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# First International Conference on Research and Advancements in Electronics, Energy, and Environment

## (ICRAEEE-2025)

**11 - 12 DECEMBER 2025**

**Faculty of Sciences**
**El Jadida, Morocco**

**ICRAEEE**

ELECTRONICS, ENERGY AND ENVIRONMENT

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**Organized by**

The Sciences and Technologies of Information and Communication Laboratory (STIC), in partnership with the Moroccan Association for Research in the Sciences of Electronics, Energy, and the Environment (MARS3E).

## Theme

***Innovation for Sustainable Development: New Perspectives in Electronics, Energy, and Environment***

Electrical & electronic engineering

Renewable energy systems & energy storage

Environmental technology & sustainable practices

Materials & applications

**Conference Publication** Scopus®


**Contact**

**Chair : Prof. Said DLIMI**

+212674036037

icraeee25@hotmail.com

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# First International Conference on Research and Advancements in Electronics, Energy, and Environment (ICRAEEE 2025)

*11-12 December 2025 – Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

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# ICRAEEE 2025 Speakers

## *Prof. Mohamed El Badaoui*

## *Jean-Monnet University, Roanne*

## *France*

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| **Biography:** | **Mohamed El Badaoui** is a Full Professor at Université Jean-Monnet (IUT de Roanne) and Director of the LASPI Laboratory (EA-3059). He also serves as a "Group Expert" at SafranTech (Paris-Saclay) within the MATD unit. His research focuses on signal processing and health monitoring of rotating machinery (bearings, gears, gearboxes, turbomachinery), with particular interests in cyclostationary analysis, source separations, high-resolution time–frequency techniques, and explainable AI for diagnostics and prognostics. He is the author of over 170 publications and co-inventor on several industrial patents. He has led numerous projects and supervised many PhD theses in partnership with the aeronautics industry. A recipient of internal distinctions, he frequently serves as an invited speaker and expert for academic and industrial organizations. |
| **Conference Title:** | When Noise Speaks: Decoding Aerospace Faults Through Signal Processing |
| **Abstract:** | In aeronautics, system reliability rests, among other factors, on our ability to mine information from "noise"—vibratory, acoustic, electrical, and operational—to surface early fault signatures. This keynote introduces a unified, physics-guided framework that couples domain modelling with advanced signal processing to detect, characterize, and track defects in critical subsystems (bearings, gears, gearboxes, and turbomachinery). We highlight cyclostationary analysis, blind source separation, and spectral/time–frequency methods that reveal harmonic structure, sideband patterns, and modulation couplings even at low SNR. Industrial case studies will demonstrate early detection, severity tracking, and actionable maintenance decisions. |

**Keywords:** Signal Processing, Noise Analysis, Aerospace Fault Diagnosis, Condition Monitoring, Feature Extraction

*Prof. Hicham BENYOUCEF*
*Mohamed VI Polytechnic University (UM6P)*
*Morocco*

Biography:

**Prof. Hicham BENYOUCEF**, a Full Professor at Mohammed VI Polytechnic University (UM6P), obtained his Ph.D (Chemistry) in 2009 from the Swiss Federal Institute of Technology Zurich (ETHZ), Switzerland. His thesis was devoted to engineering parameters for the development of highly stable, reliable and cost-effective proton exchange membranes for hydrogen fuel cells. Thereafter and as a Postdoctoral researcher at Paul Scherrer Institut (PSI), Switzerland, he participated in "S-chain project" and "Green Power project", a joint venture between Belenos Clean Power (Swatch® Group), Ecole Polytechnique Fédéral de Lausanne (EPFL) and PSI for the development of zero-emission car concept based on low temperature Fuel Cells. The project involved the manufacture of a prototype hydrogen car (30 kW) based on proton exchange membrane fuel cell technology.From 2011 to 2014 and between 2016 and 2017 he joined Chemspeed Technologies AG (part of Bruker Corporation) as an application automation and R&D automation chemist. Swiss company specialized in automation and high-throughput solutions and workflows design for the chemical-biochemical process industry and applied research. The focus was on the integration of automated platforms for the acceleration of research and development and to increase the reliability of processes and products. In between these positions, Dr. BENYOUCEF was a scientific researcher at CIC Energigune in Spain, working on the development of cathode materials for Lithium-Sulfur batteries and organic electrodes and solid polymer electrolyte materials for All-Solid-State Lithium/Sodium batteries. Currently, Prof. BENYOUCEF

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| | leads the High Throughput Multidisciplinary Research Laboratory (HTMR) within the college of Chemical Sciences & Engineering (CCSE) at /UM6P. His main interests are the development of new and smart/Self-healing materials for electrochemical energy storage and conversion (Fuel cells, Batteries) towards competitive targets (performance, durability and cost) using automated workflow design. Prof. Ben youcef has authored/co-authored over 120 articles, proceedings, scientific reports, 4 book Chapters and 3 patent applications. |
| **Conference Title:** | Development of solid electrolytes based on functionalized biopolymers and composites for high-performance & safer Lithium batteries |
| **Abstract:** | The growing demand for safer and high-performance lithium batteries has driven significant interest in solid electrolytes as alternatives to conventional liquid systems. This work focuses on the development of solid electrolytes based on functionalized biopolymers and composite materials. By combining biopolymer sustainability with tailored chemical functionalization and inorganic fillers, the proposed materials exhibit enhanced ionic conductivity, improved electrochemical stability, and increased safety. The results highlight the potential of biopolymer-based solid electrolytes as promising candidates for next-generation lithium batteries, contributing to both performance improvement and environmental sustainability. |
| **Keywords:** | Solid electrolytes, Biopolymers, Lithium batteries, Composite materials, Electrochemical performance |

***Dr Khalid Mnaouar***
***Manager of SITELECM Entreprise***
***Morocco***

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| **Biography:** | **Dr. Khaled Mnaouer** is an engineer, inventor, and entrepreneur specializing in electrical engineering and environmental solutions. As the Manager of SITELECM SARL, he leads innovative activities in industrial wastewater treatment and $CO_2$ cracking, contributing significantly to pollution control. His |

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| | expertise further extends to the fields of industrial regulation and renewable energy. A proactive inventor, he dedicates his career to designing advanced technologies for industry. His approach combines scientific rigor with practical vision, aiming to reconcile industrial performance with environmental respect. Through his work, Dr. Mnaouer has established himself as a key player committed to developing sustainable and efficient industrial processes. His career is a testament to the successful integration of multiple high-tech disciplines for a greener industry. |
| **Conference Title:** | Innovation, a Pillar of Resilience and Industrial Sovereignty |
| **Abstract:** | Innovation has become a strategic lever for strengthening resilience and ensuring industrial sovereignty in an increasingly uncertain global environment. Faced with technological disruptions, supply chain vulnerabilities, and geopolitical challenges, nations and industries must rely on innovation to sustain competitiveness, autonomy, and long-term growth. This talk explores how innovation drives resilient industrial ecosystems by fostering technological independence, accelerating digital and green transitions, and enhancing strategic capabilities. Through selected examples and forward-looking perspectives, it highlights the role of research, industry–academia collaboration, and policy frameworks in building robust and sovereign industrial systems. Innovation is not only a driver of performance but a cornerstone of sustainable resilience in the modern industrial landscape. |
| **Keywords:** | Innovation, Resilience, Industrial Sovereignty, Technological Independence, Sustainable Development |

***Dr. Tarik Kamal***
***Vaasa University***
***Finland***

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| **Biography:** | **Dr. Tariq Kamal** is a leading expert in energy and sustainable engineering, holding doctorates from the University of Cadiz, Technical University of Munich, Germany, and Sakarya University. As Assistant Professor and head of the Power Electronics and Control Group at the University of Vaasa, Finland, he conducts pioneering research in intelligent control, renewable energy systems, electric vehicles, and smart grid |

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| | integration. Dr. Kamal's work focuses on advanced energy storage solutions, including solid-state batteries and supercapacitors, through Horizon Europe projects. Previously, he was a research fellow at the Technical University of Munich, applying AI to optimize power systems. With over 100 peer-reviewed publications and approximately $20 million in research funding, Dr. Kamal collaborates globally on transformative projects. His contributions drive innovation in sustainable energy, positioning him as a leader in the field. Dr. Kamal's exceptional contributions to the field have positioned him as a global leader in sustainable energy innovation, inspiring both the academic and industrial communities in their pursuit of a cleaner, smarter energy future. |
| **Conference Title:** | Advanced Control and Energy Storage Integration for Sustainable Maritime Electrification: Insights from the AENEAS Horizon Europe Project |
| **Abstract:** | Maritime transport is undergoing a profound transformation driven by decarbonization goals, energy efficiency requirements, and the rapid electrification of ship systems. This keynote presents key advances in advanced control strategies and energy storage integration for sustainable maritime electrification, drawing on insights from the AENEAS Horizon Europe Project. The talk highlights innovative architectures combining power electronics, hybrid energy storage systems, and intelligent control to enhance reliability, efficiency, and operational flexibility of electric and hybrid vessels. Emphasis is placed on real-world validation, system-level optimization, and the role of digital control in supporting resilient and low-emission maritime operations. The AENEAS project demonstrates how coordinated research and industrial collaboration can accelerate the transition toward greener and smarter maritime transport. |
| **Keywords:** | Maritime Electrification, Energy Storage Systems, Advanced Control, Power Electronics, Sustainable Transport |

***Prof. Monica Siroux***

***University of Strasbourg***

***France***

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| **Biography:** | **Prof. Monica Siroux** is Full Professor at INSA Strasbourg (National Institute of Applied Sciences) and ICube Laboratory of University of Strasbourg France. She received her PhD in 1996 from the University Paris XII and the Accreditation to supervise research in 2008 from University of Valenciennes. Between 2013-2019 Professor Siroux was Director of the Energy Department at INSA Strasbourg and Director of a Research Chair "Innovative Walls". She leads a group of researchers and PhD students. Her main areas of research are Energy efficiency and Renewable energy. Professor Siroux published over 100 research papers in refereed international journals and international conferences and supervised over 15 PhD students. She chaired numerous international and national conferences and technical meetings. |
| **Conference Title:** | Development and application of Hybrid photovoltaic-thermal solar systems |
| **Abstract:** | Hybrid photovoltaic–thermal (PV/T) solar systems represent an advanced solution for maximizing solar energy utilization by simultaneously producing electricity and useful thermal energy. This keynote highlights recent developments in PV/T technologies, system designs, and performance optimization strategies. Emphasis is placed on real-world applications in buildings, industry, and energy networks, demonstrating how PV/T systems contribute to higher overall efficiency, reduced carbon emissions, and enhanced sustainability. The talk also addresses current challenges and future perspectives for large-scale deployment of hybrid solar solutions. |
| **Keywords:** | Hybrid PV/T systems; Renewable energy; Solar thermal integration; Energy efficiency; Sustainable applications |

*Prof. Ahmed Jellal*
*Chouaib Doukkali University*
*Morocco*

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| **Biography:** | **Prof. Ahmed Jellal**'s interests lie in the areas of mesoscopic physics, two-dimensional electron gas, quantum Hall effects, and integrable models. In recent years, his research has focused on the study of electronic properties of graphene, silicene, phosphorene, semi-metals, and transition metal chalcogenides. Prof. Jellal received his PhD in Theoretical Physics from Mohammed V University in Rabat-Morocco, in collaboration with the Abdus Salam International Centre for |

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| | Theoretical Physics (ICTP) in Trieste-Italy. He then held three postdoctoral positions at Boğaziçi (Bosphorus) University in Istanbul-Turkey, Stellenbosch University in Stellenbosch-South Africa, and Chemnitz University of Technology in Chemnitz-Germany. In 2003, he joined the Faculty of Science at Chouaib Doukkali University in El Jadida-Morocco. He has been a guest scientist for several periods at University of Adelaide in Adelaide-Australia, University of Naples in Naples-Italy, ICTP, American University in Beirut-Lebanon, Max Planck Institute in Dresden-Germany, King Fahd University of Petroleum and Minerals in Dhahran-Saudi Arabia, Paris-Saclay University in Orsay-France, and other institutions. |
| **Conference Title:** | Transport properties of semimetals and transition metal chalcogenides |
| **Abstract:** | Semimetals and transition-metal chalcogenides (TMCs) have become focal points in quantum materials research, particularly in exfoliated forms with just a few atomic layers. Charge carriers near the Dirac points of semimetals such as graphene, Dirac semimetals, and Weyl semimetals behave as massless relativistic particles, following a linear energy–momentum relation. This unique band structure gives rise to phenomena such as Klein tunneling and the chiral anomaly—effects that were once confined to high-energy accelerators, but are now accessible on a tabletop. TMC monolayers, such as $MoS_2$ and $WSe_2$, exhibit contrasting yet equally rich behavior. Their finite band gap separates the conduction and valence bands, however, electrons in the K and K′ valleys behave like massive Dirac fermions. Strong spin-orbit coupling and valley-dependent responses further open pathways to spintronics and valleytronics applications, establishing TMCs as essential components of next-generation quantum devices. In my presentation, I will introduce a new family of two-dimensional quantum materials spanning both semimetals and TMCs and examine how their exotic electronic properties evolve under tunable external forces, such as magnetic fields, laser driving, and electrostatic barriers. Through these controlled perturbations, we aim to understand the quantum dynamics that govern transport, coherence, and topological effects in these systems at the nanoscale. |
| **Keywords:** | Semimetals, Transition-metal chalcogenides, Dirac and Weyl fermions, Spintronics and valleytronics, Quantum transport and topological effects |

# Welcome Note

On behalf of the Organizing and Scientific Committees, it is our great pleasure to welcome you to the **First International Conference on Research and Advancements in Electronics, Energy, and Environment (ICRAEEE 2025)**, held on **11–12 December 2025 in El Jadida, Morocco**.

This inaugural edition of ICRAEEE provides a unique platform that brings together researchers, academics, industry experts, and young scholars from around the world. The conference aims to foster knowledge exchange, showcase recent advancements, and promote collaborations across the vital and interconnected topics of **Electrical and electronic engineering, Renewable energy systems and energy storage, Environmental Technology and sustainable practices and Advanced Materials and application.**

The program features keynote lectures delivered by distinguished speakers, in addition to oral and poster sessions covering a wide spectrum of interdisciplinary topics. We believe these sessions will stimulate fruitful discussions and inspire innovative perspectives for future research and cooperation.

We are also delighted to host this first edition in **El Jadida**, a city renowned for its cultural heritage and hospitality. We hope that your participation in ICRAEEE 2025 will be both scientifically rewarding and personally enjoyable.

We warmly thank all participants, speakers, partners, and supporting institutions for their valuable contributions to the success of this event. Your engagement is the cornerstone of this conference.

**With best regards,**

The Organizing Committee

## ICRAEEE 2025 Partners

## Conference Program

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|---|---|
| 8:00 – 9:00 | Registration |
| 9:00 – 9:30 | Opening Ceremony |
| 9:30 – 10:00 | Coffee Break / Poster Session |
| **Session Chairs:** Prof. Hamid Nebdi and Prof. Mohssin Aoutoul | |
| 10:00 – 10:45 | **Conference 1:** When Noise Speaks: Decoding Aerospace Faults Through Signal Processing<br>**Prof. Mohamed El Badaoui,** University Jean-Monnet (IUT of Roanne), France |
| **Session Chairs:** Prof. Najib Elkamoun and Prof. Khalid El Khadiri | |
| 10:45 – 11:30 | **Conference 2:** Development of solid electrolytes based on functionalized biopolymers and composites for high-performance & safer Lithium batteries<br>**Prof. Hicham Ben Youcef,** University Mohamed VI Polytechnic, Morocco |
| **Session Chairs:** Prof. Abdelhadi Kotri and Prof. Ouidade Labouidya | |
| 11:30 – 12:15 | **Conference 3:** Earth-abundant materials for energy conversion: photovoltaics and beyond<br>**Prof. Lahoucine Atourki**, Mohamed V University, Morocco |
| 12:15 – 13:15 | Oral Session 1 |
| 13:15 – 14:45 | Lunch Break |
| 14:45 – 16:15 | Oral Session 2 |
| 16:15 – 17:45 | Coffee Break / Poster Session |
| 17:45 – 19:15 | Oral Session 3 |
| **Friday, December 12, 2025** | |
| **Session Chairs:** Prof. Aziz Dkiouak and Prof. Samir Elouaham | |
| 9:00 – 9:45 | **Conference 4:** Transport properties of semimetals and transition metal chalcogenides<br>**Prof. Ahmed Jellal**, Chouaib Doukkali University, Morocco |
| **Session Chairs:** Prof. Redouane Mghaiouini and Prof. Said Amrane | |
| 9:45 – 10:30 | **Conference 5:** Innovation, a Pillar of Resilience and Industrial Sovereignty<br>**Dr. Khalid Mnawer,** Manager of SITELECM Entreprise, Morocco |

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| **Session Chairs:** Prof. Wissam Jenkal and Prof. Chouaib Ennawaoui | |
| 10:30 – 11:15 | **Conference 6:** Development and application of Hybrid photovoltaic-thermal solar systems<br>**Prof. Monica Siroux**, University of Strasbourg, France |
| 11:15 – 11:45 | Coffee Break / Poster Session |
| 11:45 – 12:45 | Oral Session 4 |
| 14:00 – 15:00 | Lunch Break |
| 15:00 – 15:45 | **Conference 7:** Advanced Control and Energy Storage Integration for Sustainable Maritime Electrification: Insights from the AENEAS Horizon Europe Project<br>**Prof. Kamal Tariq**, Vaasa University, Finland |
| 15:45 – 16:45 | Oral Session 5 |
| 16:45 – 17:15 | Coffee Break / Poster Session |
| 17:15 – 18:15 | Closing Ceremony |

# ICRAEEE 2025

# Abstracts

## Table of Contents

ID001

# Seasonal dynamics of heavy metals accumulation in natural and man-made water bodies in the mining district

Vasyl Popovych[1*], Oleh Tyndyk[1], and Nataliia Popovych[2]

[1]*Lviv State University of Life Safety, 35 Kleparivska St., 79007 Lviv, Ukraine*
[2]*Lviv District Administrative Court, 2 Cholovsky, 79018 Lviv, Ukraine*

**Abstract:**
Mining activities obviously change the environmental safety of the region and create irreversible changes in natural landscapes. Besides the mine's operation, emissions of smoke gases and combustion products, devastation of fertile lands, destruction of soil genetic horizons, discharge of waste water into water bodies, subsidence of the earth's surface, and waste piles, mining also contaminates soil, vegetation, surface and groundwater, including rivers, with heavy metals. Once ingested by the human body, heavy metals cause serious consequences for human health. The research paper analyzes the heavy metal pollution of water bodies within the mining district. The following tasks were performed to achieve the objective: according to scientific and literary sources, the relevance of the selected research was analyzed as sampling sites were established for the most accurate study of the pollution level; the radiation background in the mining area was measured; sampling of water by seasons was carried out and the level. It was found that the content of heavy metals in river water is significantly lower than in the water of man-made reservoirs.

**Keywords:**
heavy metals, chemical pollution, ecotope, environmental safety.

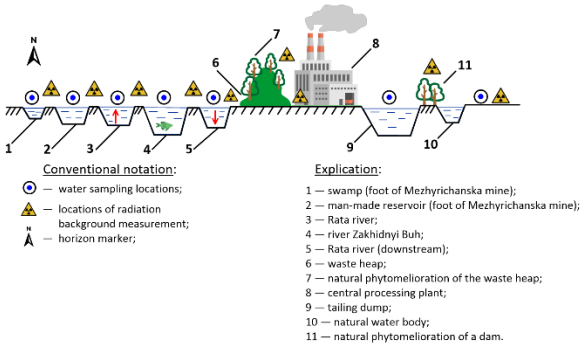


**Fig. 1:** Horizontal structure of the mining area with locations of the research sites

**References:**

[1] V. Skrobala et al. (2022). Chemical pollution peculiarities of the Nadiya mine rock dumps in the Chervonohrad Mining District, Ukraine. *Mining of Mineral Deposits*, **16**(4), 71–79.
[2] M. Petlovanyi et al. (2023). Influence of waste rock dump placement on the geomechanical state of underground mine workings. IOP Conference Series, **1156**(1), 012007.
[3] V. Kumar et al. (2020). A review of ecological risk assessment and associated health risks with heavy metals in sediment from India. *International Journal of Sediment Research*, **35**(5), 516–526.

*1st Author Biography*

*Vasyl Popovych, Doctor of Technical Sciences, professor of Lviv State University of Life Safety. The scope of his scientific research is focused on the impact of coal mine and landfill waste dumps on the hydrosphere, atmosphere and biota. He is also actively involved in research into the impact of forest fires on the environment. He actively participates in conferences of various levels, where he raises issues of environmental conservation and the implementation of nature protection systems.*

***Corresponding author:** popovich2007@gmail.com*

ID002

# Research on Benchmarking of Physical Vapor Deposition (PVD Coating) Equipment

Ying Wang[1,2], Rui Han[1,2*], Jingying Li[1,2] and Mingwei Sun[3]

[1] *China Productivity Center for Machinery Co., Ltd., Beijing, 100044, China*
[2] *Yanqi Lake Institute of Basic Manufacturing Technology Research Co., Ltd., Beijing, 100044, China*
[3] *China Academy of Machinery Science and Technology Group Co., Ltd., Beijing, 100044, China*

## Abstract :

Physical vapor deposition (PVD), as an advanced surface engineering technology, has been widely used in the industrial field due to its ability to deposit high-quality and high-performance thin films and coatings. This article conducted a benchmarking study on different PVD coating equipment, analyzing their technical characteristics, performance advantages and disadvantages, and application prospects. Through in-depth exploration of the basic concepts, common process types, and wide applications of PVD coating technology in different fields, as well as comparative analysis of R&D investment, technological level, and R&D models of PVD coating equipment in China and internationally, the current gaps and advantages are revealed. At the same time, the key factors affecting the performance of PVD coating equipment were deeply explored, including vacuum technology, heating source technology, coating materials, and other aspects. We have studied the driving role of relevant policies and looked forward to the future development trend of PVD coating equipment, providing theoretical basis and technical reference for equipment selection in actual industrial production.

## Keywords:

Physical Vapor Deposition (PVD), Coating equipment, Vacuum technology, Heating source technology, Coating material.

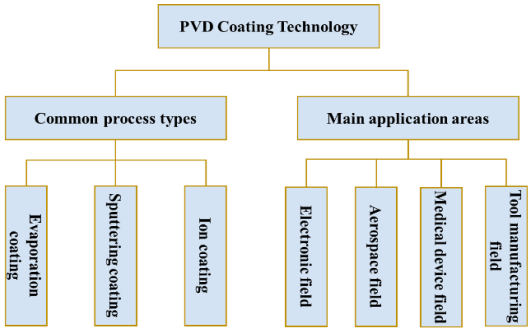


**Fig. 1:** Common process types and main application areas of PVD coating technology

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[5] Physical vapor deposition technology and application [M], Fuzhen Wang and Wencun Ma, Mechanical Industry Press, 2007.
[6] Advances in the preparation of high-entropy nitride coatings by physical vapor deposition. Cheng Chi, Chaoqian Guo, Haiqing Li, Jianwei LI, Shuaijie Qu, Cheng Zhang, Songsheng Lin. Plating and Finishing, 2023(03).

*1st Author Biography*

*Ying Wang, a senior engineer, graduated from Beihang University. She has conducted research and made in-depth explorations in the fields of intelligent manufacturing, green design, and green manufacturing. With her professional knowledge in green design and equipment manufacturing, she actively contributes to publications and conferences, aiming to promote the development of PVD coating equipment.*

***Corresponding author:** hanrui_harry@qq.com*

ID005

# Triple Cation Halide perovskites: Enhancing Stability and Efficiency in Next-Generation Solar Cells

Nadia Ouassa[1*], Lhoussine Limouny[1]

[1]*ENIM, LSTI, Physics Department, Faculty of Sciences and Technics Errachidia, Moulay Ismail University of Meknes*

**Abstract :**

Perovskite solar cells (PSCs) have gained significant attention as a promising photovoltaic technology, offering high power conversion efficiency (PCE), costeffectiveness, and ease of fabrication. Their outstanding optoelectronic properties, such as a tunable bandgap, high absorption coefficient, extended carrier diffusion length, and low exciton binding energy, contribute to their rapid advancement and potential for commercial application., contribute to their rapid development. Recent advancements in perovskite compositions, particularly triple cation halide perovskites, have led to enhanced stability and efficiency, addressing some of the key challenges associated with PSCs, such as moisture sensitivity and thermal degradation. Despite these improvements, further research is needed to optimize device longevity and scalability for commercial applications. This paper explores the latest progress in perovskite solar cells, focusing on material innovations, device engineering strategies, and stability enhancement techniques to accelerate their transition from laboratory research to industrial deployment.

