Simulation, Real Time Health Monitoring, Vital Signs Monitoring.

DIGITAL TRANSFORMATION: A PANACEA FOR LIFELONG LEARNING IN TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING IN NIGERIA.

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Abstract

This paper explored digital transformation in Technical Vocational Education and Training (TVET) for Lifelong Learning in Nigeria. The paper examined conventional TVET systems, that mainly train learners for a specific job, might be less suitable to meet the fast-evolving skills needs of automation, Artificial Intelligence, digitalisation and other technologies. The world of work is changing rapidly with digital transformation and it's driving a growing need to learn, reskill and upskill. Opportunities offered by digital technologies are like online learning platforms, virtual laboratories, simulations, AI, mobile learning, and digital credentialing, for flexible, accessible and continuous learning among others. Challenges such as inadequate digital infrastructure, poor internet connectivity, limited digital competence among teachers and learners, outdated curricula, inadequate funding, digital inequality, resistance to change are however limiting the successful digital transition of TVET. Greater investments in digital infrastructure, ongoing teacher professional development for TVET teachers, updating the curricula, more flexible and modular learning, blended learning methods, better partnerships with industry, inclusive digital policies and sustainable funding are some of the solutions to digital transformation of TVET in Nigeria. Based on the discussion, the following recommendations are made: Governments and relevant stakeholders should invest adequately in digital infrastructure in TVET institutions by providing reliable electricity, internet connectivity, computers, digital laboratories, simulation facilities, and other relevant technologies. TVET practitioners and instructors should be offer continuous professional development (CPD) in order to enhance their digital literacy, digital pedagogy and use of emerging technologies in their teaching, practical training and assessment, among others.

Keywords: Digital transformation, TVET, lifelong learning, Reskill, upskill.

ENHANCED TEACHING–LEARNING-BASED OPTIMIZATION FOR MULTI-PATH, MULTI-VEHICLE EMERGENCY MEDICAL DELIVERY UNDER FLOOD RISK: A CASE STUDY OF MALDA DISTRICT

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Abstract

Emergency medical delivery in flood-prone districts must address priority-weighted demand, vehicle capacity, emergency time windows, rapidly changing road risks, carbon emissions, and operational costs. This paper proposes an Enhanced Teaching–Learning-Based Optimization (Enhanced TLBO) algorithm that extends classical TLBO through elite multi-teacher guidance, an adaptive teaching factor, differential-evolution-style perturbation, embedded local search, and feasibility-first Pareto selection. The approach optimizes five conflicting objectives: weighted response time, carbon emissions, operational cost, flood/reliability risk exposure, and lateness-weighted unmet demand. The algorithm is evaluated using a twenty-node, four-depot, six-vehicle emergency delivery network modelled on Malda district, West Bengal, India. Four operational scenarios—normal, monsoon, severe flood, and road blockage—are considered, with three alternative paths for each origin–destination pair to represent route uncertainty. Across all scenarios, Enhanced TLBO produces feasible compromise solutions with zero constraint violations. A ten-seed statistical comparison with standard TLBO, random search, and a greedy heuristic demonstrates the effectiveness and robustness of the proposed method. The Wilcoxon signed-rank test confirms statistically significant improvements ($p < 0.05$) in every pairwise comparison. On the scalarized objective, Enhanced TLBO achieves a 10.3% mean improvement over standard TLBO and a 99.8% improvement over the greedy heuristic. The study further provides algorithmic complexity analysis and a complete mathematical formulation with explicit notation. Managerial insights support district health administrators in emergency resource allocation and risk-aware routing decisions. Finally, research questions are formulated and answered quantitatively to demonstrate the practical and methodological significance of the proposed framework. The framework therefore offers a practical decision-support mechanism for resilient emergency logistics planning, helping authorities balance service priorities, safety, sustainability, and cost during uncertain flood conditions, improving preparedness and responsiveness across district health networks.

Keywords: Teaching-learning-based optimization, Multi-objective optimization, Emergency medical logistics, Flood-resilient routing, Multi-path vehicle routing, Pareto optimization

JİA'LARIN SENKRON GENERATÖR ÜZERİNDEKİ ETKİLERİNİN FARKLI İŞLETME VE ŞEBEKE KOŞULLARI ALTINDA ÇOK PARAMETRELİ ANALİZİ

MULTI-PARAMETER ANALYSIS OF THE EFFECTS OF GICS ON A SYNCHRONOUS GENERATOR UNDER DIFFERENT OPERATING AND GRID CONDITIONS

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Abstract

Geomagnetically induced currents (GICs) can cause power transformers with grounded wye-connected windings to enter half-cycle saturation, resulting in increased magnetizing current, harmonic distortion, and reactive power demand. This nonlinear behavior in the generator step-up transformer may propagate harmonic and negative-sequence currents toward the synchronous generator, thereby increasing electromagnetic stresses and degrading voltage and reactive-power performance. In this study, the electromagnetic and electrical performance of a grid-connected synchronous generator under GIC conditions is investigated through a multi-parameter analysis using a MATLAB/Simulink-based time-domain transient model. The investigated system consists of a 13.8 kV synchronous generator, a 13.8/154 kV generator step-up transformer, a 100 km long 154 kV transmission line, a 154/33 kV step-down transformer, and a load. A total of 600 operating scenarios were evaluated by varying the equivalent GIC voltage, substation grounding resistance, load level, load power factor, and transmission-line impedance unbalance. Generator performance was assessed in terms of the equivalent negative-sequence current (I_{2eq}), stator-current total harmonic distortion ($THDI_G$), terminal voltage, active power, and reactive power. The results show that increasing the equivalent DC voltage from 0 to 500 V raises I_{2eq} to approximately 0.27 pu and $THDI_G$ to approximately 28%. Under the same conditions, the terminal voltage decreases from 1.09 pu to 0.93 pu and the active power from 0.56 pu to 0.40 pu, whereas the reactive power increases from approximately 0.35 pu to 0.52 pu. In contrast, increasing the grounding resistance limits the GIC magnitude and significantly mitigates transformer half-cycle saturation and the associated harmonic effects. These findings demonstrate that synchronous-generator performance under GIC conditions should be evaluated comprehensively by considering not only voltage and power quantities but also negative-sequence- and harmonic-based electromagnetic stress indicators.

Keywords: Geomagnetically Induced Currents, Synchronous Generator, Harmonic Distortion, Negative-Sequence Current.

Özet

Jeomanyetik kaynaklı akımlar (JİA), yıldız noktası topraklanmış güç transformatörlerinde çekirdeği yarım periyot doyumuna sürükleyerek mıknatıslanma akımının, harmonik bozulmanın ve reaktif güç talebinin artmasına neden olabilmektedir. Generatör yükseltici transformatöründe ortaya çıkan bu doğrusal olmayan davranış, harmonik ve negatif-sekans akımlarının senkron generatöre iletilmesine, elektromanyetik zorlanmaların artmasına ve gerilim–reaktif güç performansının bozulmasına yol açabilmektedir. Bu çalışmada, JİA koşullarında şebekeye bağlı bir senkron generatörün elektromanyetik ve elektriksel performansı, MATLAB/Simulink tabanlı zaman alanı geçici durum modeli kullanılarak çok parametreli olarak incelenmiştir. İncelenen sistem; 13.8 kV senkron generatör, 13.8/154 kV

generatör yükseltici transformatör, 100 km uzunluğunda 154 kV iletim hattı, 154/33 kV indirici transformatör ve yükten oluşmaktadır. Eşdeğer JİA gerilimi, trafo merkezi topraklama direnci, yük seviyesi, yük güç faktörü ve hat empedans dengesizliğinin değiştirildiği toplam 600 çalışma durumu değerlendirilmiştir. Generatör performansı; eşdeğer negatif-sekans akımı (I_{2eq}), stator akımı toplam harmonik bozulması ($THDI_G$), terminal gerilimi, aktif güç ve reaktif güç göstergeleri üzerinden değerlendirilmiştir. Sonuçlar, eşdeğer DA geriliminin 0'dan 500 V'a yükselmesiyle I_{2eq} değerinin yaklaşık 0.27 pu'ya, $THDI_G$ değerinin ise yaklaşık %28'e ulaştığını göstermiştir. Aynı koşullarda terminal gerilimi 1.09 pu'dan 0.93 pu'ya, aktif güç ise 0.56 pu'dan 0.40 pu'ya gerilerken, reaktif güç yaklaşık 0.35 pu'dan 0.52 pu'ya yükselmiştir. Buna karşılık, topraklama direncinin artırılması JİA akımını sınırlandırarak transformatördeki yarım periyot doyumunu ve buna bağlı harmonik etkileri belirgin biçimde azaltmıştır. Elde edilen bulgular, JİA koşullarında senkron generatör performansının yalnızca gerilim ve güç büyüklükleri üzerinden değil, negatif-sekans ve harmonik temelli elektromanyetik zorlanma göstergeleri de dikkate alınarak bütüncül biçimde değerlendirilmesi gerektiğini ortaya koymaktadır.

Anahtar kelimeler: Jeomanyetik Olarak İndüklenen Akımlar, Senkron Generatör, Harmonik Bozulma, Negatif-Sekans Akımı.

BETONARME PERDE DUVARLARIN DOĞRUSAL OLMAYAN NÜMERİK MODELLEME YÖNTEMLERİNİN BİNALARIN DOĞRUSAL OLMAYAN DAVRANIŞLARINA ETKİSİNİN İNCELENMESİ

INVESTIGATION OF THE EFFECT OF NONLINEAR NUMERICAL MODELING METHODS OF REINFORCED CONCRETE SHEAR WALLS ON THE NONLINEAR BEHAVIOR OF BUILDINGS

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Abstract

Shear walls are among the most critical structural elements in the design of reinforced concrete buildings under earthquake effects and in the performance evaluation of existing structural systems, in terms of increasing the lateral load-carrying capacity of the structure, providing structural stiffness, and limiting inter-story drifts. While destructive earthquakes that occurred in recent years have once again proven the importance of using shear walls, they have also clearly demonstrated the necessity of representing the non-linear behavior of these elements accurately, precisely, and realistically in seismic performance analyses. In today's engineering practice and academic research, the non-linear behavior of shear walls is simulated with significantly different numerical approaches, such as equivalent plastic hinge models based on simplified beam elements, fiber section models based on distributed plasticity, and layered shell models involving detailed finite element assumptions. However, the theoretical backgrounds of these different modeling techniques and their implementation methods in widely used engineering software can produce notable differences in final analysis results and structural responses.

This study aims to thoroughly examine the non-linear numerical modeling methods of reinforced concrete shear walls within the framework of existing literature and to comparatively evaluate the modeling alternatives in commercial software widely used in engineering practice in Turkey (ideCAD, Sta4CAD, ProtaStructure). The modeling approaches in question are addressed within the framework of key parameters such as analysis completion and computation times, software implementation convenience, and modeling complexity. In line with the findings obtained, it is aimed to explicitly demonstrate the reflections of theoretical approaches in the literature on practical engineering applications and building design processes. Thus, it is targeted to determine the most optimum, fast, and safe shear wall modeling strategies for practicing and checking engineers without compromising analysis accuracy, time efficiency, and structural safety. These evaluations will serve as a qualified baseline to facilitate decision-making mechanisms in project design and inspection processes.

Keywords: Reinforced Concrete Shear Walls, Non-linear Analysis, Fiber Model, Layered Shell, Engineering Software, Seismic Performance.

Özet

Deprem etkileri altındaki betonarme binaların tasarımında ve mevcut yapı sistemlerinin performans değerlendirmesinde perde duvarlar; yapının yatay yük taşıma kapasitesinin artırılması, yapısal rijitliğin sağlanması ve kat ötelenmelerinin sınırlandırılması açısından en kritik yapısal elemanlar arasında yer almaktadır. Son yıllarda meydana gelen yıkıcı depremler, perde duvar kullanımının önemini bir kez daha kanıtlarken, bu elemanların doğrusal olmayan (nonlineer) davranışlarının sismik performans analizlerinde doğru, hassas ve gerçekçi bir şekilde temsil edilmesinin gerekliliğini de çok net bir biçimde

ortaya koymuştur. Günümüz mühendislik pratiğinde ve akademik araştırmalarda, perde duvarların doğrusal olmayan davranışı; basitleştirilmiş çubuk esasına dayanan eşdeğer plastik mafsal modelleri, yayılı plastiklik esasına dayanan lifli yani fiber kesit modelleri ve detaylı sonlu elemanlar kabulleri içeren katmanlı kabuk yani layered shell gibi oldukça farklı nümerik yaklaşımlarla simüle edilmektedir. Ancak, bu farklı modelleme tekniklerinin sahip olduğu teorik altyapılar ile yaygın mühendislik yazılımlarındaki uygulama biçimleri nihai analiz sonuçları ve yapısal tepkiler üzerinde dikkate değer farklılıklar ortaya çıkarabilmektedir.

Bu çalışma, betonarme perde duvarların doğrusal olmayan nümerik modelleme yöntemlerini mevcut literatür çerçevesinde detaylıca incelemeyi ve Türkiye'deki mühendislik uygulamalarında yaygın olarak kullanılan ticari yazılımlardaki (ideCAD, Sta4CAD, ProtaStructure) modelleme alternatiflerini karşılaştırmalı olarak değerlendirmeyi amaçlamaktadır. Söz konusu modelleme yaklaşımları; analizlerin tamamlama ve hesaplama süreleri, yazılımsal uygulama kolaylıkları ile modelleme karmaşıklıkları gibi temel parametreler çerçevesinde ele alınmaktadır. Elde edilen bulgular doğrultusunda, literatürdeki teorik yaklaşımların pratik mühendislik uygulamalarına ve bina tasarım süreçlerine olan yansımalarının açıkça ortaya konulması amaçlanmaktadır. Böylelikle uygulayıcı ve kontrolör mühendisler için analiz doğruluğundan, zaman verimliliğinden ve yapı emniyetinden ödün vermeden en optimum, hızlı ve güvenli perde duvar modelleme stratejilerinin belirlenmesi hedeflenmektedir. Bu değerlendirmeler, proje tasarım ve denetim süreçlerindeki karar verme mekanizmalarını kolaylaştıracak nitelikli bir altlık oluşturacaktır.

Anahtar kelimeler: Betonarme Perde Duvarlar, Doğrusal Olmayan Analiz, Lifli (Fiber) Model, Katmanlı Kabuk, Mühendislik Yazılımları, Sismik Performans.

BANT DIŞI GİRİŞİM ALTINDA TWLS TABANLI SENKROFAZÖR KESTİRİMİNDE GÖZLEM PENCERESİ UZUNLUĞUNUN ETKİSİ

EFFECT OF OBSERVATION WINDOW LENGTH ON TWLS-BASED SYNCHROPHASOR ESTIMATION UNDER OUT-OF-BAND INTERFERENCE

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Abstract

This study systematically investigates the influence of observation-window length on the out-of-band interference (OOBI) performance of a Taylor Weighted Least Squares (TWLS)-based synchrophasor estimator. Rather than proposing a modified algorithm, it quantitatively characterizes the sensitivity of conventional TWLS to observation-window length and examines whether phasor and frequency estimation exhibit different window-length requirements. A 50 Hz system with a sampling frequency of 6.4 kHz and a reporting rate of 50 frames/s is considered. Seven observation windows from 1 to 5 nominal cycles are evaluated. OOBI frequencies are swept at 1 Hz resolution over 10–25 Hz and 75–100 Hz, with the interfering component set to 10% of the fundamental amplitude. Thirty random phase realizations are performed for each condition, and performance is assessed using mean total vector error (TVE) and mean frequency error (FE).

Results demonstrate a strong, metric-dependent effect of observation-window length. The worst means TVE decreases from 8.36% for a one-cycle window to 5.01% at two cycles and 1.70% at three cycles. Increasing the window to four cycles sharply reduces the worst mean TVE to 0.265%, while five cycles provide only a marginal improvement to 0.243%. In contrast, frequency estimation continues to benefit substantially from longer windows. The worst mean FE decreases from 2468.7 mHz at one cycle to 993.6 mHz at two cycles, 465.1 mHz at three cycles, 110.1 mHz at four cycles, and 26.5 mHz at five cycles. All tested OOBI frequencies satisfy the 1.3% TVE reference level for four- and five-cycle windows, whereas the proportion satisfying the 10 mHz FE reference level reaches only 21.43% and 61.90%, respectively. These findings reveal that TVE performance approaches a plateau at approximately four cycles, whereas frequency estimation continues to improve considerably with further window extension, highlighting a metric-dependent trade-off in selecting the TWLS observation window under OOBI conditions.

Keywords: Synchrophasor Estimation, Taylor Weighted Least Squares, Out-of-Band Interference.

Özet

Bu çalışma, gözlem penceresi uzunluğunun Taylor Ağırlıklı En Küçük Kareler (TWLS) tabanlı bir senkrofazör kestiricisinin bant dışı girişim (OOBI) altındaki performansı üzerindeki etkisini sistematik olarak incelemektedir. Değiştirilmiş bir kestirim algoritması önermek yerine, geleneksel TWLS'nin gözlem penceresi uzunluğuna duyarlılığı nicel olarak karakterize edilmekte ve fazör ile frekans kestiriminin farklı pencere uzunluğu gereksinimleri gösterip göstermediği araştırılmaktadır. Örnekleme frekansı 6,4 kHz ve raporlama hızı 50 çerçeve/s olan 50 Hz'lik bir sistem ele alınmıştır. 1 ila 5 nominal çevrim arasında değişen yedi gözlem penceresi değerlendirilmiştir. OOBI frekansları 10–25 Hz ve 75–100 Hz aralıklarında 1 Hz çözünürlükle taranmış ve girişim bileşeninin genliği temel bileşen genliğinin %10'u olarak belirlenmiştir. Her test koşulu için otuz rastgele faz gerçekleştirmesi uygulanmış ve performans, ortalama toplam vektör hatası (TVE) ve ortalama frekans hatası (FE) kullanılarak değerlendirilmiştir.

Sonuçlar, gözlem penceresi uzunluğunun güçlü ve metriğe bağlı bir etkisi olduğunu göstermektedir. En kötü ortalama TVE, bir çevrimlik pencere için %8,36'dan iki çevrimde %5,01'e ve üç çevrimde %1,70'e düşmektedir. Pencerenin dört çevrime çıkarılması en kötü ortalama TVE'yi keskin biçimde %0,265'e düşürürken, beş çevrime çıkarılması yalnızca sınırlı bir ek iyileşme sağlayarak bu değeri %0,243'e indirmektedir. Buna karşılık, frekans kestirimi daha uzun pencerelerden önemli ölçüde yararlanmaya devam etmektedir. En kötü ortalama FE, bir çevrimde 2468,7 mHz'den iki çevrimde 993,6 mHz'ye, üç çevrimde 465,1 mHz'ye, dört çevrimde 110,1 mHz'ye ve beş çevrimde 26,5 mHz'ye düşmektedir. Test edilen tüm OOBI frekansları dört ve beş çevrimlik pencerelerde %1,3 TVE referans seviyesini sağlarken, 10 mHz FE referans seviyesini sağlayanların oranı sırasıyla yalnızca %21,43 ve %61,90'a ulaşmaktadır. Bu bulgular, TVE performansının yaklaşık dört çevrimde bir platoya yaklaştığını, buna karşın frekans kestiriminin pencerenin daha da uzatılmasıyla belirgin biçimde iyileşmeye devam ettiğini ortaya koymakta ve OOBI koşulları altında TWLS gözlem penceresinin seçiminde metriğe bağlı belirgin bir ödünleşimi vurgulamaktadır.

Anahtar kelimeler: Senkrofazör Kestirimi, Taylor Ağırlıklı En Küçük Kareler, Bant Dışı Girişim.

NOHUT UNUNUN BUĞDAY HAMURUNUN TEKNOLOJİK VE REOLOJİK ÖZELLİKLERİ ÜZERİNDEKİ ETKİSİ

THE EFFECT OF CHICKPEA FLOUR ON THE TECHNOLOGICAL AND RHEOLOGICAL PROPERTIES OF WHEAT DOUGH

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Abstract

Chickpea flour is an important legume flour that can be used to enhance the nutritional value of wheat-based products due to its high protein, dietary fiber, vitamin, and mineral content. However, because it is gluten-free, its addition to wheat flour can affect the rheological properties and processability of the dough. The aim of this study is to determine the effects of different levels of chickpea flour addition on dough properties and to identify an appropriate substitution level. In this context, the dough development, water absorption, stability, strength, extensibility, and resistance to deformation of control and chickpea flour-added samples were evaluated. The results showed that chickpea flour addition generally increased dough stability. In particular, low levels of chickpea flour addition showed positive effects on the mixing tolerance and mechanical strength of the dough. Chickpea flour addition also affected dough energy, extensibility, and maximum strength, while medium-level addition provided a more balanced rheological profile in terms of these properties. At higher substitution levels, a decrease in some quality parameters was observed; This suggests that increasing the proportion of chickpea flour may lead to limitations in dough processing properties. Overall, the findings showed that low levels of chickpea flour addition did not negatively affect the rheological properties of wheat dough; on the contrary, at certain levels, it improved the mixing tolerance, resistance, and extensibility of the dough. Chickpea flour addition resulted in a more balanced dough structure in terms of dough development, resistance, and extensibility. In conclusion, it is thought that chickpea flour can be used to improve the nutritional properties of wheat-based products at low substitution levels.

Keywords: Chickpea flour, wheat flour, dough rheology, dough properties, substitution, functional flour

Özet

Nohut unu, yüksek protein, lif, vitamin ve mineral içeriği nedeniyle buğday bazlı ürünlerin besinsel değerinin artırılmasında kullanılabilecek önemli bir baklagil unudur. Bununla birlikte, gluten içermemesi nedeniyle buğday ununa ilavesi hamurun reolojik özelliklerini ve işlenebilirliğini etkileyebilmektedir. Bu çalışmada, buğday ununa farklı oranlarda nohut unu ilavesinin hamur özellikleri üzerindeki etkisinin belirlenmesi ve uygun ikame düzeyinin ortaya konulması amaçlanmıştır. Bu kapsamda, kontrol ve nohut unu ilaveli örneklerin hamur gelişimi, su absorbsiyonu, stabilite, dayanıklılık, uzayabilirlik ve deformasyona karşı direnç gibi temel reolojik özellikleri değerlendirilmiştir. Bulgular, nohut unu ilavesinin hamur stabilitesini genel olarak artırdığını göstermiştir. Özellikle düşük düzeydeki nohut unu ilavesinin hamurun karıştırma toleransı ve mekanik dayanıklılığı üzerinde olumlu etkiler oluşturduğu belirlenmiştir. Nohut unu ilavesinin hamurun enerji, uzayabilirlik ve maksimum direnç özelliklerini de etkilediği; orta düzeydeki ilavenin bu özellikler açısından daha dengeli bir reolojik profil sağladığı görülmüştür. Daha yüksek ikame düzeyinde ise bazı kalite göstergelerinde gerileme meydana gelmesi, artan nohut unu oranının hamur işleme özellikleri açısından sınırlayıcı olabileceğini düşündürmektedir. Genel olarak elde edilen bulgular, düşük düzeyde nohut unu kullanımının buğday hamurunun reolojik özelliklerini olumsuz etkilemediğini, aksine belirli oranlarda hamurun karıştırma toleransı, dayanıklılığı ve uzayabilirliğini iyileştirebildiğini ortaya koymaktadır. Özellikle orta düzeyde nohut unu ilavesinin hamur gelişimi, dayanıklılık ve uzayabilirlik açısından daha dengeli bir yapı sağladığı belirlenmiştir. Sonuç olarak nohut ununun, buğday bazlı ürünlerin besinsel özelliklerinin geliştirilmesi amacıyla düşük oranlarda kullanılabileceği ve uygun ikame düzeyinin belirlenmesinin ürünün teknolojik kalitesinin korunması açısından önemli olduğu düşünülmektedir.

Anahtar kelimeler: : Nohut unu, buğday unu, hamur reolojisi, hamur özellikleri, ikame, fonksiyonel un

CALIFORNIA BEARING RATIO AND SUBGRADE SUITABILITY OF CALCIUM CARBIDE WASTE-STABILISED LATERITIC SOIL UNDER SOAKED AND UNSOAKED CONDITIONS AT VARYING COMPACTION ENERGIES

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Abstract

Lateritic soils that support much of the road network in north-central Nigeria are often weak and moisture-sensitive, necessitating stabilisation for satisfactory pavement performance. This study investigated the effectiveness of calcium carbide waste (CCW), a calcium hydroxide-rich by-product of acetylene production, in improving the bearing capacity of lateritic soil from the Ajaokuta–Lokoja road. The soil, classified as A-7-6(13), had a liquid limit of 46% and a plasticity index of 21%. It was treated with 0%, 2%, 4%, 6%, 8%, and 10% CCW by dry mass and compacted at British Standard Light, West African Standard, and British Standard Heavy energies. California Bearing Ratio (CBR) tests were conducted under both unsoaked and soaked conditions. The results demonstrated consistent improvements in bearing capacity as CCW content and compaction energy increased. Under British Standard Heavy compaction, unsoaked CBR increased from approximately 10% for untreated soil to 47% at 10% CCW, while soaked CBR increased from about 6% to 39%, representing nearly a sixfold improvement. Unsoaked CBR values were generally higher than soaked values because soaking reduces matric suction; however, the difference decreased with increasing CCW content, indicating improved resistance to moisture-induced strength loss. Heavy compaction produced the highest CBR values because of increased soil density. Based on the Nigerian General Specification, CCW-treated soil met subgrade requirements across all compaction energies and met sub-base requirements under heavy compaction at higher dosages. The estimated soaked subgrade modulus increased from approximately 40–60 MPa to about 180 MPa after treatment. These findings demonstrate that CCW can effectively stabilise weak lateritic soil for pavement subgrade and, with adequate compaction, sub-base applications while potentially reducing pavement thickness and construction costs.

Keywords: California Bearing Ratio; calcium carbide waste; lateritic soil; compaction energy; soaked CBR; pavement subgrade; subgrade modulus.

EFFECT OF IMPACT STRENGTH OF 3D PRINTED CARBON FIBER-REINFORCED POLYLACTIC ACID (CF-PLA) ON DIFFERENT PRINTING PARAMETERS

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ABSTRACT

Three-dimensional printing allows designers to modify the internal structure of a component without altering its external geometry, with infill pattern and infill density being two readily adjustable parameters. This study investigates the effects of these parameters on the impact strength of carbon-fiber-reinforced polylactic acid (CF-PLA). Nine test bars were fabricated using a Bambu Lab P1S with three infill patterns—grid, concentric, and tri-hexagonal—at infill densities of 25%, 50%, and 75%. Each specimen measured 63.5 × 12.7 × 3.2 mm and was printed in a flat orientation. The specimens were evaluated using an unnotched Izod impact test on a Torsee TIT-30 pendulum machine, with the pendulum released from a fixed angle of 120°. The absorbed impact energy ranged from 6.50 J to 11.00 J. The tri-hexagonal pattern demonstrated the highest overall impact performance, averaging 10.07 J, compared with 8.28 J for the grid and 8.63 J for the concentric pattern. Increasing infill density did not consistently improve impact strength; the grid and tri-hexagonal patterns achieved their highest values at 50% infill and decreased at 75%, whereas the concentric pattern continued to improve up to 75%. Considering impact energy relative to specimen weight, the tri-hexagonal pattern at 25% infill provided the highest efficiency, absorbing energy comparable to the grid pattern at 50% infill while reducing weight by approximately 23%. These findings demonstrate that optimizing infill geometry can provide a more effective balance between impact performance and material usage in CF-PLA components.

Keywords: Additive manufacturing, Fused deposition modelling, Carbon fibre PLA, Infill pattern, Infill density, Izod impact test.

AN Ab-INITIO STUDY OF THE ADSORPTION OF H2O, NaCl, AND SALT WATER ON GRAPHITE AND GRAPHENE

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Abstract

In view of climate change, seawater desalination is of concern to mankind, as the most difficult step in water treatment is the isolation of NaCl from seawater. The methods currently used to disable seawater remain costly, so it is important to understand and improve other methods for reducing the cost of seawater filtration. An atomic-scale computational study of NaCl and H_2O adsorption on graphite and graphene is presented, with the aim of estimating the ability of graphite-graphene to remove NaCl from seawater to obtain drinking water. The calculations are based on Density Functional Theory (DFT), using the Grid-based Projector-Augmented Wave (GPAW) approach, Atomistic Simulation Environment (ASE), and Quantum ESPRESSO methods. The main results of our work are the optimization of H_2O and NaCl molecule energies and densities of molecular states, and the calculation of the optimal adsorption distance of these molecules on the adsorbent (graphite-graphene). The observed changes in adsorption energies and density of states of the adsorbent could be exploited in the perspective of seawater filter applications. Our results could contribute to the optimization of potential seawater filter applications. The present work provides interesting information to the theoretical and experi-mental communities working in this field of research. It opens up the debate on the adsorption of H2O and NaCl molecules on graphite and graphene.

Keywords: GPAW, ASE, quantum ESPRESSO, density of state (DOS), adsorption NaCl and H2O on graphite and graphene, seawater filter applications

IRON ENRICHMENT AND PHASE PARTITIONING IN KATSINA KAOLIN: UNLOCKING DUAL INDUSTRIAL VALUE

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ABSRTACT

To thoroughly refine the geochemical and industrial evaluation of these clay deposits, it is vital to examine their mineralogical context and understand how iron-bearing phases behave throughout industrial processing. The iron oxide concentration in the tailings reaches between 5% and 15%, which is notably higher than the 3.42% to 5.72% range observed in the raw kaolin. This clear enrichment indicates that iron is primarily present as discrete mineral phases, specifically hematite ($alpha - Fe_2O_3$) and goethite ($alpha - FeOOH$). These minerals are efficiently separated from the clay matrix during the washing and sedimentation stages of beneficiation. Although this purification process ensures that the refined kaolin successfully meets the strict brightness standards required for high-end ceramics and advanced paper coating, it also transforms the discarded waste stream into a concentrated "technogenic ore." Furthermore, the order of significance of the heavy metals reported in the samples with respect to location is therefore presented for the Yar'goje, Sambisa and Garfi Kaolin mines are as Fe > Mn > Pb > Zn > Ni > Cr >As. maintained uniformly across all sampled depths points toward a stable, long-term pedogenic environment. Within this stable setting, the progressive leaching of more mobile chemical elements has left behind a resilient, iron-rich kaolinite framework. Taking these factors together, the characteristics confirm that the Katsina deposits extend far beyond being a traditional source of industrial clay. Instead, they represent a highly versatile dual-resource system capable of supporting traditional silicate industries while simultaneously enabling the value-added recovery of iron oxide fractions for the production of specialized magnetic and pigment-grade materials to thoroughly refine the geochemical and industrial evaluation of these clay deposits, it is vital to examine their mineralogical context and understand how iron-bearing phases behave throughout industrial processing.