**Keywords:**

Solar cell, triple cation halid, perovskite, power conversion efficiency

**References:**

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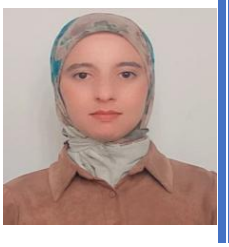
*1st Author Biography*



Nadia Ouassa, a Ph.D. student at the Faculty of Sciences and Technics Errachidia, Moulay Ismail University of Meknes, specializing in Numerical Optimization of the Performance and Stability of Perovskite-Based Solar Cells. She holds a Master's degree in Solar Technologies and has gained extensive expertise in photovoltaics and renewable energy systems. Her research focuses on enhancing the efficiency and stability of solar cells, leveraging advanced numerical modeling techniques.

***Corresponding author:** na.ouassa@edu.umi.ac.ma

ID006

# Electronic Transport in Topological Semimetals: Novel Mechanisms and Technological Potential

Lhoussine Limouny[1*]

[1]*ENIM, LSTI, Physics Department, Faculty of Sciences and Technics Errachidia, Moulay Ismail University of Meknes.*

**Abstract :**

Topological semimetals have emerged as a fascinating class of quantum materials, exhibiting unconventional electronic conduction properties governed by their unique band topology. Unlike conventional semimetals, topological semimetals such as Dirac, Weyl, and nodal-line semimetals—possess protected band crossings that give rise to exotic transport phenomena, including high carrier mobility, chiral anomaly-induced negative magnetoresistance, and anomalous Hall effects. Recent studies have focused on the interplay between topology and external perturbations, such as magnetic fields, pressure, and strain, to manipulate their conduction properties for potential applications in spintronics and low-power electronics. Advances in experimental techniques, including angle-resolved photoemission spectroscopy (ARPES) and quantum transport measurements, have provided deeper insights into the electronic structure and carrier dynamics of these materials. This study explores the fundamental conduction mechanisms in topological semimetals, highlighting recent discoveries, theoretical advancements, and their implications for next-generation electronic and quantum technologies.

**Keywords:**

Topological semimetal, Quantum materials, Electronic transport, Band gap, Dirac semimetal.

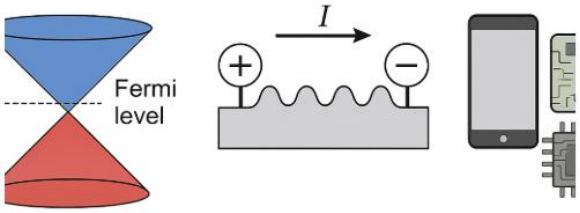



**Fig. 1:** Transport mechanisms and device applications

**References:**

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*1st Author Biography*

*Lhoussine Limouny,* is a professor specializing in materials science, Eectronics and Condenssed Matter. *Limouny currently works at the Physics Departement, Faculty of Sciences and Technology, Moulay Ismail University.*

***Corresponding author:** l.limouny@umi.ac.ma*

ID007

# Denoising abnormal and normal biomedical signal using optimal wavelet transform

Fatima Ezahrae Belkadi[1*], Samir Elouaham[1]

[1]*LISTI, National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco*

**Abstract :**

Numerous neuromuscular problems can be diagnosed thanks to the commonly used technique of electromyography (EMG), which analyzes muscle impulses. However, it can be challenging to discern between normal and diseased signals, especially in cases of myopathy, because EMG data are frequently tainted by undesired noise, such as motion distortions, power line interference, and background noise. Therefore, efficient denoising is necessary to guarantee accurate and dependable analysis. In this respect, the Optimal Wavelet technique constitutes an effective method for noise reduction while maintaining the physiological attributes of the signal. In order to reduce signal distortion, this technique applies modified thresholds and adaptively selects the best wavelets. This study assesses the efficacy of the Optimal Wavelet methodology in enhancing the quality of normal and myopathic EMG signals, juxtaposing its performance with other traditional denoising methods. According to the results, the signal-to-noise ratio has significantly improved, which makes it easier to diagnose muscular problems and improves the interpretation of EMG data.

**Keywords:**

Electromyography (EMG), Denoising, Optimal Wavelet, Normal and Myopathic Signals, Signal-to-Noise Ratio

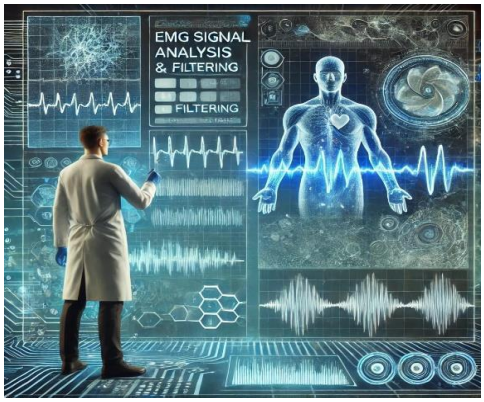


**Fig. 1:** EMG Signal Filtering and Analysis

**References:**

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*1st Author Biography*

Fatima-ezahrae Belkadi, a Ph.D. student at Ibn Zohr University, specializes in Systems Engineering and Information Technologies. Her research focuses on Machine Learning Approach for the Preprocessing and Time-Frequency Analysis of EMG Signals to Detect Muscle Anomalies.

***Corresponding author:** fatima-ezahrae.belkadi.88@edu.uiz.ac.ma*

ID008

# Performance Analysis of VMD for Phonocardiogram (PCG) Signal Processing

Jamal Isknan[1*], Samir Elouaham[1]

[1]*LISTI, National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco*

**Abstract :**

Heart murmurs are biosignals used for early diagnosis of cardiovascular diseases. Digital heart sound recordings called phonocardiograms (PCG) are essential for identifying and automatically classifying possible heart diseases, leading to more efficient and accurate diagnosis. Variational mode decomposition (VMD) is an advanced signal processing technique that can decompose broadband signals into multiple narrowband components and improve feature extraction. However, there are challenges in selecting the appropriate number of modes and penalty coefficients, which can affect the accuracy of the decomposition. To address this issue, empirical mode decomposition (EMD) was proposed to extract sub-band signals as eigenmodes. Discrete wavelet transform (DWT) is also used to improve signal analysis and noise reduction The results show that VMD is an innovative method that provides superior performance and is a more effective solution due to its lower RMSE error compared to other methods. This makes VMD a promising tool for improving heart sound analysis and early detection of cardiovascular diseases.

**Keywords:**

Phonocardiograms (PCG), Variational mode decomposition (VMD), Empirical mode decomposition (EMD), Discrete wavelet transform (DWT).

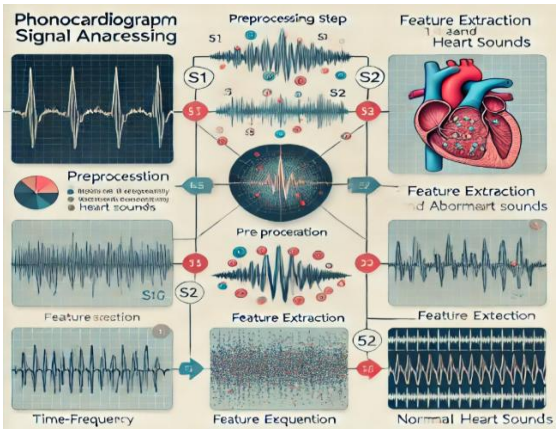


**Fig. 1:** Phonocardiogram (PCG) Signal Processing

**References:**

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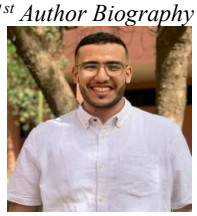
*1st Author Biography*



*Jamal Isknan, a Ph.D. student at Ibn Zohr University, specializes in Electrical Engineer. Her research focuses on Phonocardiogram (PCG) Signal Analysis and Processing*

***Corresponding author:** jamal.isknan.82@edu.uiz.ac.ma*

# ID009

## Denoising and compression ECG signal with empirical wavelet transform

Boujemaa Nassiri[1], Samir Elouaham[2*]

[1]*LISTI, National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco*
[2]*LIDRA InterDisciplinary Applied Research Laboratory, International University of Agadir – Universiapolis, Agadir, Morocco*

**Abstract :**
ECG noise can have a substantial impact on how medical professionals interpret ECG recordings, particularly when it overlaps with the QRS complex and is challenging to eliminate. The algorithms used to assess noise-removal techniques are often produced by introducing noise to noise-free ECG records, so creating intentionally contaminated signals. The SimEMG database, which includes both EMG-noise-free and EMG-contaminated ECG signals, is utilized in this situation. Utilizing the SimEMG database, the study assesses how efficiently EWT in cancellation eliminate actual EMG impurities and other noise artifacts from the recorded ECG signals. The results show that the used technique is effective in eliminating EMG artifacts and improving the ECG signal.
**Keywords:** ECG. EWT, QRS, EMG.

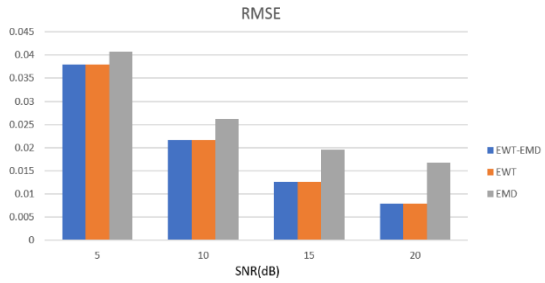



**Fig. 1:** RMSE results: normal EMG signal

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*1st Author Biography*

*Boujemaa Nassiri:was born in El Jadida, Morocco on January 1, 1974. He received a Master's degree in electronic systems and a Ph.D. degree in data processing, in 2009 and 2015, respectively, from Ibn Zohr University, Agadir, Morocco. He received the degree of ability. His research interests include biomedical signal and image processing, as well as information processing. He is the head of the Smart Grid and Artificial Intelligence team, InterDisciplinary Applied Research Laboratory Within Polytechnic School, International University of Agadir - Morroco.*

***Corresponding author:** Boujemaa.nassiri@e-polytechnique.ma*

ID010

# Memory Characteristics and Shape Reversibility in Shape Memory Alloys

Osman Adiguzel

*Firat University, Department of Physics, Elazig, Turkey*

**Abstract:**
Shape memory alloys take place in a class of advanced smart materials by exhibiting dual memory characteristics, shape memory effect and superelasticity. Shape memory effect is initiated with thermomechanical processes on cooling and deformation and performed thermally on heating and cooling, with which shape of the material cycles between original and deformed shapes in reversible way, and this behavior can be called thermoelasticity. Shape memory effect is governed by crystallographic transformations, thermal and stress induced martensitic transformations. Thermal induced martensitic transformation occurs on cooling with cooperative movement of atoms in <110 >-type directions on {110}-type plane of austenite matrix, along with lattice twinning and ordered parent phase structures turn into the twinned martensite structures, and twinned structures turn into detwinned martensite structures by means of stress induced martensitic transformations with deformation. Superelasticity is performed with stressing and releasing the material in elasticity limit at a constant temperature in the parent austenite phase region, and shape recovery occurs immediately upon releasing, by exhibiting elastic material behavior. Superelasticity is also result of stress induced martensitic transformation, and the ordered parent phase structures turn into the detwinned martensite structures with stressing. Copper based alloys exhibit this property in metastable β-phase region. Lattice twinning is not uniform in these alloys, and the ordered parent phase structures undergo the layered structures with martensitic transformation. In the present contribution, x-ray and electron diffraction studies were carried out on ternary copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections. Critical transformation temperatures of these alloys are over the room temperature. X-ray diffractograms taken in a long-time interval show that locations and intensities of diffraction peaks change with the aging time at room temperature, and this result refers to the redistribution of atoms in diffusive manner.
**Keywords:** Shape memory effect, martensitic transformation, thermoelasticity, superelasticity, twinning, detwinning

*Author Biography*

Dr. Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He studied at Surrey University, Guildford, UK, as a post-doctoral research scientist in 1986-1987, and studies were focused on shape memory effect in alloys. He worked as research assistant, in 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980. He became professor in 1996, and he has been retired on November 28, 2019, due to the age limit of 67, following academic life of 45 years. He supervised 5 PhD- theses and 3 M. Sc- theses and published over 80 papers in international and national journals; He joined over 200 conferences and symposia in international and national level as participant, invited speaker or keynote speaker with contributions of oral or poster. He served the program chair or conference chair/co-chair in some of these activities. Also, he joined over 230 online conferences in the same way in pandemic period of 2020-2024. Dr. Adiguzel received a certificate awarded to him and his group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

*Email:* oadiguzel@firat.edu.tr

ID011

# Modeling and Control of a Photovoltaic System Connected to an Electrical Grid

Hamza Kamel[1*], Fatima Id Ouissaaden[1], Fahd Elmourabit[1], Abdelaziz Khoukh[1] and Said Dlimi[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication (LSTIC), Physic department, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000 Morocco*

## Abstract :

In this paper we present a comprehensive energy management approach for networked photovoltaic (PV) systems to optimize energy production, distribution, and storage. The proposed system integrates real-time monitoring, smart energy allocation algorithms, and grid interaction to ensure efficient utilization of solar energy while minimizing energy losses. Advanced predictive models are employed to forecast energy generation and consumption patterns, enabling proactive decision-making. The energy management strategy also addresses challenges related to variability in solar power output and the coordination of distributed energy resources. Simulation results demonstrate significant improvements in system efficiency, stability, and the potential for scalable integration into smart grid infrastructures.

## Keywords:

Energy management, Photovoltaic system, Distributed energy resources, Smart grid integration, Solar energy optimization

## References:

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*1st Author Biography*

*Hamza Kamel, has expertise in the simulation and modeling of photovoltaic systems, gained through years of research in electronics and electrical engineering as a Ph.D. candidate. Specializing in photovoltaic technologies, the author is skilled in analyzing solar panel performance, optimizing energy yields, and designing efficient energy management systems. Additionally, the author has substantial experience in utilizing software to simulate the behavior of photovoltaic systems under diverse environmental conditions.*

***Corresponding author:** kamel.hamza@ucd.ac.ma*

ID012

# Modeling and Simulation of a PV System for Water Pumping in Remote Rural Areas

Id Ouissaaden Fatima[1*], Said Dlimi[1], Hamza Kamel[1], Abdelaziz Khoukh[1], and Fahd Elmourabit[1]

[1] *Laboratory of Sciences and Technologies of information and communication (LSTIC), Physics Department, Faculty of sciences, Chouaib Doukkali University, Route ben Maachou, El Jadida 24000 Morocco*

**Abstract :**

Access to water in remote rural areas remains a significant challenge, often due to the lack of reliable energy sources for water pumping systems. This study explores the modeling and simulation of a photovoltaic (PV) system designed for water pumping applications in such areas. The proposed system consists of a PV array, a power conditioning unit, and a water pump, with an emphasis on optimizing energy conversion efficiency and system reliability. Using simulation tools, the study evaluates the impact of solar irradiance, temperature variations, and load demand on system performance. Results demonstrate that a well-sized PV system can effectively supply the required energy for water pumping, ensuring sustainable water access while minimizing operational costs and environmental impact. The findings highlight the importance of system design optimization in enhancing performance and reliability for off-grid applications.

**Keywords:**

Photovoltaic system, water pumping, rural electrification, system modeling, simulation.

**References:**

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*Id Ouissaaden Fatima*

*Id Ouissaaden Fatima, a Ph.D. student at Chouaib Doukkali University, she focuses on photovoltaic systems and renewable energy applications. Her research involves the modeling and simulation of off-grid PV pumping systems for rural areas, aiming to improve efficiency and reliability. With a solid foundation in system modeling and performance evaluation, she regularly contributes to research publications and conferences, working toward sustainable energy solutions for remote communities.*

***Corresponding author:** fati.idouiss@gmail.com*

ID013

# Modeling of Perovskite Tandem Photovoltaic Cells for Advanced Efficiency

Fahd Elmourabit[1*], Yassine Essakali[1], Said Dlimi[1], Fatima Id Ouissaaden[1], Hamza Kamel[1] and Abdelaziz Khoukh[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**

The rapid advancement of perovskite solar cells has positioned them as a promising alternative for highefficiency photovoltaic applications. Lead-based perovskites, such as $MAPbI_3$ or $CsPbI_3$, exhibit superior optoelectronic properties, making them ideal for tandem solar cell architectures. This study focuses on the modeling and optimization of lead-based perovskite tandem solar cells to achieve advanced power conversion efficiencies while ensuring structural stability and efficient charge extraction. A dual-junction tandem structure is designed, incorporating a lead-based perovskite top cell with a silicon or CIGS bottom cell to maximize spectral absorption. Numerical simulations using SCAPS-1D are conducted to analyze the impact of bandgap tuning, defect passivation, and interface engineering on device performance. The study integrates $SnO_2$ as the Electron Transport Layer (ETL) due to its high mobility and stability, and PTAA as the Hole Transport Layer (HTL) for improved charge extraction and minimal recombination losses. A tunnel recombination layer ($MoO_3$ or ITO) is introduced to facilitate efficient charge transfer between sub-cells. Simulation results demonstrate that lead-based tandem perovskite-silicon solar cells can achieve efficiencies exceeding 30%, surpassing the limitations of single-junction architectures. The study highlights the critical role of interface recombination, band alignment, and transport layer selection in achieving competitive performance with industrial photovoltaic technologies. The proposed tandem design presents a high-efficiency and scalable pathway for the next generation of photovoltaics, bridging the gap between performance, manufacturability, and energy sustainability.

**Keywords:**

Perovskite, Tandem Solar Cells, SCAPS-1D, $SnO_2$ ETL, PTAA HTL

**References:**

[1] Said Dlimi, Fatima Id Ouissaaden, Noureddine El Moussaoui, Hamza Kamel, Amine El Moutaouakil, Elhadi Baghaz, Abdelaziz Khoukh, Lhoussine Limouny, Modeling, simulation and efficiency assessment of a direct coupled water pumping PV system in semi-arid coastal areas, Energy Conversion and Management: X, **23**, 2024, 100626

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*1st Author Biography*

*Fahd Elmourabit, is a Ph.D. student at Chouaib Doukkali University, specializes in semiconductor physics and nanoelectronics. His research focuses on optimizing 2D MOSFET devices under external influences like magnetic fields. With expertise in electronic transport and device modeling, he actively contributes to publications and conferences, aiming to advance the understanding and applications of 2D semiconductor technologies*

***Corresponding author:** elmourabit.fahd@ucd.ac.ma*

ID014

# Electronic Transport Phenomena in 2D Systems: A Comprehensive Review

Yassine Essakali[1*], Fahd Elmourabit[1], Fatima Id Ouissaaden[1], Hamza Kamel[1] and Said Dlimi[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**

Two-dimensional (2D) materials, such as graphene, transition metal dichalcogenides (TMDs), and semiconductor heterostructures, exhibit unique electronic transport properties due to their reduced dimensionality and quantum effects. This review explores key transport phenomena in 2D systems, including ballistic transport, quantum Hall effects, weak and strong localization, and the role of Dirac and Weyl fermions. Additionally, emerging concepts such as spintronics, valleytronics, and moiré-engineered correlated states are discussed. We highlight recent experimental advancements and potential applications in nanoelectronics, quantum computing, and energy-efficient technologies. This comprehensive overview aims to provide insights into the fundamental and applied aspects of electronic transport in 2D materials.

**Keywords:**

2D materials, electronic transport, topological insulators, superlattices, nanoelectronics.

**References:**

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*1st Author Biography*

***Yassine Essakali, is a Ph.D student at Chouaib Doukkali University,El jadida, Morroco. Specializing He has worked on various research fields of materials science and physics, including nanoelectronics, renewable energy. Additionally, His research interest now focuses on the electronic transport in two-dimensional materials.***

****Corresponding author:** yassine.essakali@gmail.com*

ID015

# Hybrid Desalination Technologies Integrating Thermal and Electromagnetic Processes: A Review

Noura Azzi[1*], Hicham Labrim[1], Rachid El Bouayadi[1] and Redouane Mghaiouini[1,2]

[1]*Advanced Systems Engineering Laboratory , National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco*

[2]*Department of Physic condensed Matter Laboratory, Faculty of Sciences, Chouaib Doukkali University, El-jadida, Morocco*

**Abstract :**

Seawater desalination is a key solution to address the global freshwater shortage. This study aims to comprehensively review desalination methods using thermal and electromagnetic methods, highlighting the processes, benefits, and challenges associated with each. Thermal methods include techniques such as multi-stage distillation (MSF), multiple-effect distillation (MED), and mechanical vapor compression (TVC and MVC). These techniques rely on evaporation and distillation to remove salts and are effective in treating highly saline water. However, they consume large amounts of energy and suffer from problems such as limescale and corrosion. Electromagnetic technology, on the other hand, stands out as an innovative means of improving the efficiency of desalination systems. Electromagnetic fields improve the compatibility of ions in water and reduce deposits on surfaces, enhancing membrane efficiency and prolonging equipment life. Studies have shown that using these fields can reduce energy consumption and deposits. This review suggests combining the two methods may provide sustainable solutions for improving desalination efficiency and reducing environmental impacts.

**Keywords:**

Seawater desalination, Thermal methods, Electromagnetic fields

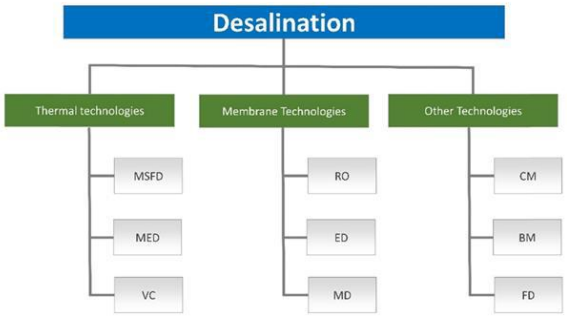


**Fig. 1:** Classification of the widely used desalination techniques

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*1st Author Biography*

*Noura Azzi, is a Ph.D. student at Ibn Tofail University, specializing in the optimization of seawater and brackish water desalination*

***Corresponding author:** noura.azzi@uit.ac.ma*

ID016

# Characterization and prediction of the Group Velocity of the Different Circumferential Waves of a Cooper Cylindrical Shell by fuzzy logic Computing Technique

Youssef Nahraoui[1], Elhoucein Aassif[2] and Samir Elouaham[3]

[1,2]Laboratoire Métrologie et Traitement de l'information, Faculté des sciences, Université Ibn Zohr, Agadir, Maroc
[3]Laboratoire d'Ingénierie des Systèmes et Technologies de l'Information- École Nationale Supérieure des Sciences Appliquées (LISTI), Université Ibn Zohr, Agadir (Maroc)

**Abstract :**
In this work, a fuzzy logic system is proposed as an appropriate solution to predict the velocity dispersion curves of the symmetric ($S_0$) and antisymmetric ($A_1$) circumferential waves propagating around an infinite length elastic cooper cylindrical shell immersed in water and it is excited perpendicularly to its axis of various radius ratio b/a (a: outer radius and b: inner radius). The group and phase velocities of highly nonlinear acoustic pressure backscattered by targets calculated from the eigenmode theory of resonances are directly related to the geometry and to the physical properties of the target; this scattering has been the subject of several studies of characterization [1, 2, 3, 4, 5]. Afterwards, they are used as data to train and to test to justify the major power of these models. This technique is able to model and to predict the group and phase velocities of the symmetric and the anti-symmetric circumferential waves, with a high precision based on different estimation errors such as mean relative error (MRE), mean absolute error (MAE) and standard error (SE). A good agreement is obtained between the output values predicted using the propose model and those computed by the eigenmode theory.