Keywords: Kaolin, Iron Oxide, Waste, (XRF) X-ray fluorescence spectroscopy, Hematite, Goethite, Mineralogical, Dept

BUCK DÖNÜŞTÜRÜCÜNÜN LESO TABANLI OPTİMAL GERİLİM KONTROLÜ

LESO-BASED OPTIMAL VOLTAGE CONTROL OF A BUCK CONVERTER

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Abstract

This study presents an observer-assisted state-feedback method for regulating the output voltage of a Buck converter under varying operating conditions. The method is designed to achieve stable and rapid output-voltage response by integrating disturbance estimation and optimal gain calculation within a unified control structure. The converter's behavior, influenced by uncertainties and external disturbances, is monitored in real time using a linear extended state observer (LESO) based on the measured output voltage. The LESO estimates not only the output voltage but also its time derivative and the total disturbance affecting the system. The estimated disturbance is counteracted during duty-ratio calculation, thereby mitigating its impact on the nominal voltage dynamics. This approach enables feedback design using a two-state structure comprising the output voltage and its rate of change, both of which are substantially decoupled from disturbance components.

The state-feedback gains are calculated using the linear-quadratic regulator (LQR) method, which balances the control signal magnitude. Continuous estimation and compensation of the total disturbance by the observer eliminate steady-state voltage deviation without the need for additional integral action. As a result, voltage regulation is achieved directly through optimal state-feedback gains, thereby simplifying implementation by reducing controller order, parameter-tuning requirements, and real-time computational load. The voltage regulation and disturbance rejection performance of the proposed method was evaluated under input-voltage variations and load disturbances. Its effectiveness was compared with that of a PI controller, using identical converter parameters, reference voltage, and disturbance conditions for consistency. Output-voltage deviation, settling time, and overshoot served as the primary performance metrics. The results indicate that the LESO+LQR structure delivers better control performance under the tested operating conditions.

Keywords: Buck converter, linear extended state observer, linear quadratic regulator, total disturbance estimation, optimal state feedback.

Özet

Bu çalışma Buck dönüştürücünün çıkış geriliminin değişken çalışma koşullarında düzenlenmesi için gözleyici destekli bir durum geri besleme yöntemi sunmaktadır. Önerilen yöntem, bozucu tahmini ile optimal kazanç hesabını aynı kontrol yapısı içerisinde değerlendirerek değişen çalışma koşullarında kararlı ve hızlı bir çıkış gerilimi cevabı elde etmeyi amaçlamaktadır. Dönüştürücünün belirsizlikler ve dış etkilerden kaynaklanan davranışı, ölçülen çıkış gerilimi üzerinden çalışan doğrusal genişletilmiş durum gözleyicisi (LESO) ile çevrim içi olarak izlenmektedir. LESO, çıkış geriliminin yanı sıra gerilimin zamana göre değişimini ve sistem üzerinde etkili olan toplam bozucuyu tahmin etmektedir. Tahmin edilen bozucu, görev oranı hesaplanırken karşı yönde uygulanmakta ve böylece nominal gerilim dinamiği üzerindeki bozucu etkisi azaltılmaktadır. Bu yaklaşım ile geri besleme tasarımı, bozucu bileşenlerden büyük ölçüde arındırılmış çıkış gerilimi ve gerilim değişim hızından oluşan iki durumlu bir yapı üzerinden gerçekleştirilmektedir.

Durum geri besleme kazançları, durum hatalarının bastırılması ile kontrol işaretinin büyüklüğü arasındaki dengeyi sağlayan doğrusal karesel regülatör (LQR) yöntemi ile belirlenmektedir. Toplam bozucunun gözleyici tarafından sürekli olarak tahmin edilip kontrol girişinde telafi edilmesi, kalıcı

gerilim sapmasının ilave bir integral etkiye ihtiyaç duyulmadan giderilmesini mümkün kılmaktadır. Bu nedenle, kontrolcüye ek bir integral durum eklenmeden, doğrudan optimal durum geri besleme kazançlarıyla gerilim düzenlemesi sağlanmaktadır. İntegral etkinin kullanılmaması, kontrolcü derecesini, ayarlanması gereken parametre sayısını ve gerçek zamanlı hesaplama yükünü azaltarak daha yalın bir uygulama sunmaktadır. Önerilen yöntemin gerilim düzenleme ve bozucu reddetme performansı, giriş gerilimindeki değişimler ve yük bozucuları altında değerlendirilmiştir. Önerilen yöntemin başarısı bir PI kontrolcü ile karşılaştırmalı olarak analiz edilmiştir. Karşılaştırmanın tutarlı biçimde yapılabilmesi amacıyla her iki kontrol yöntemi de aynı dönüştürücü parametreleri, referans gerilimi ve bozucu koşulları altında incelenmiştir. Değerlendirmede çıkış gerilimi sapması, yerleşme süresi ve aşım temel performans ölçütleri olarak kullanılmıştır. Elde edilen sonuçlar LESO+LQR yapısının incelenen çalışma koşullarında daha iyi kontrol performansı sergilediği gözlemlenmiştir.

Anahtar kelimeler: Buck dönüştürücü, doğrusal genişletilmiş durum gözleyicisi, doğrusal karesel regülatör, toplam bozucu tahmini, optimal durum geri besleme.

EFFECT OF PHOSPHORIC ACID ACTIVATION AND PYROLYSIS TEMPERATURE ON THE STRUCTURAL EVOLUTION OF HAWTHORN POMACE-DERIVED CARBON MATERIALS

FOSFORİK ASİT AKTİVASYONU VE PİROLİZ SICAKLIĞININ ALIÇ POSASI KÖKENLİ KARBON MALZEMELERİN YAPISAL ÖZELLİKLERİ ÜZERİNDEKİ ETKİSİ

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ABSTRACT

The valorization of agro-food residues into functional carbon materials represents a promising approach for waste minimization and the production of value-added materials. In this context, the transformation of lignocellulosic waste, especially those with high carbon content, into functional carbon materials that can be used in applications such as adsorption, catalysis, and energy storage through various thermochemical methods is of great importance in terms of sustainable resource use. In this study, hawthorn (Crataegus orientalis) pomace was investigated as a renewable precursor for carbon material production, with particular emphasis on the effects of pyrolysis temperature and phosphoric acid activation on the structural and chemical properties of the resulting materials. Hawthorn pomace was chemically activated using H_3PO_4 at a pomace-to-acid ratio of 1:2 and subsequently carbonized in a fixed-bed reactor under an inert nitrogen atmosphere. Carbonization was performed at 400 and 500 °C for 4 h, and the resulting activated and non-activated carbon materials were comparatively evaluated.

The carbon yield obtained without chemical activation was approximately 25.7% at 500 °C, whereas phosphoric acid activation increased the solid product yield to approximately 37%, indicating a pronounced effect of acid treatment on the carbonization behavior of the biomass. FTIR analysis revealed a progressive decrease in hydroxyl, carbonyl, and aliphatic functionalities with increasing pyrolysis temperature, accompanied by the development of a more condensed aromatic carbon structure. Phosphoric acid activation, in contrast, altered the surface chemistry of carbon materials and affected the distribution of oxygen-containing functional groups. XRD analysis further confirmed the structural transformation of hawthorn pomace during carbonization and indicated additional structural reorganization following phosphoric acid activation. Overall, the results demonstrate that pyrolysis temperature and phosphoric acid activation are important factors governing the structural evolution, product yield, and surface chemistry of hawthorn pomace-derived carbon materials. These findings highlight the potential of hawthorn processing residues as a renewable and sustainable precursor for the production of functional carbon-based materials.

Keywords: *Crataegus orientalis*; Hawthorn pomace; Phosphoric acid activation; Pyrolysis; Carbon materials; Biomass valorization

ÖZET

Tarımsal-gıda endüstrisi artıklarının fonksiyonel karbon malzemelere dönüştürülmesi, atıkların azaltılması ve katma değerli malzemelerin üretimi açısından umut vadeden bir yaklaşım sunmaktadır. Bu kapsamda, özellikle yüksek karbon içeriğine sahip lignoselülozik atıkların farklı termokimyasal yöntemlerle işlenerek adsorpsiyon, kataliz ve enerji depolama gibi uygulamalarda kullanılabilecek fonksiyonel karbon malzemelere dönüştürülmesi, sürdürülebilir kaynak kullanımı açısından büyük bir önem taşımaktadır. Bu çalışmada, alıç (Crataegus orientalis) posası, karbon malzeme üretiminde yenilenebilir bir öncül madde olarak değerlendirilmiş ve özellikle piroliz sıcaklığı ile fosforik asit aktivasyonunun elde edilen malzemelerin yapısal ve kimyasal özellikleri üzerindeki etkileri araştırılmıştır. Alıç posası, 1:2 posa/fosforik asit oranında H_3PO_4 kullanılarak kimyasal olarak aktive edilmiş ve ardından inert azot atmosferi altında sabit yataklı reaktörde karbonlaştırılmıştır. Karbonlaştırma işlemleri 400 ve 500 °C sıcaklıklarda 4 saat süreyle gerçekleştirilmiş ve elde edilen aktive edilmiş ve aktive edilmemiş karbon malzemeler karşılaştırmalı olarak değerlendirilmiştir. Kimyasal aktivasyon uygulanmadan elde edilen karbon verimi 500 °C'de yaklaşık %25,7 iken, fosforik asit aktivasyonu katı ürün verimini yaklaşık %37'ye yükseltmiş ve asit uygulamasının biyokütlenin karbonlaşma davranışı üzerinde belirgin bir etkisi olduğunu göstermiştir. FTIR analizleri, piroliz sıcaklığındaki artışla birlikte hidroksil, karbonil ve alifatik fonksiyonel gruplarda kademeli bir azalma meydana geldiğini ve bunun daha yoğunlaşmış aromatik bir karbon yapısının oluşumuna eşlik ettiğini ortaya koymuştur. Buna karşılık, fosforik asit aktivasyonu karbon malzemelerin yüzey kimyasını değiştirmiş ve oksijen içeren fonksiyonel grupların dağılımını etkilemiştir. XRD analizleri, karbonlaştırma sırasında alıç posasının yapısal dönüşümünü doğrulamış ve fosforik asit aktivasyonunun ardından ilave bir yapısal yeniden düzenlenme gerçekleştiğini göstermiştir. Genel olarak, sonuçlar piroliz sıcaklığı ve fosforik asit aktivasyonunun alıç posasından türetilen karbon malzemelerin yapısal gelişimini, ürün verimini ve yüzey kimyasını belirleyen önemli faktörler olduğunu göstermektedir. Bu bulgular, alıç işleme artıklarının fonksiyonel karbon bazlı malzemelerin üretiminde yenilenebilir ve sürdürülebilir bir öncül madde olarak kullanılma potansiyelini ortaya koymaktadır.

Anahtar Kelimeler: *Crataegus orientalis*, Alıç posası, Fosforik asit aktivasyonu, Piroliz, Karbon malzemeler, Biyokütle değerlendirme.

CFD BASED OPTIMIZATION OF AIR GUIDES FOR IMPROVING AIR CURTAIN PERFORMANCE IN OPEN REFRIGERATED DISPLAY CABINETS

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Abstract

In an open type refrigerated display cabinet used in commercial applications, air circulation is generated to cool the internal volume and the stored products. This circulation also forms an air curtain between the ambient environment and the cabinet interior. The cooling performance is directly affected by how effectively this air curtain is controlled, particularly through the guidance and regulation of the airflow. For this purpose, air guiding elements are commonly used at the front edges of the cabinet shelves to control the cold air flow. In the present study, flow and heat transfer analyses were performed for three different configurations using Computational Fluid Dynamics (CFD) with the Realizable k–ε turbulence model. The investigated configurations consisted of a case without an air guide, a flat plate air guide and an air guide with bent ends. For the configurations incorporating an air guide, optimization studies were also conducted to determine the effects of guide angle and position on the cooling performance. The results were evaluated in detail using air velocity and temperature contours. In addition, the return air temperature, which directly reflects the effectiveness of the air guides, was selected as the objective function in the optimization process. As a result of the optimization, three candidate geometries were identified for each air guide configuration based on the optimum position and angle. Among these configurations, the lowest return air temperature of 276 K was obtained with the flat plate air guide. The highest return air temperature, 282.3 K, was observed for the configuration without an air guide, while a value of 281.4 K was obtained for the air guide with bent ends. Overall, the results demonstrate that the use of an air guide has a significant effect on the return air temperature. By controlling the airflow circulation, heat transfer between the ambient environment and the cabinet interior is reduced, allowing a greater amount of cold air to be retained inside the cabinet. This improvement can also contribute to energy savings in commercial refrigerated display cabinets.

Keywords: Air Curtain, Air Flow, Computational Fluid Dynamics, Industrial Refrigerator, Thermal Barrier.

Özet

Endüstriyel olarak kullanılan açık tip bir buzdolabında iç hacmin ve ürünlerin soğutulması için bir hava sirkülasyonu oluşturulmaktadır. Bu hava sirkülasyonu aynı zamanda dış ortam ile dolap iç hacmi arasında bir hava perdesi oluşturmaktadır. Bu hava perdesinin daha verimli kullanılması için havanın farklı şekillerde yönlendirilmesi ve akışın kontrol edilmesi doğrudan soğutma performansına da etki etmektedir. Bu amaçla soğuk havanın kontrol edilmesi için dolap raflarının ön kısmında yönlendirici kanat kullanımı yaygındır. Bu çalışmada da üç farklı senaryo için Hesaplamalı Akışkanlar Dinamiği (HAD) yöntemi kullanılarak akış ve ısı transferi analizleri Realizable k–ε türbülans modeli yardımıyla yapılmıştır. Öncelikle yönlendirici kanadın olmadığı durum, düz plaka yönlendirici kanat ve uç kısımları bükülmüş yönlendirici kanatlar için sayısal çalışmalar yapılmıştır. Çalışmalar yapılırken kanadın kullanıldığı senaryolarda aynı zamanda kanatların açısı ve konumunun performansa etkisinin belirlenmesi amacıyla optimizasyon çalışmaları yapılmıştır. Sonuçlar hava hızı konturları ve sıcaklık konturları olmak üzere detaylı olarak değerlendirilmiştir. Ayrıca bu kanatların etkisinin kesin olarak görüldüğü ve optimizasyon çalışmalarında hedef fonksiyonu olarak girilen hava emiş sıcaklıkları da tespit edilmiştir. Optimizasyon sonucunda en iyi konum ve açı değeri için her bir durumda 3 tane aday geometri tespit edilmiştir. Bu geometrilerin kullanıldığı durumlarda en düşük emiş sıcaklığı 276 K olarak düz plaka sac yönlendirici ile elde edilmiştir. Ayrıca en yüksek emiş sıcaklığı yönlendirici kanat kullanılmayan durumda 282.3 K olarak bulunmuştur. Uç kısımları bükülmüş kanat için ise bu değer 281.4 K hesaplanmıştır. Sonuç olarak kanat kullanımının emiş sıcaklığına kayda değer bir etkisinin olduğu ve akış sirkülasyonuna müdahale edilerek dış ortam ile dolap iç hacmi arasındaki ısı geçişinin engellendiği tespit edilmiştir. Bu durum soğuk havanın dolap içinde daha fazla muhafaza edilmesiyle endüstriyel dolaplarda enerji tasarrufu sağlanmasına da katkıda bulunmuştur.

Anahtar kelimeler: Hava Perdesi, Hava Akışı, Hesaplamalı Akışkanlar Dinamiği, Endüstriyel Buzdolabı, Isıl Bariyer.

BAYESIAN VS. FREQUENTIST LOGISTIC REGRESSION: UNCERTAINTY QUANTIFICATION FOR CLINICAL CLASSIFICATION A LAPLACE APPROXIMATION AND MCMC COMPARISON

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Abstract

Machine learning classifiers in high-stakes settings like medical diagnosis need calibrated uncertainty, not just accurate predictions. We compare frequentist and Bayesian logistic regression on the Breast Cancer Wisconsin dataset, fitting the Bayesian model via Laplace approximation and validating it against Metropolis–Hastings MCMC. Across accuracy, log-loss, Brier score, and calibration error, the two models' point predictions are statistically indistinguishable (McNemar's $p = 1.000$), since the MAP estimate under a Gaussian prior coincides with the L2-regularized MLE. The Bayesian model's real advantage is its posterior predictive distribution: credible intervals are measurably wider for misclassified test points than for correct ones, and the Laplace approximation closely matches full MCMC posteriors (coefficient means within 0.12 units) at far lower cost. We discuss implications for uncertainty-aware deployment and the limits of Laplace-approximated inference.

Keywords: Bayesian logistic regression, maximum likelihood, uncertainty estimation, Laplace approximation, MCMC, medical diagnosis, calibration, breast cancer classification.

VALORIZATION OF CITRUS PEELS GENERATED BY A FRUIT JUICE EXTRACTION UNIT

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ABSTRACT

The fruit juice processing industry generates significant quantities of citrus peels as a major by-product of juice extraction. These residues are characterized by high moisture content, considerable organic matter, and the presence of valuable compounds, including essential oils, pectin, phenolic compounds, and fermentable sugars. Their improper disposal can generate environmental problems such as unpleasant odors, organic pollution, and greenhouse gas emissions. In the context of sustainable development and circular economy strategies, the valorization of citrus peels represents an attractive solution for reducing environmental impacts while recovering valuable resources.

This study investigates potential pathways for the valorization of citrus peels generated in fruit juice extraction units. Different recovery and conversion processes are considered, including the extraction of essential oils and pectin, recovery of bioactive compounds, production of animal feed, composting, and anaerobic digestion for renewable energy generation. Particular attention is given to the integration of material recovery and energy production in order to maximize the overall resource recovery potential and minimize residual waste generation.

The performance of these valorization pathways can be evaluated according to resource recovery efficiency, environmental impact reduction, organic matter stabilization, and potential production of value-added products or renewable energy. Operational parameters such as moisture content, substrate composition, temperature, retention time, and process optimization play an important role in improving the efficiency and sustainability of the proposed processes.

The valorization of citrus peels therefore provides an integrated approach for transforming an abundant agro-industrial residue into valuable products and renewable energy, while supporting waste reduction, resource recovery, environmental protection, and the implementation of circular economy principles within the fruit juice industry.

Keywords: Citrus peels, fruit juice industry, waste valorization, essential oils, pectin, bioactive compounds, anaerobic digestion, circular economy.

TAMAMLAYICI FİLTRELEME KULLANARAK İNSANSIZ HAVA ARAÇLARI İÇİN ÇOKLU IMU VERİ FÜZYONU VE YÖN TAHMİNİ

MULTI-IMU DATA FUSION AND ATTITUDE ESTIMATION FOR UNMANNED AERIAL VEHICLES USING COMPLEMENTARY FILTERING

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Abstract

The overall operational success of unmanned aerial vehicles and autonomous robotic platforms in navigation, guidance, and control tasks is directly dependent on achieving highly accurate, continuous, and reliable attitude estimation, even in highly dynamic and unpredictable environments. Non-linear stochastic methods commonly preferred for this purpose in the literature, such as the Extended Kalman Filter, pose significant operational obstacles, particularly in resource-constrained real-time embedded systems, due to their high computational complexity, sequential matrix operations, and case-specific precise parameter optimization requirements. To overcome these critical limitations, this study proposes an innovative dual-sensor Complementary Filter data fusion architecture that offers the advantage of low computational cost, focuses on frequency spectrum characterization, and utilizes the principle of hardware redundancy. The performance and validity of the developed hybrid algorithm have been comprehensively verified through hardware test setups designed using STM32 series microcontrollers (STM32F407 and STM32F103) alongside MPU9250 and Pololu AltIMU-10 v5 (LSM6DS33/LIS3MDL) inertial measurement units with distinct noise profiles. Within the scope of the methodology, raw accelerometer, gyroscope, and magnetometer data acquired from the sensors were converted into orientation angles using Euler kinematic equations. Subsequently, a low-pass filter was applied to eliminate high-frequency mechanical vibrations, while a high-pass filter was employed to prevent low-frequency gyroscope drift; ultimately, these signals were fused using a 50% proportional weighting coefficient. Experimental findings demonstrated that the LSM6DS33 sensor offers higher stability against gyroscope-induced drift errors, whereas the AK8963 magnetometer integrated into the MPU9250 exhibits superior immunity to environmental magnetic disturbances (soft and hard iron effects). Consequently, the proposed hardware-supported fusion architecture minimized the individual weaknesses of the sensors through algorithmic compensation, yielding a statistically significantly more robust, smoother, and more stable attitude estimation output across the roll, pitch, and yaw axes compared to single-sensor implementation.

Keywords: Inertial Sensor Fusion, Complementary Filter, Attitude Estimation, Unmanned Aerial Vehicles

Özet

İnsansız hava araçlarının ve otonom robotik platformların navigasyon, güdüm ve kontrol görevlerindeki genel operasyonel başarısı, son derece dinamik ve kestirilemez ortamlarda dahi yüksek doğrulukta, kesintisiz ve güvenilir tutum tahmini elde edilmesine doğrudan bağlıdır. Literatürde bu amaçla yaygın olarak tercih edilen Genişletilmiş Kalman Filtresi gibi non-lineer stokastik yöntemler; yüksek hesaplama

karmaşıklığı, ardışık matris işlemleri ve duruma özgü hassas parametre optimizasyonu gereksinimleri nedeniyle özellikle işlem kapasitesi sınırlandırılmış gerçek zamanlı gömülü sistemlerde ciddi operasyonel engeller yaratmaktadır. Bu kritik sınırlamaların üstesinden gelmek amacıyla bu çalışma; düşük hesaplama maliyeti avantajı sunan, frekans spektrumu karakterizasyonuna odaklanan ve donanım yedekliliği prensibinden yararlanan inovatif bir çift sensörlü Tamamlayıcı Filtre veri füzyon mimarisi önermektedir. Geliştirilen hibrit algoritmanın performansı ve geçerliliği, farklı gürültü profillerine sahip STM32 serisi (STM32F407 ve STM32F103) mikrodenetleyiciler ile MPU9250 ve Pololu AltIMU-10 v5 (LSM6DS33/LIS3MDL) atalet ölçüm birimleri kullanılarak tasarlanan donanımsal test düzenekleri aracılığıyla kapsamlı biçimde doğrulanmıştır. Metodoloji kapsamında sensörlerden elde edilen ham ivmeölçer, jiroskop ve manyetometre verileri, Euler kinematik denklemleri kullanılarak yönelim açılarına dönüştürülmüştür. Ardından, yüksek frekanslı mekanik titreşimleri elimine etmek için alçak geçiren filtre; düşük frekanslı jiroskop sürüklenmelerini engellemek için ise yüksek geçiren filtre uygulanmış ve nihayetinde bu sinyaller %50 oransal ağırlıklandırma katsayısıyla birleştirilmiştir. Deneysel bulgular, LSM6DS33 sensörünün jiroskop kaynaklı sürüklenme hatalarına karşı daha yüksek kararlılık sunduğunu, MPU9250'ye entegre edilen AK8963 manyetometresinin ise çevresel manyetik bozulmalara (yumuşak/sert demir etkileri) karşı üstün bir bağışıklık sergilediğini kanıtlamıştır. Sonuç olarak önerilen donanım destekli füzyon mimarisi, sensörlerin bireysel zayıflıklarını algoritmik bir kompanzasyonla asgari düzeye indirgeyerek, tek sensör kullanımına kıyasla yuvarlanma, yunuslama ve sapma eksenlerinde istatistiksel açıdan belirgin biçimde daha gürbüz, pürüzsüz ve kararlı bir tutum tahmini çıktısı sağlamıştır.

Anahtar kelimeler: Atalet Sensörü Füzyonu, Tamamlayıcı Filtre, Yön Tahmini, İnsansız Hava Araçları

THE IMPACT OF INTERNAL AUDITING ON CYBERSECURITY RISKS IN BANKS

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Abstract

Given that cybersecurity threats and the complexity of cyberattack methods have increased in the business environment, the importance has arisen to adopt effective methods for assessing, managing, and mitigating the potential impacts of these risks. This led to the growing importance of internal auditing in a fundamental role in risk management and internal control systems. The role of internal auditing is no longer limited to examining financial records and verifying compliance with procedures and policies, but has extended to include providing assurance and consulting services related to assessing cybersecurity risks.

The research aims to focus on the impact of internal auditing to showed cybersecurity risks in banks. It analyze the extent to which internal audit activities contribute to enhancing the efficiency of risk management and control mechanisms, thereby supporting business continuity and protecting information assets. The research employs a descriptive-analytical approach. Data was collected from a sample of commercial banks listed on the Iraq Stock Exchange using a checklist and field interviews, range of statistical methods were also used to test the research hypotheses.

The results show a high level of internal auditing influence in cybersecurity risks. Furthermore, a significant correlation and influence were found between the dimensions of internal audit and cybersecurity risk, and found that internal auditing can enhancing risk management efficiency and control mechanisms in banks.

The research concluded that developing the capabilities of internal auditors may affect cybersecurity risks. Forever, auditing programs need to more updating in with international standards of auditing directly to raising the level of preparedness of Iraqi banks to face cybersecurity threats.

Keywords: Internal Auditing; Cybersecurity Risk; Internal Control; Risk Management; Banks.

PROGRESİF VAKUM FİLTRESİ TIKANMASININ AKUSTİK KARAKTERİZASYONU VE DERİN SPEKTRAL SINIFLANDIRILMASI

ACOUSTIC CHARACTERIZATION and DEEP SPECTRAL CLASSIFICATION of PROGRESSIVE VACUUM FILTER CLOGGING

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Abstract

Filter clogging in vacuum cleaners is one of the fundamental operational problems that often progresses unnoticed by the user and directly affects suction performance. Gradual airflow restriction across the filter surface changes the operating conditions of the system while also producing measurable changes in the acoustic patterns emitted by the device. These changes make it possible to assess the filter condition using only operating sounds, without the need for additional pressure or airflow sensors. In this study, the aim was to perform multi-level classification of progressive vacuum filter clogging from acoustic signals and to characterize the spectral changes that enable this classification. The analyses used 143 unique audio recordings corresponding to filter clogging levels of 0%, 30%, 50%, 70%, and 100%. Non-overlapping and non-consecutive 5-second segments were created by randomly selecting different temporal positions from the long-duration recordings. Each segment was divided into 0.5-s subframes, and Welch power spectral density was calculated over the 20 Hz–20 kHz frequency range. Classification was performed on the resulting spectral representations using SVM, Random Forest, LSTM, 1D CNN, and CNN–LSTM models. In stratified 5-fold cross-validation, the 1D CNN achieved the best performance, with an accuracy of 98.42% ± 0.32%, a macro F1 score of 98.42% ± 0.30%, and a ROC-AUC value of 0.9997 ± 0.0002. In recording-level acoustic characterization, significant differences among clogging levels were found in 28 of 41 features, while 29 features showed a significant relationship with clogging severity. The strongest effect was observed in the dominant frequency ($\varepsilon^2 = 0.431$, $\rho = 0.587$). In addition, as clogging progressed, mid- and high-frequency energy decreased, while low-frequency content increased relatively. These findings demonstrate that progressive filter clogging produces distinct acoustic signatures and that these signatures can be used in low-cost, non-contact, and high-accuracy condition monitoring systems.

Keywords: Vacuum Filter Clogging, Acoustic Condition Monitoring, Welch Power Spectral Density, Spectral Characterization

Özet

Elektrikli süpürgelerde filtre tıkanıklığı, çoğu zaman kullanıcı tarafından fark edilmeden ilerleyen ve emiş performansını doğrudan etkileyen temel çalışma sorunlarından biridir. Filtre yüzeyindeki kademeli hava yolu kısıtlaması, sistemin çalışma koşullarını değiştirmekle birlikte cihaz tarafından yayılan akustik örüntülerde de ölçülebilir değişimler oluşturmaktadır. Bu değişiklikler, ilave basınç veya hava akışı sensörlerine ihtiyaç duymadan, yalnızca çalışma sesleri kullanılarak filtre durumunun değerlendirilmesine olanak sağlamaktadır. Bu çalışmada, akustik sinyallerden ilerleyici vakum filtresi tıkanmasının çok seviyeli sınıflandırılması ve sınıflandırmayı mümkün kılan spektral değişimlerin karakterize edilmesi amaçlanmıştır. Analizlerde %0, %30, %50, %70 ve %100 filtre tıkanıklık seviyelerine ait 143 benzersiz ses kaydı kullanılmıştır. Uzun süreli kayıtların farklı zaman konumlarından rastgele seçilen, birbiriyle örtüşmeyen ve doğrudan ardışık olmayan 5 saniyelik segmentler oluşturulmuştur. Her segment 0,5 s'lik alt çerçevelere bölünmüş ve 20 Hz–20 kHz frekans aralığında Welch güç spektral yoğunluğu hesaplanmıştır. Elde edilen spektral temsiller üzerinde SVM, Random Forest, LSTM, 1D CNN ve CNN–LSTM modelleri ile sınıflandırma yapılmıştır. Tabakalı 5

katlı çapraz doğrulamada, 1D CNN %98,42 ± %0,32 doğruluk, %98,42 ± %0,30 makro F1 skoru ve 0,9997 ± 0,0002 ROC-AUC değeri ile en iyi performansı elde etmiştir. Kayıt düzeyindeki akustik karakterizasyonda 41 özniteliğin 28'inde tıkanıklık seviyeleri arasında anlamlı farklılık, 29'unda ise tıkanıklık şiddetiyle anlamlı ilişki bulunmuştur. En güçlü etki baskın frekansta gözlenmiştir ($\varepsilon^2 = 0.431, \rho = 0.587$). Ayrıca tıkanıklığın ilerlemesiyle orta ve yüksek frekans enerjisinin azaldığı ve düşük frekans içeriğinin göreli olarak arttığı belirlenmiştir. Bu bulgular, ilerleyici filtre tıkanıklığının belirgin akustik imzalar oluşturduğunu ve bu imzaların düşük maliyetli, temassız ve yüksek doğruluklu durum izleme sistemlerinde kullanılabileceğini göstermektedir.

Anahtar kelimeler: Vakum Filtresi Tıkanması, Akustik Durum İzleme, Welch Güç Spektral Yoğunluğu, Spektral Karakterizasyon

KAMBER ETKİSİYLE GENİŞLETİLMİŞ FIALA LASTİK MODELİ TABANLI 2-DOF TAŞIT İÇİN AKTİF KAMBER KONTROLÜNÜN NSGA-II İLE ÇOK AMAÇLI OPTİMİZASYONU

MULTI-OBJECTIVE OPTIMIZATION OF ACTIVE CAMBER CONTROL FOR A 2-DOF VEHICLE BASED ON A CAMBER-EXTENDED FIALA TIRE MODEL USING NSGA-II

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Abstract

Active chassis systems are an important research area because they can adapt vehicle dynamic behavior to changing driving conditions. Within this context, active camber control offers a current approach for managing tire forces and improving lateral dynamic performance. However, studies that simultaneously address nonlinear tire behavior, independent front–rear active camber control, actuator constraints, and multi-objective optimization within a common modeling framework remain relatively limited. In this study, the classical Fiala tire model was extended to include camber effects, and the total lateral force was defined under a common friction limit. The resulting extended Fiala–camber model was integrated with a 2-DOF single-track vehicle dynamics model. Front and rear camber angles were determined by independent P controllers based on the neutral-steer yaw-rate reference error. Actuator behavior was represented by a first-order dynamic model. Camber angle and camber rate limits were directly included in the system. The controller gains were optimized using NSGA-II under nine validated driving scenarios with different vehicle speeds and steering inputs. The dynamic performance objective was defined using time-weighted RMS values of the yaw-rate tracking error and vehicle sideslip angle, normalized with respect to the passive vehicle. Control effort was represented by the normalized time-weighted RMS values of the actual front and rear camber angles. The tire submodel, vehicle dynamics, control structure, and actuator behavior were verified through analytical and numerical tests. The findings indicate that active camber control can improve yaw-rate tracking and sideslip behavior. The results also show that higher dynamic performance may require greater camber usage, leading to a clear performance–effort trade-off. The proposed approach combines nonlinear tire modeling, physical actuator constraints, and multi-objective controller optimization within a single integrated framework for active camber system design.

Keywords: Active camber, extended Fiala model, vehicle dynamics, yaw-rate control, NSGA-II, multi-objective optimization

Özet

Aktif şasi sistemleri, taşıtın sürüş koşullarına göre dinamik davranışını uyarlayabilen önemli araştırma alanlarından biridir. Bu kapsamda aktif kamber kontrolü, lastik kuvvetlerinin yönetimi ve yanal dinamik performansın iyileştirilmesi açısından güncel bir yaklaşım sunmaktadır. Bununla birlikte, doğrusal olmayan lastik davranışı, bağımsız ön-arka aktif kamber kontrolü, aktüatör kısıtları ve çok amaçlı optimizasyonun aynı modelleme çerçevesinde birlikte ele alındığı çalışmalar görece sınırlıdır. Bu çalışmada klasik Fiala lastik modeli kamber etkisiyle genişletilmiş ve toplam yanal kuvvet ortak sürtünme sınırı altında tanımlanmıştır. Elde edilen genişletilmiş Fiala-kamber modeli, 2-DOF tek izli taşıt dinamiği ile bütünleştirilmiştir. Ön ve arka kamber açıları, nötr yönlendirme esaslı yaw-rate referans hatasına dayalı bağımsız P kontrolcüleriyle belirlenmiştir. Aktüatör davranışı birinci dereceden dinamik yapı ile temsil edilmiştir. Kamber açısı ve kamber değişim hızı sınırları modele doğrudan dahil edilmiştir. Kontrolcü kazançları, farklı hız ve direksiyon taleplerini içeren dokuz doğrulanmış sürüş senaryosu altında NSGA-II kullanılarak çok amaçlı biçimde optimize edilmiştir. Dinamik performans amacı, pasif taşıta göre normalize edilmiş yaw-rate takip hatası ve gövde yan kayma açısının zaman-ağırlıklı RMS değerleri üzerinden tanımlanmıştır. Kontrol eforu ise gerçek ön ve arka kamber açılarının

normalize zaman-ağırlıklı RMS değerleri ile temsil edilmiştir. Lastik alt modeli, taşıt dinamiği, kontrol yapısı ve aktüatör davranışı analitik ve sayısal testlerle doğrulanmıştır. Elde edilen bulgular, aktif kamber kontrolünün yaw-rate takibi ve yan kayma davranışını iyileştirebildiğini göstermektedir. Sonuçlar ayrıca daha yüksek dinamik performansın daha fazla kamber kullanımı gerektirebildiğini ve bu nedenle belirgin bir performans-efor değiş tokuşunun ortaya çıktığını göstermektedir. Önerilen yaklaşım, doğrusal olmayan lastik modeli, fiziksel aktüatör sınırları ve çok amaçlı kontrolcü optimizasyonunu tek bir bütünleşik çerçevede bir araya getirmektedir.

Anahtar Kelimeler: Aktif kamber, genişletilmiş Fiala modeli, 2-DOF taşıt dinamiği, yaw-rate kontrolü, NSGA-II, çok amaçlı optimizasyon

AN INTEGRATED SOURCE-PATHWAY-SINK FRAMEWORK FOR URBAN ROADSIDE HEAVY-METAL ASSESSMENT USING ENVIRONMENTAL MAGNETISM AND DATA-DRIVEN ANALYTICS

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Abstract

Urban roadside soils are major repositories of traffic-derived heavy metals, yet conventional contamination assessments often evaluate contaminant sources, transport mechanisms, and soil-retention processes independently. This study presents an integrated Source-Pathway-Sink (SPWS) framework that combines environmental magnetism, heavy-metal geochemistry, geotechnical characterisation, spatial modelling, multivariate statistical analysis, and machine-learning (ML) techniques for rapid urban roadside contamination assessment. Surface soil samples were collected along six major road corridors in Minna metropolis, Nigeria, representing contrasting traffic intensities and land-use settings. Environmental magnetic measurements, heavy-metal concentrations, and selected geotechnical properties were analysed to characterise contaminant generation, dispersion, and retention. Spatial interpolation revealed distinct magnetic enhancement hotspots associated with major transportation corridors, while depth-profile and distance-decay analyses demonstrated progressive attenuation of ferrimagnetic particles away from traffic sources and with increasing soil depth. Multivariate analyses showed clear separation between anthropogenic contamination and soil-retention processes, whereas Random Forest Regression (RFR) identified low-frequency magnetic susceptibility (χlf) as the dominant predictor of the Heavy Metal Pollution Index (HPI), confirming its effectiveness as a rapid proxy for cumulative roadside contamination. The close agreement between observed and predicted HPI values further demonstrated the robustness of the predictive model. The proposed SPWS framework integrates contaminant generation, transport, and retention into a physically interpretable environmental assessment methodology, providing a transferable approach for pollution monitoring, environmental risk assessment, and sustainable urban land-use planning in rapidly urbanising environments.

Keywords: Source-Pathway-Sink framework; Environmental magnetism; Heavy-metal contamination; Urban roadside soils; Random Forest Regression; Spatial modelling.

TECHNO-ECONOMIC ASSESSMENT OF AN INTEGRATED PHOTOVOLTAIC–BATTERY–HYDROGEN HYBRID ENERGY SYSTEM WITH AI-BASED ENERGY MANAGEMENT: THE CASE OF NIĞDE MUNICIPALITY

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ABSTRACT

The coordinated management of energy generation, storage, and consumption is essential for improving the technical and economic performance of hybrid renewable energy systems. This study investigates the integration of photovoltaic (PV) generation, battery energy storage, and hydrogen-based heating in the Niğde Municipality service building within an artificial intelligence (AI)-based energy management framework and evaluates the techno-economic performance of the integrated system. Rather than operating the energy resources according to a fixed strategy, the proposed approach is designed to dynamically manage energy flows in response to variations in generation, consumption, battery state of charge, and electricity market conditions. The study considers a system comprising 215.6 kWp of installed PV capacity, a 150 kWe inverter, and a 400 kWh battery energy storage system. The proposed Baboon Optimization Algorithm (BOA)-based energy management layer is designed to use hourly Market Clearing Price (MCP) data to optimize grid electricity usage, while PV utilization, battery charging and discharging operations, battery state of charge (SOC) protection, and building load supply are managed by the inverter and Battery Management System (BMS). Within the proposed control strategy, grid utilization is intended to increase during low-price periods, be optimized during moderate-price periods, and be restricted during high-price periods. The impact of the hydrogen-based heating system is evaluated in terms of natural gas consumption, energy costs, and carbon emissions.

Preliminary assessments based on the available system data indicate that annual PV electricity generation is expected to reach approximately 250,000–265,000 kWh, corresponding to approximately 85–90% of the building's annual electricity consumption of 294,400 kWh. Depending on operating conditions, the hydrogen-based heating system is estimated to reduce annual natural gas expenditures by approximately 20–25% and CO_2 emissions by approximately 34 tonnes per year. Overall, the proposed approach provides an integrated framework in which energy generation, storage, consumption, and time-dependent electricity costs are jointly considered.

The proposed framework provides an applicable energy management structure for the coordinated operation of PV generation, battery storage, hydrogen-based heating, and price-oriented grid usage

control in public buildings. The proposed framework has the potential to reduce energy costs and grid dependency while increasing renewable energy utilization.

Keywords: artificial intelligence-based energy management; photovoltaic system; battery energy storage; hydrogen-based heating; techno-economic assessment; hybrid energy system

GÜNCEL n_{max} = 300 DERECELİ KÜRESEL STATİK GRAVİTE ALANI MODELLERİNİN JEOİT YÜKSEKLİKLERİ VE GRAVİTE ANOMALİLERİ AÇISINDAN KARŞILAŞTIRILMASI

COMPARISON OF RECENT DEGREE-300 GLOBAL STATIC GRAVITY FIELD MODELS IN TERMS OF GEOID HEIGHTS AND GRAVITY ANOMALIES

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Abstract

Global gravity field models (GGMs) provide a fundamental representation of the Earth's gravity field and are widely used in geodesy and geophysics. Continuous improvements in satellite gravimetry missions, observation strategies, data processing, and combination techniques have led to the development of increasingly refined global gravity field solutions. Nevertheless, recently released models may exhibit differences due to variations in the satellite observations incorporated and the methodologies adopted for gravity field recovery. This study provides a comparative assessment of three recent global gravity field models available through the International Centre for Global Earth Models (ICGEM): Tongji-GMMG2025S, GOCO2025s, and CNES_GRGS.RL05MF_u202601. In order to ensure a consistent comparison, all models were evaluated at the same maximum spherical harmonic degree and order of 300. Global spherical harmonic synthesis was performed to derive two gravity field functionals: geoid heights and gravity anomalies. The resulting global fields were compared through pairwise differences among the three models. Model-to-model consistency was quantitatively evaluated using the mean, standard deviation, root mean square (RMS), minimum, and maximum values of the differences. The geoid height differences show RMS values ranging from approximately 108 to 130 mm, while the RMS values of the gravity anomaly differences range from approximately 3.38 to 4.62 mGal. Among the investigated model pairs, GOCO2025s and CNES_GRGS.RL05MF_u202601 exhibit the smallest RMS differences for both geoid height and gravity anomaly, whereas the largest RMS differences are observed between Tongji-GMMG2025S and CNES_GRGS.RL05MF_u202601. Global difference maps further reveal the spatial distribution and magnitude of the discrepancies among the models. The results demonstrate that the three recent degree-300 gravity field solutions are broadly consistent at the global scale, while measurable model-dependent differences remain in both investigated gravity functionals.

Keywords: Global gravity field models (GGMs), geoid height, gravity anomaly, spherical harmonic synthesis, ICGEM

Özet

Küresel gravite alanı modelleri (GGM'ler), Dünya'nın gravite alanının temel bir temsilini sağlamakta ve jeodezi ile jeofizik alanlarında yaygın olarak kullanılmaktadır. Uydu gravimetri misyonları, gözlem stratejileri, veri işleme ve veri birleştirme tekniklerindeki sürekli gelişmeler, giderek daha hassas küresel gravite alanı çözümlerinin geliştirilmesine olanak sağlamıştır. Bununla birlikte, kullanılan uydu gözlemlerindeki ve gravite alanının belirlenmesinde benimsenen yöntemlerdeki farklılıklar nedeniyle yakın zamanda yayımlanan modeller arasında farklılıklar görülebilmektedir. Bu çalışmada, Uluslararası Küresel Yer Modelleri Merkezi (ICGEM) tarafından sunulan üç güncel küresel gravite alanı modeli olan Tongji-GMMG2025S, GOCO2025s ve CNES_GRGS.RL05MF_u202601 karşılaştırmalı olarak değerlendirilmiştir. Tutarlı bir karşılaştırma sağlamak amacıyla tüm modeller, maksimum küresel harmonik derece ve mertebesi 300 (n_{max} = 300) olacak şekilde değerlendirilmiştir. Küresel harmonik sentez yoluyla iki gravite alanı fonksiyoneli olan jeoit yüksekliği ve gravite anomalisi hesaplanmıştır.

Elde edilen küresel alanlar, üç model arasındaki ikili farklar yoluyla karşılaştırılmıştır. Modeller arasındaki tutarlılık, farkların ortalama, standart sapma, karesel ortalama (RMS), minimum ve maksimum değerleri kullanılarak nicel olarak değerlendirilmiştir. Jeoit yüksekliği farklarının RMS değerleri yaklaşık 108–130 mm arasında değişirken, gravite anomalisi farklarının RMS değerleri yaklaşık 3.38–4.62 mGal aralığında elde edilmiştir. İncelenen model çiftleri arasında GOCO2025s ve CNES_GRGS.RL05MF_u202601, hem jeoit yüksekliği hem de gravite anomalisi açısından en düşük RMS farklarını gösterirken, en yüksek RMS farkları Tongji-GMMG2025S ile CNES_GRGS.RL05MF_u202601 arasında gözlemlenmiştir. Küresel fark haritaları ayrıca modeller arasındaki farklılıkların mekansal dağılımını ve büyüklüğünü ortaya koymuştur. Sonuçlar, incelenen üç güncel küresel gravite alanı çözümünün küresel ölçekte genel olarak tutarlı olduğunu, ancak her iki gravite alanı fonksiyonelinde de ölçülebilir düzeyde modele bağlı farklılıkların bulunduğunu göstermektedir.

Anahtar kelimeler: Küresel gravite alanı modelleri (GGM), jeoit yüksekliği, gravite anomalisi, küresel harmonik sentez, ICGEM

YENİ TASARIMLARIN SERİ ÜRETİME AKTARIMINDA GÖZDEN KAÇAN SÜREÇ KISITLARI: MONTAJ ALETİ ERİŞİLEBİLİRLİĞİ VE BAĞLANTI ELEMANI STANDARDİZASYONU

OVERLOOKED PROCESS CONSTRAINTS IN THE TRANSFER OF NEW DESIGNS TO MASS PRODUCTION: ASSEMBLY TOOL ACCESSIBILITY AND FASTENER STANDARDISATION

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Abstract

When a completed design is released to serial production, verification concentrates on functional performance, geometric conformity and part-level manufacturability. Constraints arising from the

assembly operation itself — above all the direction from which the tightening tool must approach the fastener — are represented less explicitly in design data than the product geometry, and may remain unexamined until the part reaches the line, where corrective options are already constrained. This study addresses such constraints through a bracket introduced with a new commercial vehicle cabin platform: a 3 mm sheet-steel bracket carrying a 32 kg overhead cabinet in sets of four.

Two adaptation problems emerged during trial production. The first concerns the approach direction of the tightening tool. Owing to the bracket's position in the cabin and a protrusion on the part geometry, the tool could not be seated perpendicular to the fastener; inclined by approximately 15–20°, it could not be squarely engaged, and reliable application of the specified first-stage torque could not be assured. The condition was assessed as a process risk from geometric measurement and observation, not torque measurement. It was resolved by introducing a circular relief in the protrusion; comparative static finite element analysis confirmed that the revision does not compromise structural performance. The second problem concerns differing fastener drive types within the same operation, requiring the operator to select between bits and increasing process complexity and error likelihood. The fasteners were standardised to a single drive type.

Accessibility is well established as a design-for-assembly principle, yet predominantly as a binary question of whether the tool reaches the fastener rather than from which direction. This study treats accessibility as an executability criterion within the transfer process and shows how corrective options narrow as detection occurs later — here leaving design revision as the only viable measure, since the tightening equipment is standardised across the entire line. Directional accessibility should therefore be verified on a physical sample — additive manufacturing offering a low-cost means — before design release.

Keywords: design-to-production transfer, design for assembly, tool accessibility, fastener standardisation, trial production, assembly line

Özet

Tamamlanmış bir tasarım seri üretime aktarılırken doğrulama, işlevsel performans, geometrik uygunluk ve parça düzeyindeki üretilebilirlik üzerinde yoğunlaşmaktadır. Montaj işleminin kendisinden kaynaklanan kısıtlar — sıkma aletinin fiziksel hacmi ve bağlantı elemanına hangi doğrultudan yaklaştığı — tasarım verisinde ürün geometrisine kıyasla daha az açık biçimde temsil edilmekte, bu nedenle parça ilk kez hatta gelene kadar incelenmemiş kalabilmektedir; bu aşamada düzeltme seçenekleri hâlihazırda daralmıştır. Çalışma, bu kısıt sınıfını yeni bir ticari araç kabin platformuyla devreye alınan bir braket üzerinden ele almaktadır: yaklaşık 32 kg ağırlığındaki üst dolabı dörtlü grup hâlinde taşıyan 3 mm sac çelik braket.

Deneme üretimi sırasında iki uyarlama problemi tespit edilmiştir. Birincisi, sıkma aletinin yaklaşma doğrultusuna ilişkindir. Braketin kabin içindeki konumu ve parça geometrisindeki bir çıkıntı nedeniyle alet bağlantı elemanına dik oturtulamamakta, yaklaşma yaklaşık 15–20° eğimli gerçekleşmektedir. Bu nedenle alet ağzı tam kavrayamamakta ve öngörülen ön torkun güvenilir biçimde uygulanabilirliği güvence altına alınamamaktadır. Durum, tork ölçümüne değil, geometrik ölçüm ve operatör gözlemine dayanılarak bir süreç riski olarak değerlendirilmiştir. Problem, çıkıntı üzerinde dairesel bir boşaltma açılarak giderilmiş; karşılaştırmalı statik sonlu elemanlar analizi, revizyonun yapısal performanstan ödün vermediğini doğrulamıştır. İkinci problem, aynı montaj işlemi içinde farklı tahrik tiplerinin bulunmasıdır; bu durum operatörün uçlar arasında seçim yapmasını gerektirmekte, süreç karmaşıklığını ve hata olasılığını artırmaktadır. Bağlantı elemanları tek bir tahrik tipinde standartlaştırılmıştır.

Erişilebilirlik, montaj için tasarım ilkelerinden biri olarak yerleşmiş olmakla birlikte, ağırlıklı olarak aletin bağlantı elemanına ulaşıp ulaşmadığına dair ikili bir soru olarak ele alınmakta, hangi doğrultudan ulaştığı aynı ölçüde dikkate alınmamaktadır. Bu çalışma erişilebilirliği aktarım süreci içinde bir yürütülebilirlik ölçütü olarak ele almakta ve tespit aşaması geciktikçe düzeltme seçeneklerinin nasıl daraldığını göstermektedir; bu vakada sıkma ekipmanı hattın tamamında standartlaştırılmış olduğundan uygulanabilir tek seçenek tasarım revizyonu olmuştur. Doğrultuya bağlı erişilebilirliğin, tasarım serbest

bırakılmadan önce fiziksel bir numune üzerinde doğrulanması önerilmekte; bu doğrulama için eklemeli imalatın düşük maliyetli bir olanak sunduğu belirtilmektedir.

Anahtar kelimeler: tasarımdan üretime aktarım, montaj için tasarım, alet erişilebilirliği, bağlantı elemanı standardizasyonu, deneme üretimi, montaj hattı

LOW-TEMPERATURE CONVERSION OF FLY ASH–PYROPHYLLITE GEOPOLYMERS INTO ZEOLITIC MATERIALS UNDER ATMOSPHERIC HUMIDIFICATION

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Abstract

Fly ash has been extensively investigated as a precursor for geopolymer synthesis, while bottom ash is still less commonly used because of its coarser particles and generally lower reactivity. In the present work, both ashes were used in the same formulation to investigate their behavior during alkaline activation and their possible use in construction materials. The interest of this combination is to take advantage of the reactive aluminosilicate fraction of fly ash while incorporating bottom ash, which is often more difficult to reuse directly.

Fly ash and bottom ash were mixed and activated under alkaline conditions. The hardened materials were then examined by X-ray diffraction, FTIR spectroscopy and microstructural observations. The results showed that alkaline activation did not completely dissolve the original ash particles. Some crystalline phases from the starting materials could still be identified after hardening, while changes in the amorphous fraction were observed. In the FTIR spectra, the main band associated with Si–O–T bonds (T = Si or Al) changed after activation, reflecting the structural rearrangement that occurred during formation of the geopolymer matrix. The microstructure was not completely homogeneous. Reaction products were formed around residual particles, and some grains remained only partially reacted. This behavior can be related to the different reactivities of fly ash and bottom ash in the alkaline medium.

These observations show that bottom ash can be incorporated with fly ash rather than treated only as a residual combustion product. However, its incorporation has to be adjusted according to the characteristics of the ash because the unreacted fraction can directly affect matrix development. The combined use of these two residues may therefore be considered for preparing geopolymer-based construction materials with reduced consumption of conventional raw materials.

Keywords: Fly ash; Bottom ash; Geopolymer; Alkaline activation; Construction materials; Coal combustion residues.

AN INTEGRATED SOURCE-PATHWAY-SINK FRAMEWORK FOR URBAN ROADSIDE HEAVY-METAL ASSESSMENT USING ENVIRONMENTAL MAGNETISM AND DATA-DRIVEN ANALYTICS

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Abstract

Urban roadside soils are major repositories of traffic-derived heavy metals, yet conventional contamination assessments often evaluate contaminant sources, transport mechanisms, and soil-retention processes independently, limiting a comprehensive understanding of pollutant dynamics. This study presents an integrated Source–Pathway–Sink (SPWS) framework that combines environmental magnetism, heavy-metal geochemistry, geotechnical characterisation, spatial modelling, multivariate statistical analysis, and machine-learning (ML) techniques for rapid urban roadside contamination assessment. Surface soil samples were collected along six major road corridors in Minna metropolis, Nigeria, representing contrasting traffic intensities and land-use settings. Environmental magnetic measurements, heavy-metal concentrations, and selected geotechnical properties were analysed to characterise contaminant generation, dispersion, and retention within the roadside environment. Spatial interpolation identified distinct magnetic enhancement hotspots associated with heavily trafficked corridors, while depth-profile and distance-decay analyses demonstrated progressive attenuation of ferrimagnetic particles with increasing soil depth and distance from emission sources, reflecting limited vertical migration and localized deposition. Pearson correlation, Principal Component Analysis (PCA), and Hierarchical Cluster Analysis (HCA) distinguished anthropogenic contamination processes from soil-retention controls and revealed the complementary roles of magnetic, geochemical, and geotechnical indicators in explaining pollution patterns. Furthermore, Random Forest Regression (RFR) identified low-frequency magnetic susceptibility (χlf) as the dominant predictor of the Heavy Metal Pollution Index (HPI), substantially outperforming geotechnical variables and confirming its effectiveness as a rapid proxy for cumulative roadside contamination. The close agreement between observed and predicted HPI values, together with low residual errors, further demonstrated the robustness and predictive capability of the ML model. The proposed SPWS framework integrates contaminant generation, transport, and retention into a physically interpretable environmental assessment methodology, providing a transferable and cost-effective approach for pollution monitoring, environmental risk assessment, and sustainable urban land-use planning in rapidly urbanising environments.

Keywords: Source-Pathway-Sink framework; Environmental magnetism; Heavy-metal contamination; Urban roadside soils; Random Forest Regression; Spatial modelling.

INVESTIGATION OF THE INFLUENCE OF HIGH-FREQUENCY POWER SUPPLY ONTO POWER QUALITY

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Abstract

The growing prevalence of high-frequency power supplies (HFPS) in industrial, commercial, and residential electrical systems has introduced complex challenges to supply network power quality. This paper investigates the influence of various HFPS topologies — including switch-mode power supplies (SMPS), resonant converters, variable-frequency drives (VFDs), induction heating supplies, plasma power supplies, high-frequency uninterruptible power supplies (UPS), and electric vehicle (EV) charging systems — on the key parameters that define power quality at the point of common coupling (PCC). Operating at switching frequencies ranging from 2 kHz to several megahertz, these devices exhibit inherently non-linear current characteristics that generate a broad spectrum of electrical disturbances on the supply network.

The study systematically examines all major power quality parameters as defined by IEC 61000-4-30, IEEE 519-2014, and IEEE 1159-2019. Current and voltage harmonic distortion — particularly the injection of 3rd, 5th, and 7th harmonic components by single-phase SMPS rectifiers and the 5th and 7th harmonics from six-pulse VFD front-ends — are identified as the most pervasive effect, with total harmonic distortion (THD) levels reaching 30–80% without mitigation measures. Beyond the classical harmonic domain, HFPS switching noise populates the 2 kHz to 150 kHz supra-harmonic band, a growing concern addressed in IEC 61000-4-30 Annex D. Inter-harmonics generated by VFDs and induction heating supplies are shown to cause voltage flicker through beat-frequency amplitude modulation of the supply voltage in the 0.5–25 Hz perceptible range.

The paper further analyses the contribution of HFPS to voltage dips, arising from high inrush currents during simultaneous load energisation; voltage swells resulting from sudden HFPS load rejection; and transient overvoltages generated by the high dv/dt switching transitions of modern silicon carbide (SiC) and gallium nitride (GaN) semiconductor devices, with voltage edge rise times as short as 1–10 ns. Supply voltage unbalance caused by asymmetric single-phase HFPS distribution across three-phase networks, power factor degradation in SMPS without active power factor correction (APFC), and conducted electromagnetic interference (EMI) in the 150 kHz to 30 MHz range regulated by CISPR 32 are also characterised. Power frequency stability implications arising from the displacement of synchronous generation by power-electronic-interfaced loads are discussed.

Results show these mechanisms are interdependent: harmonic distortion excites capacitor-bank resonances; supra-harmonic beat frequencies produce flicker; and conducted EMI corrupts protection circuits. HFPS devices collectively represent a growing source of multi-parameter power quality degradation on distribution networks, requiring regulatory frameworks that address the full frequency spectrum of their emissions.

High-frequency power supply; switch-mode power supply (SMPS); variable-frequency drive (VFD); power quality; total harmonic distortion (THD); supra-harmonics; inter-harmonics; voltage dip; voltage swell; conducted EMI; power factor correction; IEC 61000; IEEE 519.

ADOPTION OF E-MOBILITY AND ITS IMPACT ON COMFORT AND SAFETY OF CITIZENS

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Abstract

The rapid development of electric and technology-enabled transportation is transforming urban mobility by offering cleaner, more efficient, and user-oriented alternatives to conventional transport. This study examines the adoption of e-mobility and its impact on the comfort and safety of citizens through the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework. The study focuses on seven core UTAUT2 constructs: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit, which explain residents' behavioral intention and adoption of e-mobility services. The study further examines whether the adoption and use of e-mobility contribute to enhanced perceptions of comfort and safety during daily travel.

Primary data are collected from citizens using a structured questionnaire designed around the UTAUT2 constructs and measures of comfort and safety. The proposed relationships are examined using Structural Equation Modeling (SEM) to determine the influence of technology-acceptance factors on e-mobility adoption and its subsequent effects on citizens travel experiences. The study provides empirical insights into the factors that encourage residents to accept and use e-mobility services and highlights the role of perceived convenience, ease of use, social influence, supporting infrastructure, enjoyment, affordability, and habitual behavior in shaping adoption decisions.

The findings indicate that e-mobility adoption is closely associated with improved comfort and safety of citizens. By integrating technology-acceptance factors with user-oriented mobility outcomes, the study contributes to the growing literature on sustainable and smart urban transportation. The findings also offer practical implications for policymakers, transport authorities, and urban planners in developing e-mobility systems that are safe, comfortable, accessible, affordable, and responsive to citizen's mobility needs.

Keywords: Adoption, Technology, E-mobility, UTAUT2, Comfort, Safety, Citizens.

ARAZİ TOPLULAŞTIRMASINDA YENİDEN TAHSİS PROBLEMİNE YÖNELİK GELİŞTİRİLMİŞ BİR HİBRİT NSGA-II ALGORİTMASI

AN IMPROVED HYBRID NSGA-II ALGORITHM FOR THE REALLOCATION PROBLEM IN LAND CONSOLIDATION

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Abstract

Real-world settings give rise to a wide variety of optimization problems, and the technique selected to A significant proportion of real-world problems require the simultaneous consideration of multiple and potentially conflicting objectives. The performance of optimization algorithms used to solve such problems may vary depending on factors such as the problem structure, scale, number of objectives, and solution representation. Therefore, developing appropriate algorithms and comparatively evaluating their performance are important for effectively solving complex multi-objective optimization problems.

In this study, an improved hybrid NSGA-II approach is proposed to enhance the quality of the Pareto-optimal solution set generated by NSGA-II. In the proposed method, diversification operators from the Genetic Algorithm (GA) and Differential Evolution (DE) are employed together to improve the balance between global and local search and enhance the exploration capability of the algorithm. The proposed method is applied to the reallocation problem in land consolidation, which is formulated as a real-world multi-objective optimization problem. Its performance is compared with eight optimization algorithms: NSGA-II, PESA-II, GA, DE, SS, EO, MPA, and HBA. The experiments are conducted over 30 independent runs, and the results obtained under different numbers of iterations are evaluated. The experimental results demonstrate that the proposed Hybrid NSGA-II achieves better performance than the other methods, particularly in assigning parcels according to landowners' preferences, and is capable of producing non-dominated solution sets with better convergence and distribution. The findings indicate that the combined use of GA and DE operators within the NSGA-II framework provides an effective approach for solving the land reallocation problem.

Keywords: Land Consolidation, Reallocation, Multi-Objective Optimization Algorithm, Non-Dominated Sorting Genetic Algorithm-II, Differential evolution algorithm

Özet

Gerçek dünya problemlerinin önemli bir bölümü, aynı anda birden fazla ve birbiriyle çelişebilen amacın dikkate alınmasını gerektirmektedir. Bu tür problemlerde kullanılan optimizasyon algoritmasının performansı; problem yapısı, ölçeği, amaç sayısı ve çözüm gösterimi gibi faktörlere bağlı olarak değişebilmektedir. Bu nedenle, uygun algoritmaların geliştirilmesi ve performanslarının karşılaştırmalı olarak değerlendirilmesi, karmaşık çok amaçlı optimizasyon problemlerinin etkin bir şekilde çözülmesi açısından önem taşımaktadır.