**Keywords:** Fuzzy logic system; Submerged elastic shell; Scattering waves; Circumferential waves; Group velocity

**References:**

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*1st Author Biography*

*Youssef Nahraoui, a Ph.D. at Ibn Zohr University, specializes information processing. His research focuses on application of fuzzy logic and neural networks in acoustic signals, he actively contributes to publications and conferences aimed at advancing the understanding and applications of technologies in the industrial field.*

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***Corresponding author:** nahraouissef@gmail.com*

ID017

# Teleworking, Social Isolation, and Job Satisfaction: A Moderated-Mediation Model Based on Perceived Organizational Performance

Laila Zaouel[1], Fatima Ezzahra Siragi[1]

[1]*National School of Commerce and Management, Hassan I University, Settat, Morocco*

**Abstract:**
This study examines the impact of teleworking intensity on employees' job satisfaction, focusing on the central role of perceived social isolation as a mediating mechanism, and perceived organizational performance as a moderating variable. Through an extensive systematic review of 102 studies published between 2014 and 2024, we highlight the ambivalent effects of intensive telework, particularly the negative psychosocial consequences associated with social isolation. The proposed conceptual model indicates that social isolation acts as a significant mediator, indirectly diminishing job satisfaction. However, a positive perception of organizational performance—including adequate managerial support, effective digital tools, and enhanced organizational clarity—substantially alleviates these negative effects. This research provides both theoretical and managerial implications, as well as clear empirical directions for future telework studies.

**Keywords:**
Telework, Social isolation, Job satisfaction, Perceived organizational performance, Moderated-mediation model.

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[3] Shin, J. (2025). *Impact of Telework on Job Satisfaction and Work–Family Balance. SAGE Open* (2025).

*1st Author Biography*

*Laila Zaouel is a Communication Officer at Cadi Ayyad University's Higher School of Technology in Essaouira, where she designs communication strategies and promotes academic, scientific, and cultural initiatives. A trilingual broadcaster and event facilitator in Arabic, French, and English, she fosters intercultural dialogue and multilingual exchanges. Currently a Doctoral Researcher in Management Sciences at Hassan First University – ENCG, her research examines telework as a structural transformation of organizations, focusing on its impact on managerial practices, communication, employee performance, and well-being. She bridges professional experience and academic research to provide evidence-based insights on management and organizational transformation in a digitalized world.*

**Corresponding author: la.zaouel@uca.ac.ma*

IDO19

# Sustainable development in low carbon, green energies and the environment

Abdeen Mustafa Omer[1*]
[1]Energy Research Institute (ERI), Nottingham NG7 4EU, United Kingdom

**Abstract :**
The move towards a de-carbonised world, driven partly by climate science and partly by the business opportunities it offers, will need the promotion of environmentally friendly alternatives, if an acceptable stabilisation level of atmospheric carbon dioxide is to be achieved. This requires the harnessing and use of natural resources that produce no air pollution or greenhouse gases and provides comfortable coexistence of human, livestock, and plants. This article presents a comprehensive review of energy sources, and the development of sustainable technologies to explore these energy sources. It also includes potential renewable energy technologies, efficient energy systems, energy savings techniques and other mitigation measures necessary to reduce climate changes. The article concludes with the technical status of the ground source heat pumps (GSHP) technologies.

**Keywords:**
Environment, Renewable energy resources, sustainable development, climate change

**References:**

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*1st Author Biography*

*Dr. Abdeen Mustafa Omer (BSc, MSc, PhD) is an Associate Researcher at Energy Research Institute (ERI). He obtained both his PhD degree in the Built Environment and Master of Philosophy degree in Renewable Energy Technologies from the University of Nottingham. He is qualified Mechanical Engineer with a proven track record within the water industry and renewable energy technologies. He has been graduated from University of El Menoufia, Egypt, BSc in Mechanical Engineering. His previous experience involved being a member of the research team at the National Council for Research/Energy Research Institute in Sudan and working director of research and development for National Water Equipment Manufacturing Co. Ltd., Sudan. He has been listed in the book WHO'S WHO in the World 2005, 2006, 2007 and 2010. He has published over 300 papers in peer-reviewed journals, 200 review articles, 30 books and 150 chapters in books.*

***Corresponding author:** abdeenomer2@yahoo.co.uk

ID020

# Design of a compact MIMO Antenna for 5G applications by combining DMS and DGS techniques

Aziz Dkiouak[1*], Abderrahim Mohammadi[2], Souad Akkader[3], Asmae Mimouni[4] and Abdelhafid El Farnane[5]

[1]*STIC Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*
[2]*STIC LabTIC, ENSA of Tangier Abdelmalek Essaadi University, Tangier, Morocco*
[3]*Laboratory of Engineering Sciences and Biosciences, Faculty of Sciences and Techniques, Hassan II University, Morocco*
[4]*Department of Physics, College of Science, Imam Mohammad Ibn Saud Islamic University (IMSIU), P.O. Box 90950, Riyadh 11623, Saudi Arabia.*
[5]*Laboratory of Materials, Signals, Systems and Physical Modelling, Faculty of Science, Ibn Zohr University, Morocco*

**Abstract :**
This paper introduces a miniaturized and simple multiple input multiple output (MIMO) antenna. The MIMO system is consists of two symmetrical radiating elements placed in close proximity to each other. To achieve the required 3.5 GHz operating band for 5G applications, a defected microstrip structure (DMS) with the geometry of a horizontal slot was introduced. By keeping a distance of between the two radiators, mutual coupling is avoided. A defective ground structure (DGS) with an inverted L shape to further improve the impedance bandwidth at 5G band. The antenna dimensions are 25 mm x 21 mm x 1.6 mm. In addition, a complete study of the various parameters characterizing the MIMO antenna is presented, such as envelope correlation coefficient (ECC), diversity gain (DG), total active reflection coefficient (TARC) and channel capacity loss (CCL). The antenna's small size and ease of design enable it to operate at 3.5 GHz, providing satisfactory configurations. These features make the system suitable for 5G applications.

**Keywords:** MIMO Antenna, 5G, DGS & DMS, TARC, CCL.

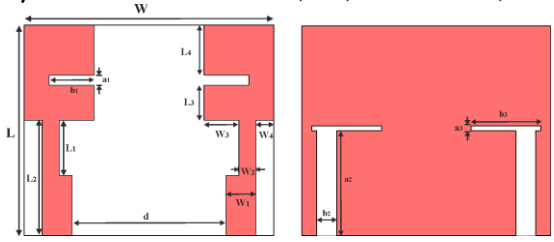


**Fig. 1:** Fig. 1. Geometry of the proposed antenna.

**References:**

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*1st Author Biography*

*Aziz Dkiouak, is a Professor and Researcher at Chouaib Doukkali University, El Jadida. He was born in September 1985, in Tayjoute town, 30 Km from Chefchaouen, Morroco. He received the PhD degree in Electronics and Telecommunications at the Faculty of Sciences, Abdelmalek Essaadi University, Tetuan, Morocco in 2020. His research interests focus mainly on printed microwave circuits and Telecommunications systems. He has authored and co-authored several papers in international refereed journals and conferences in the field of antenna and telecommunications.*

***Corresponding author:** dkiouak.aziz@ucd.ac.ma*

ID024

# Thermal insulation materials and aims for future developments

Hayate El Fokari[1*], Abderrazzak Graich[2], Mostapha Siniti[1], Redouane Mghaiouini[2,3]

[1]*Department of chemistry, Coordination and Analytical Chemistry Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[2]*Department of Physics, Condensed Matter Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[3]*Advanced Systems Engineering Laboratory, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco*

**Abstract :**

Energy conservation has become a global strategic objective, contributing to environmental protection and the preservation of natural resources. Building energy consumption for heating and cooling is considered one of the main sources of energy consumption in many countries. Therefore, suitable alternatives are constantly being sought to save energy and reduce losses. Insulation materials are the key tool in designing and constructing an energy thrifty building. This is especially true as requirements have increased, not only in terms of thermal properties, but also in terms of indoor environmental quality and environmental impact. Agricultural and/or industrial waste, and even natural fibers, are increasingly used as green insulation materials. They are an environmentally friendly and economical alternative to conventional, and their end-of-life does not pose a critical problem.

**Keywords:**

Materials, green insulation materials, thermal insulation, energy efficiency, end-of-life.


**Fig. 1:** Most common sustainable insulating materials

**References:**

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*1st Author Biography*

*EL FOKARI Hayate, a Ph.D. student at Chouaib Doukkali University, specializes in* materials *science. His research concerns Energy Efficiency, Innovative Construction Materials, and Simulating Thermal Performances of Buildings.*

***Corresponding author:** elfokari.h882@ucd.ac.ma*

ID025

# New Frontiers in Civil Engineering: Valorization, Magnetization, and Green Materials

Redouane Mghaiouini [1, 2*], Rachid EL Bouayadi[1], Driss El Hachmi[5], Hicham Labrim[1]

[1]*Advanced Systems Engineering Laboratory, NSAS, Ibn Tofail University, Morocco.*
[2] *Condensed Matter Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[3] *Laboratory of Materials, Membranes, and Nanotechnology, FS, Moulay Ismail University, Morocco.*
[4] *Laboratory of Engineering Sciences for Energy (LabSIPE), NSAS, Chouaib Doukkali University, Morocco.*
[5]*EMM Faculty of sciences, Mohammed V University in Rabat Morocco.*
[6]*Laboratory of Physical Chemistry of Applied Materials, FS Ben M'Sick, Hassan II University, Morocco.*
[7]*Molecular Modeling and Spectroscopy Research Team, FS, Chouaïb Doukkali University, Morocco.*

**Abstract :**
This study explores the application of magnetized water to enhance the mechanical properties of mortar in civil engineering. The results indicate a substantial increase of 20% to 24% in both compressive and flexural strength when compared to traditional mortar using tap water. Optimal magnetization was achieved with a 40-minute exposure time and a water flow rate of 0.6 m/s. These findings have significant implications for construction practices, offering a pathway towards improved structural performance and increased environmental sustainability through the use of magnetized water.
Chemical analyses confirm the environmental safety of all sediments, with contaminants posing no significant risk to ecosystems. By transforming dredged sediments into construction resources, this approach reduces reliance on natural aggregates, minimizes waste, and aligns with sustainable port management practices. Further research should focus on mechanical performance validation and pilot-scale implementation to advance industrial adoption.

**Keywords:**
Magnetized Water, Mortar Strength, Civil Engineering, Sustainability

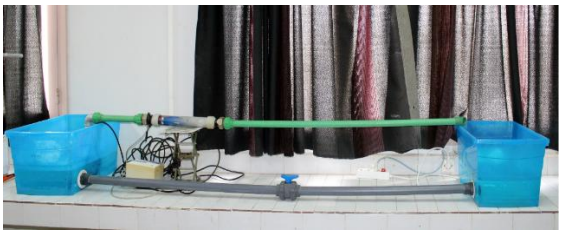

**Fig. 1**: Magnetic water production device

*1st Author Biography*

*I am a renowned professor specializing in materials science, seawater desalination, CO2 cracking, and hydrogen production/storage. I work at the Department of Electrical Engineering, Networks, and Telecommunication Systems at the National School of Applied Sciences, Ibn Tofail University. My expertise encompasses innovative materials research and addressing critical issues such as freshwater access, CO2 emissions reduction, and the promotion of hydrogen as a clean energy source.*

***Corresponding author:** redouane.mghaiouini@uit.ac.ma*

ID028

# Treatment of Circumferential Waves and analysis by fuzzy subtractive clustering Technique

Youssef Narhraoui[1], Elhoucein Aasssif[2] and Samir Elouaham[3]

[1,2]*Laboratoire Métrologie et Traitement de l'information, Faculté des sciences, Université Ibn Zohr, Agadir, Maroc*
[3]*Laboratoire d'Ingénierie des Systèmes et Technologies de l'Information - École Nationale Supérieure des Sciences Appliquées (LISTI), Université Ibn Zohr, Agadir (Maroc)*

**Abstract:**
In this work, a subtractive clustering technique is proposed to predict the group velocity of antisymmetric waves ($A_{i=1,2,....}$) moving around an infinite-length copper cylindrical shell immersed in water for different radius ratios b/a (a is greater than b). These waves have been detected in the nonlinear acoustic pressure backscattered by this target, This scattering has been the subject of several scientific characterization researches [1, 2, 3, 4, 5]. These scientific researchers have shown that the group velocities of antisymmetric waves ($A_{i=1,2,....}$) are related to the physical properties and the geometry of this tube cylindrical. The values calculated from the eigenmode theory of resonances were taken as a database for the learning phase to justify the robustness of these models. The measurement of different errors such as different estimation errors such as mean relative error (MRE), mean absolute error (MAE) and standard error (SE). proves that the technique presented in this paper has shown its power to predict the group velocity of these antisymmetric waves with high accuracy. The values predicted by the proposed model and the theoretical values obtained by eigenmodes are almost equal.

**Keywords:** Fuzzy logic system; submerged elastic shell; Scattering waves; Circumferential waves; Group velocity

**References:**

[1] G. Maze, "Acoustic scattering from submerged cylinders. MIIR Im/Re: Experimental and theoretical study," J. Acoust. Soc. Amer., vol. 89, pp. 2559–2566, 1991
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[4] Maze G., Ripoche J, Visualization of acoustic scattering by elastic cylinders at low ka, J.Acoust Soc. Am. 73, 41-43 (1983).

*1st Author Biography*

***Youssef Nahraoui**, a Ph.D. at Ibn Zohr University, specializes information processing,. His research focuses on application of fuzzy logic and neural networks in acoustic signals, he actively contributes to publications and conferences aimed at advancing the understanding and applications of technologies in the industrial field.*

***Corresponding author:** nahraouissef@gmail.com*

ID30

# Failure Analysis of a New Three-Phase High-Voltage Power Supply for Microwave Generator Systems

Hayat ElKhatat[1*], Boubaker Bahni[2], Aziz Dkiouak[3], Said Dlimi[3]

[1]*Electrical Engineering Department, High School of Applied Sciences, Abdelmalek Essaadi University, Tangier, Morocco.*
[2]*Laboratory for Sustainable Innovation and Applied Research. Polytechnic school - Universiapolis Agadir, Morocco*
[3]*Laboratory of Sciences and Technologies of Information and Communication, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*

**Abstract :**
This study examines the failure mechanisms observed in a newly developed three-phase high-voltage power supply intended for microwave generator applications. High-power microwave systems operate under severe electrical, thermal, and electromagnetic constraints, making power-supply reliability a critical performance factor. The analysis focuses on the main failure modes encountered during operation, including insulation degradation, semiconductor switching faults, thermal overstress, and electromagnetic interference–induced instability. Experimental evaluations were conducted under steady-state, transient, and overloaded conditions to assess the dynamic behavior of the system and detect early signs of deterioration. Complementary numerical simulations were used to analyze electric-field distribution, component stress, and the effects of phase imbalance. Results show that transient over voltages and uneven phase loading significantly accelerate component aging, leading to reduced system stability and reliability. Based on these findings, several improvements are proposed, such as enhanced insulation materials, optimized filtering stages, and continuous monitoring of critical parameters. The study provides practical insights for improving the robustness and service life of high-voltage power supplies in modern microwave generator systems.

**Keywords:** High-voltage power supply, Microwave generators, Failure analysis, Three-phase systems, Insulation breakdown, Power electronics reliability.

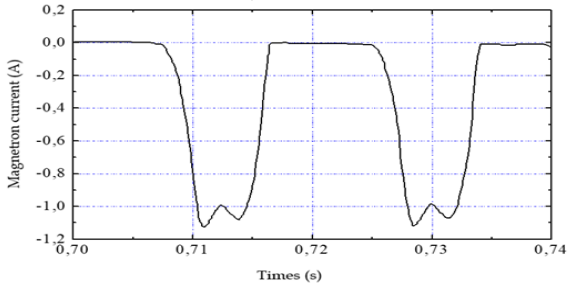


**Fig. 1:** Experimental time-domain waveform of the magnetron current of a single-phase high-voltage power supply for one magnetron per phase

**References:**

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[2] Kazimierczuk, M. K. *High-Frequency Power Supplies: Design, Analysis, and Applications.* Wiley, 2015.
[3] Wu, B., & Narimani, M. *High-Power Converters and AC Drives.* Wiley-IEEE Press, 2017.

*1st Author Biography*

***Dr. Hayat Elkhatat**, is a Ph.D. graduate in Electrical Engineering from Abdelmalek Essaâdi University, Morocco. My expertise lies in the analysis and optimization of magnetic circuits, with a particular focus on designing more efficient and adaptable transformers. My research combines advanced modeling techniques, electromagnetic theory, and material characterization to improve energy conversion systems. I actively contribute to scientific publications and conferences, aiming to advance sustainable and high-performance electrical technologies.*

***Corresponding author:** hayatt.elkhatat@gmail.com*

ID035

# Sustainable mortars based on industrial sludge for energy-efficient building applications

El Mokhtar El Hafidi[1*], Abdelhadi Mortadi[2], El Ghaouti Chahid[3], Said Laasri[3]

[1]*Laboratory of Engineering Science for energy (labSIPE) ENSA, Chouaib Doukkali University, El Jadida, Morocco.*
[2]*Laboratory Physics of Condensed Matter (LPMC). Chouaib Doukkali University, El Jadida, Morocco.*
[3]*Polydisciplinary faculty of Sidi bennour, Chouaib Doukkali University, El Jadida, Morocco.*

**Abstract :**
The construction sector is under growing pressure to advance both sustainability and energy performance due to its considerable environmental footprint. This research explores the feasibility of incorporating sludge generated from industrial wastewater treatment in detergent production as a partial replacement for cement in mortar formulations. Characterized by high levels of silica ($SiO_2$) and calcium oxide (CaO), the sludge was introduced into mortar mixtures at varying rates from 0% to 30%. The resulting mortars were assessed for mechanical behavior—specifically, compressive and flexural strengths—as well as thermophysical parameters like thermal conductivity and diffusivity. Findings reveal that replacing up to 20% of cement with sludge preserves structural performance while enhancing thermal insulation by lowering both conductivity and diffusivity. However, higher replacement ratios lead to increased porosity and a reduction in mechanical strength. This strategy provides an innovative means of repurposing industrial by-products, lowering carbon emissions, and preserving raw materials, thereby contributing to the creation of more sustainable and energy-efficient building materials.

**Keywords:**
Industrial wastewater sludge; cement substitution; mechanical properties; thermal insulation; energy efficient materials.

*1st Author Biography*

*Dr. El Mokhtar El Hafidi is a physicist specializing in materials science and renewable energy technologies. He holds a Ph.D. in Materials Physics and Energy from Chouaïb Doukkali University. His research focuses on the development and application of advanced materials for sustainable energy systems and water treatment technologies. With over 14 peer-reviewed publications, several patents, and active participation in international conferences, Dr. El Hafidi has demonstrated expertise in wastewater valorization, solar-driven desalination, and complex conductivity analysis. His interdisciplinary approach integrates experimental methods, numerical simulation, and electrochemical analysis. He is also an experienced peer reviewer for major international journals and has contributed to academic training and mentoring*

***Corresponding author:** elhafidi.e@ucd.ac.ma*

ID036

# Optimization of Ammonia Nitrogen and Color Removal from Leachate Using Kaolin

Mahmoud H. Abubakar[1*], Zaynab A. Belel[1], Sabo Bala[1], Abubakar Sadiq Mahmoud[2] and Zawawi Daud[3]

[1]*Department of Civil Engineering, Modibbo Adama University Yola, Nigeria.*
[2]*Interdisciplinary Research Center for Construction and Building Materials, King Fahd University of Petroleum and Minerals, 31261, Dhahran, Saudi Arabia*
[3]*Faculty of Civil and Built Environment Engineering, University Tun Hussein Onn Malaysia, Johor, Malaysia.*

**Abstract :**
The discharge of untreated leachate and owing to the presence of diverse constituents such as heavy metals, nutrients, inorganic matter, color, ammonia nitrogen (NH3-N), and other contaminants into aquatic environments can lead to eutrophication and the mortality of diverse aquatic organisms as well as pose a potential risk for ecological balance. The aim of the present investigation was to evaluate the adsorptive removal of ammoniacal nitrogen and color by kaolin powder using response surface methodology (RSM). A four-variable central composite design (CCD) was used to correlate the adsorption parameters (pH, adsorbent dose, shaking speed and shaking time). The morphological characteristics of the adsorbent were carried out using scanning electron microscopy (SEM). The adsorption variables were optimized using the central composite design (CCD) of RSM. The results showed that the remediation of NH3-N and color was optimum at pH 4, adsorbent dosage of 17 g/L, 125 rpm shaking speed, and 30 min shaking time. The yield of NH3-N and color removal at optimized conditions was 66% and 94%, respectively. The interaction between the adsorbent parameter was found significant ($p<0.01$). The optimized output had a desirability of 1, demonstrating the fitness of the proposed models to predict the adsorption treatment. The findings revealed the suitability and potential of the kaolin as alternative adsorbent for removal some contaminants in leachate.

**Keywords:**
Optimization, Color, NH3-N, Kaolin, Leachate.

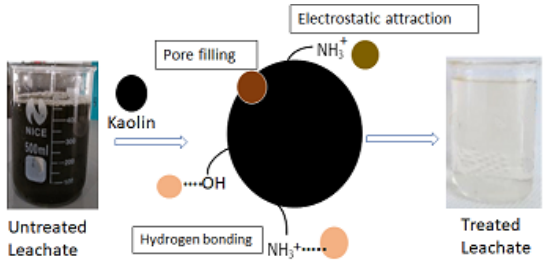


**Fig. 1:** Visualization of leachate treatment process

## References:

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*1st Author Biography*

*Mahmoud H. Abubakar, a Senior Lecturer at Modibbo Adama University, Yola, Nigeria. He specializes in water and wastewater treatment. His research focuses on water and wastewater treatment using non-conventional media. He researches to develop sustainable and environmentally friendly materials for use in water and wastewater treatment. He actively contributes to publications and conferences aimed at promoting understanding of technological advancements in sustainable water and wastewater treatment.*

***Corresponding author:** hijabmahmoud@mau.edu.ng*

ID039

# Enhancing Trust-ORBAC through Adaptive Trust Evaluation: A Survey on Identity Threat Detection Integration

Asmaa Kassid[1*], Dounia El Idrissi[2], Khalid El Khadiri[3], Najib El Kamoune[3]

[1] *Ecole Marocaine Des Sciences De L'Ingénieur Casablanca, Maroc*
[2] *ISGA Institut Supérieur d'Ingénierie et des Affaires, Maroc*
[3] *Laboratoty of STIC , Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
The dynamic and distributed environments, particularly meeting real-time security demands, pose limitations to traditional access control mechanisms due to the rapid evolution of cyber threats in this decade. Though the Trust-ORBAC model incorporates levels of trust to make access controls dynamic, the computation of trust is often done using static or historical data, making it unresponsive to real-time dangers. In this work, we review recent developments in trust evaluation mechanisms with a focus on the implementation of ITDR systems. We study the potential of behavioral anomalies, identity risk signals, and threat intelligence for the dynamic trust assessment and adaptive access control policy enforcement. This review aims at highlighting the gaps and suggesting the dynamic and responsive utilization of the Trust-ORBAC model's gap-based level of trust evaluation methodologies on the model's adaptive design to enhance model effectiveness.