Bu çalışmada, NSGA-II algoritmasının ürettiği Pareto-optimal çözüm kümesinin kalitesini artırmak amacıyla geliştirilmiş hibrit bir NSGA-II yaklaşımı önerilmektedir. Önerilen yöntemde, Genetik Algoritma (GA) ve Diferansiyel Evrim (DE) algoritmalarının çeşitlendirme operatörleri birlikte kullanılarak global ve yerel arama arasındaki dengenin iyileştirilmesi ve algoritmanın keşif yeteneğinin artırılması amaçlanmıştır. Önerilen yöntem, gerçek çok amaçlı optimizasyon problemi olan arazi toplulaştırma kapsamında yeniden tahsis problemine uygulanmıştır. Yöntemin performansı; NSGA-II, PESA-II, GA, DE, SS, EO, MPA ve HBA olmak üzere sekiz farklı optimizasyon algoritmasıyla karşılaştırılmıştır. Deneyler 30 bağımsız çalıştırma üzerinden gerçekleştirilmiş ve farklı iterasyon sayıları altında elde edilen sonuçlar değerlendirilmiştir. Deneysel sonuçlar, önerilen Hibrit NSGA-II yönteminin özellikle parsellerin işletme tercihlerine yerleştirilmesi açısından diğer yöntemlere kıyasla daha başarılı sonuçlar elde ettiğini ve daha iyi yakınsama ve dağılıma sahip baskın olmayan çözüm kümeleri üretebildiğini göstermiştir. Elde edilen bulgular, GA ve DE operatörlerinin NSGA-II yapısı içerisinde birlikte kullanılmasının arazi yeniden tahsis probleminin çözümünde etkili bir yaklaşım olduğunu ortaya koymaktadır.

Anahtar kelimeler: Arazi Toplulaştırma, Yeniden Tahsis, Çok Amaçlı Optimizasyon Algoritması, Baskın Olmayan Sıralamalı Genetik Algoritma-II, Diferansiyel Evrim Algoritması

TÜRKÇE GRAF-RAG SİSTEMLERİNDE ÇEKİM EKLERİNİN DÜĞÜM BÜTÜNLÜĞÜNE ETKİSİ

THE EFFECT OF INFLECTIONAL SUFFIXES ON NODE INTEGRITY IN TURKISH GRAPH-RAG SYSTEMS

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Abstract

Graph-based retrieval-augmented generation (Graph-RAG) turns a document collection into a knowledge graph. Entities become nodes, relations become edges, and questions are answered by following paths between nodes. The method assumes each entity occupies a single node. If an entity is split across several nodes, the paths break and the system cannot assemble the passages the question needs. English and Turkish diverge at this point. In English the city name stays "Istanbul" in every sentence, so a correct mention builds a correct node. In Turkish the same entity appears as "İstanbul'un", "İstanbul'da" and "İstanbul'u". A model may label all three correctly and reach a high named-entity recognition (NER) F1, yet the graph still holds three nodes. Two remedies for this fragmentation introduce new errors. The first merges the forms under the root "İstanbul"; identity is restored, but the relation carried by the suffix is lost: "İstanbul'un" is genitive, "İstanbul'da" locative, "İstanbul'u" accusative. The second merges by embedding similarity; the threshold that reduces fragmentation also merges unrelated entities. Words with similar contexts but opposite meanings collide below it: "yükseliş" and "düşüş" then share a node, and the system returns the reversed claim. These effects are measured on a fixed Turkish Wikipedia and news corpus. Four indexes are compared: (i) surface forms, (ii) root-based merging, (iii) embedding-based entity resolution, (iv) an identity–relation split (root as node, suffix as relation). There the suffix is tested as edge type and as edge property, since a label per case can inflate the schema. Morphological-analyzer error is also reported, since a wrong lemma distorts the score. Results are reported as NER F1, node fragmentation, antonym collision and question-answering accuracy. Rather than proposing a new architecture, the study shows where the Graph-RAG identity assumption breaks in Turkish and how far a simple identity–relation split repairs node integrity.

Keywords: Natural Language Processing, Knowledge Graph, Retrieval-Augmented Generation (RAG), Entity Resolution, Turkish NLP, Morphological Analysis

Özet

Graf tabanlı geri getirmeli üretim (Graf-RAG), belge kümesini bir bilgi grafına çevirir. Varlıklar düğüm, aralarındaki ilişkiler kenar olur; sorular bu düğümler arasında yol izlenerek yanıtlanır. Yöntem, aynı varlığın tek düğümde toplanmasını varsayar. Varlık birkaç düğüme bölünürse yollar kopar ve sistem soruyla ilgili metin parçalarını toplayamaz. İngilizce ile Türkçe bu noktada ayrılır. İngilizce metinlerde kent adı her cümlede "Istanbul" olarak kalır; varlığı doğru işaretlemek düğümü de doğru kurar. Türkçede aynı varlık "İstanbul'un", "İstanbul'da" ve "İstanbul'u" biçimlerinde geçer. Bir model üçünü de doğru etiketleyip yüksek NER F1 alabilir; graf yine de üç ayrı düğüm tutar. Parçalanmayı gidermek için kullanılan iki yöntem yeni hatalar doğurur. Birincisi, biçimleri "İstanbul" kökünde birleştirmektir; kimlik onarılır, ancak ekin taşıdığı ilişki silinir. "İstanbul'un" ilgi, "İstanbul'da" bulunma, "İstanbul'u" belirtme halidir. İkincisi, vektör gömmelerinin benzerliğine göre birleştirmektir; bu kez parçalanmayı azaltan eşik ilgisiz varlıkları da aynı düğümde toplar. Bağlamı benzer ama anlamı zıt sözcükler bu eşiğin altında çakışır; "yükseliş" ile "düşüş" böyle birleşirse sistem doğru parçayı getirip ters iddiayı üretir. Çalışma bu etkileri sabit bir Türkçe Vikipedi ve haber derleminde ölçer. Dört indeks karşılaştırılır: (i) yüzey biçimleri, (ii) kökte birleştirme, (iii) gömme tabanlı varlık çözümlemesi, (iv) kökü düğüm kimliği,

çekim ekini ilişki sayan kimlik–ilişki ayrımı. Dördüncü indekste ek, hem kenar türü hem kenar özniteliği olarak denenir; her hâl için yeni etiket üretmek şemayı şişirebilir. Biçimbilim çözümleyicisinin hata oranı da raporlanır, çünkü yanlış kök parçalanma ölçümünü bozar. Sonuçlar NER F1, düğüm parçalanması, zıt anlam çakışması ve soru-cevap doğruluğu üzerinden verilir. Çalışma, yeni bir mimari önermekten çok, Graf-RAG'in kimlik varsayımının Türkçede nerede kırıldığını ve basit bir kimlik–ilişki ayrımının düğüm bütünlüğünü ne ölçüde onardığını göstermeyi amaçlar.

Anahtar kelimeler: Doğal Dil İşleme, Bilgi Grafı, Geri Getirmeli Üretim (RAG), Varlık Çözümleme, Türkçe NLP, Biçimbilimsel Analiz

SICAK HADDELENMİŞ ÇELİK RULOLARIN SARIM HIZININ OPTİMİZASYONU VE SOĞUTMA SUYUNUN MEKANİK ÖZELLİKLERE ETKİSİ

OPTIMIZATION OF WINDING SPEED OF HOT-ROLLED STEEL COILS AND THE EFFECT OF COOLING WATER ON MECHANICAL PROPERTIES

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Abstract

Hot rolling is an important production stage in which semi-finished steel products obtained from continuous casting are plastically deformed at high temperatures. This process produces steel coils with the desired thickness and width. Rolling temperature, deformation amount, cooling conditions, and winding parameters directly affect the mechanical properties of the material. The coil winding stage after hot rolling is particularly important due to phase transformations and internal stresses in the material. In this study, the optimization of the winding speed of steel coils and the effect of cooling water on mechanical properties were investigated using data from 22 coils produced in an industrial production line. The winding speed varied between 5.8 and 16.2 m/s. The yield strength ranged from 267 to 383 MPa, while the tensile strength varied between 279 and 443 MPa. The elongation values were between 30% and 41%. The average yield strength was approximately 305 MPa. The results showed that changes in winding speed particularly affected the tensile strength. More balanced mechanical properties were obtained at low and medium winding speeds. In addition, a winding speed range of approximately 10–12 m/s was found to provide a suitable operating range for balanced mechanical properties. The mechanical properties were evaluated according to the requirements specified in the EN 10025 standard. The results showed that the samples met the requirements for yield strength and elongation. However, direct numerical measurements of cooling water flow rate were not available in the current data set. Therefore, the effect of cooling water was evaluated qualitatively. Considering winding speed together with cooling water flow rate and coiling temperature may contribute to more effective process optimization. The results indicate that optimizing winding speed together with laminar cooling conditions is important for maintaining product quality and stable mechanical properties in hot-rolled steel coils.

Keywords: Hot rolling, Coiling speed, Cooling water, Mechanical properties, Steel coil

Özet

Sıcak haddeleme prosesi, sürekli dökümden elde edilen yarı mamul çelik ürünlerinin yüksek sıcaklıklarda plastik deformasyona uğratılarak istenilen kalınlık ve genişlikte rulolar haline getirilmesini sağlayan önemli bir üretim aşamasıdır. Bu proses sırasında haddeleme sıcaklığı, deformasyon miktarı, soğuma koşulları ve sarım parametreleri malzemenin mekanik özelliklerini doğrudan etkilemektedir. Özellikle sıcak haddeleme sonrası bobin sarım aşaması, malzeme iç yapısında oluşan faz dönüşümleri ve iç gerilmeler açısından kritik bir öneme sahiptir. Bu çalışmada çelik ruloların sarım hızının optimizasyonu ve soğutma suyunun mekanik özelliklere etkisi, endüstriyel üretim hattından elde edilen 22 adet bobine ait veriler kullanılarak incelenmiştir. İncelenen numunelerde sarım hızının 5,8–16,2 m/s aralığında değiştiği, akma dayanımı değerlerinin 267–383 MPa, çekme dayanımı değerlerinin 279–443

MPa ve kopma uzaması değerlerinin %30–41 aralığında olduğu belirlenmiştir. Ortalama akma dayanımı yaklaşık 305 MPa olarak hesaplanmıştır. Elde edilen sonuçlar, sarım hızındaki değişimin özellikle çekme dayanımı üzerinde etkili olduğunu ve düşük ve orta seviyedeki sarım hızlarında daha dengeli mekanik özelliklerin elde edildiğini göstermiştir. Ayrıca, yaklaşık 10–12 m/s sarım hızı aralığının mekanik özelliklerin dengelenmesi açısından uygun bir çalışma aralığı sunduğu belirlenmiştir. Elde edilen mekanik özellikler EN 10025 standardında belirtilen gereklilikler dikkate alınarak değerlendirilmiş ve numunelerin akma dayanımı ile kopma uzaması bakımından uygun sonuçlar verdiği görülmüştür. Bununla birlikte, mevcut veri setinde soğutma suyu debisine ilişkin doğrudan sayısal ölçümlerin bulunmaması nedeniyle soğutma suyunun etkisi nitel olarak değerlendirilmiştir. Bu nedenle sarım hızının, soğutma suyu debisi ve sarım sıcaklığı gibi proses değişkenleriyle birlikte ele alınmasının üretim koşullarının daha etkin biçimde optimize edilmesine katkı sağlayacağı düşünülmektedir. Çalışma sonuçları, sarım hızının laminer soğutma koşullarıyla birlikte optimize edilmesinin sıcak haddelenmiş çelik rulolarda ürün kalitesinin ve mekanik özelliklerin stabilitesinin sağlanması açısından önemli olduğunu ortaya koymaktadır.

Anahtar kelimeler: Sıcak haddeleme, Sarım hızı, Soğutma suyu, Mekanik özellikler, Çelik rulo

SELÜLOZUN YAPISI VE YAYGIN SELÜLOZ TÜRLERİ

STRUCTURE OF CELLULOSE AND COMMON TYPES OF CELLULOSE

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Abstract

Cellulose is one of the most abundant natural polymers in nature and is composed of glucose chains derived from a renewable resource. As one of the main structural components of plant cell walls, cellulose has significant potential for use in a wide range of industrial applications due to its physical, mechanical, and chemical properties. Its insolubility in water, highly crystalline structure, high tensile strength, and chemical reactivity make cellulose a valuable raw material, particularly for the production of functional materials. In addition, its economic feasibility, environmentally friendly nature, and non-toxic properties further increase the importance of cellulose in sustainable material production.

The hydroxyl (OH) groups present in the structure of cellulose can be modified through various chemical modification processes to obtain cellulose derivatives with different properties. The main cellulose derivatives include cellulose ethers and cellulose esters. In cellulose ethers, the hydrogen atoms of the hydroxyl groups, or the hydroxyl groups themselves, are replaced with specific chemical groups, resulting in properties that differ from those of cellulose, such as solubility, viscosity, thermal stability, and film-forming ability. These properties enable cellulose ethers to be used in the food, pharmaceutical, cosmetic, textile, paint, and construction industries.

Cellulose esters are generally divided into two classes: organic and inorganic esters. Organic esters can be used in plastics, coatings, films, and packaging materials due to their various functional properties, while inorganic esters are employed in more specialized applications. Therefore, the chemical modification of cellulose not only enhances the existing properties of this natural polymer but also enables the development of new application areas. Consequently, cellulose and its derivatives have become important alternatives for sustainable, environmentally friendly, and versatile materials.

Keywords: Cellulose, Cellulose Derivatives, Cellulose Ethers, Cellulose Esters

Özet

Selüloz, doğada en bol bulunan doğal polimerlerden biri olup yenilenebilir bir kaynak olan glikoz zincirlerinden oluşmaktadır. Bitkilerin hücre duvarlarının temel yapısal bileşenlerinden biri olan selüloz, sahip olduğu fiziksel, mekanik ve kimyasal özellikler sayesinde çok çeşitli endüstriyel alanlarda önemli bir kullanım potansiyeline sahiptir. Suda çözünmemesi, yüksek kristalin yapısı, yüksek çekme dayanımı ve kimyasal reaktivitesi, selülozu özellikle fonksiyonel malzemelerin üretiminde değerli bir hammadde hâline getirmektedir. Bunun yanı sıra ekonomik açıdan uygun olması, çevre dostu ve toksik olmayan bir yapıya sahip bulunması, selülozun sürdürülebilir malzeme üretimindeki önemini daha da artırmaktadır.

Selülozun yapısında bulunan hidroksil (OH) grupları, çeşitli kimyasal modifikasyon işlemleriyle değiştirilerek farklı özelliklere sahip selüloz türevleri elde edilebilmektedir. Bu türevlerin başında selüloz eterleri ve selüloz esterleri gelmektedir. Selüloz eterlerinde hidroksil gruplarındaki hidrojen atomlarının veya hidroksil gruplarının belirli kimyasal gruplarla değiştirilmesi sonucunda selülozdan farklı çözünürlük, viskozite, termal kararlılık ve film oluşturma özellikleri ortaya çıkmaktadır. Bu özellikler, selüloz eterlerinin gıda, ilaç, kozmetik, tekstil, boya ve yapı sektörlerinde kullanılmasına olanak sağlamaktadır.

Selüloz esterleri ise genel olarak organik ve inorganik esterler olmak üzere iki sınıfa ayrılmaktadır. Organik esterler, farklı fonksiyonel özellikleri sayesinde plastik, kaplama, film ve ambalaj malzemelerinde kullanılabilirken, inorganik esterler daha özel uygulamalarda değerlendirilmektedir. Dolayısıyla selülozun kimyasal olarak modifiye edilmesi, doğal polimerin mevcut özelliklerini geliştirmekte ve yeni kullanım alanlarının ortaya çıkmasını sağlamaktadır. Bu durum, selüloz ve türevlerini sürdürülebilir, çevre dostu ve çok yönlü malzemeler açısından önemli bir seçenek hâline getirmektedir.

Anahtar kelimeler: Selüloz, Selüloz Türevleri, Selüloz Eterleri, Selüloz Esterleri

TÜRKİYE'DE SELÜLOZCA ZENGİN BAŞLICA TARIMSAL BİYOKÜTLE KAYNAKLARI

MAJOR CELLULOSE-RICH AGRICULTURAL BIOMASS SOURCES IN TÜRKIYE

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Abstract

In response to rapid population growth, industrial development, and the increasing demand for raw materials, the utilization of alternative and renewable resources has become increasingly important for sustainable production. Although wood remains one of the primary sources of cellulose, its intensive use may contribute to deforestation, resource depletion, and environmental concerns. Therefore, agricultural crops and the considerable amounts of agricultural residues generated during harvesting and processing have attracted growing attention as alternative raw materials for cellulose production. These residues, which are often underutilized or treated as waste, contain significant amounts of cellulose and can provide an economically and environmentally advantageous feedstock.

This study focuses on evaluating the potential of major agricultural residues generated in Türkiye for cellulose production. The regional cellulose production potential was estimated by considering annual agricultural production quantities and the cellulose content of the corresponding crop residues. The results revealed substantial differences among Türkiye's geographical regions. The Southeastern Anatolia Region demonstrated the highest cellulose production potential, reaching approximately 6,225,009 tons. This was followed by the Mediterranean Region, with an estimated potential of 5,693,727 tons. In contrast, the Eastern Anatolia Region exhibited the lowest cellulose production potential among the regions evaluated.

The findings indicate that Türkiye possesses considerable agricultural residue resources that could be utilized as alternative feedstocks for cellulose production. Converting these residues into value-added cellulose-based materials could contribute to more efficient resource utilization while reducing agricultural waste and its associated environmental impacts. Furthermore, the utilization of locally available agricultural residues may support the development of regional bio-based industries and reduce dependence on conventional raw materials. Overall, agricultural residues represent a promising and sustainable source of cellulose, particularly in regions with high agricultural production. Their effective utilization could contribute significantly to the principles of circular economy, sustainable resource management, and environmentally friendly production.

Keywords: Agricultural Residues, Cellulose, Sustainable Production, Alternative Raw Materials

Özet

Hızlı nüfus artışı, endüstriyel gelişme ve hammadde talebindeki artış doğrultusunda, sürdürülebilir üretim için alternatif ve yenilenebilir kaynakların kullanımı giderek daha önemli hâle gelmektedir. Odun, selülozun başlıca kaynaklarından biri olmaya devam etse de yoğun kullanımı ormansızlaşma, kaynakların tükenmesi ve çevresel sorunlara yol açabilmektedir. Bu nedenle, tarımsal ürünler ile hasat ve işleme süreçlerinde ortaya çıkan önemli miktardaki tarımsal artıklar, selüloz üretimi için alternatif hammadde kaynakları olarak giderek daha fazla ilgi görmektedir. Genellikle yeterince değerlendirilmeyen veya atık olarak kabul edilen bu artıklar, önemli miktarda selüloz içermekte ve ekonomik ve çevresel açıdan avantajlı bir hammadde kaynağı sunmaktadır.

Bu çalışmada, Türkiye'de oluşan başlıca tarımsal artıkların selüloz üretimi açısından potansiyeli değerlendirilmiştir. Bölgesel selüloz üretim potansiyeli, yıllık tarımsal üretim miktarları ve ilgili tarımsal artıkların selüloz içerikleri dikkate alınarak tahmin edilmiştir. Sonuçlar, Türkiye'nin coğrafi bölgeleri arasında önemli farklılıklar olduğunu göstermiştir. Güneydoğu Anadolu Bölgesi, yaklaşık 6.225.009 ton ile en yüksek selüloz üretim potansiyeline sahip bölge olarak belirlenmiştir. Bu bölgeyi 5.693.727 tonluk tahmini potansiyel ile Akdeniz Bölgesi takip etmiştir. Buna karşılık, Doğu Anadolu Bölgesi değerlendirilen bölgeler arasında en düşük selüloz üretim potansiyeline sahip bölge olmuştur.

Elde edilen bulgular, Türkiye'nin selüloz üretiminde alternatif hammadde olarak değerlendirilebilecek önemli miktarda tarımsal artık kaynağına sahip olduğunu ortaya koymaktadır. Bu artıkların katma değerli selüloz esaslı malzemelere dönüştürülmesi, kaynakların daha verimli kullanılmasına katkı sağlarken tarımsal atık miktarının ve buna bağlı çevresel etkilerin azaltılmasına da yardımcı olabilir. Ayrıca, yerel olarak temin edilebilen tarımsal artıkların kullanılması, bölgesel biyo-tabanlı endüstrilerin gelişimini destekleyebilir ve geleneksel hammaddelere olan bağımlılığı azaltabilir. Genel olarak, tarımsal artıklar, özellikle tarımsal üretimin yüksek olduğu bölgelerde, selüloz için umut vadeden ve sürdürülebilir bir kaynak oluşturmaktadır. Bu kaynakların etkin biçimde değerlendirilmesi; döngüsel ekonomi, sürdürülebilir kaynak yönetimi ve çevre dostu üretim ilkelerine önemli katkılar sağlayabilir.

Anahtar kelimeler: Tarımsal Atık, Selüloz, Sürdürülebilir Üretim, Alternatif Hammadde

PLC TABANLI SIVI SEVİYE KONTROL SİSTEMİ TASARIMI VE GERÇEKLEŞTİRİLMESİ

DESIGN AND IMPLEMENTATION OF A PLC-BASED LIQUID LEVEL CONTROL SYSTEM

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Abstract

In industrial automation systems, liquid level control plays a critical role in process safety, energy efficiency, and product quality. In this study, a single-tank liquid level control system was prepared as a prototype at an appropriate height. A pressure sensor with a suitable measurement range was used for level measurement. The experimental setup of the liquid level process was used to obtain its static (input/output) and dynamic characteristics. For the set up model, a PLC-based PID control system was designed and tested in a simulation environment. The primary aim of this study is to demonstrate the applicability of the PID algorithm on a programmable logic controller (PLC), improve the dynamic performance of the system through optimized control parameters, and provide a practical solution for industrial applications. The experimental setup was built on a single-tank liquid level system, where the feedback signal obtained via the pressure sensor was applied to the PLC. The PID algorithm developed on the PLC processed the error signal between the reference value and the measured value, obtained a PWM control signal to operate the pump and valve. PID parameters (Kp, Ki, Kd) were tuned using different methods, and performance criteria such as stability, overshoot, rise time, and settling time were analyzed.The study compared manual control, classical PID, and PID parameter tuning methods optimized according to different error criteria. Results showed that optimized PID parameters provided lower overshoot, shorter settling time, and higher tracking accuracy. Furthermore, PLC-based control was demonstrated to offer advantages in terms of reliability, flexibility, and ease of integration in industrial environments.This simulation-based study confirms the effectiveness of PLC-based PID control systems in liquid level processes and establishes a foundation for future applications of adaptive control, fuzzy logic, or artificial intelligence-supported control algorithms.

Keywords: PLC, PID control, Pressure sensor, Industrial automation, Process control

Özet

Endüstriyel otomasyon sistemlerinde sıvı seviye kontrolü, proses güvenliği, enerji verimliliği ve ürün kalitesi açısından kritik bir rol oynamaktadır. Bu çalışmada, öncelikle uygun yükseklikte tek tanklı bir sıvı seviye kontrol sistemi prototip olarak hazırlanmıştır. Seviye ölçümü için uygun ölçüm aralığına sahip olan basınç sensörü kullanılmıştır. Sıvı pompalamak için ise DC beslemeli uygun güçte bir sıvı pompası kullanılmıştır. Prototip olarak hazırlanmış olan sıvı seviye prosesinin deneysel yolla statik (Giriş/Çıkış) ve dinamik karakteristikleri elde edilmiştir. Elde edilen model için PLC tabanlı PID kontrol sistemi tasarlanmış ve benzetim ortamında test edilmiştir. Çalışmanın temel amacı, PID algoritmasının programlanabilir lojik kontrolör (PLC) üzerinde uygulanabilirliğini göstermek, kontrol parametrelerinin

optimize edilmesiyle sistemin dinamik performansını iyileştirmek ve endüstriyel uygulamalara yönelik pratik bir çözüm sunmaktır.Deneysel düzenek, tek tanklı sıvı seviye sistemi üzerine kurulmuş olup; basınç sensörü aracılığıyla elde edilen geri besleme sinyali PLC'ye uygulanmıştır. PLC üzerinde geliştirilen PID algoritması, referans değer ile ölçülen değer arasındaki hata sinyalini işleyerek elde edilen PWM kontrol ainyali ile pompa ve vana kontrolünü sağlamaktadır. PID parametreleri (Kp, Ki, Kd) farklı yöntemlerle ayarlanmış ve sistemin kararlılık, aşım, yükselme süresi ve oturma süresi gibi performans kriterleri incelenmiştir. Çalışmada, manuel kontrol**,** klasik PID ve farklı hata kriterlerine göre optimize edilmiş PID parametre ayarlama yöntemleri karşılaştırılmıştır. Sonuçlar, optimize edilmiş PID parametreleri ile sistemin daha düşük aşım, daha kısa oturma süresi ve daha yüksek izleme doğruluğu sağladığını göstermektedir. Ayrıca PLC tabanlı kontrolün, endüstriyel ortamlarda güvenilirlik, esneklik ve kolay entegrasyon açısından avantaj sunduğu ortaya konmuştur. Benzetim ortamında gerçekleştirilen bu çalışma, PLC tabanlı PID kontrol sistemlerinin sıvı seviye proseslerinde etkinliğini kanıtlamakta ve gelecekte adaptif kontrol**,** bulanık mantık veya yapay zekâ destekli kontrol algoritmaları için altyapı oluşturmaktadır. Böylece endüstriyel otomasyon alanında daha gelişmiş ve akıllı kontrol sistemlerinin tasarımına katkı sağlanması hedeflenmektedir.

Anahtar kelimeler: PLC, PID kontrol, Basınç sensörü, Endüstriyel otomasyon, Proses kontrol

DOĞRUSAL DİNAMİK SİSTEMLER İÇİN YAPAY ZEKÂ TABANLI GÖZLEMLEYİCİLER

ARTIFICIAL INTELLIGENCE-BASED OBSERVERS FOR LINEAR DYNAMIC SYSTEMS

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Abstract

In linear dynamic systems modeled in state-space form, the accurate estimation of state variables from noisy input–output measurement data is of critical importance for control performance and system safety. Classical observer structures, particularly the Luenberger observer and the Kalman filter, provide effective solutions for linear systems. However, these methods exhibit limited performance under parameter uncertainties, measurement noise, and modeling errors. For this reason, artificial intelligence–based observers have emerged as a strong alternative due to their adaptive learning and optimization capabilities. In this study, the design of artificial intelligence–based observers for linear dynamic systems is addressed. Artificial neural networks (ANNs) are employed to estimate state variables using noisy input–output measurement data, offering a more flexible structure compared to classical methods. ANN-based observers are trained using the backpropagation algorithm and, through online learning, are able to adapt to varying system dynamics. Furthermore, optimization techniques such as particle swarm optimization (PSO) and genetic algorithms (GA) are utilized to enhance the tuning of observer gains. Simulation studies conducted in MATLAB demonstrate that ANN-based observers achieve lower mean squared error (MSE) and faster convergence compared to the classical Luenberger observer. Even under noise and parameter uncertainties, ANN-based observers maintain high stability. For instance, in tests performed on a second-order mass–spring–damper system, the ANN-based observer achieved lower estimation error than classical approaches. Additionally, ANN observers optimized with PSO yielded more robust results against parameter variations. In conclusion, artificial intelligence–based observers represent a powerful alternative to classical methods for state estimation in linear dynamic systems. This approach has the potential to provide reliable and flexible solutions in industrial automation, process control, and autonomous systems.

Keywords: Linear systems, Observer design, Artificial intelligence, ANN, PSO, GA, State estimation.

Özet

Durum uzayı formunda modellenmiş olan doğrusal dinamik sistemlerde gürültü içeren giriş-çıkış ölçüm değerlerinden durum değişkenlerinin istenen doğrulukta kestirimi, kontrol performansı ve sistem güvenliği açısından kritik öneme sahiptir. Klasik gözlemleyici yapıları, özellikle Luenberger gözlemcisi ve Kalman filtresi, doğrusal sistemler için etkin çözümler sunmaktadır. Ancak bu yöntemler, parametre belirsizlikleri, ölçüm gürültüsü ve modelleme hataları altında sınırlı performans göstermektedir. Bu nedenle yapay zekâ tabanlı gözlemleyiciler, adaptif öğrenme ve optimizasyon yetenekleri sayesinde güçlü bir alternatif olarak öne çıkmaktadır. Bu çalışmada, doğrusal dinamik sistemler için yapay zekâ tabanlı gözlemleyici tasarımı ele alınmıştır. Yapay sinir ağları (ANN), sistemin gürültü içeren giriş–çıkış ölçüm değerlerini kullanarak durum değişkenlerini tahmin etmekte ve klasik yöntemlere kıyasla daha esnek bir yapı sunmaktadır. ANN tabanlı gözlemciler, hata geri yayılım algoritması ile eğitilmekte ve çevrim içi öğrenme sayesinde değişen sistem dinamiklerine uyum sağlamaktadır. Ayrıca parçacık sürü optimizasyonu (PSO) ve genetik algoritma (GA) gibi yöntemler, gözlemci kazançlarının optimizasyonunda kullanılabilmektedir. MATLAB ortamında gerçekleştirilen simülasyonlarda, ANN tabanlı gözlemcilerin klasik Luenberger gözlemcisine kıyasla daha düşük ortalama kare hata (MSE) ve daha hızlı yakınsama sağladığı gözlemlenmiştir. Gürültü ve parametre belirsizlikleri altında bile ANN

tabanlı gözlemciler yüksek kararlılık göstermiştir. Örneğin ikinci dereceden kütle–yay–sönüm sistemi üzerinde yapılan testlerde, ANN tabanlı gözlemci klasik yöntemlere göre daha düşük tahmin hatası elde etmiştir. Ayrıca PSO ile optimize edilen ANN gözlemciler, parametre değişimlerine karşı daha dayanıklı sonuçlar vermiştir. Sonuç olarak, yapay zekâ tabanlı gözlemleyiciler doğrusal dinamik sistemlerde durum değişkenlerinin kestiriminde klasik yöntemlere güçlü bir alternatif olarak değerlendirilmektedir. Bu yaklaşım, endüstriyel otomasyon, proses kontrol ve otonom sistemlerde güvenilir ve esnek çözümler sunma potansiyeline sahiptir.

Anahtar kelimeler: Doğrusal sistemler, Gözlemleyici tasarımı, Yapay zekâ, ANN, PSO, GA, Durum kestirimi.

FDM 3D BASKIDA SERTLİK-SÜNEKLİK ÖDÜNLEŞİMİNİN ÇOK KRİTERLİ KARAR VERME İLE OPTİMİZASYONU: ELASTİK MODÜL VE MAKSİMUM GERİNİM ODAKLI BİR YAKLAŞIM

OPTIMIZATION OF STIFFNESS-DUCTILITY TRADE-OFF IN FDM 3D PRINTING THROUGH MULTI-CRITERIA DECISION MAKING: AN APPROACH FOCUSED ON ELASTIC MODULUS AND MAXIMUM STRAIN

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Abstract

The relationship between stiffness (elastic modulus, E) and ductility (strain at break, ε_d) in Fused Deposition Modeling (FDM) 3D printing was investigated using Gaussian process regression (GPR) surrogate models and multi-criteria decision-making (MCDM) methods. The leave-one-out cross-validation accuracy of the surrogate models was R2=0.521 for E and R2=0.359 for ε_d. Preliminary analyses revealed that the relationship between E and ε_d varies fundamentally depending on the infill pattern: a strong positive correlation was observed for the Cubic pattern (r=0.63), indicating that the two properties rise together with no trade-off; a weak positive correlation was found for Grid (r=0.33); and the classical negative trade-off was detected exclusively in the Lines pattern (r=-0.32). Motivated by this finding, independent SPEA2 (Strength Pareto Evolutionary Algorithm 2) optimizations were conducted for each infill pattern, and the resulting solutions were aggregated to construct a global Pareto front. The resulting 120-point global Pareto front comprises exclusively Grid (60 points) and Lines (60 points) solutions; no Cubic solution remains non-dominated, which is an expected outcome given the positive correlation observed for this pattern. TOPSIS and VIKOR methods, applied to the global front with equal weights (0.5/0.5), both recommended the Lines pattern, a layer thickness of 0.4 mm, and nearly identical temperatures (236–237 °C). The methods differed only slightly in predicted print speed (44.1 vs. 47.1 mm/s; the difference in predicted E and ε_d is negligible). In a secondary weighting scenario prioritizing stiffness (0.7/0.3), both methods consistently shifted towards higher print speeds. The findings demonstrate that the stiffness-ductility trade-off is not a universal characteristic of FDM parts, but rather is conditioned by the infill pattern. Furthermore, the study confirms a high level of agreement between TOPSIS and VIKOR at the recommendation level for the specific problem investigated.

Keywords: Multi-Criteria Decision Making; TOPSIS; VIKOR; SPEA2; Stiffness-Ductility Trade-Off; FDM Additive Manufacturing.

Özet

Füze edilmiş modelleme (Fused Deposition Modeling, FDM) tabanlı 3B baskı süreçlerinde sertlik (elastisite modülü, E) ile süneklik (kopma uzaması, ε_d) arasındaki ilişki, Gauss süreci regresyonu (GPR) vekil modelleri ve çok kriterli karar verme (MCDM) yöntemleri kullanılarak incelenmiştir. Vekil modellerin birini-dışarıda-bırak (leave-one-out) çapraz doğrulama performansı E için R^2=0,521, ε_d için ise R^2=0,359 olarak hesaplanmıştır. Ön analizler, E ile ε_d arasındaki ilişkinin dolgu desenine bağlı olarak niteliksel farklılıklar gösterdiğini ortaya koymuştur: Kübik deseninde güçlü pozitif bir korelasyon (r=0,63) gözlenmiş ve bu iki özellik arasında bir ödünleşim (trade-off) bulunmadığı belirlenmiştir; Grid

deseninde zayıf pozitif korelasyon (r=0,33) mevcutken, klasik negatif ödünleşim yalnızca Lines deseninde (r=-0,32) tespit edilmiştir. Bu bulgu ışığında, her bir dolgu deseni için bağımsız SPEA2 (Strength Pareto Evolutionary Algorithm 2) optimizasyonları yürütülmüş ve elde edilen çözümler birleştirilerek global bir Pareto cephesi oluşturulmuştur. Oluşturulan 120 noktalık global Pareto cephesinin tamamı Grid (60 nokta) ve Lines (60 nokta) desenlerinden oluşmakta; Cubic desenine ait hiçbir çözüm baskın (non-dominated) kalmamıştır. Bu durum, söz konusu desendeki pozitif korelasyonun bir sonucu olarak beklenen bir bulgudur. Global Pareto cephesine eşit ağırlıklı (0,5/0,5) TOPSIS ve VIKOR yöntemleri uygulanmış; her iki yöntem de Lines desenini, 0,4 mm katman kalınlığını ve birbirine çok yakın sıcaklık değerlerini (236–237 °C) önermiştir. Yöntemler yalnızca baskı hızı tahmininde küçük bir farklılık göstermiştir (44,1'e karşı 47,1 mm/s; tahmini E ve ε_d değerleri arasındaki fark ihmal edilebilir düzeydedir). Sertliğe öncelik veren bir ikincil ağırlıklandırma senaryosunda (0,7/0,3) ise her iki yöntem de tutarlı bir şekilde daha yüksek baskı hızlarına yönelmiştir. Sonuçlar, sertlik-süneklik ödünleşiminin FDM parçalarında evrensel bir özellik olmadığını, aksine dolgu deseni tarafından koşullandığını göstermenin yanı sıra, incelenen problem özelinde TOPSIS ve VIKOR yöntemlerinin öneri düzeyinde yüksek bir uyum sergilediğini kanıtlamaktadır.

Anahtar kelimeler: Çok Kriterli Karar Verme; TOPSIS; VIKOR; SPEA2; Sertlik-Süneklik Ödünleşimi; FDM Eklemeli İmalat.

KATEGORİK FAKTÖRLÜ FDM TASARIMLARINDA OPTİMAL ÖLÇÜT VE ARAMA ALGORİTMASI SEÇİMİNİN ML GENELLEME BAŞARISINA ETKİSİ

THE IMPACT OF OPTIMAL CRITERION AND SEARCH ALGORITHM SELECTION ON ML GENERALIZATION SUCCESS IN CATEGORICAL FACTOR FDM DESIGNS

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Abstract

This study investigates the effect of optimal experimental design criteria on the generalization performance of machine learning surrogate models using an FDM 3D printing dataset that includes a categorical factor (infill pattern). Four optimality criteria (D-, E-, G-, and V-optimal) and two search algorithms (Wynn-Mitchell and DETMAX) were compared across three design sizes (p = 25, 30, 35) and three mechanical responses (tensile strength, elastic modulus, and strain at break). The categorical factor was coded ordinally {-1, 0, +1} alongside three continuous factors, and all design selections were performed. The results demonstrate that search algorithm choice substantially affects design outcomes: the two algorithms selected different designs in 27 of 36 (criterion, design size, response) combinations (75%). Hold-out R^2 values of the XGBoost surrogate were generally low, with negative values in most combinations, attributable to the limited sample size (25–35 points from an 81-point full factorial pool) combined with the rich higher-order interaction structure of FDM responses. Performance of optimality criteria differed markedly by criterion: E-optimal and G-optimal achieved success rates of 78% and 67%, respectively, while D-optimal and V-optimal achieved only 33% and 22%. This variation was driven entirely by criterion choice rather than by the response variable. The only design size at which a single criterion was best across all three responses was p = 35 (E-optimal); in general, no single criterion was universally superior. These findings indicate that in industrial experimental designs involving categorical factors, both optimality criterion selection and search algorithm choice directly affect surrogate model generalization and should be carefully evaluated prior to application.

Keywords: Optimal experimental design, D-/E-/G-/V-optimal criteria, search algorithm comparison, multi-response optimization, FDM additive manufacturing.

Özet

Bu çalışma, kategorik bir faktör (dolgu deseni) içeren bir FDM 3D baskı veri seti kullanılarak, optimal deneysel tasarım kriterlerinin makine öğrenimi vekil modellerinin genelleme performansı üzerindeki etkisini incelemektedir. Dört optimalite kriteri (D-, E-, G- ve V-optimal) ve iki arama algoritması (Wynn-Mitchell ve DETMAX), üç tasarım boyutu (p = 25, 30, 35) ve üç mekanik tepki (çekme mukavemeti, elastik modül ve kopma gerinimi) üzerinden karşılaştırılmıştır. Kategorik faktör, üç sürekli faktörle birlikte {-1, 0, +1} şeklinde sıralı olarak kodlanmış ve tüm tasarım seçimleri gerçekleştirilmiştir. Sonuçlar, arama algoritması seçiminin tasarım sonuçlarını önemli ölçüde etkilediğini göstermektedir: iki algoritma, 36 kombinasyondan (kriter, tasarım boyutu, tepki) 27'sinde (%75) farklı tasarımlar seçmiştir. XGBoost ikamesinin hold-out R^2 değerleri genel olarak düşüktü ve çoğu kombinasyonda negatif değerler görüldü; bu durum, sınırlı örneklem büyüklüğü (81 puanlık tam faktöriyel havuzdan 25–35 puan) ile FDM tepkilerinin zengin yüksek mertebeden etkileşim yapısının birleşimine atfedilebilir. Optimalite kriterlerinin performansı, kritere göre belirgin farklılıklar gösterdi: E-optimal

ve G-optimal sırasıyla %78 ve %67 başarı oranlarına ulaşırken, D-optimal ve V-optimal sadece %33 ve %22 oranlarına ulaştı. Bu farklılık, yanıt değişkeninden ziyade tamamen kriter seçiminden kaynaklanmıştır. Üç yanıt değişkeninin tümünde tek bir kriterin en iyi sonuç verdiği tek tasarım büyüklüğü p = 35 (E-optimal) idi; genel olarak, hiçbir tek kriter evrensel olarak üstün değildi. Bu bulgular, kategorik faktörleri içeren endüstriyel deneysel tasarımlarda, hem optimalite kriteri seçiminin hem de arama algoritması seçiminin, vekil modelin genelleştirilmesini doğrudan etkilediğini ve uygulamadan önce dikkatle değerlendirilmesi gerektiğini göstermektedir.

Anahtar kelimeler: Optimal deney tasarımı, D-/E-/G-/V-optimal ölçütler, arama algoritması karşılaştırması, FDM eklemeli imalat.

EFFECTS OF FSW-INDUCED MICROSTRUCTURAL HETEROGENEITY AND TOOL INCLUSIONS ON THE FATIGUE LIFE OF 6082-T6 ALUMINUM ALLOY JOINTS

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Abstract.

This study investigates the effects of friction stir welding (FSW) on the microstructure, chemical composition, and mechanical properties of AA 6082-T6 aluminum alloy, with the aim of assessing the structural integrity of welded joints. Aluminum sheets with a thickness of 4 mm were welded using a rotational speed of 1400 rpm and a traverse speed of 80 mm/min. The welded joints were characterized through tensile tests, Vickers microhardness measurements, fatigue crack propagation tests according to ASTM E647, and microstructural and chemical analyses using optical microscopy, scanning electron microscopy coupled with energy-dispersive spectroscopy (SEM-EDS), and X-ray fluorescence (XRF). The mechanical results indicate that the weld nugget exhibits good consolidation, achieving a tensile strength of 289 MPa, which is higher than that of the other joint regions but lower than the 347 MPa measured for the base metal. The heat-affected zone (HAZ) represents the weakest region, with a tensile strength of 190 MPa. A significant reduction in microhardness is also observed in the HAZ and thermo-mechanically affected zone (TMAZ), particularly on the advancing side. Fatigue crack propagation analysis based on Paris' law shows that the crack growth rate (da/dN) in the FSW joints exceeds that of the base metal when the stress intensity factor range (ΔK) is greater than 25 MPa·m$^{1/2}$. Microstructural observations reveal dynamic recrystallization within the weld nugget, resulting in significant grain refinement with grain sizes ranging from 1 to 20 µm. In contrast, the HAZ exhibits grain coarsening and dissolution of the strengthening Mg_2Si precipitates. SEM-EDS analysis also identifies iron-rich particles, likely originating from tool wear. Overall, FSW produces sound joints with no major defects; however, the process induces localized structural softening and reduces the fatigue crack propagation resistance of AA 6082-T6.

Keywords: Friction stir welding (FSW), 6082-T6 aluminum alloy, Microstructure–property relationships, Fatigue crack growth (FCG), ASTM E647

DESIGN AND PERFORMANCE OPTIMIZATION OF A LEAD-FREE $Cs_4CuSb_2Cl_{12}/Cs_2PtI_6$ DUAL-ABSORBER SOLAR CELL WITH ENHANCED SPECTRAL UTILIZATION

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Abstract

Lead-free photovoltaic absorbers are often limited by incomplete spectral coverage and defect-assisted carrier recombination. Consequently, a single absorber may not provide both broad photon harvesting and efficient charge collection. In this study, a lead-free dual-absorber solar cell with the configuration FTO/ZnO–g-C_3N_4/$Cs_4CuSb_2Cl_{12}$/Cs_2PtI_6/Cu_2O was numerically investigated using SCAPS-1D. The wider-bandgap $Cs_4CuSb_2Cl_{12}$ absorber was placed near the illuminated side, whereas the narrower-bandgap Cs_2PtI_6 layer was positioned behind it to absorb longer-wavelength photons transmitted through the front absorber. The current density–voltage (J–V) and quantum-efficiency (QE) characteristics of the corresponding single-absorber devices were first compared with those of the dual-absorber structure under identical simulation conditions. The combined device retained a strong response in the visible region while extending its QE response to approximately 920 nm. The thickness and bulk defect density of each absorber were subsequently varied to evaluate their effects on the open-circuit voltage (Voc), short-circuit current density (Jsc), fill factor (FF), and power conversion efficiency (PCE). Based on these analyses, thicknesses of 0.3 μm for $Cs_4CuSb_2Cl_{12}$ and 0.8 μm for Cs_2PtI_6 were selected. Device performance remained relatively stable at low defect densities but declined as the defect concentration increased. A bulk defect density of 1E14 cm^{-3} was therefore adopted for both absorbers. Under AM1.5G illumination at 100 mW cm^{-2} and 300 K, the optimized device achieved a Voc of 1.30 V, Jsc of 25.93 mA cm^{-2}, FF of 86.13%, and PCE of 36.16%. These simulated results indicate that combining absorbers with complementary spectral responses, together with appropriate control of their thicknesses and bulk defect densities, can substantially improve device performance.

Keywords: Lead-Free Solar Cell, Dual-Absorber Photovoltaic Device, Bulk Defect Density, Absorber Thickness Optimization, Wide-Bandgap Absorber

POLITICAL INTENT OR LEGAL OBLIGATION? ENVIRONMENTAL AGREEMENTS AND ECOLOGICAL PRESSURE IN THE G7 ECONOMIES.

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Abstract

This study examines the determinants of ecological pressure in the G7 countries over 1990-2024 using the ecological footprint pressure index, which scales the consumption-based ecological footprint by domestic biocapacity and thus captures the demand and the supply side of the sustainability balance. Environmental diplomacy is measured in two ways: the cumulative stock of environmental treaties signed and the cumulative stock of treaties that have come into force. In view of the presence of both cross-sectional dependence and slope heterogeneity, the Augmented Mean Group estimator is used to estimate long-run elasticities and the panel FMOLS and DOLS are employed to verify them, while a panel vector error-correction model is used to determine the direction of causality. The stock of signed treaties bears no statistically significant relationship with ecological pressure, whereas the stock of treaties in force reduces it significantly. Energy consumption increases the ecological pressure and trade openness decreases it, a result that a consumption-based measure cannot attribute to the offshoring of resource intensive production, while renewable energy is insignificant. The income terms carry the expected quadratic signs, but applying the Lind and Mehlum (2010) U-test, which unlike conventional sign-based inference requires the turning point to lie within the observed data range and slope to be significant on both sides of it, a valid Environmental Kuznets curve is not confirmed. The findings are consistent with legal enforceability, rather than diplomatic expression, being the property through which international environmental agreements register in ecological outcomes. G7 countries must therefore convert signature into binding obligation to restore ecological balance and speed up progress toward SDG 15 (Life on Land) and SDG 17 (Partnerships for the Goals).

Keywords: Ecological footprint pressure index; Environmental diplomacy; Multilateral environmental agreements; Environmental Kuznets curve

FORMULATION AND EVALUATION OF LOPERAMIDE LIQUISOLID COMPACTS

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ABSTRACT

Liquisolid technique is a novel technique. It is used to improve the dissolution rate of the poorly water soluble drugs like loperamide. The liquisolid compacts were prepared by using carrier, coating material & liquid medication. Liquisolid compact refer to the formul ations that are formed by conversion of liquid drugs, drug suspension or solution in non-volatile solvents into dry, non-adherent, free flowing and compressible powder mixture. The crystallanity of the newly formulated drug and the interaction between excipients was examined by X-ray powder diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR). finally the increased dissolution rate of poorly water soluble drug. Loperamide is a Piperidine derivative, it is used in treatment of Anti diarrheal agent.

Keywords: loperamide, liquisolid compacts, X-RD, FT-IR, dissolution profil

SODYUM TETRABORAT AKTİVASYONU İLE ÇAY ATIĞINDAN SÜRDÜRÜLEBİLİR GÖZENEKLİ KARBON ÜRETİMİ VE SÜPERKAPASİTÖR UYGULAMALARI

SUSTAINABLE PRODUCTION OF TEA WASTE-DERIVED POROUS CARBON VIA SODIUM TETRABORATE ACTIVATION FOR SUPERCAPACITOR APPLICATIONS

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Abstract

The growing demand for efficient and sustainable energy storage technologies has stimulated considerable interest in the development of biomass-derived carbon materials for supercapacitor electrodes. In this context, industrial biomass residues represent attractive carbon precursors owing to their abundance, low cost, renewability, and potential contribution to waste valorization. This study investigates the conversion of industrial tea waste into porous carbon materials through sodium tetraborate ($Na_2B_4O_7$) activation and evaluates the influence of carbonization temperature on their electrochemical energy storage performance. Tea waste was mixed with $Na_2B_4O_7$ at a biomass-to-activating-agent mass ratio of 1:0.5 and thermally treated at 400, 500, and 600 °C. The resulting carbon materials were subsequently evaluated as electrode materials for supercapacitor applications. A progressive improvement in electrochemical performance was observed with increasing treatment temperature. The specific capacitance values obtained for the carbons prepared at 400, 500, and 600 °C were 114, 126, and 137 F g^{-1}, respectively, with the highest capacitance achieved at 600 °C. The enhanced capacitive behavior at elevated carbonization temperatures can be associated with the development of a more favorable carbon structure and pore characteristics for charge storage and electrolyte-ion transport. Although the obtained capacitance values indicate moderate electrochemical performance, the results demonstrate the feasibility of converting an abundant industrial residue into a functional electrode material using a relatively simple activation strategy. Overall, this preliminary investigation highlights the potential of sodium tetraborate-assisted valorization of tea waste as a sustainable route for producing carbon-based materials for electrochemical energy storage. Further optimization of the activation ratio and processing conditions may provide additional improvements in porosity, conductivity, and capacitive performance.

Keywords: Tea waste; Biomass-derived carbon; Sodium tetraborate activation; Supercapacitor; Electrochemical energy storage

Özet

Verimli ve sürdürülebilir enerji depolama teknolojilerine yönelik artan talep, süperkapasitör elektrotlarında kullanılmak üzere biyokütle türevi karbon malzemelerin geliştirilmesine olan ilgiyi önemli ölçüde artırmıştır. Bu bağlamda endüstriyel biyokütle atıkları; bol miktarda bulunmaları, düşük maliyetli ve yenilenebilir olmaları ve atıkların katma değerli ürünlere dönüştürülmesine katkı sağlama potansiyelleri nedeniyle karbon öncülü olarak dikkat çekmektedir. Bu çalışmada, endüstriyel çay atıklarının sodyum tetraborat ($Na_2B_4O_7$) aktivasyonu yoluyla gözenekli karbon malzemelere dönüştürülmesi araştırılmış ve karbonizasyon sıcaklığının elektrokimyasal enerji depolama performansı üzerindeki etkisi değerlendirilmiştir. Çay atığı, 1:0,5 biyokütle/aktivasyon ajanı kütle oranında $Na_2B_4O_7$ ile karıştırılmış ve 400, 500 ve 600 °C sıcaklıklarda ısıl işleme tabi tutulmuştur. Elde edilen karbon malzemeler daha sonra süperkapasitör uygulamalarında elektrot malzemesi olarak değerlendirilmiştir. Isıl işlem sıcaklığının artmasıyla birlikte elektrokimyasal performansta kademeli bir iyileşme gözlenmiştir. 400, 500 ve 600 °C'de üretilen karbon malzemeler için sırasıyla 114, 126 ve 137 F g^{-1} özgül kapasitans değerleri elde edilmiş ve en yüksek kapasitans 600 °C'de hazırlanan malzemede

belirlenmiştir. Yüksek karbonizasyon sıcaklıklarında gözlenen gelişmiş kapasitif davranış, yük depolama ve elektrolit iyonlarının taşınımı açısından daha elverişli bir karbon yapısının ve gözenek özelliklerinin gelişmesiyle ilişkilendirilebilir. Elde edilen kapasitans değerleri orta düzeyde bir elektrokimyasal performansa işaret etmekle birlikte, sonuçlar bol miktarda bulunan endüstriyel bir atığın nispeten basit bir aktivasyon yaklaşımıyla işlevsel bir elektrot malzemesine dönüştürülebileceğini göstermektedir. Genel olarak bu ön çalışma, sodyum tetraborat destekli çay atığı valorizasyonunun elektrokimyasal enerji depolama uygulamalarına yönelik karbon esaslı malzemelerin sürdürülebilir üretimi için umut vadeden bir yaklaşım olduğunu ortaya koymaktadır. Aktivasyon oranının ve üretim koşullarının daha ileri düzeyde optimizasyonu ile gözeneklilik, elektriksel iletkenlik ve kapasitif performansın daha da geliştirilebileceği öngörülmektedir.

Anahtar kelimeler: Çay atığı; Biyokütle türevi karbon; Sodyum tetraborat aktivasyonu; Süperkapasitör; Elektrokimyasal enerji depolama

SAVUNMA SANAYİİNDEKİ BÜYÜMENİN MÜHENDİSLİK PROGRAMLARI TERCİHLERİNE YANSIMASI

THE REFLECTION OF DEFENCE INDUSTRY GROWTH ON PREFERENCES FOR ENGINEERING PROGRAMMES

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Abstract

The defense industry is one of the most important sectors offering employment opportunities to graduates from a wide range of engineering disciplines, including computer, electrical and electronics, mechanical, mechatronics, materials and aerospace engineering. This study examines how the growth of Türkiye's defense industry was reflected in students' preferences for engineering programs between 2018 and 2026. The analysis draws on programs quotas, placement figures, occupancy rates and admission scores published by ÖSYM and YÖK. These data were evaluated alongside the 2018-2023 sector indicators reported by the Defense and Aerospace Industry Manufacturers Association and the 2023-2025 data published by the Presidency of Defense Industries. Between 2018 and 2023, the sector's turnover increased by 72%, while employment grew by 35%. Over the same period, the number of students placed in the selected engineering programs rose by 24%. These figures indicate that, during the first period of the analysis, the growth of the defense industry and student demand for relevant engineering programs followed broadly similar trends. This pattern began to change after 2023. Defense and aerospace exports increased from approximately USD 5.5 billion in 2023 to USD 10 billion in 2025, while the number of ongoing projects exceeded 1,400. Despite this strong momentum in the sector, the number of students placed in defense-related engineering programs declined from 40,732 in 2023 to 32,944 in 2026. Similarly, the total number of available places was reduced from 42,531 to 36,533. In brief, the rapid growth of the defense industry in recent years has not been accompanied by a comparable increase in the number of students entering relevant engineering programs. Notable differences can also be observed across university types and cities. According to the 2026 data, engineering programs at public universities were almost fully occupied, whereas the occupancy rate at foundation universities remained at approximately 65%. A comparison of Ankara and Istanbul also reveals contrasting patterns. In Ankara, student demand was distributed more evenly between public and foundation universities. In Istanbul, demand for well-established public universities remained strong, while foundation universities were left with a considerable number of unfilled places. Taken together, these findings show that the growth of the defense industry supports interest in engineering education but is not sufficient on its own to determine students' preferences. Their decisions are shaped not only by the size and employment potential of the sector, but also by tuition fees, scholarship opportunities, institutional reputation, the quality of education, the city in which the university is located and, perhaps most importantly, employment prospects after graduation.

Keywords: Defence industry, Engineering education, University preference, Human resources, Higher education

Özet

Savunma sanayii; bilgisayar, elektrik-elektronik, makine, mekatronik, malzeme ve havacılık gibi farklı mühendislik programlarında mezunların kendine yer bulduğu en kritik sektörlerin başında geliyor. Bu çalışmada, Türkiye'de savunma sanayiindeki büyümenin 2018-2026 yılları arasında üniversitelerdeki mühendislik bölümleri tercihlerine nasıl yansıdığını incelendi. Araştırmada ÖSYM ve YÖK'ün açıkladığı kontenjan, yerleşen sayısı, doluluk oranları ve puan verilerini; Savunma ve Havacılık Sanayii İmalatçılar Derneğinin 2018-2023 sektör göstergeleri ve Savunma Sanayii Başkanlığının 2023-2025

verileriyle birlikte değerlendirildi. 2018-2023 yılları arasında sektörün cirosu %72, istihdamı ise %35 oranında büyüdü. Mühendislik programlarına yerleşen öğrenci sayısı %24 arttı. İlk dönemde, sektördeki büyüme ile mühendislik tercihlerinin birbiriyle oldukça uyumlu seyrettiği görülmektedir. 2023'ten sonra bu eğilimin değiştiği gözlenmektedir. Savunma ve havacılık ihracatı 2023'teki 5,5 milyar dolarlık seviyesinden 2025'te 10 milyar dolara yükselirken, yürütülen proje sayısı da 1.400'ü geçmiştir. Sektördeki bu ivmeye rağmen, savunma sanayi ile ilişkili mühendislik bölümlerine yerleşen öğrenci sayısı 2023'te 40.732 iken 2026'da 32.944'e kadar geriledi. Benzer şekilde, toplam kontenjanlar da 42.531'den 36.533'e çekildi. Özetle, son yıllarda savunma sanayiindeki hızlı büyümenin mühendislik bölümlerine yerleşen öğrenci sayısına yansımadığını görüyoruz. Üniversite türleri ve şehirler özelinde de dikkat çekici farklar bulunmaktadır. 2026 verilerine baktığımızda devlet üniversitelerindeki programlar neredeyse tamamen dolarken, vakıf üniversitelerinde doluluk oranı %65 seviyesinde kalmıştır. Şehir bazında Ankara ve İstanbul kıyaslandığında ise Ankara'da devlet ve vakıf üniversiteleri arasında daha dengeli bir tercih dağılımı öne çıkıyor. İstanbul'da ise köklü devlet üniversitelerine talep güçlü bir şekilde sürse de vakıf üniversitelerinde ciddi bir kontenjan boşluğu oluşmuş durumda. Tüm bu veriler bize gösteriyor ki; savunma sanayiinin büyümesi mühendislik eğitimine olan ilgiyi besliyor ama tek başına yeterli olmuyor. Öğrencilerin tercihlerini sadece sektörün büyüklüğü değil; okul ücretleri, burs imkânları, üniversitenin prestiji, eğitimin kalitesi, yaşanan şehir ve elbette mezuniyet sonrası iş garantisi gibi pek çok dinamik şekillendiriyor.

Anahtar kelimeler: Savunma sanayii, Mühendislik eğitimi, Üniversite tercihi, İnsan kaynağı, Yükseköğretim

MACROECONOMIC TRAJECTORY AND INSTITUTIONAL ADAPTATION: ASSESSING POST-ASSOCIATION AGREEMENT GROWTH PATTERNS IN GEORGIA

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ABSTRACT

This research presents a rigorous empirical examination evaluating the long-term macroeconomic performance and output trajectories of Georgia within the structural framework of European Union associate partner status. Contextualised within the broader dynamics of the Eastern Partnership Initiatives, the investigation critically assesses whether regulatory alignment under the Deep and Comprehensive Free Trade Agreement (DCFTA) serves as an authentic engine of real economic convergence towards European productivity standards, or whether it reinforces structural trade asymmetries.

The structural evaluation demonstrates that while associate status has successfully anchored macroeconomic governance, boosted institutional quality, and reduced sovereign yield spreads, the resulting economic expansion remains unevenly distributed across the real economy. Georgia's observed post-agreement GDP growth relies heavily on non-tradable service sectors, logistics, real estate development, and consumption supported by external financial transfers, rather than a robust expansion of high-value manufacturing or technology-intensive exports. Consequently, structural trade imbalances persist, as domestic producers face lingering non-tariff friction, strict rules-of-origin requirements, and limited capital access when attempting to penetrate the EU Single Market.

When evaluated against regional peers, the findings confirm that regulatory synchronisation alone is insufficient to guarantee structural economic transformation. Although Georgia maintains strong administrative compliance metrics, its growth model remains exposed to external terms-of-trade shocks and persistent domestic supply-side bottlenecks. The paper demonstrates that converting associate integration status into durable income convergence requires a strategic shift in macroeconomic policy: moving beyond passive regulatory adaptation toward active industrial development, targeted human capital cultivation, infrastructure modernisation, and high-yielding domestic capital accumulation strategies designed to build sustainable export competitiveness.
Keywords: Macroeconomic Performance, Economic Convergence, Structural Trade.

EXPERIMENTAL ANALYSIS OF 3D PRINTED MATRIX UNDER TENSILE AND IMPACT LOADING

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ABSTRACT

The mechanical performance of fused-filament-fabricated polymer structures is strongly influenced by internal geometry, infill density, and reinforcement strategy, limiting the reliable selection of lightweight 3D-printed components for load-bearing and energy-absorbing applications. This study experimentally investigates the tensile and impact behaviour of polylactic acid (PLA)-based additively manufactured structures incorporating triangular, hexagonal, and tri-hexagonal internal geometries. Specimens with different infill levels and reinforcement configurations, including glass-fibre and epoxy/glass-fibre systems, were fabricated and mechanically characterised using a universal testing machine under tensile loading and a drop-weight impact testing system. The results demonstrate a pronounced dependence of mechanical performance on cellular geometry, infill density, and reinforcement condition. Under tensile loading, the 100% infill hexagonal PLA/glass-fibre configuration exhibited the highest ultimate tensile stress of 72 MPa, a Young's modulus of 2.88 GPa, and a maximum load of 450 N, outperforming the other investigated geometries. Glass-fibre-reinforced specimens generally exhibited higher tensile strength and stiffness than the corresponding epoxy/glass-fibre configurations, while increasing infill density improved tensile performance. Under impact loading, the triangular-core structure with 10% infill and a 2 mm face sheet achieved the highest absorbed energy of 29.665 J at an impact velocity of 2.801 m/s. Overall, the findings demonstrate that optimisation of cellular architecture can substantially improve the mechanical response of FFF-manufactured PLA composites and that the optimal geometry depends on the loading condition: hexagonal architectures favour tensile stiffness and strength, whereas triangular architectures provide superior impact-energy absorption. These results provide useful design guidance for lightweight, mechanically efficient additively manufactured polymer-composite structures.