**Keywords:**
Trust-ORBAC model , ITDR, Dynamic Trust Evaluation,Adaptive Security, Access Policies.

*1st Author Biography*

*Asmaa Kassid, was born in 1987 in El Jadida, Morocco. She holds a Ph.D. in Computer Science, earned through her research at the STIC Laboratory of Chouaib Doukkali University (UCD), where she focused on developing access control policies for e-learning platforms. Currently, she is a lecturer at EMSI (École Marocaine des Sciences de l'Ingénieur), where she continues to share her expertise in computer science, particularly in the fields of information systems security and online learning technologies.*

***Corresponding author:** a.kassid@emsi.ma*

ID041

# Biological and ecological features of western thuja and the role of the sum of effective temperatures in the development and growth of its cultivars

Volodymyr P. Kycheryavyj[1], Volodymyr S. Kycheryavyj[1], Vasyl Popovych[2] and Pavlo Bosak[2*]

[1] National Forestry University of Ukraine, 103 Gen. Chuprynky str., 79057 Lviv, Ukraine
[2] Lviv State University of Life Safety, 35 Kleparivska St., 79007 Lviv, Ukraine

**Abstract :**
The indicator of the sum of effective temperatures reveals the essence of ontogenetic processes that occur during the development and growth of western thuja and its cultivars introduced into the landscaping of Lviv. The characteristic features of the influence of generative and vegetative processes are highlighted, dusting is distinguished, periods and sums of effective temperatures are determined. The beginning and duration of pollination gave grounds to group the cultivars into three groups: the first group (late April – early May: *'Aureospicata', 'Brabant', 'Columna' 'Douglasii Pyramidalis', 'Globosa', 'Fastigiata', 'Filiformis' 'Malonyana', 'Pendula', 'Pyramidalis'*; the second group (end of the first decade of May): *'Smaragd', 'Spiralis'*; the third group (late second decade of May- early June): *'Holmstrup', 'Variegata' 'Wareana'*. The results of the study of generative and vegetative development of western thuja cultivars formed the basis for assessing the success of acclimatisation and introduction of plants into the landscaping of Lviv.

**Keywords:**
total effective temperatures, cultivar, vegetative and generative development, Thuja occidentalis L.

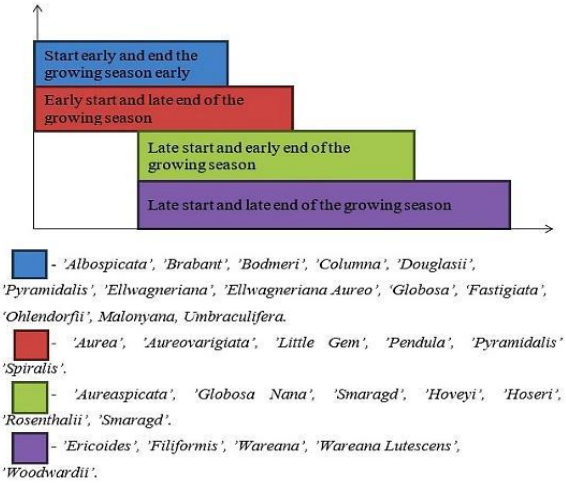


Fig. 1: Crops distribution by phenogroups

**References:**
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*2st Author Biography*

*Pavlo Bosak, Candidate of Technical Sciences, Associate Professor of Lviv State University of Life Safety. His research focuses on the formation of phytocoenoses-reclaimers in the zone of influence of coal mine dumps. He is also actively involved in researching the impact of forest fires on the environment, reclamation of disturbed lands, and the impact of technologically hazardous facilities on the environment. He actively participates in conferences of various levels, where he raises issues of environmental protection and implementation of environmental protection systems and environmental and technological safety*

***Corresponding author:** bosakp@meta.ua

ID042

# The Paradox Between Security and Privacy in TLS 1.3 Traffic

Dounia El Idrissi[1*], Asmaa Kassid[2] , Khalid Elkhadiri[3], Najib Elkamoune[3]

[1]*École Supérieure de Technologie, Université Ibn Zohr, Guelmim, Maroc*
[2]*École Marocaine des Sciences de l'Ingénieur (EMSI), Centre Casablanca, 105 et 154, Rue El Bakri, Casablanca, Maroc*
[3]*Laboratoire des Sciences et Technologies de l'Information et de la Communication (STIC), Faculté des Sciences, Université Chouaïb Doukkali, El Jadida, Maroc.*

**Abstract :**
The widespread adoption of TLS/SSL encryption establishes confidentiality as the standard for communication, effectively protecting users' privacy. However, this very protection creates a critical blind spot for traditional intrusion detection systems based on deep packet inspection (DPI), rendering these tools ineffective against fully encrypted traffic flows. The transition to TLS 1.3 and the increasing deployment of Encrypted Client Hello (ECH) exacerbate this issue by removing the last visible metadata, notably the Server Name Indication (SNI). Unlike simple data encryption, ECH represents a fundamental protocol evolution that complicates existing traffic analysis techniques. This research investigates how to identify malicious threats (command and control, data exfiltration) within fully encrypted network traffic without compromising user privacy. We first analyze the impact of TLS 1.3's novel features—Encrypted ClientHello (ECH), zero-round-trip time (0-RTT) session resumption, and Perfect Forward Secrecy (PFS)—on the effectiveness of current traffic analysis methods. We then present an overview of recent advances in TLS 1.3 traffic classification using machine learning and TLS fingerprinting, examining the advantages and limitations of each approach. Given that the large-scale deployment of TLS 1.3 remains nascent, this research fills a significant gap in scientific literature.

**Keywords:**
Innovation Encrypted traffic analysis, cybersecurity, TLS 1.3, Encrypted Client Hello (ECH), Deep Learning.

**References:**

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*1st Author Biography*

*Dounia ELIDRISSI, received a Ph.D. in Computer Networks and security from the Faculty of Sciences, University Chouaïb Doukkali, El Jadida, Morocco. Currently Associate Professor at the École Supérieure de Technologie de Guelmim, Université Ibn Zohr, Guelmim, Morocco. Her research interests include IP networks, Tunnels, IPsec, IPv6/IPv4 transition, IP mobility, LISP, Security, and Quality of Service.Higher School of Technology.*

***Corresponding author:** dounia.elidrissi@isga.ma*

ID044

# Mechanical characterization of cement-based composite materials by ultrasound

Hicham Banouni[1*], Azzedine Bita[1], Nabil Khatib[1], Mourad Derra[1], El Houssine Ouacha[1]
[1]*LMTI, Faculty of Sciences, Ibn Zohr University, Morocco*

**Abstract :**
Cement, the basis of the construction industry, is our glue for developing composite materials to obtain the mechanical properties of the resulting compounds. Ultrasound provides us with information on certain mechanical properties such as Young's modulus and Poisson's modulus. They can even track their changes during the cement's solidification. This feature is completely absent in mechanical tests, which makes our method, which is ultrasonic testing, more fruitful. In this paper we will present the evolution of Young's modulus and Poisson's modulus as a function of the solidification of a composite material based on cement paste. The extracted results show an influence of fibers on the mechanical properties of cement. This influence will appear on the final product.

**Keywords:**
Longitudinal waves velocity, transversal waves velocity, Young modulus, Poisson modulus.

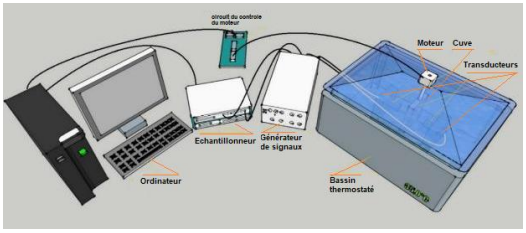


Fig. 1: The experimental process diagram

**References:**

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[2] (Nabil Khatib, 2024)
[3] (Hamid Kaddami, 2021)
[4] (Hicham Mesbah, 2025)

*1st Author Biography*

*First Author, an associate professor in Applied Sciences Faculty Ait Melloul at Ibn Zohr University, specializes in Instrumentation and signal processing. His research nondestructive control testing using ultrasonic waves*

***Corresponding author:** h.banouni@uiz.ac.ma*

ID045

# Design of Low Mutual Coupling MIMO Antenna for 2.4 GHz Using Orthogonal Polarization Diversity

Rajae Tribak[1*], Hicham Setti[1], Aziz Dkiouak[2] and Larbi Setti[1]

[1]*Research Group In Emerging And Sustainable Technologies, Faculty Polydisciplinary, Abdelmalek Essaadi University Larache, Morocco*
[2]*STIC Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract:**
This paper presents the design and simulation of a compact MIMO antenna structure optimized for operation within the 2.4 GHz frequency band, which is widely utilized in wireless applications such as Wi-Fi, Bluetooth, and various Internet of Things (IoT) devices. The proposed MIMO antenna features a novel configuration, incorporating a modified rectangular patch on a cost-effective FR-4 substrate. To improve isolation between the two antenna elements within the operating band, orthogonal polarization is employed, effectively minimizing mutual coupling and enhancing overall MIMO performance. Simulation results demonstrate excellent impedance matching at the target frequency, with a return loss $S_{11}$ of –30.57 dB around 2.4 GHz, indicating minimal reflection and efficient power transfer. The antenna exhibits stable performance across the 2–3 GHz range, with a distinct resonance peak confirming its narrowband characteristics. The envelope correlation coefficient (ECC) is observed to be near zero, indicating low signal correlation between the elements, and a high diversity gain (DG) is achieved. These results highlight the suitability of the proposed MIMO antenna for integration into modern embedded and portable wireless communication systems.

**Keywords:**
Mutual coupling, MIMO antenna, Orthogonal polarization diversity, IoT systems, ECC, DG.

**References:**

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*1st Author Biography*

*Tribak Rajaa, A Ph.D. student at the Polydisciplinary Faculty of Larache, Abdelmalek Essaâdi University, specializes in microwave engineering and antenna design. Her research focuses on the development and optimization of microstrip antennas for 5G and millimeter-wave applications. With expertise in electromagnetic simulation and high-frequency device modeling, she actively contributes to publications and conferences, aiming to advance the performance and integration of modern wireless communication systems.*

***Corresponding Author :*** *tribak.rajae@etu.uae.ac.ma*

ID048

# Four-Element MIMO Antenna System for SHFB Applications using Polarization Diversity

Aziz Dkiouak[1*], Khalid El Khadiri[1], Said Amrane[1], Abdelali El Aroudi[2] and Abderrahim Haddad[1]

[1]*STIC Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*
[2]*Department of Electronics, Electrical Engineering and Automatic Control, Universitat Rovira i Virgili, 43002 Tarragona, Spain*
[3]*LabSTIC Laboratory, National School of applied Sciences, Abdelmalek Essaadi University, Tetouan, Morocco*

**Abstract:**
This work presents a four-element multiple-input multiple-output (MIMO) antenna for super high frequency band (SHFB) applications using polarization diversity and cross-neutralization line. This structure consists of four T-shaped patches with a partial ground plan, powered by a CoPlanar Waveguide (CPW) line. The compact system is based on polarization diversity. This configuration shifts the phase of the four antennas by 90° to provide better isolation between the different antenna ports. The cross-neutralization line blocks the current flowing between the antenna elements and thus reduces mutual coupling. The suggested structure was developed with dimensions of 31 × 31 × 1.6 mm³ and achieves less than -10 dB (Sii<-10 dB) with a total bandwidth of 5.71 GHz (2.82 to 8.53 GHz), achieving an isolation of more than -10.8 dB over the desired band. Envelope correlation coefficient (ECC) <0.25 and diversity gain (DG) >9.8 dB are evaluated, as well as the antenna's radiation and diversity performance. In general, simulated, measured, and theoretical results correspond well.

**Keywords:** MIMO antenna, SHFB, polarization diversity, cross-neutralization line, envelope correlation coefficient, diversity gain.

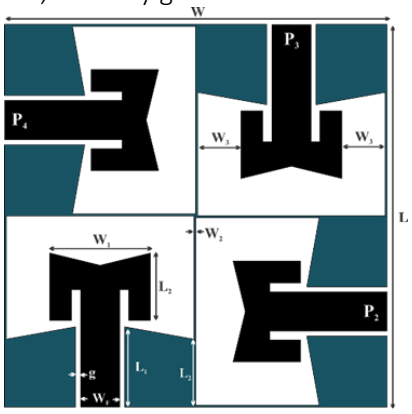


Fig. 1. Geometry of the proposed antenna.

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*1st Author Biography*

*Aziz Dkiouak, is a Professor and Researcher at Chouaib Doukkali University, El Jadida. He was born in September 1985, in Tayjoute town, 30 Km from Chefchaouen, Morroco. He received the PhD degree in Electronics and Telecommunications at the Faculty of Sciences, Abdelmalek Essaadi University, Tetuan, Morocco in 2020. His research interests focus mainly on printed microwave circuits and Telecommunications systems. He has authored and co-authored several papers in international refereed journals and conferences in the field of antenna and telecommunications.*

***Corresponding author:** dkiouak.aziz@ucd.ac.ma*

ID050

# Protecting cooling water systems from inorganic scale deposits using an environmentally friendly antiscalant: experimental and theoretical study

Mohamed El housse[1], Abdallah Hadfi[1], Ilham Karmal[1], Mustapha Nassiri[1], Sara Darbal[1], Nour Eddine Iberache[1], Imane Ammayen[1], Said Ben-aazzaa[1], M'barek Belattar[1] et Ali Driouiche[1]

[1]*Process Engineering Laboratory, Team "Materials and Physico-Chemistry of Water", Faculty of Sciences, Ibn Zohr University, Agadir, Morocco*

**Abstract :**

One of the most common problems in industrial water treatment is scale deposits in recirculating water systems, which seriously disrupt production in a variety of industries [1,2]. Conventional scale inhibitors have proven to be effective, but they are expensive and harmful for the environment. Recently, organic food waste has gained scientific attention as a resource of high-performance compounds, both for chemical and biological activity. In this context, the current study aims to investigate the scaling-inhibiting capacity of hydroalcoholic extracts obtained from food wastes from the Sous Massa region of Morocco. The anti-scale behaviour of the studied extracts is determined by means of two experimental tests (conductivity test and LCGE test) under the following experimental conditions: T=25, 35, and 45°C and TH=40°f. The inhibition mechanism was then investigated by scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR), as well as by theoretical methods such as molecular dynamics (MD) simulations and density functional theory (DFT) calculations [3]. Results show that the tested extracts had interesting inhibition properties exceeding 90%. SEM images and FTIR spectra show a change in the shape of the scale and crystalline phases obtained in the presence of the inhibitor as compared with those obtained in the absence of the inhibitor. Furthermore, theoretical calculations support experimental results. Accordingly, organic food waste can be valorized as a source of efficient eco-industrial inhibitors.

**Keywords:**

Food waste; scaling; DFT; molecular dynamics simulations

**References:**

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*1st Author Biography*

*Mohamed El housse, a Ph.D. student at Ibnou Zohr University, specializes in mineral and environmental chemistry. His research focuses on the study of scaling problems in industrial systems using eco-freindly approach. With expertise in scaling inhibition, he actively contributes to publications and conferences, aiming to protect cooling water systems from inorganic scale deposits using an environmentally friendly antiscalant using experimental and theoretical study*

***Corresponding author:** elhousse.mohamed@gmail.com*

ID051

# Novel Ring DRA for Automotive Radar Systems at 77 GHz

*Abderrahim Haddad*[1]*, *Azize Bhaij*[1], *Redouane Jouali*[2], *Karima Benkhadda*[3], *Fadwa El Moukhtafi*[1], *Mohssin Aoutoul*[1], Dlimi Said[1], *Samia Zarrik*[3], *Nabil Farhane*[4], Obbadi Abdellatif[5], *Elhadi Baghaz*[5]

[1]*STIC Lab., Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*
[2]*LTI Lab., ENSA, Chouaib Doukkali University, El Jadida, Morocco*
[3]*ETIME Lab, Faculty of Science, Ibn Tofail University, Kenitra, Morocco*
[4]*Physics, USMBA/LESSI/FSDM, Fez, Morocco*
[5]*EIE Lab., Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
In this paper, a novel Ring Dielectric Resonator Antenna (Ring DRA) with a dielectric constant of Eps = 27 is presented for Long Range Radar (LRR) applications. A simple rectangular slot is used to excite this proposed Ring DRA through a 50 Ω microstrip feed-line mechanism printed below the substrate. Our proposed Ring DRA exhibits a high gain of 9.53 dB at 77.8 GHz, along with a very high efficiency of 97% at 77 GHz. Far-field radiation pattern and return loss parameter of the structure have been investigated to determine the optimal design. The results demonstrated very low S11 values, around -30.7 dB, ensuring sufficient directional radiation pattern properties at the center frequency (77 GHz) for automotive radar systems. Parametric studies of the Ring DRA have been analyzed using CST-MW Studio Software.

**Keywords:**
Automotive Radar Systems, Ring DRA, Anti-collision radar, Long Range Radar, 77 GHz.

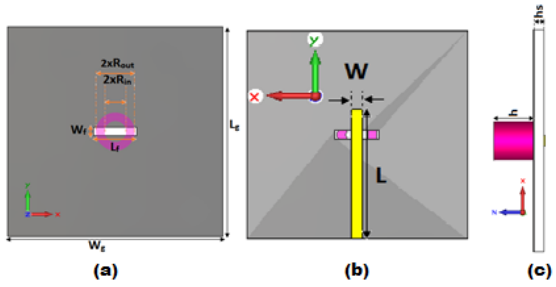


**Fig. 1:** Configuration of the proposed Ring DRA, (a) top view , (b) back view, and (c) side view.

**References:**

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1st Author biography

*Abderrahim Haddad received his PhD degree in Electronics and Telecoms in 2018 from Chouaib Doukkali University in El Jadida, Morocco. His research focuses on the design and development of Dielectric Resonator Antennas (DRAs), Microstrip Patch Antennas (MPAs), and MIMO antennas for automotive radar sensors. Additionally, he works on the design of DRAs and MPAs for 5G applications.*

***Corresponding author:** haddaddoctorat@gmail.com*

ID52

# Denoising electroencephalogram signals using TQWT

Samir Elouaham[1*] , Youssef Nahroui[1], Boujemaa Nassiri[2]

[1]*LISTI, National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco*
[2]*LIDRA InterDisciplinary Applied Research Laboratory, International University of Agadir – Universiapolis, Agadir, Morocco*

**Abstract :**
Electroencephalographic (EEG) signals provide a valuable window into human brain activity, but their analysis is complicated by the presence of various types of noise and artifacts (electrical interference, ocular movements, muscle activity, etc.). Effective preprocessing is therefore essential to ensure the integrity of the information contained in EEG signals. In this context, we propose the use of the Tunable Q-Factor Wavelet Transform (TQWT) as an advanced filtering technique. TQWT enables flexible decomposition of the signal into frequency sub-bands by adjusting the Q-factor to optimize frequency and temporal resolution according to the spectral content. This approach facilitates the isolation of characteristic brain rhythms (delta, theta, alpha, beta, gamma), while effectively attenuating unwanted artifacts. Experimental results obtained from EEG recordings demonstrate that TQWT not only improves the signal-to-noise ratio but also preserves the fine morphology of the signals, which is crucial for applications in cognitive neuroscience and brain-computer interfaces. This study highlights the potential of TQWT as a powerful tool for adaptive EEG signal filtering.
**Keywords:** EEG, TQWT, Q-factor

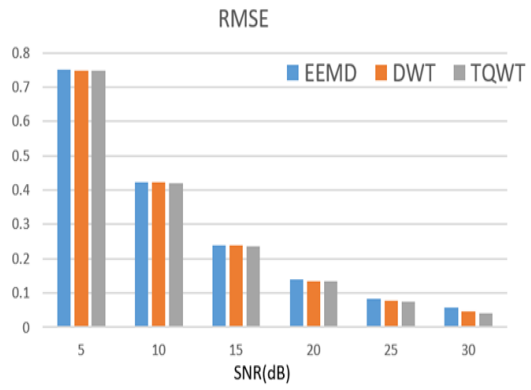


**Fig. 1:** RMSE results: EEG signal

**References:**

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*1st Author Biography*

*Samir Elouaham received a Ph.D. degree in signal processing in 2014 from Ibn Zohr University, Morocco. Currently, he is a Professor at the Department of Physics, IBNOU ZOHR University, AGADIR, Morocco*

***Corresponding author:** s.elouaham@uiz.ac.ma*

ID054

# Modeling the Outlet Temperature of a Hybrid PV-T Collector Using Artificial Neural Networks under Moroccan Saharan Climate

Bouchta Jaouad[1], Nait Alla Abderrahmane[1,2], Bouchta Said[1,2], Benshab Mouna[1]

[1]*LGEMS Energy Engineering, Materials and Systems Laboratory, ENSA, Ibn Zohr University, Agadir, Morocco*
[2]*FSAAM, Ibn Zohr University, Ait Melloul, Morocco.*

**Abstract:**
This work presents a study on a hybrid photovoltaic-thermal (PV-T) collector aimed at evaluating the influence of several environmental parameters on its electrical and thermal performance. Based on real meteorological data from the Moroccan Sahara, an Artificial Neural Network (ANN) model was developed to capture the complex nonlinear relationships between key variables such as inlet temperature, ambient temperature, solar radiation, and time. This model accurately predicts the outlet temperature of the heat transfer fluid. Its performance was assessed using the coefficient of determination ($R^2 = 0.998$) and the mean squared error (MSE = 0.085), demonstrating excellent prediction accuracy.

**Keywords:**
Hybrid PV-T, Artificial Neural Networks, Artificial Intelligence, Moroccan Sahara, Thermal prediction, Modeling, Outlet temperature

*1st Author Biography*

*BOUCHTA Jaouad, Ph.D. student at Ibn Zohr University, specializing in energy, materials, and systems. His research focuses on hybrid PV-T systems, and he is actively involved in writing scientific articles and participating in conferences.*

***Corresponding author:** jaouad.bouchta@edu.uiz.ac.ma*

ID056

# Mapping Global Research on Environmental Governance and Sustainability

Riski[1] , Eko Priyo Purnomo[2] , and Tiara Khairunnisa[3]
[1]*Department of Government Affairs and Administration, Jusuf Kalla School of Government, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia, 55183*

**Abstract :**
This research aims to identify trends, collaboration patterns, and key actors in global scientific publications related to environmental governance and sustainable development. To support the achievement of the Sustainable Development Goals (SDGs), environmental governance and sustainable development are part of the central issues in every global discourse the idea of environmental governance and sustainable development connects environmental and social issues. A bibliometric approach was used to map global developments in the study of environmental governance and sustainability. Data sources were obtained by accessing journals in the Scopus database, using the keywords "Environmental Governance" and "Sustainability", over the past decade, starting from January 01, 2015 to May 28, 2025. Analysis was conducted on relevant scientific articles and reviews, applying co-occurrence analysis techniques to identify key keywords and thematic relationships, as well as co-authorship and co-citation analysis to map collaborations and core literature. Data visualization was performed using Citespace and R-Studio software, based on recognition of their advanced functionality, especially their ability to generate thematic maps and collaboration networks. The results show that there is an increasing focus in academia on environmental and sustainability issues, a trend of growing global concern about climate change and environmental degradation, with terms such as sustainability, governance, climate change and public participation appearing frequently and closely related, suggesting that these issues are a major focus of global research.
**Keywords:** Environmental governance, Sustainability, Sustainable development, Bibliometric analysis, Research mapping

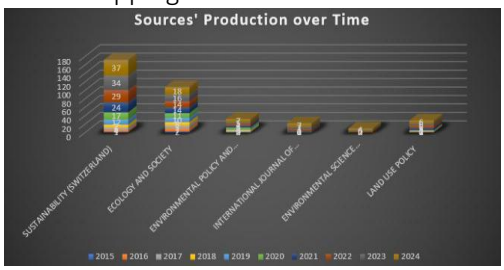


**Fig. 1:** Trends in journal source productivity from 2015 to 2025

**References:**

[1] M. Aria and C. Cuccurullo, "bibliometrix: An R-tool for comprehensive science mapping analysis," J. Informetr., vol. 11, no. 4, pp. 959–975, 2017.
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*1st Author Biography*

*Riski, is currently enrolled in the Master of Government Science program at Universitas Muhamadiyah Yogyakarta, with a specialization in Public Policy, Environmental Sustainability, and Local Government Politics. Her research is centered on the field of public policy. He has demonstrated expertise in Conflict Policy Management and has contributed to publications and conferences that aim to advance the understanding of public policy, local politics, and sustainability.*

***Corresponding author:** riskytamiang18@gmail.com

ID057

# Seasonal variability of physico-chemical parameters of water in Tamalout dam (Midelt, Morocco): Environmental implicateons

Lhoussaine Jait[1] ; Abdelkader Chahlaoui[1]; Youssef Haddadi[1]
[1]*Natural Resources Management and Development Team . Environment and Health Laboratory. Department of Biology, Faculty of Sciences, Moulay Ismaïl University, B.P.11201 Zitoune , Meknes, Morocco.*

**Abstract :**
Water quality monitoring in semi-arid regions is crucial for managing freshwater resources under increasing climatic and anthropogenic pressures. This study investigates the seasonal variability of physico-chemical parameters in the Tamalout Dam (Midelt, Morocco), a recently constructed reservoir with limited prior research. Over 2023, monthly water samples were collected from six stations, including tributaries and varying depths within the reservoir. Analyses included field measurements, laboratory testing, and multivariate statistics (Spearman correlation and Principal Component Analysis). Results reveal two dominant environmental processes: (1) geochemical mineralization driven by lithology and evaporation, reflected in elevated conductivity, salinity, and major ion concentrations; and (2) biological degradation associated with organic matter inputs, leading to moderate levels of $BOD_5$, COD, and occasional oxygen depletion at depth. Seasonal patterns showed increased stratification and hypoxia risk during summer, while nutrient levels remained low, indicating a limited risk of eutrophication. The study concludes that while water quality remains within acceptable limits, specific risks such as summer hypoxia warrant continuous monitoring. These findings contribute to baseline knowledge for sustainable management of semi-arid reservoirs and support integrated water resources strategies in Morocco's vulnerable highland ecosystems.