Keywords; Fused Filament Fabrication; Polylactic Acid (PLA); Glass Fiber Reinforcement; Lattice Geometry; Tensile Strength; Impact Energy Absorption; Infill Density

IMPACT OF TIME AND COST ON ENGINEERING PROJECT PERFORMANCE: A DATA-DRIVEN ANALYSIS USING PYTHON

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ABSTRACT

Engineering projects play an important role in technological advancement, infrastructure development, and broader economic growth. However, their successful implementation is often influenced by limited resources, the complexity of project activities, and uncertainties related to project schedules and costs. As a result, effective project management is crucial for coordinating these factors and ensuring that projects achieve their intended objectives. Project performance is a key indicator of successful project management, with time and cost being among the most influential determinants of overall project outcomes. Understanding how these key factors influence project performance is therefore essential for improving project planning, management practices, and overall project outcomes. This study investigates the effects of project duration and cost on engineering project performance using quantitative and data-driven approaches. A secondary dataset containing records of engineering projects was analysed using Python-based statistical techniques. Descriptive statistics were employed to summarise the characteristics of the data, followed by Pearson correlation analysis to examine the relationships among the study variables. A multiple linear regression model was then developed to evaluate the combined effects of project duration and cost on project performance and to establish a predictive model. The findings indicate that actual project cost has a moderate positive relationship with project performance, whereas project duration demonstrates a relatively weak negative relationship. The regression model explains approximately 26.9% of the variance in project performance, suggesting that although time and cost contribute to project outcomes, other organisational and managerial factors also influence project success. Overall, the study demonstrates the usefulness of data-driven analytics and regression modelling in supporting project planning, forecasting, and decision-making in engineering project management.

Keywords: Project Performance, Pearson Correlation Analysis, Time Management, Cost Management.

CHITOSAN-DERIVED CARBON DOTS/POLYANILINE-NIS_2 NANOSTRUCTURE FOR ELECTROCHEMICAL WATER SPLITTING

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ABSTRACT

Currently, the global shift towards sustainable hydrogen generation has spurred efforts to develop advanced and active electrocatalysts for water splitting. However, the high cost and scarcity of platinum and iridium-based materials, which have superior catalytic activity for oxygen evolution reaction (OER) and hydrogen evolution reaction (HER), respectively, restrict their widespread application. Here, a systematic doping-dependent nickel disulfide (NiS_2) based nanostructure synthesized through co-precipitation approach to serve as efficient electrocatalyst in alkaline media. Multiple characterizations including XRD, FTIR, and TEM analysis were utilized to confirm the structural, morphological and chemical feautres of NiS_2, PANI-NiS_2, and various concentrations (1 and 3%) of carbon dots incorprated NiS_2.Various concentrations 1 and 3 wt percentage (wt.%) of carbon dots (CDs) and a fixed amount (2 wt%) of polyaniline (PANI) were introduced into NiS_2 to form a ternary electrode system. The optimum amount 3 wt% of CDs/PANI-NiS_2 demonstrated the highest electrocatalytic efficiency. The electrochemical characterization revealed that 3 wt% CDs/PANI-NiS_2 achieved an overpotential of ∼201 mV at a current density of 10 mA cm^{-2} for OER with low Tafel slope of 44 mV dec^{-1}, and ∼115 mV for HER with a Tafel slope of 172 mV dec^{-1}. Moreover ,long-term stability performance of optmizd sample are added which confirmed its applicibaility on industrial scale. The obtained results confirmed that these materails are suitable and good candiate for oxygen evoultion reactiona nd hydrogen evolutuion reaction in 1M KOH. These synergistic results encourage that the optimized concentration of CDs in binary system of fixed amount (PANI-NiS_2), fabricated on Ni-foam showed potential as a promising material for electrochemical water splitting.

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EVALUATING THE ASSOCIATION BETWEEN INTANGIBLE ASSET INVESTMENT AND ENTERPRISE PERFORMANCE: EVIDENCE FROM LISTED VIETNAMESE FIRMS

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ABSTRACT

This study examines the association between accounting-recognized intangible assets and the financial performance of listed non-financial firms in Vietnam over the 2023–2025 period. Annual financial ratios were calculated from audited financial statements and then averaged across the three years to construct one firm-level observation for each sampled company. The descriptive sample comprises 28 firms, while the cross-sectional OLS regressions use 27 complete firm-level observations. Return on assets (ROA) and return on equity (ROE) are employed as measures of profitability, with firm size (SIZE) and financial leverage (LEV) included as controls. The estimated coefficient on the intangible asset ratio (TAI) is negative but statistically insignificant in both the ROA model ($\alpha_1 = -0.5070$; $t = -1.625$) and the ROE model ($\gamma_1 = -0.7599$; $t = -1.670$). Accordingly, neither H1 nor H2 is supported. By contrast, financial leverage is negatively and significantly associated with both ROA ($\alpha_3 = -27.9516$; $p < 0.01$) and ROE ($\gamma_3 = -25.1797$; $p < 0.05$), whereas firm size is positive but statistically insignificant. These findings do not imply that intangible resources lack strategic value. Rather, they indicate that balance-sheet-recognized intangible assets constitute a narrow proxy for the broader intangible resource base emphasized by the Resource-Based View. The results are also consistent with possible recognition constraints and delayed returns on intangible investment, although these mechanisms are not directly identified by the cross-sectional design. The study therefore highlights the need for cautious interpretation of accounting-based intangible asset measures and more informative disclosure of both recognized and unrecognized intangible resources.

Keywords: intangible assets; corporate profitability; Vietnam; ROA; ROE.

UNDERSTANDING FRETTING WEAR AND TRIBOCORROSION IN HEAD-NECK TAPER JUNCTION: A REVIEW OF FINITE ELEMENT MODELING

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Abstract

Fretting corrosion is one of the primary causes of failure in modular total hip replacements and occurs when two contacting surfaces are subjected to small-amplitude oscillatory tangential movement in the presence of body fluids. Wear debris is generated not only at the articulating surface between the femoral head and the acetabular cup but also at the head–neck taper junction. Fine wear debris can be released into the surrounding tissues, potentially leading to pain, hypersensitivity, adverse tissue reactions, and ultimately revision surgery. Therefore, improving the performance of the head–neck taper junction by minimizing the surface damage and debris requires a better understanding of fretting corrosion in this junction. In recent years, finite element (FE) modeling has become an effective tool for investigating the fretting wear in the taper junction. Early studies primarily focused on the mechanical fretting wear because it is probably more straightforward for modeling. More recently, corrosion has also been implemented in the finite element simulations, enabling a more comprehensive assessment of the taper degradation. This paper reviews the finite element (FE) studies investigating the fretting wear and corrosion at the head–neck taper junction, with particular emphasis on the effect of design and loading parameters on the damage mechanisms. Specifically, it examines the effects of assembly load, material combination, femoral head size, neck taper size, angular mismatch, relative position between the centers of the femoral head and the neck taper, and loading direction on the mechanical response (contact pressure, contact area, and micromotion), wear behavior (wear depth, material loss, and wear rate), and fatigue life of the head–neck taper junction.

Keywords: Head-neck taper junction, fretting corrosion, mechanical wear, chemical wear, finite element analysis

NUMERICAL ASSESSMENT OF HEAT EXTRACTION ENHANCEMENT IN PHOTOVOLTAIC–PHASE CHANGE MATERIAL (PV–PCM) COLLECTORS

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Abstract

The thermal management of photovoltaic (PV) modules is essential for maintaining their electrical performance under elevated operating temperatures. In this study, a numerical investigation is conducted to assess the effectiveness of phase change materials (PCMs) in enhancing heat extraction and regulating the operating temperature of photovoltaic–PCM (PV–PCM) collectors. A transient computational model is developed to analyze the coupled thermal behavior of the PV module and PCM layer under realistic operating conditions. The proposed approach enables the evolution of PV temperature, PCM melting fraction, heat storage, and electrical performance to be systematically evaluated over time. Particular attention is given to the interaction between sensible and latent heat transfer mechanisms and their contribution to the thermal regulation of the PV module. The results demonstrate that PCM integration significantly limits the temperature rise of the PV cells by absorbing a considerable portion of the excess thermal energy through latent heat storage. The extent of this thermal regulation depends strongly on the thermophysical properties of the PCM, particularly its melting temperature and latent heat capacity. The reduction in PV operating temperature consequently improves the electrical conversion efficiency compared with the conventional PV configuration. The numerical results highlight the potential of PV–PCM collectors as an effective passive thermal management strategy for reducing PV overheating while simultaneously enhancing energy conversion performance. The findings provide useful insights for the thermal design and optimization of PCM-assisted photovoltaic systems.

Keywords: PVT modules; Energy efficiency; Solar collectors; Nanofluids.

INVESTIGATION OF THE EFFECT OF RELATIVE THICKNESS OF COMPOSITE UAV WINGS ON AERODYNAMIC PERFORMANCE USING SIMULATION METHODS

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Abstract

Advances in microelectronics, Global Positioning Systems (GPS), low-cost sensors, and lithium-ion polymer (LiPo) batteries have propelled unmanned aerial vehicles (UAVs) from military applications into commercial, industrial, agricultural, and forestry sectors. Modern UAVs integrate state-of-the-art technologies to achieve extended flight endurance, wide operational ranges, and high speeds, making them ideal for surveying, mapping, and large-scale environmental monitoring. Key agricultural and forestry applications include crop health assessment, precision pesticide spraying, and forest fire detection. Despite the availability of advanced manufacturing technologies, designing UAVs with cost-effective materials, particularly composites such as fiberglass, remains a key priority. Utilizing composite materials significantly reduces structural weight, improves mechanical strength, and optimizes aerodynamic performance, especially for UAV wings. Driven by these developments, designing and manufacturing low-cost UAVs with stable performance has become increasingly important. Achieving high aerodynamic efficiency requires selecting an optimal wing profile. Therefore, this study employs ANSYS Fluent software to investigate the aerodynamic characteristics of rectangular composite UAV wings with an aspect ratio of 5 across various relative thickness profiles. Numerical simulation results indicate that, at a constant aspect ratio, wings with greater relative thickness exhibit superior aerod dynamic efficiency across varying angles of attack. Specifically, at an angle of attack of 18^0, the lift coefficients for wings with relative thicknesses of 9%, 12%, and 15% are 0.877, 0.971, and 1.091, respectively. These findings offer a practical reference for selecting optimal composite UAV wing configurations tailored to agricultural and forestry applications as well as other fields, ultimately enhancing structural durability, flight maneuverability, and component maintainability, especially facilitating the replacement of damaged wings.

Keywords: UAV, wing, composite materials, relative thickness, lift coefficient, drag coefficient

NUMERICAL INVESTIGATION OF INTERFACE DEFECT DENSITY AND ETL SELECTION IN $BaZrS_3$-BASED SOLAR CELLS USING GZO, SnO_2, AND TiO_2: A SCAPS-1D STUDY

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Abstract

$BaZrS_3$, a promising chalcogenide perovskite, is still the subject of most simulation studies which employ TiO_2 or SnO_2 as the ETL. In this SCAPS-1D simulation work, we investigate the use of Gallium-doped Zinc Oxide (GZO) as an alternative ETL in the device structure FTO/ETL/$BaZrS_3$/$CuSbS_2$ and compare it with TiO_2 and SnO_2. In order to make the simulation more realistic, we included series and shunt resistances of 15 Ω and 500 Ω, respectively, set the optical transmission to 80%, and used a bulk defect density of 10^{16} cm^{-3} in each layer. Under these conditions, the GZO device achieved the highest efficiency at 11.87% (V_{OC} = 1.0845 V, J_{SC} = 16.34 mA/cm^2, FF= 53.60%), outperforming both TiO_2 (10.68%) and SnO_2 (9.60%). We further examined the sensitivity of each device to defects at the ETL/absorber interface by varying the total interface defect density and the electron and hole capture cross-sections. As the interface defect density increased, the efficiency, V_{OC}, J_{SC}, and FF of the GZO device all decreased significantly, whereas those of TiO_2 and SnO_2 remained almost unchanged. This indicates that the GZO/$BaZrS_3$ interface is more susceptible to recombination losses than the other materials. On the other hand, altering the electron and hole capture cross-sections had almost no effect on any of the performance parameters for any of the three ETLs, which means that in this system, defect density is far more important than the capture cross-section when it comes to interface recombination. In conclusion, GZO appears to be a good and efficient choice as an ETL for $BaZrS_3$ solar cells, but its interface must be well passivated if it is to function reliably in practical applications.

Keywords: SCAPS-1D, Chalcogenide Perovskite, Interface Defect, Capture Cross-Section Holes, Capture Cross-Section Electrons

GIDALARDA MİKROPLASTİK VE NANOPLASTİK KONTAMİNASYONU: GÜNCEL DURUM VE GELECEK PERSPEKTİFLERİ

MICROPLASTIC AND NANOPLASTIC CONTAMINATION IN FOODS: CURRENT STATUS AND FUTURE PERSPECTIVES

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ÖZET

Günümüzde dünya nüfusunun hızla artması, plastik ürünlerin üretim ve kullanım miktarlarının da önemli ölçüde yükselmesine neden olmaktadır. Plastik üretimindeki bu artış, çevrede biriken plastik atıkların miktarını artırırken, fiziksel, kimyasal ve biyolojik süreçler sonucunda oluşan mikroplastik ve nanoplastiklerin çevresel kirleticiler arasındaki önemini de giderek artırmaktadır. Çevresel ortamlarda yaygın olarak bulunan bu plastik parçacıklar; tarımsal üretim, sulama, gıda işleme, taşıma, depolama ve ambalajlama gibi gıda zincirinin farklı aşamalarında gıdalara bulaşabilmektedir. Son yıllarda gerçekleştirilen araştırmalar, içme suyu, deniz ürünleri ve çeşitli işlenmiş gıdalarda mikroplastik ve nanoplastiklerin bulunabileceğini ortaya koymuştur. Bu durum, söz konusu parçacıkların insan sağlığı üzerindeki olası etkileri nedeniyle gıda güvenliği ve halk sağlığı açısından önemli bir araştırma konusu haline gelmiştir. Bu çalışmada, gıdalarda mikroplastik ve nanoplastik kontaminasyonunun başlıca kaynakları, bulaşma yolları, çevresel ve gıda işleme süreçlerindeki oluşum mekanizmaları ile tespit ve analiz yöntemleri güncel literatür doğrultusunda değerlendirilmektedir. Ayrıca, bu parçacıkların insan sağlığı üzerindeki potansiyel etkileri daha geniş bir bağlamda ele alınmakta ve özellikle genel sağlık ve refah üzerindeki olası etkilerine vurgu yapılmaktadır. Gelecekte daha hassas ve güvenilir analiz tekniklerinin geliştirilmesi, standart örnekleme ve analiz metodolojilerinin oluşturulması, risk değerlendirme yaklaşımlarının güçlendirilmesi ve sürdürülebilir plastik kullanımının teşvik edilmesi büyük önem taşımaktadır. Mikroplastik ve nanoplastiklerin gıda güvenliği açısından oluşturduğu risklerin kapsamlı biçimde anlaşılması için disiplinler arası çalışmaların artırılması ve uluslararası düzeyde ortak standartların geliştirilmesi gerekmektedir.

Anahtar kelimeler: Plastik, Mikroplastik, Nanoplastik, Gıda Kontaminasyonu, Gıda Güvenliği, Çevre Kirliliği, İnsan Sağlığı.

ABSTRACT

In recent decades, the rapid growth of the world population has led to a significant increase in the production and use of plastic products. This increase in plastic production has resulted in a growing accumulation of plastic waste in the environment, while microplastics and nanoplastics formed through physical, chemical, and biological processes have become increasingly important environmental pollutants. These plastic particles, which are widely distributed in environmental compartments, can enter food at various stages of the food chain, including agricultural production, irrigation, food processing, transportation, storage, and packaging. Recent studies have demonstrated the presence of microplastics and nanoplastics in drinking water, seafood, and various processed foods. This situation has become an important concern for food safety and public health due to the potential effects of these particles on human health. This review evaluates the major sources and pathways of microplastic and nanoplastic contamination in food, their formation mechanisms during environmental and food-processing processes, and current detection and analytical methods based on the recent literature. Furthermore, the potential effects of these particles on human health are discussed in a broader context, with particular emphasis on their possible implications for overall health and well-being. In the future, the development of more sensitive and reliable analytical techniques, the establishment of standardized sampling and analytical methodologies, the improvement of risk assessment approaches, and the

promotion of sustainable plastic use will be of great importance. A better understanding of the risks posed by microplastics and nanoplastics to food safety requires increased interdisciplinary research and the development of internationally harmonized standards.

Keywords: Plastics, microplastics, nanoplastics, food contamination, food safety, environmental pollution, human health.

ET ÜRÜNLERİNDE AKRİLAMİD VARLIĞI: PİŞİRME VE SAĞLIK RİSKİ

PRESENCE OF ACRYLAMIDE IN MEAT PRODUCTS: COOKING AND HEALTH RISKS

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ÖZET

Gıdalar, yaşamın sürdürülebilmesi, büyümenin, gelişmenin ve vücut fonksiyonlarının düzenli olarak yerine getirilebilmesi için gereken enerji ve besin öğelerini sağlayan en temel hayati unsurlardır. Et ve et ürünleri besinsel içeriği ile ön plana çıkdan önemli gıdalardan biridir. Makro ve mikro bileşenler açısından oldukça zengin olan et ve et ürünleri genellikle tüketimden önce pişirme işlemi uygulanmaktadır. Nitekim pişirme işlemi ile birlikte insan sağlığı açısından risk teşkil eden bileşiklerin oluşumu söz konusudur. Akrilamid, karbonhidrat açısından zengin gıdaların yüksek sıcaklıkta işleme sırasında oluşan ve potansiyel kanserojen, nörotoksik ve genotoksik etkileri nedeniyle önemli endişeler yaratan, ısıya bağlı bir kirleticidir. Akrilamid oluşumu çoğunlukla patates ve tahıl bazlı ürünlerle ilişkilendirilmekle birlikte, yüksek sıcaklıklarda işlenen ve pişirilen bazı et ve et ürünlerinde de oluşabileceği bildirilmektedir. Et ürünlerinde akrilamid oluşumu; ürünün bileşimi, serbest amino asit ve indirgen şeker içeriği, pH, nem düzeyi, pişirme sıcaklığı, işlem süresi ve uygulanan ısıl işlem yöntemine bağlı olarak değişiklik gösterebilmektedir. Özellikle kızartma, ızgara ve yüksek sıcaklıkta fırınlama gibi işlemler, akrilamid oluşumunu artırabilecek kritik faktörler arasında değerlendirilmektedir. Bu çalışmada, et ve et ürünlerinde akrilamid oluşumunun kimyasal ve teknolojik mekanizmaları, oluşumu etkileyen ürün özellikleri ve farklı pişirme koşullarının akrilamid düzeyleri üzerindeki etkileri güncel literatür doğrultusunda ele alınmaktadır. Ayrıca akrilamidin maruziyetin halk sağlığı açısından taşıdığı olası riskler, düşük sıcaklıkta ve kontrollü pişirme, pişirme süresinin optimize edilmesi, uygun ön işlemler, marinasyon ve doğal antioksidan kullanımı gibi akrilamid oluşumunu azaltmaya yönelik stratejiler değerlendirilmektedir.

Anahtar kelimeler: Gıda, Et ve et ürünleri, akrilamid, sağlık

ABSTRACT

Foods are the most fundamental vital elements, providing the energy and nutrients necessary for sustaining life, growth, development, and the proper functioning of bodily processes. Meat and meat products are important food commodities that stand out due to their nutritional value. Being rich in both macro- and micronutrients, meat and meat products are generally subjected to cooking processes before consumption. However, cooking may also lead to the formation of compounds that pose potential risks to human health. Acrylamide is a heat-related contaminant that forms during high-temperature processing, particularly in carbohydrate-rich foods, and raises significant concerns due to its potential carcinogenic, neurotoxic, and genotoxic effects. Although acrylamide formation is primarily associated with potato- and cereal-based products, its formation has also been reported in certain meat and meat products processed and cooked at high temperatures. The formation of acrylamide in meat products may vary depending on product composition, free amino acid and reducing sugar contents, pH, moisture level, cooking temperature, processing time, and the applied thermal processing method. In particular, processes such as frying, grilling, and high-temperature baking are considered critical factors that may promote acrylamide formation. In this study, the chemical and technological mechanisms underlying acrylamide formation in meat and meat products, the product characteristics affecting its formation, and the effects of different cooking conditions on acrylamide levels are discussed in light of the current literature. Furthermore, the potential public health risks associated with acrylamide exposure, as well as strategies for reducing acrylamide formation, including low-temperature and controlled cooking,

optimization of cooking time, appropriate pretreatments, marination, and the use of natural antioxidants, are evaluated.

Keywords: Food, Meat and meat products, Acrylamide, Health

PERFORMANCE-GOVERNED DEFECT PHYSICS AND THERMAL DYNAMICS IN $AGBIS_2/CEO_x/CUI$ HETEROJUNCTION SOLAR CELLS

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Abstract

Lead-based perovskites, CdTe, and scarce CIGS absorbers have propelled thin-film photovoltaics but face toxicity and supply constraints. offers a sustainable alternative with a tunable ~1.4 eV bandgap, ultra-high absorption (10^5-10^6 cm^{-1}), and defect tolerance—achieving >11% efficiency with theoretical limits near 26%. The judicious selection of CeO_x and CuI enables a favorable type-II band alignment at both contacts, with CeO_x providing a large conduction band offset to effectively block holes and CuI offering a deep valence band level to efficiently extract holes while mitigating interface recombination, thereby complementing the inherent defect tolerance of $AgBiS_2$. In this work, a comprehensive numerical simulation of an FTO/CeO_X/$AgBiS_2$/CuI solar cell is conducted using SCAPS-1D. The reference device demonstrates an open-circuit voltage (V_{OC}) of 1.0088 V, a short-circuit current density (J_{SC}) of 30.94 mA/cm^2 , a fill factor (FF) of 79.96%, and a power conversion efficiency (PCE) of 24.96%. Device analysis shows that increasing the absorber bulk defect density from 10^{12} to 10^{16} cm^{-3} markedly degrades V_{OC}, FF , and PCE, whereas HTL bulk defects have a negligible effect. Severe recombination losses occur due to interfacial trap states at both transport layer heterojunctions, while elevated temperatures (290–450 K) primarily diminish V_{OC}. Spectral analysis of the quantum efficiency reveals an absorption onset at approximately 400 nm—rather than 300 nm, which is consistent with the optical bandgap of $AgBiS_2$—and maintains a broad response extending up to 890 nm, confirming effective carrier collection over the primary absorption region.Our results confirm $AgBIs_2$ as a viable Pb-free rival to CdTe/CIGS, where performance is governed by defect-assisted recombination and interfacial energy alignment, underscoring its promise for next-generation eco-friendly photovoltaics.

Keywords: $AgBiS_2$, Heterojunction solar cells, SCAPS-1D, Interface recombination, Defect dynamics, Thermal dependence

THERMOMECHANICAL FATIGUE RESPONSE OF ADDITIVELY MANUFACTURED CARBON/ONYX COMPOSITES WITH DIRECTLY PRINTED AND DRILLED HOLES

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ABSTRACT

Additive manufacturing of continuous-fiber-reinforced thermoplastic composites offers new opportunities for integrating functional features such as holes directly during fabrication, thereby avoiding secondary machining operations. However, the influence of hole-generation strategy on fatigue-related thermomechanical behavior remains insufficiently understood. This study investigates the stepwise cyclic self-heating and mechanical degradation of continuous-carbon-fiber/Onyx composites containing no hole, conventionally drilled holes, and directly printed holes. Tension–tension cyclic tests were performed from 30% to 80% of the corresponding ultimate tensile force using 5% load increments, 10,000 cycles per step, a frequency of 5 Hz, and a load ratio of R=0.1. Temperature evolution was monitored using contact thermocouples and infrared measurements, while apparent cyclic stiffness was determined from the machine force–displacement response. The stabilized temperature rise increased progressively with loading level for all configurations. Bilinear analysis yielded thermographic transition loads of approximately 50.1%, 59.9%, and 74.3% of Fu for the no-hole, printed-hole, and drilled-hole configurations, respectively. Above 65% of Fu, the printed-hole specimens exhibited, on average, approximately 24% greater stabilized self-heating than the drilled specimens. This stronger thermal response was accompanied by an apparent stiffness reduction of approximately 3.1%, compared with 1.1% for drilled holes. These results demonstrate that hole-generation strategy significantly influences cyclic energy dissipation and thermomechanical degradation, with conventionally drilled specimens exhibiting the more stable high-load cyclic response under the investigated conditions.

Keywords: Additive manufacturing, Continuous Carbon Fiber, Stepwise fatigue, Self-heating, Open-hole composites, Thermography

PHYSICOCHEMICAL AND TEXTURAL PROPERTIES OF DEEP-FRIED CHICKEN NUGGETS AS AFFECTED BY WHEAT SUBSTITUTION WITH CORN-BRAN IN BATTER

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Abstract

This study evaluated the effect of substituting wheat flour with corn-bran flour in the batter formulation on the physicochemical and textural properties of deep-fried chicken nuggets. The wheat flour in the batter was substituted with corn-bran flour at different levels using simplex lattice mixture design. The batter constituted a total of 3 g flour (wheat and corn-bran) and water.

The nuggets were analysed for moisture content, fat content, colour attributes, and texture profile properties using standard laboratory procedures. Data obtained were subjected to ANOVA. The inclusion of corn-bran flour in the batter significantly ($p<0.05$) affected the quality attributes of the chicken nuggets. Moisture and fat contents ranged from 54.33-64.76% and 6.56-7.82%, respectively. Hardness, adhesiveness, springiness, cohesiveness, gumminess and chewiness values ranged from 38.87 - 66.36 N, -0.084 - 0.953 N.S, 0.809 - 0.903, 0.694 - 0.809, 18.68 - 41.29 N and 15.59 - 38.89 N, respectively. Increasing corn-bran inclusion improved moisture retention and reduced fat content, while also increasing product firmness and chewiness. The results indicate that corn-bran flour can be used as a functional batter ingredient for producing lower-fat deep-fried chicken nuggets. Thus, wheat flour substituted with corn-bran flour at 0.75 g and 2.25 g, respectively in batter formation is recommended for producing low-fat and physically acceptable chicken nuggets.

Keywords: Chicken Nugget, Corn-bran, Batter Formulation, Deep-fat frying

"NUMERICAL OPTIMIZATION OF FTO/TiO_2/$AgBiS_2$/Spiro-OMeTAD SOLAR CELLS: ASSESSING THICKNESS, THERMAL, AND RESISTIVE PARAMETER EFFECTS"

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Abstract

The development of sustainable photovoltaic technologies requires the replacement of toxic and scarce absorber materials with environmentally friendly alternatives. Silver bismuth sulfide ($AgBiS_2$) has emerged as a promising lead-free absorber. Its photovoltaic performance strongly depends on the careful optimization of device parameters. In this study, an FTO/TiO_2/$AgBiS_2$/Spiro-OMeTAD heterojunction solar cell was developed and analyzed using the SCAPS-1D simulation tool. Four key parameters were systematically investigated absorber layer thickness (0.3–1.5 µm), operating temperature (300–450 K), shunt resistance (Rsh: 10–10^5 Ω·cm²), and series resistance (Rs: 5–25 Ω·cm²). The simulated current-voltage characteristics show that an absorber thickness of approximately 0.5–0.8 µm provides the most favorable performance. A thinner layer of 0.3 µm results in insufficient light absorption, while increasing the thickness beyond 1.0 µm increases bulk recombination and leads to reductions in the fill factor and open-circuit voltage. Temperature analysis indicates that increasing the operating temperature from 300 K to 450 K causes a continuous decrease in open-circuit voltage, highlighting the importance of effective thermal management. The shunt resistance analysis shows that low Rsh values, particularly below 10^3 Ω·cm², increase leakage currents and negatively affect device performance. Maintaining Rsh above 10^4 Ω·cm² is therefore important for minimizing leakage and maintaining proper device operation. Similarly, increasing the series resistance produces greater resistive losses, with values above 5 Ω·cm² causing noticeable reductions in fill factor and overall efficiency. These results provide practical parameter ranges for the design and optimization of $AgBiS_2$-based solar cells. Also, the study demonstrates that the TiO_2/Spiro-OMeTAD charge transport structure, combined with optimized absorber thickness, effective thermal management, and controlled parasitic resistances. This can significantly improve the performance of $AgBiS_2$ photovoltaic devices and support their potential as environmentally safer alternatives to lead-based thin-film solar technologies.