**Keywords:**
Tamalout Dam, Water Quality, Seasonal Variability, Principal Component Analysis (PCA), Semi-Arid Reservoirs

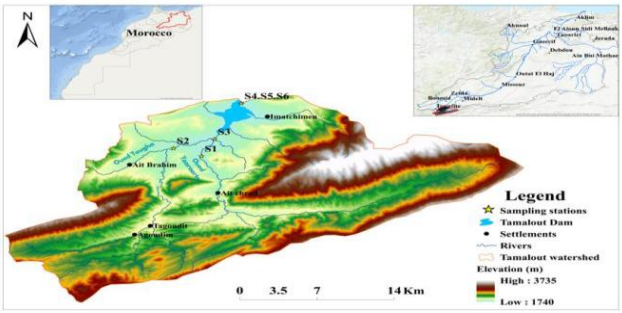


**Fig. 1:** Location map of the Tamalout Dam watershed showing the sampling stations, rivers, main settlements, and watershed boundaries.

**References:**

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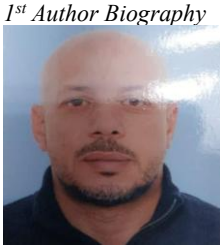

*Lhoussaine Jait is a fourth-year Ph.D. student at the Faculty of Sciences, Moulay Ismaïl University of Meknès (Morocco). His research focuses on the physico-chemical, bacteriological, and diatom-based assessment of water quality in the Tamalout Dam (Midelt province). He is particularly interested in seasonal variations, ecological indicators, and integrated water monitoring approaches in semi-arid environments.*

***Corresponding author:** lh.jait@edu.umi.ac.ma*

ID058

# Valorization of Crushed Mussel Shells in Compressed Earth Blocks: Impact on Mechanical and Thermal Properties

Chaimaa Khalil[1*], Mohamed Barbachi[1]

[1]*Laboratorry of Mechanics, Processes, Energy and Environment (LMPEE) National School of applied Science, Ibn Zohr University, Agadir, Morocco*

**Abstract :**

Natural materials such as raw earth have recently regained attention due to their availability, low environmental impact, and favorable hygrothermal properties. Consequently, earthen construction materials are being reconsidered as sustainable and affordable alternatives for addressing global housing needs. This study investigates the mechanical and thermal performance of compressed earth blocks (CEBs) incorporating crushed mussel shells (CMS) as a partial replacement material, with and without Portland cement stabilization. Two series of CEBs were produced with varying CMS contents (0%, 5%, 10%, and 15%) and compacted using a static load. Series 1 consisted of unstabilized blocks, while Series 2 included blocks stabilized with cement. The mineralogical composition of the raw soil and CMS was characterized using X-ray diffraction (XRD), while the morphology of CMS was analyzed via scanning electron microscopy (SEM). Compressive and tensile strengths were evaluated after 14 and 28 days of curing. Thermal conductivity was measured using the transient hot-disk method. The results indicate that the inclusion of CMS enhanced the thermal insulation properties of the CEBs. However, increasing CMS content was associated with a significant reduction in mechanical strength. These findings suggest that crushed mussel shells can serve as an effective thermal additive in earthen construction materials, but their use must be optimized to maintain structural integrity.

**Keywords:**

Compressed earth blocks, crushed mussel shells, mechanical behavior, thermal behavior.

**Fig. 1:** Splitting tensile test (CDE, 2000)

**References:**

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*1st Author Biography*

*Chaimaa Khalil, a researcher specializes in optimizing and analyzing sustainable building materials, focusing on stabilization methods, mechanical strength, and durability of earth blocks. Her research aims to develop eco-friendly construction solutions using local materials and responsible processes to minimize the industry's environmental impact.*

***Corresponding author:** chaimaa.khalil@edu.uiz.ac.ma

ID061

# Dissolution rate and recrystallization in Na2O- MoO3-P2O5 glasses

Lahbib Abbas[1*] and L. Bih[2]

[1]*Chemistry department, Moulay Ismail University Meknes, Faculty of Science and Technology Er-Rachidia, Morocco*
[2]*Université Moulay Ismail, Laboratoire des sciences et métiers de l'ingénieur, École nationale supérieure d'Arts et Métiers, Maroc / Email: l.Bih@ umi.ac.ma.*

**Abstract :**
Phosphate glasses have been able to establish themselves and have received renewed interest from several research teams around the world. The interest shown in phosphate glass in our laboratory contributes to the valorization of Moroccan phosphates and brings added value to the latter by diversifying their field of application. The aim of this work is to develop and study the dissolution rate and recrystallization of Na2O-MoO3- P2O5 glasses, and then carry out a structure-properties correlation of these glasses. The variation in DR as a function of Na2O alkali oxide shows that chemical durability decreases with increasing Na2O content in the glass. The increase in DR is rapid for the first additions of Na2O modifier oxide. Thereafter, there is little variation in DR for compositions relative to contents x=0.05-0.15. For higher levels of alkaline oxide, dissolution again increases significantly. We focused on chemical compositions with constant Mo/P ratios (Mo/P=1; 0.5). For each system studied, we present the results of X-ray diffraction analysis of glasses from the two families Mo/P=1 (x=0.67) and Mo/P=0.5 (x=0.5). Analysis of the X-ray diffractograms of the crystalline glass associated with the composition (y=20 mol%) shows the formation only of the NaMoPO6 phase.

**Keywords:**
Dissolution rate, recrystallization, property-structure correlation, molybdenum phosphate glasses.

*1st Author Biography*

*Lahbib Abbas, a Ph.D. qualified lecturer at Moulay Ismail University, specialises in the development and physico-chemical characterisation of vitreous and crystalline bio-materials. His research focuses on the development, characterisation and biological and mechanical properties of bio-glasses for clinical applications. Thanks to his expertise in elaboration, physico-chemical characterisation and property-structure correlation, he actively contributes to publications and conferences, with the aim of advancing the understanding and applications of biomaterials technologies.*

***Corresponding author:** l.abbas@umi.ac.ma.*

ID062

# Application of artificial neural network models for predicting wastewater treatment plant performance and effluent quality

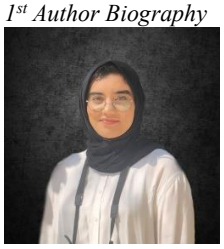
Karima Bakkali[1,2*], Fatima Elazhara[2,3], Azzedine Elmidaoui[1,2]

[1]*Laboratory of Advanced Materials and Process Engineering, Faculty of Sciences, Ibn Tofail University, P.O. Box: 1246, Kenitra – Morocco*
[2] International Water Research Institute,*Mohammed VI Polytechnic University, Ben Guerir - Morocco*
[3]*National School of Chemical Engineering, Ibn Tofail University, Kenitra - Morocco.*

**Abstract :**
In this study, artificial neural networks (ANN) were employed to monitor pollution levels and predict effluent quality and removal efficiencies in full-scale Wastewater Treatment Plants (WWTPs), aiming to minimize process disruptions and achieve cost savings through optimized operations. A Multi-Layer Perceptron (MLP) architecture, a type of feedforward neural network trained using the backpropagation algorithm, was developed to model the behavior of five key water quality indicators: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), nitrogen, and phosphorus. Separate predictive models were designed for each parameter. Two distinct MLP configurations were implemented: one with 5 hidden layers and another with 10. Model performance was evaluated using the coefficient of determination ($R^2$) and Mean Squared Error (MSE). The results showed both models achieved high predictive accuracy, with $R^2$ values from 0.91 to 0.99 for the 5-layer model and 0.95 to 0.99 for the 10- layer model, indicating excellent model fit and generalization ability. These findings highlight the robustness and efficiency of MLP models in capturing nonlinear relationships between raw influent and treated effluent quality. Such models offer a promising approach for advanced process monitoring and water quality control. They also provide a reliable framework for future research in predictive modeling, contributing to improved environmental performance and sustainable management of wastewater treatment systems.

**Keywords:**
Machine learning, Artificial neural networks, pollution, Wastewater Treatment Plant

*1st Author Biography*



*Karima BAKKALI, a Ph.D. student at Ibn Tofail University, focuses her research on the treatment and reuse of wastewater. Her research focuses on the application of artificial neural networks for monitoring pollution levels and predicting effluent quality and treatment performance in full-scale wastewater treatment plants, with the goal of optimizing operations, minimizing process disruptions, and enhancing water reuse strategies.*

***Corresponding author:** karima.bakkali@uit.ac.ma*

ID067

# Towards an Intelligent Aircraft Surface Inspection System: Image-Based Recognition and Classification of Structural Defects

Souhila Chabane[1,2,3*], Oumaima Mesbahi[2,3], Nuno Pereira Santos[2,3], Mouhydine Tlemcani[3], Jose Lourenco de Saude[1,2]

[1] *CTI Aeroespecial*
[2]*Chair in Aerospace Science and Technology CEIIA, University of Evora*
[3]*Instrumentation and Control Laboratory, Center for Sci-Tech Research in Earth System and Energy - CREATE, Escola de Ciências e Tecnologia, University of Évora*

**Abstract :**
With the ongoing growth and modernisation of the aviation industry, ensuring aircraft structural integrity is essential for maintaining safety, minimising unexpected downtime, and complying with regulations. Surface anomalies—such as corrosion, cracks, paint degradation, and mechanical deformation—can critically affect airworthiness. This study presents a comprehensive analysis and classification of surface defects by type, affected area, and material to establish a standardised Defect Classification Catalogue. This catalogue supports the creation of a structured database using Roboflow, which is used to train models for automatic defect detection and classification through advanced image processing and convolutional neural networks (CNNs). The innovation of this work lies in building a validated and standardised image dataset, grounded in a consistent terminology derived from scientific literature and industrial standards. This improves annotation accuracy and supports reliable model training.
A structured pipeline has been implemented, consisting of:

1. Image acquisition from open-source, industrial, and field sources;
2. Data augmentation (e.g., rotation, noise injection, cropping);
3. Manual annotation using the proposed classification system;
4. Expert validation to ensure precision.

To support predictive maintenance and enhance traceability, a centralised platform—Aircraft Inspection Repository (AIR)—has been developed. AIR enables interactive visualisation, central access to annotated inspection data, and facilitates integration with maintenance systems, thereby supporting informed decision-making and continuous structural monitoring.

**Keywords:**
Aircraft Inspection, Image Processing, Defect Classification Catalogue, Roboflow, Data Annotation.

*1st Author Biography*

*Souhaila Chabane, a Ph.D. Engenheira | Investigadora Principal at CTI Aerao Especial, Chair in Aerospace Science and Technology CEIIA, Instrumentation and Control Laboratory, Center for Sci-Tech Research in Earth System and Energy - CREATE, Escola de Ciências e Tecnologia, University of Evora, Portugal. Specializes in Geophysics, Materiel, aeronautics and Aerospace. This research primarily focuses on the development of an automated system for detecting and classifying aircraft surface defects using image processing and machine learning techniques. The study emphasises the creation of a standardised defect classification catalogue and a validated image dataset to train convolutional neural networks (CNNs). Additionally, it aims to enhance defect traceability and integrate inspection data into predictive maintenance workflows through the development of the Aircraft Inspection Repository (AIR).*

***Corresponding author:** souhila.chabnel@uevora.pt

ID068

# Redefining online assessment with AI: towards ethical and authentic personalisation

Kaoutar Smahi[1*], Ouidad Labouidya[1], Khalid El Khadiri[1]

[1]*STIC Laboratory ,Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
This article examines the transformations brought about by artificial intelligence in online assessment, articulating two complementary dimensions[1]. The first, 'cognitive,' aims to decipher and model learners' mental processes by carefully analysing their responses, problem-solving strategies, and interactions with assessment tools. Adaptive systems based on predictive models provide individualised feedback, highlight sticking points, and promote metacognitive development. The second, called 'authentic,' consists of reproducing high-fidelity professional or practical situations; via virtual or augmented environments, each action and each decision generates data that can be used to assess the mobilisation of procedural skills in a secure simulated context[2].However, the implementation of these innovations raises important methodological and ethical issues: it is necessary to develop consistent validity and reliability indicators in order to compare approaches, rigorously adapt protocols to disciplinary specificities, and ensure ethical governance that protects algorithmic fairness and data confidentiality. By combining cognitive rigour and contextual authenticity, this article proposes a conceptual framework that can guide the design of online assessment tools that are robust, inclusive and aligned with the skills required in the professional era.

**Keywords:**
Online assessment,Artificial intelligence,Cognitive assessment,Authentic assessment

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*1st Author Biography*

*SMAHI Kaoutar, a PhD student at Chouaib Doukkali University in Morrocco. Her areas of interest include e-learning, docimology, e-assessment techniques and quality.*

***Corresponding author: smahi.k@ucd.ac.ma***

ID071

# 1 Dimensional Residual Network Architecture for EEG Denoising

Nisrine Zaliga[1*], Samir Elouaham[1], Azzedine Dliou[1], Amine Saddik[1]

[1]*LISTI,National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco*

**Abstract :**
The purpose of this study is to introduce and evaluate a one-dimensional Residual Network designed for the denoising of electroencephalogram (EEG) signals. Through the use of the architecture's layered design and residual connections, intricate features can be captured directly from the data. This technique provides a robust, data-driven approach for removing artifacts from data. In this study, we compare the effectiveness of EEG-ResNet with three well-known signal decomposition methods: the Empirical Wavelet Transform (EWT) [1], [2], [3], Ensemble Empirical Mode Decomposition (EEMD)[4], and Improved Complete Ensemble EMD with Adaptive Noise (ICEEMDAN)[5], which decompose signal components either in the frequency domain or into intrinsic mode functions (IMFs).

**Keywords:**
EEG, Residual Neural Network, EEMD, EWT, signal denoising.

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*1st Author Biography*

*First Author, a Ph.D. student at Ibn Zohr University, specializes in Embedded Systems and Signal Processing. Her research focuses on denoising ECG and EEG signals, as well as their classification. With expertise in Embedded Systems and Computer Sciences, she actively contributes to publications and conferences, in order to advance the understanding and applications of ECG and EEG signals denoising techniques.*

***Corresponding author:** nisrine.zaliga@edu.uiz.ac.ma*

ID075

# Investigation of structural, elastic, electronic, magnetic and optical properties for the full Heusler alloy Fe2NbSn: DFT calculation and Monte Carlo simulation

A. Elhania[1]*, T. Mouhrach[1,2,3], H. Saadi[1], A. Lafhal[1,4], E. B. Choubabi[1], M. El Bouziani[1]

[1]*Team of Theoretical Physics, Laboratory L.P.M.C., Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[2]*LS2ME Laboratory, Polydisciplinary Faculty, Sultan Moulay Slimane University, 25000 Khouribga, Morocco.*
[3]*Sorbonne University, Paris Cité University, Univ Paris Est Créteil, CNRS, IRD, INRAE, Institute of Ecology and Environmental Sciences of Paris, IEES Paris, F-75005 Paris, France.*
[4]*Chouaib Doukkali University Higher School of Education and Training (ESEF) El Jadida, Morocco.*

**Abstract :**
In this study, a combined approach of density functional theory (DFT) and Monte Carlo (MC) simulations has been implemented to investigate the magnetic, electronic, elastic and optical properties of the semi-metallic Heusler alloy $Fe_2NbSn$. DFT calculations reveal a band gap of 0.926 eV in the minority spin channel, while the majority spin channel retains a metallic character, confirming the semi-metallic nature of the compound. Magnetic analysis indicates that iron (Fe) atoms are the main contributors, with a magnetic moment of 1.01 µB, while niobium (Nb) atoms exhibit a weak induced magnetic polarization of-0.17 µB; tin (Sn) atoms, meanwhile, remain non-magnetic, leading to a total magnetic moment of 2.1 µB per unit cell. The study of magnetic properties was further investigated by means of MC simulations based on the three-dimensional Ising model, enabling the evolution of magnetization, magnetic susceptibility, specific heat and Binder cumulant to be monitored, and critical exponents characteristic of the system to be extracted. The results obtained for the compound $Fe_2NbSn$ indicate similar semi-metallic behavior and a ferromagnetic-paramagnetic phase transition at a critical temperature Tc ≈ 355 K, in good agreement with experimental data. The critical exponents determined ($\alpha \approx 0.166$, $\beta \approx 0.306$, $\gamma \approx 1.218$, $\nu \approx 0.510$) are consistent with those of the three-dimensional Ising model, validating the observed universal critical behavior.

**Keywords:**
Density functional theory, Fe2NbSn Heusler, electronic properties, Wien2k, Monte Carlo simulation.

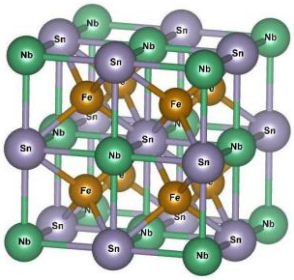


**Fig. 1:** Crystalline structure of the Fe2NbSn

**References:**
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*1st Author Biography*

*Ahmed Elhani, PhD student at Chouaib Doukkali University, specializing in the study of magnetic properties and stability of materials for applications in spintronics and magnetic refrigeration. His research relies on ab initio calculations and Monte Carlo simulations to model the magnetic behavior of materials at the atomic scale. With his expertise in numerical simulation and physical modeling, he actively contributes to publications and conferences with the aim of advancing the understanding and applications of advanced magnetic materials.*

***Corresponding author:** ahmed.elhani@ucd.ac.ma*

ID078

# A Comparative Analysis of CCUS Technologies for the Decarbonization of Concrete

Brahim Jouamai [*1], Hassan Elminor [1], Abderrahim Belabid [1]

[1] *Department of Mechanics, Materials and Civil Engineering, National School of Applied Sciences, Ibn Zohr University, Agadir 80000, Morocco*

## Abstract:

The concrete industry is a major source of $CO_2$, accounting for 37% of total emissions [1], which necessitates the development of effective decarbonization technologies to achieve global climate objectives. A key challenge is integrating carbon capture, utilization, and storage (CCUS) technologies into concrete without compromising essential material performance and energy efficiency. We conducted a comparative analysis of nine emerging CCUS technologies, categorized as mineral sequestration, bio-based additives, and engineered systems. Each pathway was evaluated for $CO_2$ sequestration efficiency, impact on mechanical strength, and potential for scalable, energy-efficient implementation. The analysis revealed a critical trade-off between carbon uptake and compressive strength. Washout-pretreated biochar demonstrated a promising balance, offering significant sequestration (150-200 kg $CO_2/m^3$) while maintaining structural-grade strength (27.6 MPa), unlike other methods that prioritized strength over carbon removal. No single technology offers a complete solution. Our findings suggest that a strategic portfolio of CCUS technologies, combining different approaches based on performance and energy requirements, presents the most viable pathway for the sectoral decarbonization of the concrete industry and provides a roadmap for targeted industrial action.

## Keywords:

Sectoral Decarbonization; Climate Mitigation; Carbon Capture Utilization and Storage (CCUS); Sustainable Construction; Carbon-Negative Concrete.

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*1st Author Biography*

*Brahim Jouamai, a Ph.D. student at Ibn Zohr University, specializes in carbon-negative concrete designed to reduce $CO_2$ emissions. His work centers on experimentally determining the optimal mix formulations and curing conditions for lime-based and pozzolan-enhanced concretes, with the ultimate goal of mitigating climate change through improved $CO_2$ sequestration in building materials. He has presented his findings at international conferences and contributed to peer-reviewed publications on sustainable construction materials.*

***Corresponding author:** brahim.jouamai.17@edu.uiz.ac.ma*

ID079

# AI-based antenna design and optimization using MOZO algorithm

Bilal Jellam[1*], Saida Ahyoud[1], Mustapha El halaoui[1]

[1]*Laboratory of Information Technology and System Modeling (TIMS), Faculty of Science, Abdelmalek Essaadi University, Tetouan, Morocco*

## Abstract:

Wireless communication has revolutionized technology in recent year's performance and capacity is affected when new smart devices arrive. the 5G technology comes with high performance antenna solutions that can deliver faster data rates, lower latency, and enhanced reliability. Printed antennas due to their low cost, compact size and ease of fabrication are becoming an essential component in 5G wireless communication systems like (massive MIMO, mm Wave…)[1]. This papers will explores the optimization of printed antennas for 5G application , focusing on the use advanced MOZO [2]technique to enhance performance metrics like bandwidth, gain, efficiency and beamforming capabilities , we will present a comprehensive study of antenna design techniques, which can significantly improve the overall performance, a multi objective optimization approach is implemented to fine tune key parameters while meeting the stringent demands of 5G network, including mm Wave frequency bands. The Simulation validation demonstrate the effectiveness of this optimization technique in achieving optimal antenna performance for 5G communication systems by using CST and MATLAB as software for simulation we can achieve better connectivity and efficiency.

## Keywords:

Millimeter-wave (mm Wave), 5G antenna optimization, printed antenna, AI.

## References:

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*1st Author Biography*

*Bilal Jellam, completed a bachelor's degree in Electronics in 2018 at the Faculty of Science, Abdelmalek Essaadi University in Tetouan. Building on this foundation, he pursued a Master in Electronics and Telecommunications, which was conferred in 2023 from the same institution. Currently, he is engaged in doctoral research at the Laboratory of Information Technology and System Modeling at the Faculty of Science, Abdelmalek Essaadi University. The focus of he's doctoral studies is on modulation and optimization of 5G antenna, highlighting a strong dedication to exploring a Abdelmalek Essaadi University advanced topics in electronics and telecommunications.*

**Corresponding author:* Bilal.jellam@etu.uae.ac.ma

ID080

# Embedded Hardware Architecture development for Electrocardiogram Signal Denoising

Bouchra Bendahane[1*], Wissam Jenkal[1], Mostafa Laaboubi[2] and Boujemaa Nassiri[3]

[1]*System Engineering and Information Technology Laboratory, National School of Applied Sciences, Ibn Zohr University, Agadir, Morocco*
[2]*Faculty of Applied Sciences, Ibn Zohr University, Ait Melloul City, Morocco*
[3]*Interdisciplinary Applied Research Laboratory, International University of Agadir - Universiapolis, Agadir, Morocco*

**Abstract :**

Numerous are the embedded systems that have been suggested to clean the ECG signal from the noises that get added during its recording. However, hardware, time, and power consumption are still challenging due to the high complexity of the considered algorithms. The DWT-ADTF is a recent low-complexity technique that has shown its performance against ECG noises. This paper presents a low-hardware and low-power DWT-ADTF-based hardware architecture providing high-quality and real-time ECG signal denoising. The denoising quality assessment is based on the MSE, PRD, and SNRimp metrics. These benchmarks are given on average for different MIT-BIH ECG arrhythmia signals which are corrupted with various colored noise at different input SNR values. The power, hardware, and time consumption, as well as processing frequency benchmarks, are used for the architectural performance evaluation. The proposed architecture provides efficient results that outperform those related to the prior DWT-ADTF architecture as well as other recent published works. Furthermore, the proposed architecture represents a suitable solution that can be adopted for real-time ECG monitoring systems.