Keywords: absorber thickness optimization, SCAPS-1D, temperature dependence, series resistance, shunt resistance, lead-free photovoltaics

COMPUTATION OF RELATIVE HUMIDITY AND TEMPERATURE IN A CABINET SOLAR DRYER USING SENSIBLE MATERIALS

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ABSTRACT

This study investigated the variation in temperature and relative humidity in a cabinet solar dryer integrated with a sensible-heat storage material, specifically painted black granite stones, during the drying of jute mallow leaves (Corchorus olitorius). The aim was to evaluate the thermal performance of the dryer and its effect on drying rate and moisture removal. A cabinet solar dryer fitted with tinted glass and granite stones as heat storage media was constructed to stabilize drying conditions. Jute mallow samples were dried in the cabinet dryer, while an oven dryer served as a reference for moisture determination. Temperature, relative humidity, and weight loss were recorded hourly from 8:00 am to 11:00 pm across five drying trials. Results showed that the cabinet solar dryer maintained internal temperatures of 60–65°C, significantly higher than ambient temperatures of 28–35°C. The incorporation of granite stones reduced temperature fluctuations by approximately 15–20% compared to a conventional cabinet dryer. Relative humidity inside the drying chamber decreased from about 70–75% to 30–35% during active drying, creating favorable conditions for moisture removal. Drying rates were highest during midday, achieving 30–40% cumulative moisture loss within 6–9 hours under favorable solar radiation. The dryer also retained heat for 3–4 hours after sunset, maintaining temperatures above 35°C and supporting continued drying. Moisture content was reduced from about 72% (wet basis) to below 14% within 18–24 hours. The study demonstrates that granite stones improve heat retention, stabilize humidity, and enhance drying efficiency in cabinet solar dryers for small-scale agricultural applications

Keywords: Cabinet dryer, Temperature, Relative humidity, Sensible materials, Drying, Moisture content

EVALUATING THE ASSOCIATION BETWEEN INTANGIBLE ASSET INVESTMENT AND ENTERPRISE PERFORMANCE: EVIDENCE FROM LISTED VIETNAMESE FIRMS

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ABSTRACT

This study examines the association between accounting-recognized intangible assets and the financial performance of listed non-financial firms in Vietnam over the 2023–2025 period. Annual financial ratios were calculated from audited financial statements and then averaged across the three years to construct one firm-level observation for each sampled company. The descriptive sample comprises 28 firms, while the cross-sectional OLS regressions use 27 complete firm-level observations. Return on assets (ROA) and return on equity (ROE) are employed as measures of profitability, with firm size (SIZE) and financial leverage (LEV) included as controls. The estimated coefficient on the intangible asset ratio (TAI) is negative but statistically insignificant in both the ROA model ($\alpha_1 = -0.5070$; $t = -1.625$) and the ROE model ($\gamma_1 = -0.7599$; $t = -1.670$). Accordingly, neither H1 nor H2 is supported. By contrast, financial leverage is negatively and significantly associated with both ROA ($\alpha_3 = -27.9516$; $p < 0.01$) and ROE ($\gamma_3 = -25.1797$; $p < 0.05$), whereas firm size is positive but statistically insignificant. These findings do not imply that intangible resources lack strategic value. Rather, they indicate that balance-sheet-recognized intangible assets constitute a narrow proxy for the broader intangible resource base emphasized by the Resource-Based View. The results are also consistent with possible recognition constraints and delayed returns on intangible investment, although these mechanisms are not directly identified by the cross-sectional design. The study therefore highlights the need for cautious interpretation of accounting-based intangible asset measures and more informative disclosure of both recognized and unrecognized intangible resources.

Keywords: intangible assets; corporate profitability; Vietnam; ROA; ROE.

PHASE SHIFT CARRIER-BASED PULSE WIDTH MODULATION TECHNIQUE FOR MODULAR MULTILEVEL CONVERTER IN INDUSTRIAL MOTOR DRIVE APPLICATIONS

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Abstract:

This article presents a comprehensive investigation of a Phase Shift Carrier-Based Pulse Width Modulation (PSC-PWM) strategy tailored for Modular Multilevel Converter (MMC) systems driving induction motors, with the objective of enhancing voltage waveform quality, reducing harmonic distortion, and improving dynamic performance in medium- to high-power industrial drives. The novelty of this work lies in the application of a finely tuned PSC-PWM scheme that introduces phase-shifted triangular carrier signals across individual sub-modules of the MMC to effectively increase the equivalent switching frequency without raising the actual switching frequency of each power device, thereby minimizing switching losses while significantly improving output waveform quality. The methodology involves mathematical modelling and simulation of the MMC topology integrated with an induction motor load, where the PSC-PWM technique is employed to control the voltage output of each sub-module. The proposed control strategy is benchmarked against conventional sinusoidal PWM and nearest level control techniques under identical operating conditions to assess performance in terms of Total Harmonic Distortion (THD), switching frequency effects, and torque response. Findings from simulation studies and experimental validation on PSC-PWM technique leads to a substantial reduction in THD, improved voltage balancing among sub-modules, and smoother torque profiles in the motor, even under dynamic load conditions.

Keywords: Power electronics, Modular multilevel converter.

METHYLENE BLUE REMOVAL FROM WASTEWATER USING A HIGH-PERFORMANCE WASTE-DERIVED ADSORBENT

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ABSTRACT

The growing demand for efficient and sustainable water treatment technologies has intensified interest in converting industrial solid waste into value-added functional materials. In this work, an industrial by-product was upcycled into a high-efficiency adsorbent through a chemical activation route, aiming to enhance surface functionality and adsorption performance. The physicochemical properties of the treated material were characterized using XRD, FTIR, SEM and XRF analyses, confirming the development of a more porous structure and the introduction of active surface sites favorable for pollutant capture.

Adsorption experiments were carried out using representative organic pollutants commonly found in contaminated effluents. The treated material exhibited significantly improved adsorption capacities compared to the raw precursor, with rapid uptake kinetics and strong affinity toward persistent contaminants. The effects of pH, contact time, initial concentration, and temperature were also investigated to elucidate the adsorption mechanisms involved.

The results demonstrate that converting industrial waste into functionalized adsorbents offers a promising, low-cost and environmentally responsible alternative for sustainable water treatment. This research highlights the potential of waste-derived materials to contribute to circular economy strategies while providing efficient solutions for pollutant removal.

Keywords: industrial waste valorization; adsorption; chemical activation; water treatment; functional materials.

A HYBRID $CdMn_2O_4$/PANI COMPOSITE ELECTROCATALYST FOR ENHANCED OXYGEN EVOLUTION REACTION

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Abstract

The rapid depletion of fossil fuels and the environmental pollution associated with the large-scale utilization of conventional energy resources have created an urgent need for sustainable and renewable energy sources. Electrochemical water splitting is considered a promising approach for sustainable hydrogen production, in which efficient electrocatalysts play a crucial role in improving the reaction kinetics. In this study, a $CdMn_2O_4$/PANI composite was synthesized through a hydrothermal technique and investigated as an electrocatalyst for the oxygen evolution reaction (OER). The structural and morphological characteristics of the prepared composite were evaluated, while scanning electron microscopy revealed an aggregated surface morphology. Thermogravimetric analysis was also performed to investigate the thermal stability of the composite. The electrochemical performance of the $CdMn_2O_4$/PANI composite was evaluated in an alkaline KOH electrolyte. The composite demonstrated a low overpotential of 244 mV at 10 mA cm^{-2}, indicating favorable OER activity. Furthermore, a Tafel slope of 82.6 mV dec^{-1} demonstrated improved reaction kinetics and efficient electron transport. The enhanced OER performance of the $CdMn_2O_4$/PANI composite can be attributed to its increased surface area and improved electrical conductivity resulting from the incorporation of polyaniline. These findings demonstrate the potential of the $CdMn_2O_4$/PANI composite as an efficient and durable electrocatalyst for alkaline water oxidation and sustainable energy applications.

Keywords: $CdMn_2O_4$/PANI, oxygen evolution reaction, electrocatalyst, hydrothermal synthesis, water splitting, alkaline medium

DIFFERENTIAL PHOTOCALORIMETRY: A PAST ENGINEERING TECHNIQUE THAT REMAINS RELEVANT TODAY

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ABSTRACT

In the 1980s, IBM (International Business Machines) manufactured the most powerful computers of the time at its Endicott facility (Broome County): the IBM 308X series (e.g., 3081, 3083, 3084) for large enterprises and the IBM 4381 (4300 Series) for medium-sized businesses. These high-end mainframe systems utilized pioneering LSI (large-scale integration) technology and thermally conductive (water-cooled) MCM (multi-chip module) modules.

To manufacture printed circuit boards (PCBs) [1] with lines as wide as a strand of hair (today, with ULSI integrated circuits, production has reached 10 nm and research has reached 0.1 nm or even less), a photolithography process was used, specifically resins from the RISTON family, which are dry film negative photoresists (crosslinking under UV exposure). This photoresist was laminated onto a copper plate and then exposed to UV light using a mask that defined the printed circuit (following exposure, etching, and stripping of the photoresist). During the photolithography process, the portion exposed to light cross-linked, while the unexposed portion was easily dissolved by a solvent, methyl chloroform (**MCF**).

The optimization of the photosensitive layers used was achieved through a technique developed on-site : the emerging field of photocalorimetry [2], the principles of which we outline here, along with its advantages and the numerous applications that were subsequently developed in fields as diverse as UV coatings, dental resins, stealth technology, Additive manufacturing 3D, UV uring of high-performance resins, polyimides, BMIs, and more.

Keywords : Photocalorimetry, UV coatings, Kinetics, Optimization of UV curing.

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**IBM no longer has a physical presence in Endicott, New York. The company ended its final local office lease at 1701 North Street in October 2023, concluding nearly a century of operations in its historical birthplace. The former manufacturing and office complex has since been undergoing total demolition to clear the site for future redevelopment.*

ARYLATION OF SYMMETRIC BIS(4-BROMOPHENYL) SCHIFF BASE *VIA* SUZUKI COUPLING REACTION AND THEIR BIOACTIVITY PROFILING

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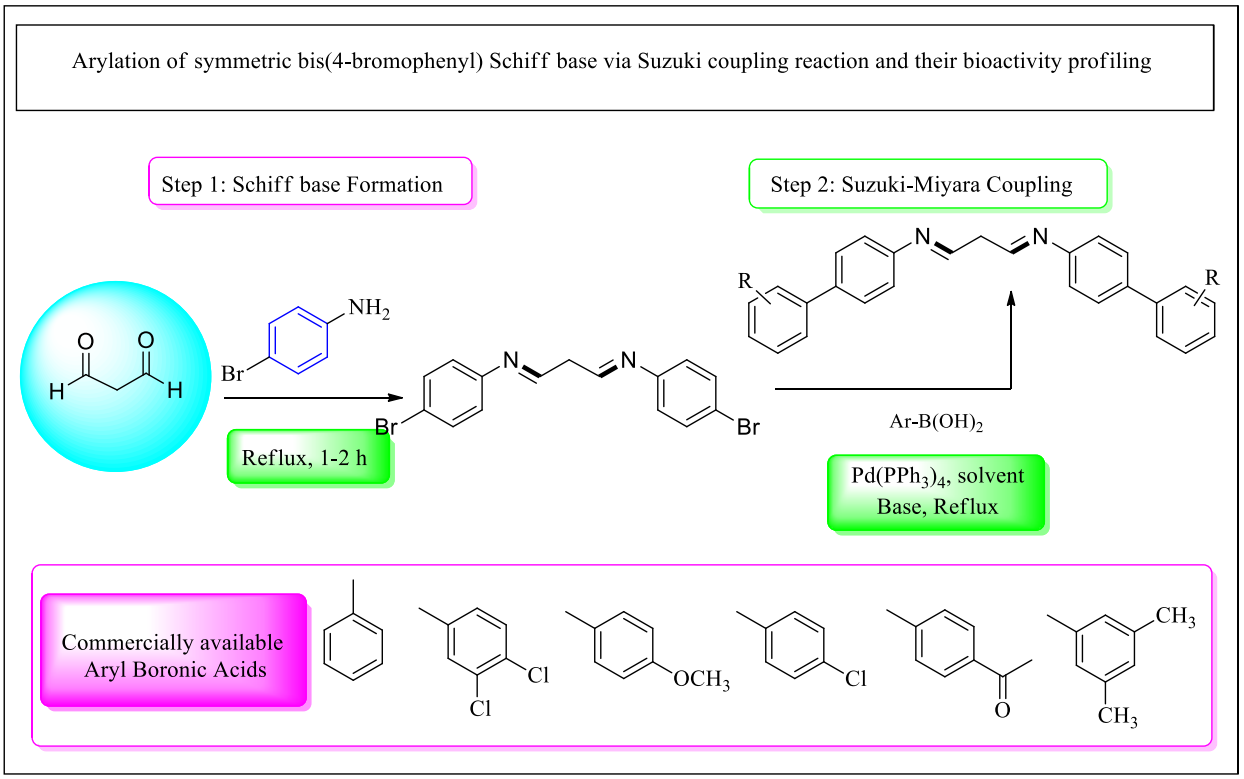
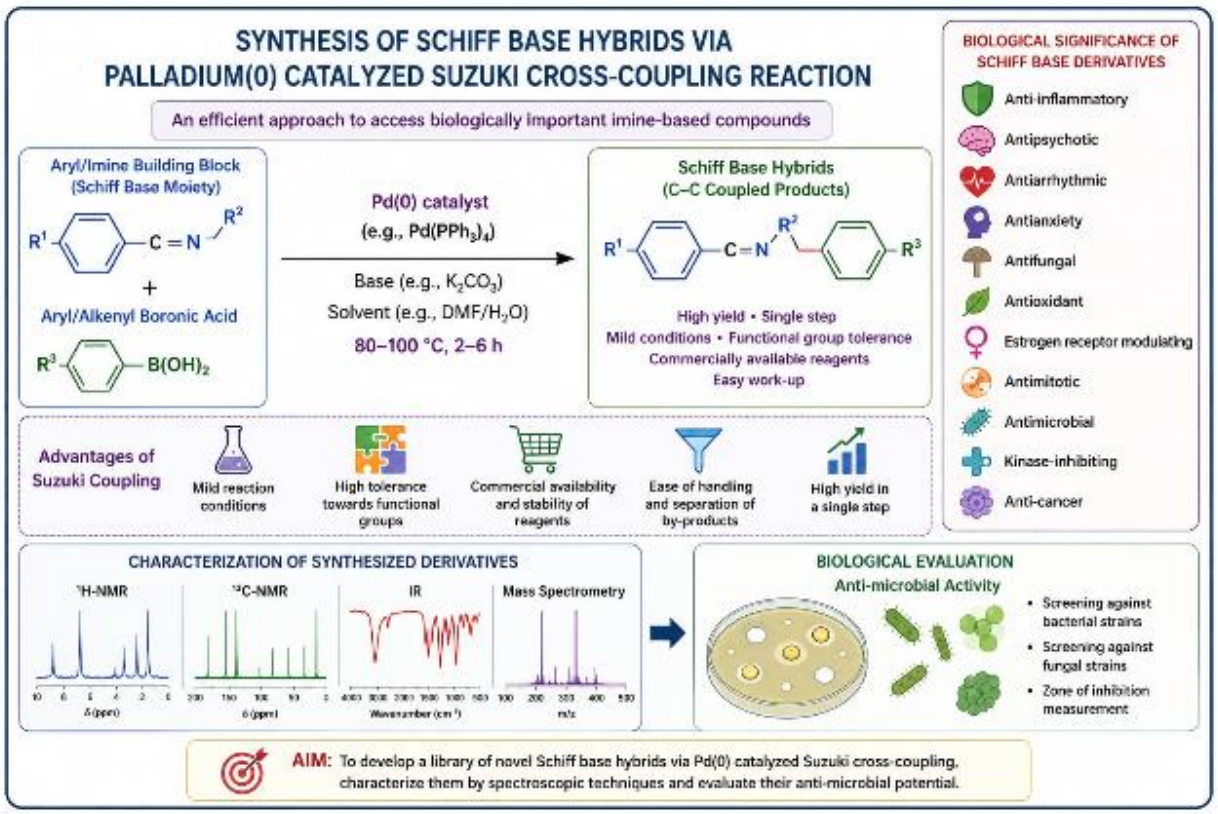
ABSTRACT

Schiff base derivatives have a significant role in the pharmaceutical industry as anti- inflammatory, antipsychotic, antiarrhythmic, antianxiety, antifungal, antioxidant, estrogen receptor modulating, antimitotic, antimicrobial, kinase-inhibiting, and anti-cancer. These derivatives have been synthesized *via* different methodologies. Among these various new synthetic methods that have been developed for the synthesis of Schiff base derivatives, Suzuki cross-coupling reaction is an easy way to build a carbon-carbon bond in synthesizing organic compounds as it gives a high yield in a single step and has advantages over other reactions due to mild conditions, high tolerance towards functional groups, the commercial availability and stability of its reagents, and the ease of handling and separating by-products from its reaction mixtures. So keeping in view the importance of imine-based compounds, we have planned to synthesize Schiff base hybrids through a palladium (0) catalyzed Suzuki cross-coupling reaction. All the synthesized derivatives will be characterized by using spectroscopic techniques such as ^{13}C-NMR, ^{1}H-NMR, IR, and mass spectrometry, and their anti-microbial activities will also be checked.




SYNTHESIS OF SCHIFF BASE HYBRIDS VIA
PALLADIUM(0) CATALYZED SUZUKI CROSS-COUPLING REACTION
An efficient approach to access biologically important imine-based compounds
Aryl/Imine Building Block
(Schiff Base Moiety)
Aryl/Alkenyl Boronic Acid
Pd(0) catalyst
(e.g., Pd(PPh3)4)
Base (e.g., K2CO3)
Solvent (e.g., DMF/H2O)
80–100 °C, 2–6 h
Schiff Base Hybrids
(C–C Coupled Products)
High yield • Single step
Mild conditions • Functional group tolerance
Commercially available reagents
Easy work-up
BIOLOGICAL SIGNIFICANCE OF SCHIFF BASE DERIVATIVES
Anti-inflammatory
Antipsychotic
Antiarrhythmic
Antianxiety
Antifungal
Antioxidant
Estrogen receptor modulating
Antimitotic
Antimicrobial
Kinase-inhibiting
Anti-cancer
Advantages of Suzuki Coupling
Mild reaction conditions
High tolerance towards functional groups
Commercial availability and stability of reagents
Ease of handling and separation of by-products
High yield in a single step
CHARACTERIZATION OF SYNTHESIZED DERIVATIVES
¹H-NMR
¹³C-NMR
IR
Mass Spectrometry
BIOLOGICAL EVALUATION
Anti-microbial Activity
Screening against bacterial strains
Screening against fungal strains
Zone of inhibition measurement
AIM: To develop a library of novel Schiff base hybrids via Pd(0) catalyzed Suzuki cross-coupling, characterize them by spectroscopic techniques and evaluate their anti-microbial potential.

SYNTHESIS OF BIOACTIVE FURAN BASED COMPOUNDS *VIA* SUZUKI CROSS COUPLING REACTION

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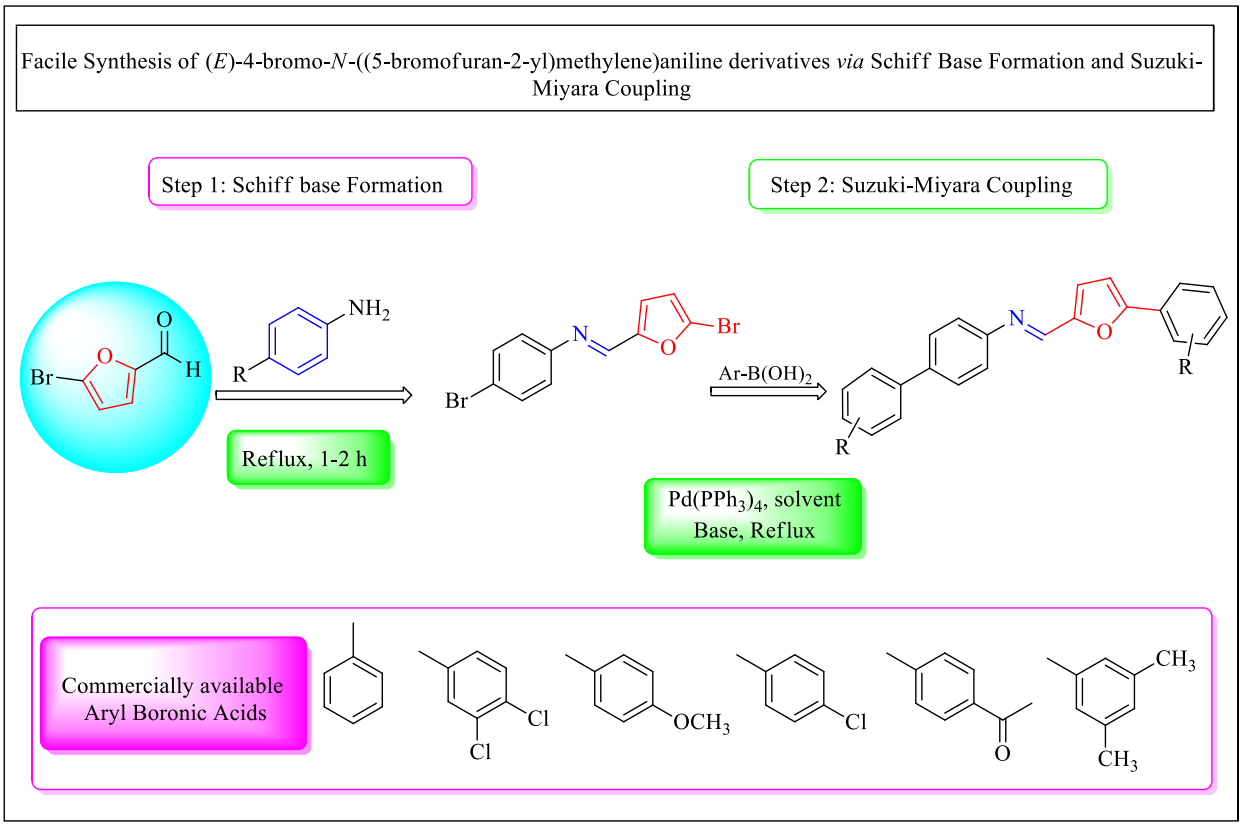
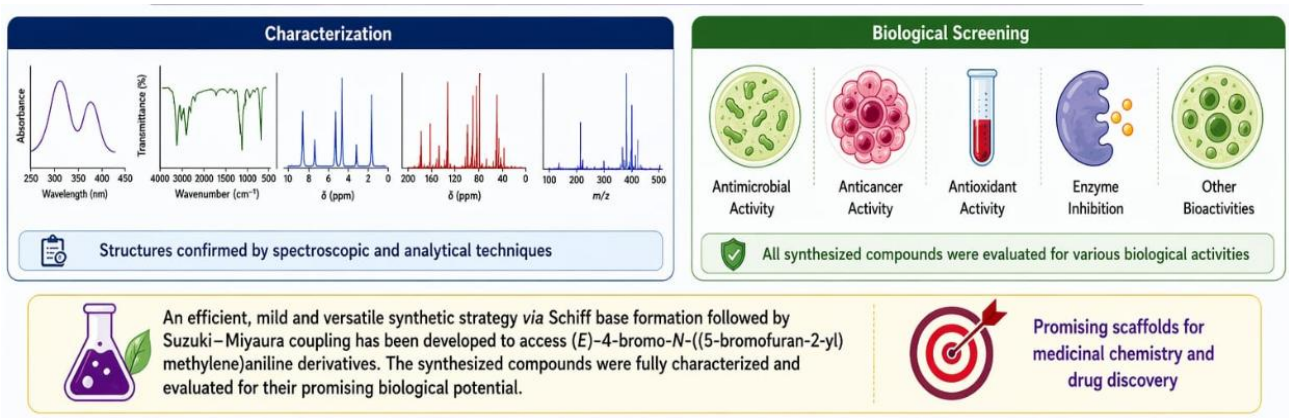
ABSTRACT

Suzuki-Miyaura coupling reaction can be considered a very effective method towards *C-C* bond formation owing to their stability, selective nature and wide range. It has been found favorable compared with other couplings due to milder reactions condition, good resistance towards various functionalities available easily which are also quite reactive hence easy separation products. A facile and milder synthesis method has been reported to synthesize (*E*)-4-bromo-*N*-((5-bromofuran-2-yl)methylene)aniline derivatives. Firstly, the desired Schiff base was synthesized by reacting furan aldehydes and suitable primary amines. Concurrently with this work Suzuki-Miyaura coupling reaction was carried out of several readily accessible commercial aryl boronic acids to obtain corresponding products. Various analytical methods such as UV-Visible spectra, FTIR spectrum, ^{1}H NMR, ^{13}C NMR and mass spectroscopies have been employed for characterizing prepared molecules. Also, all the synthesized compounds were screened to assess their biological potential.




Characterization
Absorbance
Wavelength (nm)
Transmittance (%)
Wavenumber (cm⁻¹)
δ (ppm)
δ (ppm)
m/z
Structures confirmed by spectroscopic and analytical techniques
Biological Screening
Antimicrobial Activity
Anticancer Activity
Antioxidant Activity
Enzyme Inhibition
Other Bioactivities
All synthesized compounds were evaluated for various biological activities
An efficient, mild and versatile synthetic strategy via Schiff base formation followed by Suzuki–Miyaura coupling has been developed to access (E)-4-bromo-N-((5-bromofuran-2-yl) methylene)aniline derivatives. The synthesized compounds were fully characterized and evaluated for their promising biological potential.
Promising scaffolds for medicinal chemistry and drug discovery

QUANTUM TELEPORTATION AND ENTANGLEMENT VIA QUANTUM CHANNELS IN BIMETALLIC FE_2CU_2 BASED ON SPIN-1/2 ISING-HEISENBERG CHAIN MODEL

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Abstract

This paper investigates quantum teleportation and entanglement in polymeric bimetallic Fe_2Cu_2 coordination compounds, employing the exactly solvable spin-1/2 Ising-Heisenberg model. Using the transfer-matrix method, we systematically analyze how the anisotropy parameter Δ affects quantum entanglement and teleportation fidelity through Heisenberg spin dimers functioning as quantum channels. Additionally, we analytically calculate the channel concurrence, output state concurrence, formation entanglement, fidelity, and average fidelity as functions of temperature, magnetic field, and anisotropy for different input states, with comprehensive thermomagnetic phase diagrams identifying regions of quantum advantage. Our analysis reveals that Δ governs the fundamental balance between entanglement capacity and magnetic thermal robustness. Consequently, the strongly anisotropic regime is very stable, retaining quantum advantage even at high temperatures and strong magnetic fields due to improved longitudinal correlations, whereas the isotropic case reaches the best teleportation fidelity at low temperatures and weak fields. The results indicate demonstrate that maximally entangled input states consistently outperform partially entangled states. These findings establish that magnetic coordination polymers with tunable anisotropy constitute promising platforms for quantum communication applications, offering a balance between operational fidelity and environmental robustness.

EVALUATING THE EDUCATIONAL AND GEOTOURISM POTENTIAL OF GEOSITES IN SEMI-ARID MOROCCO: THE ERRACHIDIA REGION AS A CASE STUDY

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Abstract

Geosites are increasingly recognized not only for their scientific importance but also for their potential to support geoscience education, geotourism, and local sustainable development. The Errachidia region of southeastern Morocco contains a remarkable diversity of geological and geomorphological features that offer important opportunities for educational and tourism-oriented use. This study proposes an assessment approach focused on evaluating the educational and geotourism potential of geosites, while considering their accessibility, scientific significance, attractiveness, and vulnerability. The assessment builds on quantitative geosite evaluation principles and integrates criteria related to the capacity of each site to communicate geological and geomorphological features to different audiences. Educational evaluation considers the clarity and diversity of geological features, their potential for field-based learning, and their suitability for interpretation and scientific communication. Geotourism evaluation considers accessibility, landscape and aesthetic interest, tourism potential, visitor experience, and the possibility of integrating sites into geotouristic routes. These dimensions are considered alongside vulnerability and existing conservation measures to ensure that increased visitation does not compromise the integrity of geosites. Field observations and spatial analysis using GIS and remote sensing provide complementary information for evaluating site characteristics and accessibility. The proposed framework aims to identify geosites with high educational and geotourism potential and to support their integration into sustainable educational programs and geotourism strategies. The approach may contribute to enhancing the visibility and sustainable use of the geological heritage of Errachidia while promoting greater public awareness of geodiversity.

Keywords: Geoheritage; geotourism; geoconservation; semi-arid environment

ENHANCEMENT OF AN INTELLIGENT WEB-BASED ACADEMIC PROJECT MANAGEMENT SYSTEM WITH AUTOMATED TOPIC CLASSIFICATION AND DUPLICATE DETECTION

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ABSTRACT

The administration of academic project allocations in higher education institutions is frequently hindered by manual coordination, redundant research topics, and unstandardized approval workflows. These inefficiencies often lead to unintended duplication of research effort, uneven supervisor workload distribution, and administrative delays. This paper presents the enhancement of an intelligent, web-based academic project management system integrating automated topic classification and semantic duplicate detection. The system leverages Natural Language Processing (NLP) techniques, employing Term Frequency-Inverse Document Frequency (TF-IDF) feature extraction alongside cosine similarity and deep semantic vector embeddings to evaluate incoming project proposals against historical repository archives. Additionally, supervised machine learning classifiers are implemented to categorize proposed research topics into domain-specific academic clusters automatically. The web platform is architected using a responsive three-tier framework that streamlines proposal submissions, real-time similarity screening, role-based supervisor allocations, and milestone tracking. Empirical evaluation on departmental proposal datasets demonstrates high classification accuracy and robust duplicate detection rates, effectively flagging semantically similar and identical submissions while maintaining minimal processing latency. The enhanced system provides an automated, transparent, and scalable framework that minimizes academic redundancy, simplifies administrative workflows, and enhances research quality management across academic departments.

Keywords: Academic Project Management, Duplicate Detection, Natural Language Processing (NLP), Topic Classification, Semantic Similarity, Machine Learning, Three-Tier Architecture.

SEMI-ANALYTICAL INVESTIGATION OF A NON-LINEAR INITIAL VALUE PROBLEM IN A CANCER MODEL

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Abstract

Cancer is a serious disease characterized by the uncontrolled growth and spread of abnormal cells in the body. It can develop in almost any organ or tissue and may spread to other parts of the body if not detected and treated early. The Homotopy Pertubation Method (HPM) is employed to address the system of non-linear differential equations and generate a semi-analytical solution for the Cancer disease Protected-Susceptible-Infected-Treated (PSITPS) model. These Methods results were compared with the MATLAB numerical simulation. There is a good agreement between the numerical simulation and the approximate analytical results. In addition, each parameter was varied to examine its impact on the behaviour of individuals in the model. The findings of this study provide useful guidance for researchers on the use of semi-analytical methods in infectious disease epidemiological modelling.

Keywords: Epidemic model, Cancer, non-linear initial value problem, Homotopy Pertubation method (HPM), numerical simulation.

CAD-BASED DESIGN AND COMPARATIVE ASSESSMENT OF A TRANSPORTABLE LIFTING SYSTEM FOR MODERATE LOAD HANDLING

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Abstract

Transportable lifting systems are beneficial in construction, workshops, maintenance and logistics for moderate loads with higher mobility and flexibility. Traditional lifting equipment can be heavy, difficult to move or reliant on permanent infrastructure. Today's lifting systems for moderate-load applications often suffer from portability, compactness and ease of deployment limitations. The aim of the project is to design a transportable lifting system by use of CAD and to study its advantages over the conventional lifting systems. A three-dimensional model of the lifting mechanism, structural frame, actuator configuration and transport features were created using SolidWorks. The proposed design was analyzed with the help of CAD-based dimensions, kinematic and structural considerations and the results were evaluated in terms of its portability, compactness, load handling capacity and operational needs. The evaluation shows that the presented design offers a portable and small solution with a higher deployment flexibility for dealing with moderate loads. The study demonstrates that the proposed CAD-based lifting concept is feasible and provides a workable design basis for subsequent fabrication, experimental verification and further optimization.

Keywords- CAD-Based Design; Transportable Lifting System; Moderate Load Handling; Mechanical Lifting Mechanism; Comparative Assessment.

FROM RAW ELECTROENCEPHALOGRAPHY TO AUTOMATED ACTION: FEATURE EXTRACTION FOR INTERPRETABLE MACHINE LEARNING IN BRAIN-COMPUTER INTERFACE SYSTEMS

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ABSTRACT

Brain-Computer Interfaces represent a critical frontier in human-technology interaction by converting electroencephalography (EEG) signals from non-invasive electrodes placed on the scalp into physical automation with a short delay. Translating EEG signals, measuring a mere few microvolts, into meaningful machine learning (ML) outputs can, however, prove to be challenging. These noisy neural signals suffer from high noise floors and muscle/eye artefacts and are afflicted too by properties rendering their ML processing hard: notably dynamic non-stationarity and high dimensionality. In the present work, a structured study is undertaken into feature extraction protocols optimized to work under industrial-strength ML frameworks, weighing up predictive power with ease of model interpretability, as well as considering low-latency for control. Investigation is done on state-of-the-art EEG feature extraction that spans four feature classes: their representation in raw time domain statistical parameters; in spectral density-based features of the frequency domain; in wavelet decompositions (merging both time and frequency information); and finally those within the spatial topological domain, including such techniques as CSP (Common Spacial Pattern) filtering and Riemannian geometry. Additionally, this study also sets out to explore the means by which feature representations of brain signals help their graph-readability and thus the ease of their interpretation. With the assistance of (t-SNE or UMAP) dimensionality reduction and (SHAP and LIME) Explainable AI (XAI) frameworks, raw multichannel neural activations and feature vectors are transferred from their abstract numerical representation into readily understandable 2D topomaps and cluster graphs. Finally, trade-offs when coupling extracted feature vectors with real-life automation systems, such as assistive robotics, neuro-rehabilitation devices, and smart IoT triggers are analyzed. This synthesis provides practical paradigms for developing transparent, high-precision BCI pipelines capable of reliable real-time operation.

Keywords: Brain-Computer Interface (BCI), EEG Signal Processing, Feature Extraction, Explainable AI (XAI), Machine Learning, Real-Time Automation.

DESIGN AND IMPLEMENTATION OF AN INTEGRATED WEB APPLICATION FOR FOOD ORDERING AND CATERING TRAINING AT RAUFAZ KITCHEN, KATSINA.

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Abstract

Small food businesses often rely on manual processes for managing food orders, while access to structured catering training remains limited. This study presents the design and implementation of an integrated web application for food ordering and catering training, using Raufaz Kitchen, Katsina, as a case study. The proposed application addresses challenges associated with manual order processing and limited access to digital catering learning resources by integrating food ordering and training functionalities within a single platform. Customers can browse food categories, view food items, place orders, and access catering training materials, including recipes, tutorials, and learning resources. Administrators can manage users, food categories, food items, and customer orders through an administrative interface. The application was developed using the Waterfall software development model and implemented using HTML, CSS, JavaScript, PHP, MySQL, and Bootstrap. Functional testing was conducted using defined test cases covering user registration, authentication, food browsing, ordering, and administrative operations. Usability, security, and stakeholder feedback were also considered during system evaluation. The results of the functional testing showed successful execution of the tested system operations, while stakeholder feedback indicated that the application was easy to navigate and supported efficient management of food orders. The study demonstrates the feasibility of integrating online food ordering and catering training within a web-based application to support digital service delivery and learning in small food businesses.

Keywords: Online Food Ordering, Catering Training, Web-based Application, Digital Transformation, Order Management.

A DFT STUDY OF THE STRUCTURAL, ELECTRONIC, MECHANICAL, AND DYNAMIC PROPERTIES OF COMPLEX HYDRIDES FOR HYDROGEN STORAGE UNDER TRIAXIAL STRAIN

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Abstract

Hydrogen storage remains one of the main bottlenecks to the development of hydrogen as a clean energy vector. This first-principles study, based on Density Functional Theory (DFT), investigates two hydrogen-rich double perovskite hydrides, Li_3GaH_6 and Na_3GaH_6, as candidates for solid-state hydrogen storage. Calculations performed with the CASTEP software (GGA-PBE functional) show that both compounds crystallize in a thermodynamically stable monoclinic structure, with negative formation enthalpies, and satisfy the mechanical and dynamic stability criteria. Electronically, both materials behave as direct-gap semiconductors. Regarding storage performance, Li_3GaH_6 exhibits a gravimetric capacity of 6.26 wt% and a volumetric capacity of 117.74 g H_2/L, while Na_3GaH_6 reaches 4.18 wt% and 85.65 g H_2/L, both compounds showing good results, with Li_3GaH_6 exceeding the U.S. Department of Energy (DOE) targets of 5.5 wt% and 40 g H_2/L. Applying hydrostatic strain (-6% to +6%) further modulates the desorption temperature without altering the chemical composition: for Li_3GaH_6, it drops from 579 K to 488 K under -6% strain, while for Na_3GaH_6 it decreases from 622 K to 551 K under +6% strain. These results identify both materials as promising candidates for hydrogen storage, with Li_3GaH_6 standing out for its higher storage capacity and a desorption temperature that can be tuned through strain engineering.

Keywords: Hydrogen storage; Double perovskites; Stability; DFT; Gravimetric capacity; Hydrostatic strain; Desorption temperature;

APPLICATION OF THE THEORY OF PLANNED BEHAVIOUR IN FOOD WASTE RESEARCH: A BIBLIOMETRIC AND SYSTEMATIC REVIEW

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Abstract

This study presents a systematic literature review and bibliometric analysis of research applying the Theory of Planned Behaviour (TPB) to explain food waste (FW) behaviour, a critical sustainability challenge with substantial economic, environmental, social, and food security implications. Following the PRISMA guidelines, 107 peer-reviewed articles retrieved from the Scopus database were included in the final analysis. Keyword co-occurrence analysis using VOSviewer was conducted to map the intellectual structure, thematic clusters, and temporal evolution of TPB-based FW research during the 2015–2025 period. The findings indicate that attitude, subjective norms, and perceived behavioural control remain the core determinants most frequently examined in explaining FW reduction intentions, although their relative influence varies across research contexts. The bibliometric analysis further identifies four major thematic clusters and reveals an evolution of the field from a predominant focus on individual psychological determinants towards broader concerns related to sustainability, food security, and societal issues. Several themes, including habits, moral norms, personal motivation, and cultural contexts, remain comparatively underexplored, highlighting important opportunities for extending the TPB framework in future research. By integrating systematic evidence synthesis with bibliometric mapping, this review provides a comprehensive overview of how the TPB has been applied and evolved within FW research. The findings clarify the current intellectual structure of the field, identify key theoretical and contextual gaps, and provide a research agenda for extending TPB-based explanations of FW behaviour and developing more context-sensitive approaches to promoting sustainable food consumption.

Keywords: Food waste; Theory of Planned Behaviour; Systematic review; Sustainable consumption.

THE ROLE OF ROBOTICS IN TRANSFORMING THE AUTOMOBILE INDUSTRY: ENHANCING EFFICIENCY, QUALITY, AND SAFETY.

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Abstract

This paper looks into the use of robotics in the automobile industry and its impact on manufacturing efficiency, quality, worker safety, and production costs. Specifically it examines efficiency: robotics has accelerated production speeds while maintaining near-perfect precision; Assessing safety: robots have reduced workplace injuries, exposure to toxic fumes, and ergonomic strains; and evaluating production cost: robots reduce costs through various means, such as minimizing material scrap and operating expenses. The study explores various types and applications of robotic systems used in vehicle production. We look into how robots have transformed the industry and some of the crucial roles they play in the industry. This study takes on a qualitative literature review supported by industrial performance data to evaluate the impact of robotics on productivity, manufacturing quality, worker safety, and production cost. The findings indicate that robotics has become a strategic competitive advantage in modern automobile manufacturing.

Keywords: robotics; automobiles; industry; safety; workplace; vehicles; performance; production

MICROCONTROLLER-BASED CHARACTER DISPLAY SYSTEM

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ABSTRACT

This paper presents the design and development of a microcontroller-based character display system for displaying alphanumeric characters and user-defined messages on a liquid crystal display (LCD). The proposed system uses a microcontroller as the main control unit and a 16×2 LCD module as the display interface. The microcontroller is programmed to initialize the LCD, send control commands, and transmit character data for display. The system provides a simple, low-cost, reliable, and energy-efficient method of displaying information. It can be easily modified to display different messages according to application requirements. The proposed system has potential applications in electronic notice boards, digital information displays, industrial monitoring systems, educational equipment, and embedded-system applications. The project demonstrates the effective use of microcontroller programming and LCD interfacing for real-time character display.

A REVIEW ON RECENT TRENDS, MECHANICAL AND CHEMICAL PROPERTIES AND APPLICATIONS OF BIO-COMPOSITE MATERIAL

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ABSTRACT

In recent years, the interest in the bio-composite (called as green composites) materials has increased exponentially owing to the potential of replacing to conventional materials used in manufacturing industries. Bio composite materials are made using natural fibers or natural resins instead of synthetic fibers (e.g. carbon, glass fibers) or resins (e.g. poly vinyl alcohol, epoxy resins). The bio-based fibers such as jute, sisal, flax, hemp, bamboo, hair, wool, silk etc., are derived from plants or animals. Also natural matrix substances such as natural rubber, polyester etc. are produced from plants. Many researchers are attracted by the advantages of bio-composites such as the ease of disposal and being able to be composted after the expiration date which is not generally possible with conventional synthetic materials, being renewable, sustainable. Moreover, the similar mechanical properties of bio-composites allow to apply to many different products. This study reviews the mechanical and chemical properties, recent trends and application of bio-composites in recent years.

ANALYSIS AND DESIGN OF $NiCo_2O_4$/g-CN ELECTROCATALYS VIA HYDROTHERMAL ROUTE TOWARDS ENHANCED OERPERFORMANCE.

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Abstract

The world is facing a significant threat with the widespread consumption of natural resources, particularly fossil fuels. Continuous growth in global population and rapid economic expansion will increase energy demand continuously. To meet these crises, water splitting is considered an effective approach. In this work, a hydrothermal method was used to generate a composite of g-CN integrated with $NiCo_2O_4$, and its OER activity was measured. The produced materials were thoroughly analyzed utilizing a wide range of physical methods. $NiCo_2O_4$/g-CN nanocomposite has a mesoporous structure due to equally scattered nanoparticles on g-CN nanosheet assessed via SEM. This boosts electron mobility and active surface area. TGA analysis was done for thermal stability verification. Electrochemical study was examined in alkaline solution, showed a reduced Tafel value of 37.5 mV dec^{-1} and ŋ of 230 mV at j of 10 mA cm^{-2}, which allows for facilitated charge transfer and enhanced catalytic sites. The composite exhibits efficient OER performance because of increased surface area and higher electrical conductivity. This shows that $NiCo_2O_4$/g-CN is an efficient electrocatalyst for improved OER activity and opens the door for its potential use into large-scale renewable energy generation for future.

Keywords

Spinel/g-CN nanocomposite, hydrothermal process**,** Electrocatalyst, Oxygen evolution reaction, Water splitting

EVRENSEL OLMAYAN $U(1)_X$ SİMETRİK BİR MODELDE PESKİN-TAKEUCHI PARAMETRELERİ

THE PESKIN-TAKEUCHI PARAMETERS IN A NON-UNIVERSAL $U(1)_X$ SYMMETRIC MODEL

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Abstract

This paper investigates the aplication of the oblique Peskin–Takeuchi parameters (S, T, U) in an extended version of the Standard Model which includes a group of a non-universal $U(1)_X$ additional symmetry. The theoretical framework of the model $SU(3)_C \otimes SU(2)_L \otimes U(1)_Y \otimes U(1)_X$, is made by defining the gauge charges of the new fermions. The generalized expressions for S, T y U are derived with the coupling to the $U(1)_X$. Next, a numeric analysis is implemented to evaluate the different contributions of the new states in quantum loops that modify the polarization functions of gauge fields. The main results and the corresponding discussion can be found in the analysis and conclusions sections.

Keywords: Peskin-Takeuchi, parameters S T U, $U(1)_X$ model, constraints

Özet

Bu çalışma, evrensel olmayan ek bir $U(1)_X$ simetrisi içeren genişletilmiş bir Standart Model versiyonunda oblik Peskin–Takeuchi parametrelerinin (S, T, U) uygulanmasını incelemektedir. $SU(3)_C \otimes SU(2)_L \otimes U(1)_Y \otimes U(1)_X$ modelinin teorik çerçevesi, yeni fermiyonların ayar yüklerinin tanımlanmasıyla oluşturulmuştur. $U(1)_X$ ile olan etkileşim göz önünde bulundurularak S, T ve U için genelleştirilmiş ifadeler türetilmiştir. Ardından, ayar alanlarının polarizasyon fonksiyonlarını değiştiren kuantum döngülerindeki yeni durumların farklı katkılarını değerlendirmek için sayısal bir analiz uygulanmıştır. Ana sonuçlar ve ilgili tartışma, analiz ve sonuç bölümlerinde bulunabilir.

Anahtar kelimeler: Peskin-Takeuchi, S T U parametreleri, $U(1)_X$ modeli, kısıtlamalar

CURRENT STATUS OF HOUSEHOLD WASTE MANAGEMENT IN MARINE ENVIRONMENTAL PROTECTION IN SAM SON, VIETNAM

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Abstract

This study examines the current status of household solid waste and wastewater management among local residents and business households in the coastal area of Sam Son, Thanh Hoa Province, Vietnam. Based on a questionnaire survey of 151 residents and business owners, the findings indicate that although waste collection services are conducted regularly, source separation of solid waste has not been implemented consistently. Environmentally harmful practices, including open burning, burial, and the direct disposal of waste onto beaches and other public areas, remain prevalent, negatively affecting the coastal landscape and undermining the goal of sustainable tourism development. In addition, the local wastewater treatment system faces significant shortcomings, with untreated domestic wastewater still being discharged directly into the coastal environment, placing considerable pressure on marine ecosystems. From a social perspective, although public awareness has improved through environmental education and communication campaigns, community-based monitoring, public criticism of environmentally harmful behaviors, and the establishment of grassroots self-governing environmental organizations remain limited. Based on these findings, the study highlights the need for comprehensive solutions, including investment in environmental infrastructure, strengthening monitoring and enforcement mechanisms, and promoting community-based management models to ensure the sustainable protection of the marine environment.

Keywords: Waste management; Household solid waste; Marine environmental protection; Vietnam

AI-DRIVEN MODELLING OF IMMUNE RESPONSES FOR PERSONALIZED MEDICINE

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ABSTRACT

The integration of artificial intelligence (AI) with immunological research is transforming the landscape of personalized medicine by enabling precise modelling of immune responses at individual and population levels. Traditional immunological models have been limited in their ability to capture the complex, nonlinear interactions among immune cells, cytokines, and host genetics. Recent advances in machine learning (ML) and deep learning (DL) now allow the integration of multiomics, single-cell, and clinical datasets to construct dynamic models capable of predicting immune behaviour in health and disease. AI-driven modelling has been particularly impactful in predicting patient-specific responses to vaccines, autoimmune therapies, and cancer immunotherapies, where variability in immune reactions often dictates treatment efficacy. Moreover, digital twin frameworks, virtual replicas of patient immune systems, are emerging as innovative tools for simulating therapeutic interventions and forecasting immune outcomes. These computational models integrate genomics, proteomics, metabolomics, and environmental data to enable precise stratification of patients, personalized therapeutic planning, and improved prognostic accuracy. However, challenges such as data heterogeneity, algorithmic bias, and limited interpretability remain key barriers to clinical translation. Addressing these gaps requires standardized data pipelines, interpretable AI frameworks, and cross-disciplinary validation involving clinicians, data scientists, and immunologists. Overall, AI-driven immune modelling represents a transformative paradigm for personalized medicine, with the potential to revolutionize diagnostics, vaccine development, and therapeutic optimization in the coming decade.

Keywords: Artificial intelligence, immune modelling, personalized medicine, digital twin, deep learning, immunotherapy, multiomics integration, predictive modelling, and systems immunology.

ENGINEERING HYBRID BIOMASS BEADS FOR DYE REMOVAL: UNRAVELING MULTILAYER ADSORPTION, DUAL-SITE ENERGETICS, AND DIFFUSION MECHANISMS ACROSS SCALES

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Abstract

Introduction and Purpose: The discharge of synthetic dyes into aquatic environments represents an important environmental concern because of their persistence and potential adverse effects. This study aimed to develop a recoverable hybrid biomass material, ACTb@Alg, for the removal of Orange G from water. Activated carbon was produced from Tobacco tree (Tb) biomass and encapsulated in alginate to form wet hybrid beads, combining the adsorption properties of biomass-derived activated carbon with easy solid-liquid separation.

Materials and Methods: Tobacco tree biomass was chemically activated and carbonized to obtain activated carbon, which was subsequently encapsulated in alginate beads. Batch adsorption experiments were performed to evaluate Orange G removal. The adsorption data were analyzed using pseudo-first-order kinetic modeling; Langmuir, Freundlich, and Temkin isotherms; Weber-Morris and Boyd diffusion models; and the Hill 2E statistical physics model. Thermodynamic analysis and density functional theory (DFT) calculations were also employed to investigate the adsorption behavior and mechanism.

Results: ACTb@Alg achieved an Orange G removal efficiency of 97.43% and a maximum experimental adsorption capacity of 32.5 mg/g at an initial concentration of 20 mg/L. The kinetic data were best described by the pseudo-first-order model. Among the investigated isotherms, the Freundlich model provided the most appropriate description, suggesting multilayer adsorption on a heterogeneous surface. Weber-Morris and Boyd analyses indicated contributions from both film and intraparticle diffusion. Statistical physics analysis using the Hill 2E model revealed two energetically distinct adsorption sites and a sequential adsorption mechanism. Thermodynamic results indicated that the process was spontaneous and endothermic.

Discussion and Conclusion: The results demonstrate that ACTb@Alg is an effective and easily recoverable biomass-based adsorbent for Orange G removal. Its adsorption behavior involves surface heterogeneity, multiple energetic sites, and combined diffusion mechanisms. DFT calculations further contributed to understanding the adsorption process at the molecular scale. These findings highlight the potential of activated-carbon/alginate hybrid beads as a practical material for the treatment of dye-contaminated water.

Keywords: activated carbon (AC), Tree Tobacco (Tb), Orange G (OG), activated carbo- alginate composite ACTb@Alg, DFT, Experimental design.

Cu-ZnO THIN FILMS FOR ENHANCED PHOTOVOTAIC PERFORMANC

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ABSTRACT

Pure and copper-doped zinc oxide (ZnO) thin films were deposited on glass substrates via ultrasonic spray pyrolysis at 450°C for 30 minutes. This study investigates the impact of varying copper (Cu) doping levels, ranging from 0.02 to 0.20 atomic fraction, on the structural and optical properties of ZnO films. X-ray diffraction (XRD) analysis reveals that copper doping induces structural disorder and the formation of a secondary CuO phase, which becomes more pronounced with higher Cu concentrations. Optical transmittance measurements indicate a decline in transmittance as Cu content increases. Concurrently, the refractive index of the films increases with higher copper doping. The bandgap energy of the films decreases with increasing Cu concentration, suggesting enhanced electronic interactions within the ZnO matrix due to copper incorporation. These findings provide insights into how Cu doping influences the optical and structural characteristics of ZnO films, which could be valuable for applications in optoelectronic and photonic devices.

Keywords: Thin films; X–ray diffraction; Optical properties

THE "KENH BONG" RELIEF-CARVING TECHNIQUE IN NORTHERN VIETNAMESE COMMUNAL HOUSE ARCHITECTURE AND ITS REINTERPRETATION IN CONTEMPORARY MATERIALS

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ABSTRACT

The "kenh bong" (kênh bong) relief-carving technique represents one of the most sophisticated achievements of Vietnamese folk architectural art, reaching its pinnacle in the 17th-century communal houses (đình làng) of the Northern region. Distinguished by its multi-layered spatial depth, dramatic interplay of light and shadow, and intricate integration of sacred animal, floral, and geometric motifs within a single carved panel, kenh bong transcends mere ornamentation — it constitutes a structural language that encodes the cultural values and spiritual worldview of agrarian communities in the Red River Delta (Hoàng Đạo Cương & Nguyễn Hồng Kiên, 2018).

Despite its cultural significance, this technique remains underexplored in terms of contemporary design application. Most existing scholarship approaches kenh bong from a conservation and art-historical perspective, without examining how its formal principles — layered relief, rhythmic depth, and symbolic density — might be reinterpreted using modern fabrication methods and materials.

This study addresses that gap through two complementary objectives. First, it analyzes the formal and technical characteristics of kenh bong as documented in three representative communal houses: Tay Dang, Chu Quyen, and Dinh Bang. Second, it examines the feasibility of reinterpreting these characteristics using contemporary materials and fabrication technologies, including CNC wood carving, laser-cut composite panels, and cast stone relief — assessing each method's capacity to preserve the technique's defining visual qualities of depth, layering, and chiaroscuro effect.

Findings suggest that while no single contemporary method fully replicates the tactile and symbolic richness of hand-carved kenh bong, a material-selection framework can guide designers in choosing appropriate reinterpretation strategies based on spatial context, budget, and desired fidelity to the original. This study contributes a practical bridge between intangible heritage preservation and contemporary interior design practice.

Keywords: kenh bong carving, Northern Vietnamese communal house, contemporary materials, heritage reinterpretation, interior design

CHEMICAL KNOWLEDGE AND THE CRITICAL INTERPRETATION OF REALITY IN THE CONTEXT OF THE INFODEMIC

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ABSTRACT

This paper investigates how chemical knowledge can contribute to building a critical understanding of reality in the contemporary context. It starts from the observation that historical and social transformations, especially the consolidation of productive models based on the fragmentation of work, associated with the intensification of information circulation, have influenced the way knowledge is produced, disseminated, and interpreted. In this scenario, the phenomenon of infodemic stands out, characterized by an excess of information, often unverified, which hinders critical analysis and the distinction between facts and opinions. The research is based on a qualitative approach, of a theoretical and exploratory nature, based on a literature review and analysis of secondary data from national and international institutions. From this basis, the relationship between social structure, fragmentation of knowledge, and difficulties in the formation of critical thinking is discussed, highlighting limitations in the interpretation of scientific information and in the evaluation of the reliability of sources. In this context, the work proposes a reflection on the role of the natural sciences — especially Chemistry — in overcoming these limitations. It is argued that Chemistry, by articulating different levels of understanding of matter (macroscopic, microscopic, and symbolic), constitutes a relevant tool for the development of critical thinking, favoring the ability to interpret phenomena, analyze information, and make informed decisions in everyday life. The central argument indicates that the teaching of Chemistry, when oriented beyond the memorization of content, can significantly contribute to the formation of critical subjects, capable of understanding and questioning the reality in which they are inserted.

Keywords: Chemistry; critical thinking; infodemic; science education; interpretation of reality.

MECHANICAL BEHAVIOR OF BITUMEN/HDPE COMPOSITES UNDER THREE-POINT BENDING

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Abstract

Plastic waste represents a major environmental challenge, and its incorporation into engineering materials can provide an alternative approach for its valorization. This study investigates the mechanical behavior of bitumen/High-Density Polyethylene (HDPE) composites with different HDPE volume fractions and evaluates the influence of temperature on their flexural properties.

Bitumen 40/50 and HDPE were used to prepare composite specimens containing 10–90% HDPE by volume. Specimens measuring 160 × 40 × 20 mm were subjected to three-point bending tests according to ASTM D790-07 at 0 and 25 °C. A constant crosshead speed of 0.7 mm/min was applied, and flexural strength, flexural modulus, load–deflection behavior and toughness were evaluated.

The results indicate a strong dependence of the mechanical behavior on HDPE content and temperature. At 25 °C, the 40% and 50% HDPE composites reached flexural strengths of 4.37 and 4.02 MPa, respectively. At 0 °C, the maximum measured flexural strength was 8.28 MPa for the 80% HDPE composition. Increasing the temperature caused significant reductions in the flexural properties, with flexural strength decreasing by approximately 38% and 34% for the 40% and 50% HDPE composites, respectively. The 40% HDPE/60% bitumen composition exhibited the most favorable toughness.

These results demonstrate the importance of HDPE volume fraction and temperature in determining the mechanical performance of bitumen/HDPE composites and provide useful guidance for further development of bitumen/polymer composite materials.

Keywords: HDPE; bitumen; composite materials; flexural behavior; temperature; toughness.

FACILE FABRICATION OF ZINC ALUMINIUM SULPHIDE REDUCED GRAPHENE OXIDE NANOCOMPOSITE FOR HIGH-PERFORMANCE SUPERCAPACITOR APPLICATIONS

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ABSTRACT

Rapid consumption of fossil fuels causes energy depletion and CO_2 emissions. Therefore, the production of substitute energy resources is urgently needed. In this study, a Zinc Aluminium sulphide ($ZnAl_2S_4$) and Zinc Aluminium sulphide reduced Graphene Oxide ($ZnAl_2S_4$/rGO) nanocomposite was fabricated via a hydrothermal technique. The nanocomposite demonstrated a specific capacitance (C_s) of 714.6 F/g at 1 A/g, an energy density (E_d) of 16.7 Wh/kg, and a power density (P_d) of 205 W/kg. According to the Nyquist plot, the $ZnAl_2S_4$/rGO nanocomposite's solution resistance (R_s) was calculated to be 0.93 Ω. It also demonstrated CV capacitance retention of 93% even after 5000 cycles. The inclusion of rGO enabled the electrolyte and electrode surface to form an ideal connection for rapid electrolyte ion diffusion. Its high surface area provided more electroactive sites, resulting in improved specific capacitance. Additionally, an asymmetric two-electrode study was conducted, and the findings showed an improved E_d of 38.4 Wh/kg and P_d of 2080 W/kg. The $ZnAl_2S_4$/rGO nanocomposite is an attractive capacitive electrode material for upcoming energy storage technologies, according to the results obtained.

Keywords: $ZnAl_2S_4$; $ZnAl_2S_4$/rGO; Electrode material; Hydrothermal method

BARRIERS AND ENABLERS OF TECHNOLOGY TRANSFER: AN ANALYSIS OF INNOVATION PROJECTS ASSESSMENTS RESULTS

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Abstract

This study examines the structural and operational constraints affecting the transition of scientific research into industrial applications within the Moroccan innovation ecosystem, specifically focusing on the agricultural sector. The analysis is based on expert committee feedback and evaluation reports conducted under the technology transfer program framework, which assessed projects on technical feasibility, market readiness, regulatory compliance, and the robustness of industrial partnerships.

The findings reveal that while scientific foundations are often solid, the path to commercialization is obstructed by several systemic challenges. A primary hurdle is the deficit in formal industrial engagement, as many projects lack signed Letters of Intent or co-financing agreements. This lack of partnership limits the ability to conduct essential pilot tests in real-world environments. Furthermore, technical innovation frequently precedes regulatory planning, leaving projects without clear strategies for essential certifications or safety standards. In the agricultural domain, this is compounded by the difficulty of scaling from laboratory prototypes to representative greenhouse surfaces.

Economically, there is a recurring gap in detailed modeling, where projects often fail to quantify the Return on Investment or accurately estimate production costs compared to existing market alternatives. Additionally, while patent filing is common, it is rarely integrated into a broader business strategy that includes Freedom to Operate studies or international extension plans, which are vital for preventing legal disputes.

In conclusion, to bridge the "valley of death" between research and the market, project holders must shift from a purely scientific focus to a market-driven strategy. Successful valorization requires the early integration of industrial partners, strict adherence to international standards, and a robust economic demonstration of the technology's value proposition. This transition is essential for ensuring that agricultural innovations move beyond the proof-of-concept stage to achieve sustainable industrial and social impact.

Keywords: Technology Transfer program, TRL, Industrial Partnership, Regulatory Strategy, Scale-up.

Topic: Akademik Teşvik

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İlgili makama;

3. Uluslararası Mühendislik Bilimleri Kongresi 04-06 Eylül 2026 tarihleri arasında Konya'da 26 farklı ülkenin akademisyen/araştırmacılarının katılımıyla gerçekleşmiştir. Kongre kapsamında sunumu yapılan 189 bildirinin 91 adeti Türkiye'den katılımcılar tarafından; 98 bildiri ise 188 ülkeden katılımcılar tarafından sunulmuştur. Kongre 16 Ocak 2020 Akademik Teşvik Ödeneği Yönetmeliğine getirilen "Tebliğlerin sunulduğu yurt içinde veya yurt dışındaki etkinliğin uluslararası olarak nitelendirilebilmesi için Türkiye dışında en az beş farklı ülkeden sözlü tebliğ sunan konuşmacının katılım sağlaması ve tebliğlerin yarıdan fazlasının Türkiye dışından katılımcılar tarafından sunulması esastır." değişikliğine uygun düzenlenmiştir.

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İlgi'de kayıtlı yazınız gereğince, Üniversitemiz ile İktisadi Kalkınma ve Sosyal Araştırmalar (İKSAD) Enstitüsü iş birliğiyle 04-06 Eylül 2026 tarihleri arasında düzenlenecek olan 3. Uluslararası Mühendislik Bilimleri Kongresi'nde (ICES-2026) görev almak üzere, Fakülteniz öğretim üyelerinden Prof. Dr. Bayram AKDEMİR'in Kongre Başkanı, Prof. Dr. Nurettin ÇETİNKAYA, Prof. Dr. Murat CEYLAN, Prof. Dr. Salih GÜNEŞ, Prof. Dr. Seral ÖZŞEN, Prof. Dr. Akif DURDU ve Dr. Öğr. Üyesi Şeyda PARLAR'ın ise Kongre Düzenleme Kurulu Üyesi olarak görevlendirilmeleri uygun görülmüştür.

Bilgilerini ve gereğini rica ederim.

Prof. Dr. Osman Nuri ÇELİK
Rektör

Bu belge, güvenli elektronik imza ile imzalanmıştır.

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