**Keywords:**

ECG, Denoising, Embedded, Hardware, Architecture

**References:**

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*1st Author Biography*

*Bouchra Bendahane, received her master's degree in industrial computing and instrumentation engineering from Moulay Ismail University, Faculty of Sciences and Technics, Errachidia, Morocco, in 2019. She is currently preparing for her PhD degree in biomedical signal processing and embedded electronics at the System Engineering and Information Technology Laboratory, National School of Applied Sciences, Ibn Zohr University, Agadir City, Morocco. Bouchra has published several conference papers. She also supervises master's students in the themes of biomedical signal processing and embedded systems. Her research interests are electronics, signal processing, instrumentation, and embedded systems for biomedical applications.*

***Corresponding author:** bouchra.bendahanne@edu.uiz.ac.ma*

ID082

# Critical and Compensation Behaviors of a Mixed-Spin Ising System on a Two-Dimensional Graphene-like Structure

*Abdelhak Boukhal[1,*], Nabil Hachem[1] and Mohammed El Bouziani[1]*

*[1]Theoretical Physics Group, Laboratory LPMC, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract:**
This study investigates the magnetic and critical properties of a mixed spin-1/2 and spin-3/2 Ising system on a two-dimensional graphene-like structure were investigated using the mean-field approximation based on the Gibbs-Bogoliubov inequality. We studied the effects of exchange interactions, crystal field, and external magnetic field on the magnetizations and phase diagrams of the system. First- and second-order phase transitions, critical end-points and compensations temperatures were obtained for specific physical system's Hamiltonian parameters. The influence of several physical parameters on blocking temperature has also been highlighted.

**Keywords:**
Phase diagram, Magnetization, Graphene monolayer, Ising model, Mean-field

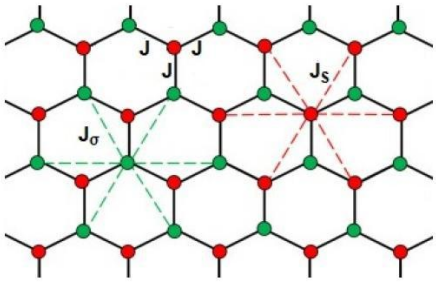


**Fig. 1:** Schematic illustration of a graphene monolayer with mixed spins σ = 1/2 (green balls) and S = 3/2 (red balls).

**References:**

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*1st Author Biography*

*Abdelhak Boukhal, is a PhD student at Chouaib Doukkali University, he specializes in materials and energetics physics. His research focuses on the magnetic properties and compensation behavior of a mixed spin 1/2 and 3/2 ferrimagnetic Ising system on a graphene-like monolayer, using the mean-field approximation. The effects of Jσ and JS exchange interactions, crystal field Δ, external magnetic field h and temperature T on the magnetizations, susceptibilities and phase diagrams of the system were studied. For the appropriate physical parameters of the system, we plotted the curves of sublattice and total magnetizations per site, as well as the total susceptibility per site.*

***Corresponding author:** boukhal.abdelhak@ucd.ac.ma*

ID083

# Enhanced reliability in smart airport lighting system modules through the integration of a rechargeable battery backup with charging circuit

Amine Derraa[1*,2], Najat Ouaaline[1] and Boujemaa Nassiri[2]

[1] *Engineering, Industrial Management and Innovation Research Laboratory, Faculty of Sciences and Techniques, Hassan 1st University, Settat, Morocco.*

[2] *Interdisciplinary Applied Research Laboratory – LIDRA, International University of Agadir – Universiapolis, Morocco.*

**Abstract:**

In order to improve operational continuity during power outages, this paper proposes the design and integration of a rechargeable battery backup system into smart airport lighting modules. This solution includes a lithium-ion cell, a specialized linear charging circuit based on the MCP73831 integrated circuit, and a diode-based power path management technique. It is suitable for applications requiring a stable 5 V/1 A power supply. To guarantee reliable performance under varying input conditions, this setup can be easily combined with an existing buck-boost converter. Experimental validation confirms stable output voltage, effective power source switching, and adequate backup duration. This solution enables the development of smart lighting systems for vital airport infrastructure that are more resilient and self-sufficient. The paper also outlines future research directions, including developing scalable energy storage systems and applying AI/ML to estimating battery health and performing predictive maintenance.

**Keywords:**

Smart Airport Lighting, Battery-Integrated Power Supply, Buck-Boost Converter, Li-ion Charging Circuit, Predictive Battery Maintenance.

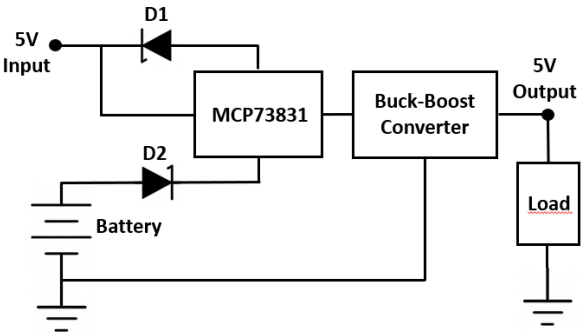


**Fig. 1:** Bloc diagram of rechargeable battery backup system into smart airport lighting

**References:**

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[3] Zhang, C., et al. (2020). A review on deep learning applications in battery management systems." Energy AI, 1, 100005.

*1st Author Biography*

*Amine Derraa, was born in Casablanca, Morocco on July 1, 1991. He received a Bachelor's degree and Master's degree in automatic, signal processing, and industrial computing engineering from Hassan 1st University, Settat, Morocco in 2013 and 2015 respectively. He is currently working towards his Ph.D. in Electronics and industrial computing at FST of Settat, University Hassan 1st, Morocco. since November 2021. His research involves the design, development, and implementation of fault detection systems for airport lighting lamps.*

***Corresponding author:** a.derraa@uhp.ac.ma*

ID086

# Reflection coefficient measurement technique for real-time monitoring of milk coagulation

*Nidae Jaafari* [1*], *Firdaous Bakkali*[1], Abdellah Amghar[1]

[1]*Laboratory of Metrology and Information Treatment, Faculty of sciences, Ibn Zohr University, BP 8106, 80000 Agadir, Morocco*

**Abstract :**
When rennet is added to milk, coagulation is monitored using a non-invasive ultrasonic method. This method is based on the analysis of the reflection coefficient of ultrasonic waves reflected by a flat layer of milk, and aims to monitor the enzymatic coagulation process. Tracking the evolution of the reflection coefficient during milk coagulation enables us to identify two distinct phases: the enzymatic phase, then the aggregation phase. It also makes it possible to accurately determine coagulation time, an essential parameter in cheese production. The study was carried out using three different rennet concentrations and temperatures, in order to evaluate the effect of these variables on the coagulation process.

**Keywords:**
ultrasonic, milk coagulation, reflection coefficient, coagulation time

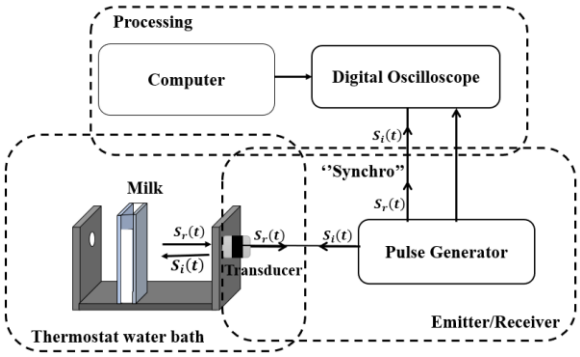


**Fig. 1:** Ultrasonic measurement system diagram.

**References:**
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*1st Author Biography*

*Jaafari Nidae has a PhD in physics, specializes in electronics and information processing, graduate of the Agadir Faculty of Science. Our research focuses on non-destructive testing using ultrasound techniques, with a particular interest in the processing of backscattered signals. She is particularly interested in monitoring the milk coagulation process and accurately determining coagulation time, a key parameter in the cheese industry.*

***Corresponding author:** nidae.jaafari@edu.uiz.ac.ma*

ID087

# Modeling and Optimization of Marine Renewable Energy Conversion Chains: Perspectives for Sustainable Production

Boubker Koudair[1], Abderrahmane Ouchatti[1], Boujemaa Nassiri[2]
[1]*Electrical Engineering Department Hassan II University FSAC, Casablanca, Morocco*
[2]*Interdisciplinary Applied Research Laboratory – LIDRA, International University of Agadir – Universiapolis, Morocco.*

**Abstract :**
This research presents an in-depth study on Marine Renewable Energies (MRE), aiming to optimize their exploitation and integration into the global energy landscape. In response to technical and economic challenges posed by the harsh marine environment, it proposes innovative solutions in the modeling and simulation of energy conversion chains, highlighting the crucial role of advanced control systems in maximizing power output. The study focuses on three main categories of MRE: Wave Energy, Tidal Energy, and Offshore Wind Energy. It details the complete energy conversion chain—from kinetic to electrical energy—with particular attention to the modeling of Permanent Magnet Synchronous Generators (PMSG) and Linear Synchronous Generators (LSG). LSGs are especially noted for their ability to directly convert linear motion into electricity, thereby simplifying the overall conversion process. Extensive simulations using MATLAB/Simulink are conducted to evaluate system behavior and optimize performance. Advanced control strategies, including Maximum Power Point Tracking (MPPT), as well as the integration of Artificial Intelligence (AI) and Machine Learning techniques, are employed to enhance energy output and ensure grid stability. This study concludes that the efficient utilization of MRE relies on robust electrical machine design, intelligent control systems, and ongoing technological innovation, all of which are essential to achieve reliable, sustainable, and large-scale electricity generation from marine sources.

**Keywords:**
Marine Renewable Energies, Wave Energy, Floating Wind Turbines, Advanced Control Systems, Artificial Intelligence

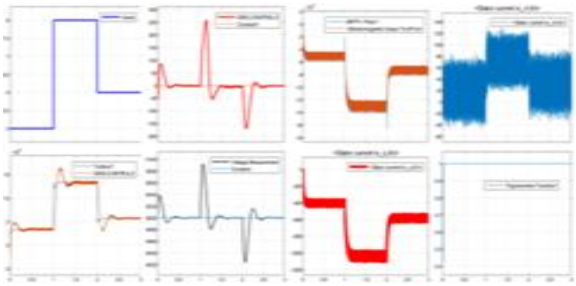

**Fig. 1:** Illustration of a portion of the results obtained

**References:**

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[3] Production d’ énergie à partir de. G. Damy, M. authier.

*1st Author Biography*

*Boubker Koudair, born on December 30, 1973, in Béni Mellal, Morocco, holds a Bachelor's degree in Electrical Engineering (1998), an Agrégation (2013), and a Research Master's degree (2023) from ENSET, Mohammed V University. Since November 2024, he has been pursuing a Ph.D. at the Faculty of Sciences Ain Chock, Hassan II University, focusing on microgrids for marine energy harvesting. His research interests include the optimization of power electronic converter control strategies and the development of efficient marine energy recovery systems.*

***Corresponding author:** koudair.boubker75@gmail.com*

ID088

# 32GHz Rhombic Microstrip Patch Antenna (RMPA) for Next Generation mmWave Systems

Karima Benkhadda[1], Sanae Habibi[1], Abderrahim Haddad[2], Fatehi ALtalqi[1], Abdelhak Bendali[1], Samia Zarrik[1], Zahra Sahel[1], Mohamed Habibi[1], Abdelkader Hadjoudja[1]

[1]*Laboratory of Electronics Treatment Information, Mechanic and Energetic, FS, Ibn Tofail University, Kenitra, Morocco*
[2]*Laboratory of Sciences and Technologies of Information and Communication, FS, Chouaib Doukkali University, Morocco*

**Abstract :**
This work presents the investigation, design, and simulation of a Rhombic Microstrip Patch Antenna (RMPA) operating at 32GHz for millimeter Wave (mmWave) 5G technology and radar systems. The proposed RMPA consists of a rhombic-shaped radiating patch etched on the top of a low loss Rogers RT5880LZ dielectric substrate, selected for its excellent performance at high frequencies. The design is optimized to achieve compact size, effective impedance matching, and high efficiency. The results demonstrate a very low S11 value of approximately-31.43 dB, a VSWR of 1.055, high gain of 7.158dBi, high directivity of 8.179 dBi, and high radiation efficiency of 87.52%. Additionally, the RMPA exhibits a wide impedance bandwidth of 8.48GHz. All simulations were performed using CST Microwave Studio software. Based on these promising results, the proposed RMPA is a strong candidate for integration into next generation mmWave systems, including 5G applications and radar sensors.

**Keywords:**
Millimeter-Wave, 5G, Bandwidth, Radar systems, VSWR.

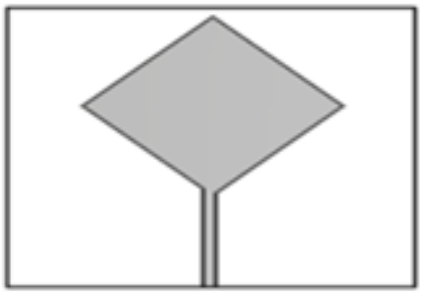

**Fig. 1:** Rhombic Microstrip patch antenna

**References:**

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*1st Author Biography*

*Karima Benkhadda, is currently a Ph.D. student in Telecommunication Systems Engineering at the University of Kenitra, Morocco. She earned her master's degree in Teaching and Training Professions in Physics-Chemistry from the same university in 2019, and her bachelor's degree in Networks and Telecoms in 2011.*

***Corresponding author:** karima.benkhadda@uit.ac.ma*

ID089

# Adaptive Cruise Control of a Thermal Engine Vehicle Using Model Predictive Control

Mohamed Bouasrya[1], Wissam Jenkal[1], Mustapha Laaboubi[1]
[1]*Laboratoire d'Ingénierie des Systèmes et Technologies de l'Information (LISTI), Ecole Nationale des Sciences Appliquées (ENSA) , Université Ibnou Zohr, Agadir, Maroc*

**Abstract :**
Adaptive Cruise Control (ACC) systems are integral to modern vehicle automation, enabling longitudinal speed regulation while maintaining safe inter-vehicular distances. However, implementing ACC in internal combustion engine (ICE) vehicles presents distinct challenges due to nonlinear throttle-brake dynamics, actuator lags, and fuel consumption constraints [4]. Addressing these issues, this paper proposes an MPC-based ACC strategy specifically designed for ICE-powered vehicles. The proposed method employs Model Predictive Control to compute optimal acceleration profiles that enforce safety constraints, minimize fuel usage, and improve ride comfort. A high-fidelity dynamic model of a thermal engine vehicle was developed, incorporating drivetrain characteristics such as torque converter behavior, gearshift delays, and braking dynamics. The control architecture integrates a modular prediction model, constraint-aware optimization, and real-time control logic for responsive adaptation to lead vehicle maneuvers. Simulation results demonstrate that the system effectively maintains a safe following distance, with a minimum time headway of 2 seconds, while achieving smooth velocity tracking and reducing aggressive actuation. Quantitative error analysis confirms the controller's precision, with RMSE in velocity tracking below 0.2 m/s and inter-vehicle spacing errors under 0.3 m. This work highlights the viability of MPC for energy-efficient and safety-compliant longitudinal control in ICE vehicles. Future extensions include comparative evaluations with PID, Fuzzy Logic, and H∞ controllers, and real-time validation through Hardware-in-the-Loop (HIL) testing.

**Keywords:**
Adaptive Cruise Control, Model Predictive Control, Internal Combustion Engine, Vehicle Automation

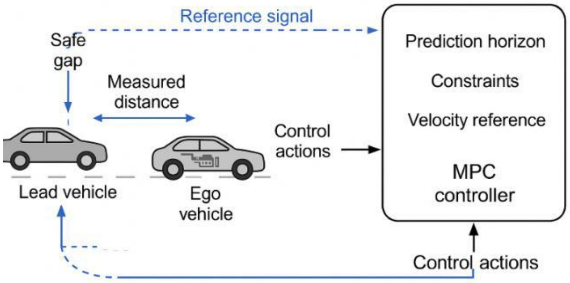


**Fig. 1:** Overview of the MPC-based ACC architecture for thermal engine vehicles.

**References:**

[1] A. Vahidi and A. Eskandarian, "Research advances in intelligent collision avoidance and adaptive cruise control," IEEE Transactions on Intelligent Transportation Systems, vol. 4, no. 3, pp. 143–153, 2003.
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*1st Author Biography*

*Mohamed Bouasrya, a Ph.D. student at the National School of Applied Sciences, Ibn Zohr University, specializes in control systems, vehicle automation, and intelligent transportation. His research focuses on the design and implementation of Adaptive Cruise Control strategies using advanced control methods such as Model Predictive Control, with an emphasis on energy optimization and crash avoidance in thermal and hybrid vehicles. With experience in simulation, embedded systems, and automotive validation, he actively contributes to academic publications and collaborative projects aiming to advance smart mobility and sustainable vehicle technologies.*

***Corresponding author:** mohamed.bouasrya.61@edu.uiz.ac.ma*

ID091

# Design and Optical Evaluation of BF2-Modified g-C3N4: Experimental Characterization, TD-DFT Insights, and Selective Metal Ion Sensing

*Soumaya Agren* [1], *Kaouther abbassi*[1], Jamal El Haskouri[2] and *Mohammed Hassen V Baouab*[1]

[1] *Laboratory of Physico-Chemistry of Innovative Materials (LR24ES16), Preparatory Institute for Engineering Studies of Monastir, University of Monastir, Avenue of the Environment, 5000 Monastir, Tunisia*
[2] *Department of Inorganic Chemistry, Instituto de Ciencias de Los Materiales de la Universitad de Valencia, Calle Catedratico José Beltran 2, 46980 Paterna, Valencia, Spain*

**Abstract:**
A novel boron difluoride-functionalized graphitic carbon nitride material (g-BF2) was synthesized via Lewis acid–base complexation to enhance the optoelectronic and sensing performance of pristine g-C3N4. Structural and morphological characterizations (FTIR, XRD, SEM, TGA) confirmed successful BF2 integration, which induced increased thermal stability (~24%) and altered surface features. TD-DFT calculations revealed electronic modifications, including bandgap narrowing (6.524 → 6.448 eV) and enhanced charge delocalization. Photophysical analyses showed a fluorescence redshift from 472 to 518 nm, indicative of intramolecular charge transfer enhancement. The g-BF2 material exhibited selective fluorescence "turn-off" sensing for $Cu^{2+}$, $Co^{2+}$, and $Ni^{2+}$ ions, with detection limits of 20.8 µM, 25.3 µM, and 35.7 µM, respectively. Binding stoichiometries were determined via Benesi–Hildebrand analysis, revealing 1:1 complex for $Cu^{2+}$/$Ni^{2+}$ and 1:2 for $Co^{2+}$. These findings highlight g-BF2 as a promising bifunctional platform for optoelectronic applications and metal ion sensing.

**Keywords:**
Modified g-C3N4; BF2 moieties; Luminescence; Theoretical calculations; Chemosensor.

*1st Author Biography*

*Soumaya Agren, an Assistant Professor. A chemistry doctor graduated from the faculty of science of university of Monastir, specializes in luminescent materials' synthesis and applications, nanomaterials and polymers' modification for catalytic applications. Her work centers on experimentally determining the optimal conditions for the synthesis of new materials following green chemistry conditions. She has presented her findings at national conferences and contributed to peer-reviewed publications on luminescence, catalysis, organic synthesis and polymers' modification.*

***Corresponding author:** soumaya-agren@outlook.fr

ID097

# Derivative Superposition-Based Linearization of a GaN Power Amplifier for 5GHz Applications

Abderrahim El Mouftih[1*], Moustapha El Bakkali[1], Naima Amar Touhmi[1] and Aziz Dkiouak[2]

[1] *Electronic and Smart Systems (ESS) Team, Intelligent Systems Design (ISD) laboratory, Faculty of Sciences, Abdelmalek Essaadi University, Tetouan, Morocco*
[2] *STIC Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
Non-linear distortions in RF power amplifiers are a major limitation in mod-ern communication systems. This paper presents a derivative superposition architecture employing a combination of common-source and common-gate transistors to reduce these non-linearities. Cosimulation results obtained from a GaN Transistor CGHV59070 fabricated by Cree Wolfspeed and Rogers Substrate validate the effectiveness of this approach, demonstrating an out-put power of 32.4 dBm and an OIP3 of 47.5 dBm at 5 GHz.

**Keywords:**
Derivative Superposition, GaN, Power Amplifier, Linearization, Wi-Fi.

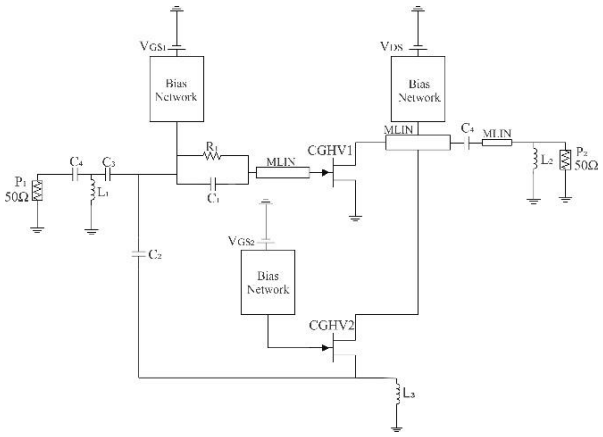


**Fig. 1:** Proposed Derivative Superposition Based Power amplifier Architecture

**References:**

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*1st Author Biography*

*Abderrahim El Mouftih, a Ph.D. student at Abdelmalek Essaadi University, specializes in Low-Noise Amplifiers and Power Amplifiers. His research focuses on optimizing the linearity of linear and nonlinear circuits with the technique of Derivative superposition. With expertise in electronics and telecommunications, he actively contributes to publications and conferences, aiming to advance in the understanding and applications of RF amplifiers.*

***Corresponding author:** abderrahim.elmouftih@etu.uae.ac.ma*

ID0100

# Hybrid Thermal and Electromagnetic Field-Assisted Desalination: A Bibliometric and Research Trends Analysis

Noura Azzi[1*], Hicham Labrim[1], Rachid El Bouayadi[1] and Redouane Mghaiouini[1,2]
[1]*Advanced Systems Engineering Laboratory , National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco*
[2]*Department of Physic condensed Matter Laboratory, Faculty of Sciences, Chouaib Doukkali University, El-jadida, Morocco*

**Abstract :**
Freshwater scarcity has become a critical global challenge, increasing the need for efficient desalination of seawater and brackish water. Desalination is essential for the survival of humans, animals, and plants. It is a critical industry for a sustainable planet, and we cannot live without water. Thermal desalination methods such as multi-effect distillation, multi-stage distillation, thermal vapor compression, and mechanical vapor compression are widely used, but are still limited by high energy consumption and pollution. This study presents a bibliometric analysis based on Elsevier's Scopus database (2019–2025) to examine research trends in thermal desalination and electromagnetic field-assisted systems. Using VOSviewer, cross-country collaboration networks and keyword evolution maps were constructed. The results indicate a growing interest in hybrid EMF-assisted desalination, with significant contributions from leading research countries. This integration provides a promising approach to improve performance, reduce energy demand, and support sustainable water resource management. Keywords: seawater desalination, brackish water, MED, MSF, TVC, MVC, electromagnetic fields, hybrid desalination.

**Keywords:**
Seawater desalination, brackish water, Thermal methods, Electromagnetic fields, hybrid desalination.

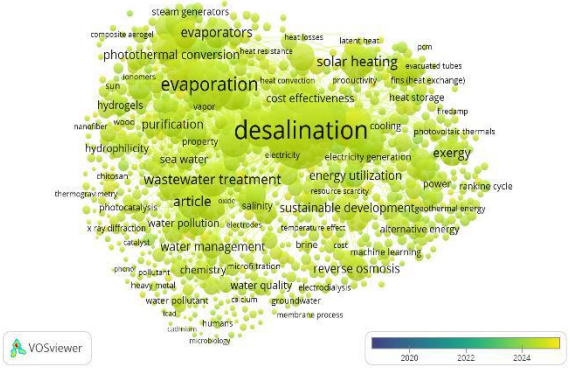


**Fig. 1:** Keyword Frequency Map on Time (VOSviewer Analysis)

**References:**

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*1st Author Biography*

*Noura Azzi, is a Ph.D. student at Ibn Tofail University, specializing in the optimization of seawater and brackish water desalination*

***Corresponding author:** noura.azzi@uit.ac.ma*

ID101

# Numerical Simulation and analysis of the n-i-p structure of the double junction

Yassine Essakali[1*], Fahd Elmourabit[1], Fatima Id Ouissaaden[1], Hamza Kamel[1] and Said Dlimi[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**

In this work, a numerical simulation is carried out to investigate the performance of a double-junction solar cell based on an n-i-p architecture. The structure consists of two subcells stacked in series, each with a tailored bandgap to efficiently absorb different regions of the solar spectrum. Using simulation tools such as SCAPS-1D, the electrical behavior of the cell is analyzed under standard AM1.5 illumination. The impact of various physical parameters such as layer thickness, doping concentration, and defect density on the current-voltage characteristics is examined. Special attention is given to the role of the intrinsic (i) layers in enhancing charge carrier separation and reducing recombination losses. The results show that optimizing the thickness and material properties of the intermediate layers can significantly improve overall cell efficiency. This study contributes to a deeper understanding of multi-junction solar cells and provides insights into design strategies for high-performance photovoltaic devices.

**Keywords:**

2D materials, electronic transport, topological insulators, superlattices, nanoelectronics.

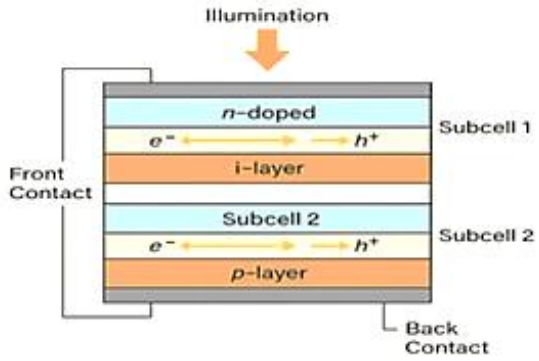


**Fig. 1:** The n-i-p structure of double junction

**References:**

[1] Green, M. A., et al. "Solar cell efficiency tables (version 60)." Prog. Photovolt: Res. Appl., vol. 30, no. 7, 2022.

[2] A. Luque, S. Hegedus (Eds.), Handbook of Photovoltaic Science and Engineering, 2nd ed., Wiley, 2011.

*1st Author Biography*

*Yassine Essakali, is a Ph.D. student at Chouaib Doukkali University, specializing in semiconductor physics, nanoelectronics, and 2D materials. His current research focuses on electronic transport phenomena in 2D nanostructures, particularly under the influence of external magnetic fields. He investigates the impact of quantum effects, defects, and interface interactions on carrier mobility and conductivity in nanoscale devices such as solar cells and field-effect transistors. With solid expertise in modeling and simulation of low-dimensional systems, he actively contributes to the development of next-generation nanoelectronic technologies.*

***Corresponding author:** yassine.essakali@gmail.com*

ID102

# Theoretical study of the effect of internal acceptors insertion on phenothiazine-based dye DSSC photoelectrical properties

Hamoud Toubbali[1*], Abdelhamid Khadiri[1], Hassan Zarrok[1], Mounir El Hezzat[1] and Abdelkader Zarrouk[2]
[1]*Laboratory of Advanced Materials and Process Engineering, Faculty of Sciences, Ibn Tofail University, P.O. Box. 133, 14000 Kenitra, Morocco.*
[2]*Laboratory of Materials, Nanotechnology and Environment, Faculty of Sciences, Mohammed V University in Rabat, Av. Ibn Battouta, PO Box 1014, Agdal-Rabat, Morocco.*

**Abstract:**
Phenothiazine (PTZ) based dyes have attracted the attention of many researchers in dye sensitized solar cells (DSSC) field. This work takes into account five novel metal-free organic sensitizers (designed based on a phenothiazine-based dye "SR1") by studying the influence of auxiliar acceptor insertion on their optoelectronic and photovoltaic properties. Theoretical study was performed by using density functional theory (DFT) and time-dependent DFT (TD-DFT) methods to investigate the geometry, HOMO and LUMO energy, the molecular electrostatic potential (MEP) and the maximum wavelength absorption (λmax). Also, the chemical parameters were calculated. The conclusion of this study shows that the insertion of various auxiliar acceptors has a positive influence on UV-vis absorption spectra and Gap energy of reference dye, which can make the designed dyes good suspect for future DSSC practical applications. Furthermore, SR1-THDP and SR1-QTHZ sensitizers have shown the best results with the lowest band gaps and the highest wavelength values.

**Keywords:**
DSSC, Phenothiazine (PTZ) based dye, Auxiliar acceptors, DFT, TD-DFT.


**Fig. 1:** Molecular electrostatic potential (MEP) maps of studied dyes

**References:**
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*1st Author Biography*

*Hamoud Toubbali, a Ph.D. student at Ibn Tofail University, specializes in material sciences and computational chemistry. His research focuses on optimizing solar cells devises, especially Dye-Sensitized Solar Cells (DSSC).*

***Corresponding author:** hamoud.toubbali@uit.ac.ma*

ID103

# Study and design of the RF part of a passive RFID tag at 900MHz frequency for the ISO 18000-6c standard

Sanae Habibi[1*], Abdelhak Bendali[1], Mohamed Habibi[1], Abdelkader Hadjoudja[1]

[1]*Laboratory of Electronic Systems, Information Processing, Mechanics and Energy, Faculty of sciences, Ibn tofail University Kenitra, Morocco*

**Abstract :**

In this paper, we present the study and design of the RF part of a passive RFID tag that must operate at the 900MHz frequency required by the ISO 18000-6c standard. The RFID tag consists of an antenna and a chip. The transponder chip is made up of three main structures that communicate with each other: an analog block, a digital block, and a memory (EEPROM, for example), as shown in figure 1. The memory contains all information relating to the tag or the product associated with it. The digital part interprets all EPC commands from the reader (EPC is a communication protocol commonly used in UHF RFID). The RF-analog front-end of the passive RFID transponder is divided into several sub-assemblies, a voltage rectifier, a demodulator, and a modulator, each with its own functionality. The rectifier (or energy recuperator) converts the radio-frequency signal coming from the antenna into a supply voltage, while the demodulator converts the RF signals received into a binary digital signal intelligible to the digital block. Finally, the retro-modulator modifies the chip impedance at regular intervals when the binary response is emitted by the digital part, transforming this response into a modulated signal thanks to the amplitude and/or phase variation of the reflected signal. All the blocks of the analog RF part are simulated using ADS (Advanced Design System) software and TSMC RF CMOS 0.18µm process library.

**Keywords:**

UHF RFID, RF front-end, Rectifier, Demodulator, Retro-modulator

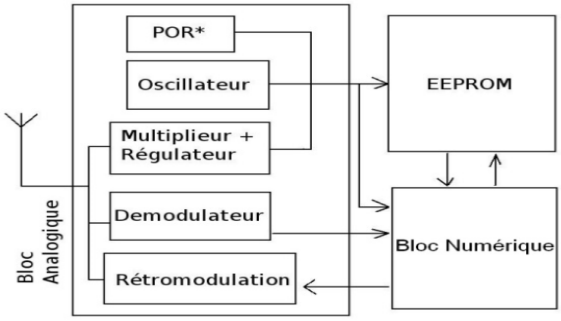


**Fig. 1:** The RF part of a passive RFID tag

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*1st Author Biography*

*Sanae Habibi, was born in 1992 in Kenitra, Morocco. In 2018, She obtained her Master's degree in embedded electronics and telecommunications systems from the Faculty of Sciences, Department of Physics, Ibn Tofail University, Kenitra, Morocco. She obtained his Thesis in Electronics and Telecommunication from the Faculty of Sciences of Kenitra, Morocco, in 2024 Member of the Laboratory of Electronic Systems, Information Processing, Mechanics and Energy at the same university, working on security of the front-end of the transmission chain for UHF RFID technologies.*

***Corresponding author:** sanae.habibi@uit.ac.ma*

ID104

# Artificial Intelligence of Things and Smart City Sustainability: Toward a Multidimensional Framework

Soukaina Ait Bahado[1], Siham Hamdani[1]
[1]*Laboratoire Interdisciplinaire de Recherche en Economie, Innovation et Mangement des Organisation ENCG Casablanca Hassan II University of Casablanca*

**Abstract:**
The integration of artificial intelligence of things (AIoT) into smart cities opens up major opportunities for sustainable urban development. This conceptual research, based on a structured exploratory review of the literature, analyzes how AIoT is redefining the opportunities, challenges, and prospects related to the sustainability of urban infrastructure. The literature remains fragmented regarding the integrated conditions for AIoT success in the service of urban sustainability, justifying the need for a multidimensional analytical framework. This framework highlights the technological, strategic, and institutional levers essential to optimizing the sustainable impact of AIoT. The results show that AIoT can improve energy efficiency, reduce pollution, and strengthen infrastructure resilience, but challenges remain, including system interoperability, secure data management, and territorial disparities. This work thus proposes an integrated approach to guide urban actors toward more adaptive and inclusive development models, in line with sustainability objectives. This contribution addresses a theoretical gap by articulating a holistic vision of AIoT in the sustainable governance of smart cities.

**Keywords:**
Smart city- AIOT- Sustainability urban development- Conceptual framework.

**References:**

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*1st Author Biography*

*Soukaina Ait Bahado, Ph.D. student at Hassan II University of Casablanca, specializing in smart cities with a focus on the integration of digital technologies and sustainable urban development. Research explores the use of advanced technologies such as artificial intelligence and the Internet of Things to improve urban management while promoting environmental sustainability.*

***Corresponding author:** soukaina.aitbahado-etu@etu.univh2c.ma*

ID107

# The environmental impact of no-tillage and conventional tillage systems in cereal production: A life cycle assessment

Imane El Bakali[1*], Imane Fadil[1], Abdelkader Ait El Mekki[2], Nassreddine Maatala[1], and Rachid Harbouze[1]

[1]*The Institute of Agronomy and Veterinary Medicine Hassan II (IAV Hassan II), Rabat, Morocco*
[2]*National School of Agriculture of Meknes (ENAM), Meknès, Morocco*

**Abstract :**
Direct seeding is one of the three pillars of conservation agriculture, promoted to enhance the sustainability of cereal production in Morocco. However, its environmental benefits require further empirical evidence. In this context, our study evaluates the environmental impact of no-tillage compared to conventional tillage in the production of wheat, durum wheat, and barley in the province of Sidi Kacem, Morocco. Data from 200 cereal farms were analyzed using the standard ISO Life Cycle Assessment (LCA) methodology. Results were reported for seven impact categories: land use, climate change, marine eutrophication, terrestrial eutrophication, ionizing radiation, freshwater ecotoxicity, and acidification. For all crops, the direct seeding system generated a lower environmental impact, except for barley in the acidification and terrestrial eutrophication categories, due to higher fertilizer input linked to limited crop rotation. The analysis of life-cycle stages revealed that field emissions were the most impactful contributors across most categories, except for ionizing radiation and climate change. Fertilizer production, machinery, and seed inputs were the dominant contributors to the remaining categories. We recommend accelerating the dissemination of direct seeding practices for their environmental benefits. However, to maximize impact, this approach must be integrated with the other pillars of conservation agriculture.

**Keywords:**
direct seeding, cereals, sustainable agriculture, conservation agriculture, Morocco.

*1st Author Biography*

*Imane El Bakali, a Ph.D. student at the Institute of Agronomy and Veterinary Medicine Hassan II (IAV Hassan II), specializes in economic and social sciences applied to agriculture, with expertise in sustainable agricultural innovations, their impact, and related policies.*

***Corresponding author:** i.elbakali@iav.ac.ma*

ID108

# $^{56}$Fe capture cross sections analysis in ASPIS Iron88 benchmark using ENDF/B-VIII.0 evaluation

M. Kaddour[1], T. El Bardouni[1], E. Chakir[2], T. El Ghalbzouri[1], H. Boukhal[1]
[1]*Radiations and Nuclear Systems Laboratory, University Abdelmalek Essaadi, Faculty of Sciences of Tetuan, Morocco.*
[2]*Nuclear Physic Laboratory, Faculty of Sciences of Kenitra, Morocco.*

**Abstract :**
The iron is an essential material for fusion and fission reactors, particle accelerators. Therefore, a correct set of nuclear data for the main iron isotopes is highly important for nuclear application modeling. Consequently, the validation of the new iron nuclear data in the shielding benchmark is therefore needed. The sensitivity and nuclear uncertainty are essential to analyze and validate the quality of the iron nuclear data. In this study, sensitivity and uncertainty analysis of reaction rates due to $^{56}$Fe capture uncertainties are carried out in ASPIS Iron88 benchmark. The reaction rates and their sensitivities are calculated by MCNP6 by using two variance reduction techniques, the weight window and the energy cut-offs. The 56Fe cross sections and their covariance matrices are taken from ENDF/B-VIII.0 and they are processed by NJOY99 system. The sensitivities and uncertainties of the reaction rates are calculated in three energy groups for $^{27}$Al(n,α)$^{24}$Na detector and in four energy groups for $^{32}$S(n,p)$^{32}$P, $^{103}$Rh(n,n')$^{103}$Rhm, $^{115}$In(n,n')$^{115}$In and $^{197}$Au(n,γ)$^{198}$Au/Cd detectors. The obtained results show that the reaction rate uncertainties due to 56Fe capture uncertainties are observable when $^{197}$Au(n,γ)$^{198}$Au/Cd, $^{103}$Rh(n,n')$^{103}$Rhm and $^{115}$In(n,n')$^{115}$Inm are used. The analysis of the $^{56}$Fe capture uncertainties in the reaction rates by using ENDF/B-VIII.0 evaluation, the analysis of the sensitivities and the covariance matrix of the studied cross section indicate that the $^{56}$Fe capture cross section needs some improvements in the energy range 0.001 eV-19.6 MeV.

**Keywords:**
*Reaction rate sensitivity, covariance matrix, nuclear data uncertainty, MCNP6, ASPIS Iron88*

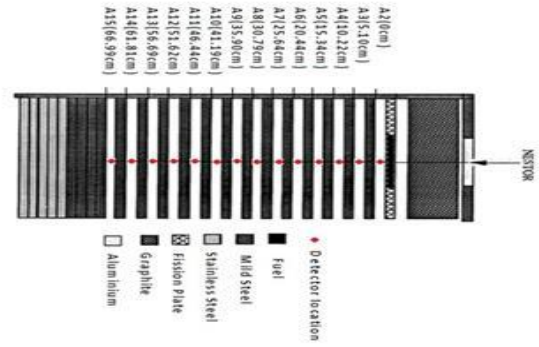


**Fig. 1:** Layout of the ASPIS Iron88 benchmark

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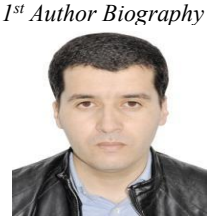

*Mohamed Kaddour a Moroccan doctor specializes in nuclear physics. His research focuses on optimizing the nuclear data. With expertise in MCNP particle transport code modeling and calculation, he actively contributes to publications and conferences, aiming to advance the accuracy of the nuclear data used in the simulation of the new nuclear reactors.*

***Corresponding author:** moh-gad@live.fr*

ID109

# 79 GHz Hemispherical Dielectric Resonator Antenna Design for Millimeter-Wave Automotive Sensors

Abderrahim Haddad[1*], Redouane Jouali[2], Azize Bhaij[1], Sanae Habibi[3], Fadwa El Moukhtafi[1], Mohssin Aoutoul[1], Aziz Dkiouak[1], Fatehi ALtalqi[3], Said Dlimi[1], Youssef Errami[4], Obbadi Abdellatif[4]

[1]*STIC Lab., Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*
[2]*LTI Lab., ENSA, Chouaib Doukkali University, El Jadida, Morocco*
[3]*ETIME Lab, Faculty of Science, Ibn Tofail University, Kenitra, Morocco*
[4]*EIE Lab., Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
In this work Hemispherical shaped Dielectric Resonator Antenna (HDRA) with a dielectric constant of εr=24 is presented for automotive Short Range Radar (SRR) applications. The proposed HDRA is excited using a simple 50 Ω microstrip feed-line mechanism printed in the substrate' top. Our proposed HDRA presents a high gain of 13.7dBi at 79.4 GHz, a very high efficiency of 97 % and directional radiation pattern properties at the resonant frequency (79 GHz) required for radar applications

**Keywords:**
Automotive Radar Systems, Ring DRA, Anti-collision radar, Long Range Radar, 77 GHz.

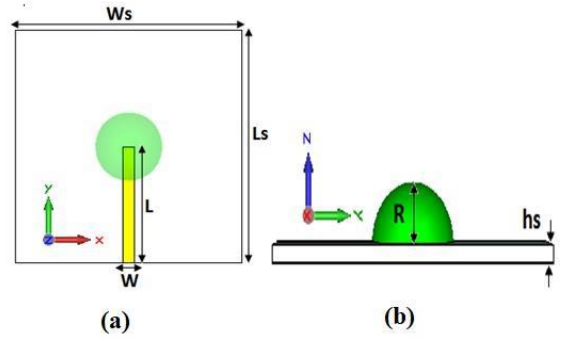


**Fig. 1:** Configuration of the proposed HDRA, (a) top view, and (b) side view.

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1st Author biography

*Abderrahim Haddad received his PhD degree in Electronics and Telecoms in 2018 from Chouaib Doukkali University in El Jadida, Morocco. His research focuses on the design and development of Dielectric Resonator Antennas (DRAs), Microstrip Patch Antennas (MPAs), and MIMO antennas for automotive radar sensors. Additionally, he works on the design of DRAs and MPAs for 5G applications.*

***Corresponding author:** haddaddoctorat@gmail.com*

ID110

# Scalability Evaluation Between OpenMP MPI and OpenCL

Mohsine Kartita[1*], A. Barodi[2,3], Mohamed Chahid[1], Mohammed Benbrahim[1], and Abdelkarim Zemmouri[1,2]
[1]*Laboratory of Advanced Systems Engineering (ISA), National School of Applied Sciences, Ibn Tofail University, Morocco*
[2]*Scientific Research and Innovation Laboratory (SRILab), Higher School of Technology, Ibn Tofail University, Morocco*
[3]*Applied Interdisciplinary Sciences Laboratory (LISA), National School of Applied Sciences, Hassan First University,, Morocco*

## Abstract :

This paper presents a study of the need to scale computing performance when a problem becomes more complex. When a relatively simple problem is due to its low cost, power efficiency, and compact design, a small micro-processor is initially chosen and sufficient to solve this problem. However, as the problem evolves and becomes more complex (for whatever reason) and more computing performance is needed, abandoning the use of the single processor is inevitable, and going through another solution which is parallelism is required. This allows tasks to be executed in parallel, which will improve the speed and the efficiency. OpenMP, MPI and OpenCL Parallel Computing Methods (PCMs) are the most ones used nowadays, OpenMP and OpenCL are dedicated for the shared memory architectures and MPI is dedicated for the distributed memory architectures. Moreover, five benchmark applications are implemented using the mentioned PCMs above and a scalability evaluation has been performed. Therefore, the scalability evaluation demonstrated that OpenCL scaled better than OpenMP and MPI showing great performance improvements in 3 test cases, while MPI delivered better performance than OpenMP and OpenCL in 2 test cases.

## Keywords:

OpenMP, MPI, OpenCL, Parallel Computing, Embedded Systems.

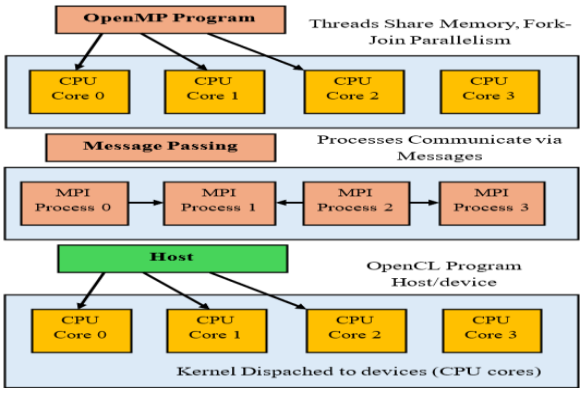


**Fig. 1:** Utilization of CPU Cores by OpenMP, MPI, and OpenCL

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*1st Author biography*

*Mohsine Kartita, a Ph.D. student at Ibn Tofail University, specializes in embedded systems. His research focuses on enhancing the real-time performance of embedded devices by efficiently leveraging available processing units, aiming to reduce latency and increase speedup without relying on GPUs. With expertise in industrial electronics and parallel computing, he actively contributes to scientific publications and conferences, striving to advance the understanding and utilization of CPU cores in embedded technologies.*

***Corresponding author:** mohsine.kartita@uit.ac.ma*

ID112

# Intelligent Image-Based Detection of Surface Anomalies in Aircraft Structures

Oumaima Mesbahi[1,2*], Souhila Chabane[1,3], Nuno Pereira Santos[1,2], Adriano Del Pino Lino[3], Mouhaydine Tlemçani[1,2], José Manuel Mota Lourenço da Saúde[3]

[1]*Instrumentation and Control Laboratory- Center for Sci-Tech Research in Earth System and Energy – CREATE, Universidade de Évora*

[2]*Cátedra CEiiA de Ciência e Tecnologia Aeroespacial, Universidade de Évora*

[3]*CTI Aeroespecial, Cátedra CEiiA de Ciência e Tecnologia Aeroespacial, Évora*

**Abstract :**

In the aviation industry, the structural integrity of aircraft is paramount to ensure safety and reliability [1]. Regular inspections and maintenance are critical to detecting anomalies on aircraft surfaces that could lead to catastrophic failures if left unaddressed. Traditional inspection methods often involve human visual checks, which are time-consuming, subject to human error, and require extensive expertise [2,3]. This work explores the application of advanced image processing techniques for the automated detection of aircraft surface faults, such as cracks, corrosion, dents, and delamination. Using image processing to detect aircraft surface findings has the potential to transform the maintenance process in aviation. This technology enables continuous monitoring, early detection of issues, and data-driven decision-making for maintenance and repair. It also offers scalability, allowing for efficient inspection of large aircraft fleets. The work discusses the benefits of this approach, such as improved safety, reduced inspection costs, and enhanced reliability, along with its integration with existing maintenance workflows.

**Keywords:**

Image Processing, fault detection, aircraft surface.

**References:**

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*1st Author biography*

*Oumaima Mesbahi, holds a Ph.D. in Mechatronics and Energy Engineering from the University of Évora and a Master's degree in Electromechanical Engineering from ENSAM. She is currently a researcher at the University of Évora, where she works in the field of image processing, applying machine learning techniques and metaheuristic algorithms for fault diagnosis on aircraft surfaces. In addition, she also works on developing monitoring devices for photovoltaic systems and large-scale environmental monitoring. Her research interests include robotics, image processing, machine learning, and combinatorial optimization. She has published several articles in high-impact international journals, addressing topics such as fault diagnosis in photovoltaic systems and advanced algorithms for parameter estimation*

***Corresponding author:** omesbahi@uevora.pt*

ID119

# Integration of an Intelligent Adaptive Assessment System Based on AI and Predictive Analytics in online Learning

Kaoutar Smahi[1*], Ouidad Labouidya[1], Khalid El Khadiri[1]

[1]*STIC Laboratory ,Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
This work presents an intelligent adaptive revision assistant designed to support students in online learning environments through personalized, AI-driven assessment strategies. Rather than acting as a complete platform, the system functions as a lightweight tool that can be integrated into existing learning ecosystems, offering students adaptive questionnaires, feedback and revision suggestions as their learning profile evolves. Using Artificial Intelligence techniques such as natural language processing, semantic similarity analysis, and predictive modeling, the assistant dynamically adjusts question difficulty, content sequencing, and revision paths according to each student's performance and cognitive progression. The system also provides instructors with key indicators of student engagement and mastery levels, enabling more informed and responsive teaching interventions. Designed to enhance autonomy, motivation, and authenticity in evaluation, this assistant supports a learner-centered vision of online education. Initial experiments in remote learning settings suggest that the assistant improves revision efficiency, promotes deeper engagement, and aligns well with the goals of adaptive and authentic assessment in digital education.

**Keywords:**
Online learning environments, personalized assessment, Artificial Intelligence, revision

**References:**

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*1st Author Biography*

*Kaoutar Smahi, a PhD student at Chouaib Doukkali University in Morrocco. Her areas of interest include e-learning, docimology,e-assessment techniques and quality.*

***Corresponding author: smahi.k@ucd.ac.ma***

ID121

# Digitalisation microfinance for sustainable social innovation : A conceptual framework for eco-responsible micro-projets

Kenza Hassane[1]*, Siham Hamdani[1]
[1] *Laboratoire Interdisciplinaire de Recherche en Économie Innovation et Management des Organisations (LIREIMO), École Nationale de Commerce et de Gestion de Casablanca, Université HASSAN II Casablanca, Morocco*

**Abstract:**
Since its creation by Muhammad Yunus in 1976, microfinance, designed to support vulnerable micro-entrepreneurs, has faced major challenges. In the digital era, microfinance institutions are entering a new phase of development through the digitalization of financial services. The rise of digital technologies offers new opportunities to transform this sector while addressing social and environmental issues. However, the literature remains fragmented regarding the integrated role of digital microfinance in promoting environmentally responsible practices within vulnerable populations. This conceptual paper aims to demonstrate how the digitalization of microfinance can serve as a lever for sustainable social innovation to support the emergence of eco-responsible micro-projects. By drawing on social innovation theory and the sustainable development framework, we propose a conceptual model that links digitalization, social innovation, environmental sustainability, and the emergence of eco-responsible micro-projects. This conceptual framework is developed through a narrative review of recent interdisciplinary literature on digital microfinance, social innovation and sustainability. It provides a theoretical contribution and opens avenues for future empirical research to test and refine the proposed model, ultimately guiding practitioners toward an inclusive and digital microfinance that promotes the creation and long-term viability of eco-responsible initiatives.

**Keywords:**
Microfinance, Digitalization, Social Innovation, Sustainability, Eco-responsible micro-projects.

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*1st Author Biography*

*Kenza Hassane, a PHD student at Ecole Nationale de Commerce et de Gestion de Casablanca, Université Hassan II, specializes in Marketing and Microfinance. His researches focuses on Microfinance, digitalization and social innovation in order to propose an innovative and inclusive model for empowering vulnerable micro-entrepreneurs by developing an integrative framework that links digitalization, social innovation and empowerment.*

***Corresponding author:** kenza.hassane@edu.encgcasa.ma*

ID122

# Smart Urban Parking: Using IoT and RFID Technology for Street Parking

*Fatima-Zahrae Sotor[1*], Outman El Hichami[1], Adnan Souri[2]*
*[1]Applied Mathematics and Computer Sciences Team. Higher Normal School, Abdelmalek Essaadi University, Morocco.*
*[2]New Trend Technology Team, Faculty of Sciences, Abdelmalek Essaadi University, Morocco.*

## Abstract :

City centers are being more and more affected by traffic jams, fuel consumption, and air pollution from the inefficient parking facilities. This paper introduces a Smart Street Parking System solution based on IoT sensors and RFID technology for Moroccan cities to solve the parking issue in urban areas. The system could potentially provide timely vehicle locating, identifying, and pricing on the fly while vehicles are on the road. In a pilot deployment in Tangier, Morocco, the authors observed 40% savings in search time for parking and a 20% reduction in the emissions of vehicles during peak-hour conditions. The architecture of the system combines GPS, RFID, and cloud solutions for accurate, low-cost infrastructure-assisted parking space finding (98% accuracy vehicle ID, 92% user satisfaction). Significantly, RFID-mobile solutions were also 60% more cost-effective than sensor networks, with deployment costs of less than $110 per parking space. By doing so, this solution contributes toward urban sustainability initiatives by optimizing space usage, minimizing congestion, and establishing a pattern for growth in developing cities. The results demonstrate the potential of data-driven parking management for improving urban mobility and for informing larger smart city planning activities in resource-limited settings.

## Keywords:

Smart Parking, IoT, RFID, Urban Mobility.

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*1st Author Biography*

*Fatima-Zahrae Sotor, a Ph.D. student at Abdelmalek Essaadi University, specializes in computer sciences. Her research focuses on the construction of RF-ID and IoT integrated smart parking systems for smart cities in Morroco. Combining the power of real-time data analytics, dynamic pricing and new sustainable technology she is working to shape the reduction of traffic congestion and the environmental impact the world's fast-growing cities.*

***Corresponding author**: fatimazahraesotor@gmail.com*

ID123

# Hysteresis Characteristics of a Core–Shell Nanotube with (3/2, 3) Mixed Spins

Mohammed SALAMA[1*]

[1] *LPMC Laboratory, Theoretical Physics Group, Faculty of Sciences, Chouaïb Doukkali University, 24000 El Jadida, Morocco*

**Abstract :**

This work focuses on a ferrimagnetic Ising nanotube with spin-3/2 core and spin-3 shell. The BlumeCapel model and the mean-field approach, based on the Gibbs-Bogoliubov inequality, are used to numerically examine the hysteresis behavior of this system as a function of various parameters, namely exchange interactions, crystal fields, and temperature. Although the mean-field method, derived from statistical mechanics, neglects fluctuations, it has been successfully applied to describe various phase transition phenomena, particularly with regard to hysteresis. Different magnetic domains are determined, explained by the observed single or multiple hysteresis loop phenomena, resulting from competition between the external magnetic field and the various parameters of the system, whether of order or disorder. This type of hysteresis behavior, outside the operating environment, theoretically qualifies the system for various applications in different industries. However, this research is of particular interest to designers and experimenters, who can design prototypes that enable experimental results to be compared, or even reconciled, with those predicted by theory.

**Keywords:**

Ferrimagnetic nanotube; mixed spins; mean-field; coercive field.

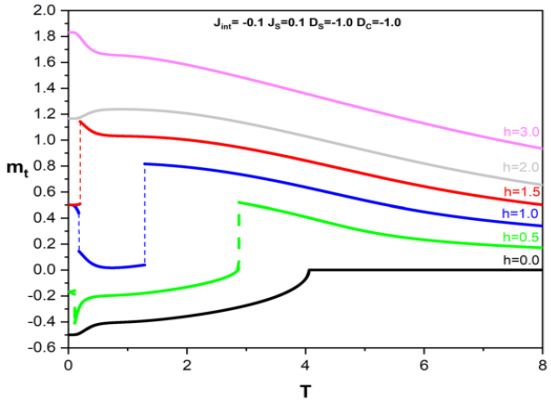


**Fig. 1:** Effect of external magnetic field on total system magnetization

**References:**

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*1st Author Biography*

*Mohammed SALAMA is a Ph.D. candidate in Physics and Engineering at Chouaib Doukkali University, Faculty of Sciences, El Jadida, Morocco, where he is affiliated with the Laboratory of Condensed Matter Physics (LPMC). His doctoral research focuses on condensed matter physics and materials physics, with particular emphasis on magnetic properties, phase transitions, and magnetocaloric effects in low-dimensional and nanostructured systems, including graphene-based and antiperovskite materials.*

***Corresponding author:** salama.m@ucd.ac.ma*

ID125

# Magnetic behavior of a VI3 bilayer

*Youssef Chegrane[1]*, Nabil Hachem[1], Mohammed El Bouziani[1]*

*[1]Laboratory LPMC, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*

**Abstract:**

The mean-field approximation has been used to study the magnetic properties and critical behavior of a ferromagnetic $VI_3$-like bilayer within the framework of a spin-1 Ising-type model. The influences of specific physical parameters, namely the interlayer exchange interaction $J_{int}$ and the crystal field $D$, on the system's magnetization and susceptibility have been highlighted and examined. Various phase diagrams have been plotted and discussed in the ($J_{int}$, temperature) and ($D$, temperature) planes. This study yielded some intriguing results, including second- and first-order phase transitions and tricritical behavior. Lastly, the impacts of the external magnetic field and the crystal field on the system's blocking temperature have been explored under certain physical conditions. The findings of this study may contribute to the development of $VI_3$-based spintronic technologies.

**Keywords:**

$VI_3$ Bilayer; Ferromagnetic; Ising model; Mean-field; Phase transition.

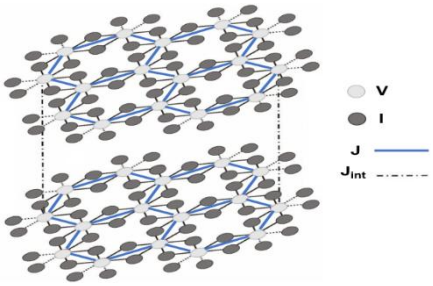


**Fig. 1:** Schematic illustration of a $VI_3$ bilayer structure.

**References:**

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*1st Author Biography*

*Youssef Chegrane, a PhD student at Chouaib Doukkali University, specializing in statistical physics and condensed matter physics. His research focuses on the theoretical study of devices based on magnetic materials used for various applications.*

***Corresponding author:** chegrane.youssef@ucd.ac.ma*

ID127

# Smart Wind Energy for Rural Uzbekistan: Feasibility of Small-Scale Wind Turbines in Bukhara region with ANFIS Control

Ulugbek Muinov[1*], Botir Usmonov[1]
[1]*Department of Automation and Control, Tashkent Chemical Technological Institute, 100011, Tashkent, Uzbekistan.*

**Abstract :**
Uzbekistan is facing growing energy demand due to limited natural gas resources and environmental concerns. This paper explores the feasibility of powering rural areas using small-scale wind turbines (SWTs) for sustainable off-grid electrification. The proposed system includes a wind turbine, DC generator, and a buck converter regulated by an Adaptive Neuro-Fuzzy Inference System (ANFIS). The study is based on theoretical modeling, simulation, and performance analysis under varying wind conditions using NASA wind speed data for the Bukhara region. Results show that the average mechanical power output is 6.3 kW, with only 27 out of 366 days falling below 1 kW. This indicates strong potential for wind-based rural electrification. A comparative analysis between ANFIS and conventional PI controllers demonstrates that ANFIS provides better voltage stability and responsiveness across variable wind speeds. The system maintains constant power and voltage output, highlighting its efficiency and adaptability. Economic and environmental evaluations suggest that SWTs can reduce fossil fuel dependence, lower industrial power costs, and contribute to emissions reduction. The findings confirm that small wind systems offer a viable, sustainable energy solution for rural Uzbekistan. Leveraging localized renewable resources and advanced control strategies, SWTs can play a key role in achieving the country's renewable energy targets and enhancing energy security.

**Keywords:**
Small-Scale Wind Turbines, ANFIS Controller, Buck Converter, Wind Energy Simulation, Uzbekistan

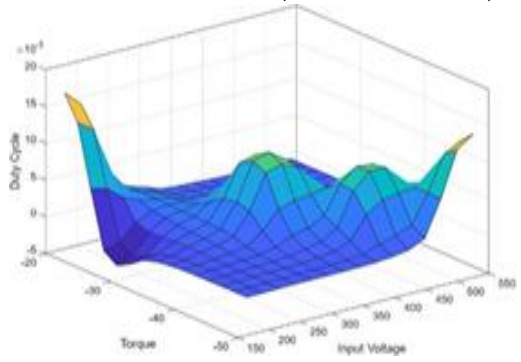


**Fig. 1:** Surface of the ANFIS controller

**References:**

[1] A. C. Zebra, E. Bontempi, and P. Zambelli, "Review of hybrid renewable energy systems in mini-grids for off-grid electrification in developing countries," Renew. Sustain. Energy Rev., 144, p. 111036, 2021
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*1st Author Biography*

*Ulugbek Muinov, is a PhD student at the Tashkent Chemical-Technological Institute, Uzbekistan. His research focuses on renewable energy technologies, with a specialization in small-scale wind turbines, adaptive control systems, and automation in energy systems. His recent work involves optimizing wind turbine performance using Adaptive Neuro-Fuzzy Inference Systems (ANFIS) for rural electrification in low wind speed regions like Bukhara. He has practical experience in SCADA systems, OT/ICS cybersecurity, and power system automation as well as IEC61850 projects across Central Asia.*

***Corresponding author:** themuinov@yandex.ru*

ID128

# SCAPS-1D based numerical study of CNGS serving as BSF and additional absorber in CIGS thin-film photovoltaic devices

Driss Mazili[1], Said Amrane[1], Mohamed Abouricha[2]
[1]*STIC, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[2]*LPTHE, Department of Physics, Faculty of Sciences, Ibnou Zohr University, Agadir, Morocco.*

**Abstract :**
Solar cells employing CIGS absorbers have shown higher efficiency compared to many other thin-film photovoltaic technologies. In this study, we propose a device architecture with the configuration ITO/CdS/CIGS/CNGS, where CdS is used as the buffer layer, ITO serves as the transparent window, and CNGS performs a dual role as both an additional absorber and a Back Surface Field (BSF). Numerical simulations were conducted using SCAPS-1D to investigate the effects of absorber layer thickness and doping level, interfacial defect states, parasitic resistances, and the influence of temperature on device performance. The optimized design demonstrated excellent photovoltaic parameters with a Voc of 1.18 V, Jsc of 31.70 mA/cm², a fill factor of 74.60 %, and a power conversion efficiency of 34.43 %. The proposed heterostructure highlights a promising pathway for enhancing the efficiency of CIGS-based solar cells, achieving results that surpass several previously reported designs.

**Keywords:**
SCAPS-1D, prospective, CIGS, BSF

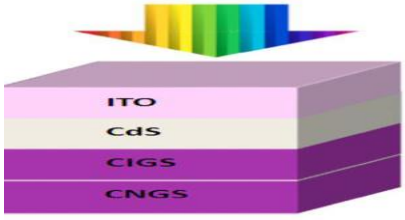


**Fig. 1:** Solar cell architecture

**References:**

[1] E. Oublal et al. (2024). Photovoltaic efficacy of CNGS as BSF and second absorber for CIGS thin film solar cells- numerical approach by SCAPS-1D framework: terials Science and Engineering B 305 (2024) 117401

*1st Author Biography*

*Redouane Mazili, born in 1981, is a Moroccan researcher specializing in materials physics. He obtained a Bachelor's degree in Physics from the Faculty of Sciences at Chouaïb Doukkali University in El Jadida, before continuing his graduate studies at the Faculty of Sciences, Aïn Chok, Casablanca, where he earned a Master's degree in Physics, with a specialization in Condensed Matter. He is currently a PhD candidate at the Faculty of Sciences in El Jadida, within the STIC Laboratory, where his research focuses on the characterization and modeling of materials for perovskite-based solar cells. His work contributes to the advancement of sustainable and high-performance energy solutions.*

***Corresponding author:** mazili.mazili81@gmail.com*

ID129

# Optimal tilt angel for south facing of a Single/double-Slope Solar Still Unit case study in the southern region of Saudi Arabia

Saeed Alqaed

[1]*Mechanical Engineering Department, College of Engineering, Najran University, P.O. Box (1988), Najran. 61441, Saudi Arabia*

**Abstract :**

This study investigates the best tilt angle for south-facing single- and double-slope solar still units in the southern region of Saudi Arabia. The tilt angle has a strong effect on how much solar radiation enters the still and how well water vapor condenses on the cover. Based on the local latitude of about 18°N. The analysis using meteorological equipment at the engineering college of Najran University in Saudi Arabia, LSI also gathered data on the south Saudi Arabia (Jazan/Abha/Najran region) horizontal solar radiation from "Climate.OneBuilding.Org." After evaluating the monthly, seasonal, and annual fixed tilt. The results show that the optimum annual tilt angle is around 18°. In winter, a steeper tilt of about 33° gives better performance, while in summer, a lower tilt of not less than 12° is more effective. For double-slope units, both sides should use the same tilt angle for balance. These results show that choosing the proper tilt angle improves water production and increases the efficiency of solar desalination in areas facing water scarcity

**Keywords:**

Optimal Tilt, South-facing, and Solar Still

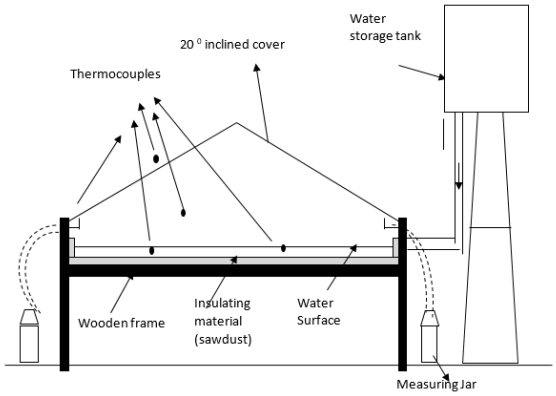


**Fig. 1:** The double slope solar still's fundamental operation

**References:**

[1] Hassan Z. Al Garni, Anjali Awasthi, David Wright,Optimal orientation angles for maximizing energy yield for solar PV in Saudi Arabia,Renewable Energy Volume 133,2019,

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*1st Author Biography*

*Saeed Alqaed, is currently working as Associate Professor in Mechanical Engineering Department, Najran University, Saudi Arabia. He acquired his Ph.D. in 2017 from the University of Dayton, Dayton OH, USA. His research interests have been vastly diverse, beginning with combined heat and power systems, which led to the dissemination of numerous novel applications in combined heat and power systems to focus on in-building energy informatics, and to community energy reduction, and finally, geothermal energy and renewable energy. He is currently involved in several research projects in solar thermal energy nanoparticles applications in heat transfer processing, sustainable energy, and energy transition.*

***Corresponding author:** saeed.alqaed@gmail.com

ID130

# Energy Performance Analysis of BIPV Double-Skin Facades with Phase Change Material in a Commercial Building in a Hot-Arid Climate

Khaled Almazam

*Architectural Engineering Department, College of Engineering, Najran University, Saudi Arabia*

**Abstract :**
This study investigates the energy performance of a Building Integrated Photovoltaic (BIPV) double-skin facade (DSF) integrated with Phase Change Material (PCM) in a minimum standard commercial building in Riyadh, Saudi Arabia, focusing on the south facade. Riyadh's hot-arid climate presents significant cooling demands, making effective thermal insulation critical. The analysis using energy modelling to simulate four facade configurations: a base case (traditional BIPV DSF without PCM) and three scenarios incorporating 1 cm thick transparent paraffin wax PCM (melting point 28°C, latent heat 200 kJ/kg) in different positions: (1) PCM laminated to the outer side of the inner window, (2) PCM between the BIPV and air gap, and (3) PCM on the outer side of the BIPV. Simulation results estimate cooling load energy reductions of 15-20% for Scenario 1, 20-30% for Scenario 2, and 10-15% for Scenario 3 compared to the base case, with Scenario 2 being the most effective due to its ability to cool the BIPV panel and minimize heat transfer to the interior. Despite challenges posed by warm nights limiting PCM cycling, partial phase change still provides significant benefits. These findings underscore the potential of PCM-enhanced BIPV DSF to improve energy efficiency in hot climates, with Scenario 2 recommended for maximum performance. Further research into higher-melting-point PCMs and advanced simulation tools is suggested to optimize system design.

**Keywords:**
BIPV, Double-skin Facade, Phase Change Material, Energy Consumption, Cooling Load.

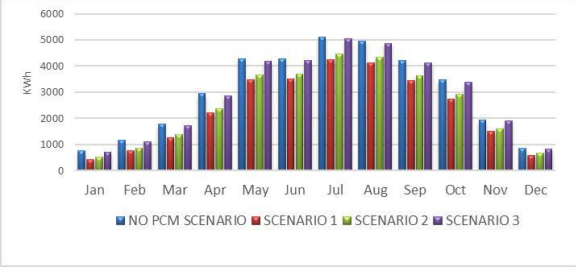


**Fig. 1:** Monthly cooling electricity consumption (kWh) with and without PCM

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*1st Author Biography*

*Khaled Almazam is an Assistant Professor at Najran University, Saudi Arabia. He holds a Ph.D. and M.A. in Architecture from the University of Kansas and an M.S. in Architecture from the University of Arizona. His expertise includes energy systems, sustainability, and Building-Integrated Photovoltaics (BIPV). He has published widely on innovative solar technologies and energy-efficient design in hot arid climates.*

***Corresponding author:** Kaalmazam@nu.edu.sa*

ID131

# Towards High-Performance and Safer Energy: A Comprehensive Review of Aqueous Zinc-Ion Batteries

Firdaous Boualam[1,2*], Ayyoub El-Bchiri[2], Asmae Hamraoui[1,2], Fatima EL Bachraoui[2], Fouad Ghamouss[2], Bouchaib Manoun[1,2]

[1]*Radiation - matter and instrumentation research laboratory- Faculty of science and &technology Settat Morocco*
[2]*University Mohammed VI Polytechnic (UM6P), Materials Science, Energy and Nanoengineering Department, Lot 660, Hay Moulay Rachid, 43150 Benguerir, Morocco*

**Abstract :**
Aqueous zinc-ion batteries (AZIBs) have gained attention as next-generation energy storage systems due to their intrinsic safety, environmental compatibility, low cost, and the natural abundance of zinc. Compared to conventional lithium-ion batteries, AZIBs offer non-flammability, high ionic conductivity of aqueous electrolytes, and scalability for both grid storage and portable electronics. This review summarizes recent advances in AZIB research, with emphasis on cell design, electrode materials, and electrolyte optimization. Particular attention is given to cathode materials such as manganese-based oxides, vanadium compounds, and organic frameworks, alongside strategies to protect zinc anodes by mitigating dendrite growth and improving reversibility. The discussion also outlines fundamental electrochemical mechanisms of zinc-ion storage, including ion transport, redox processes, and the role of structural stability in cycling performance. Key challenges such as limited durability, dissolution of active materials, and parasitic side reactions—are critically examined. Finally, perspectives highlight the importance of rational material design and interface engineering to enhance safety, durability, and overall performance. This work aims to provide general guidance and inspiration for advancing efficient and sustainable zinc-based energy storage technologies.

**Keywords:**
Zinc-ion batteries (ZIBs); Electrode materials; Electrolyte optimization Structural tailoring; Cycling stability; Scalable synthesis; Energy storage


**Fig. 1:** Characterization, simulation, and calculation approaches for understanding zinc-ion batteries.

**References:**
[1] A Structural Perspective on Prussian Blue Analogues for Aqueous Zinc-Ion Batteries
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[2] Recent Progress in Cathode-Free Zinc Electrolytic MnO2 Batteries : Electrolytes and Electrodes https://doi.org/10.3390/batteries11050171

*1st Author Biography*

***Firdaous Boualam,** A state process engineer and Ph.D. student at FST Settat in collaboration with the MSN Department at UM6P Benguerir, specializes in energy storage and advanced battery materials. Her research focuses on developing and optimizing safe, high-performance aqueous zinc-ion batteries. With expertise in materials synthesis, electrochemical characterization, and process engineering, she actively contributes to advancing next-generation energy storage technologies.*

***Corresponding author:** firdaous.boualam.doc@uhp.ac.ma*

ID132

# Tailoring Calcination Temperature for Enhanced Structural Properties and Catalytic Efficiency of Nickel Orthophosphates in 2-Propanol Decomposition

W. El kasiti[1*], R. Lahkale[1], E. Sabbar[1]
[1]*Dept. of chemistry, Laboratory of Material's Physical- Chemicals, Faculty of Sciences, University of Chouaib Doukkali, El Jadida, Morocco.*

**Abstract :**
In recent decades, nickel orthophosphates have gained attention as promising materials for heterogeneous catalysis due to their structural versatility, acidity, and ion-exchange capacity [1]. Their ability to be modified by thermal treatment makes them attractive candidates for applications in selective reactions and environmentally friendly processes [2]. In this work, nickel phosphate ($Ni_3(PO_4)_2$) was synthesized by coprecipitation and calcined at different temperatures (450, 500, and 600 °C) to obtain mixed nickel phosphates with enhanced thermal stability. The materials were characterized by X-ray diffraction (XRD) and infrared spectroscopy (FTIR), and their catalytic performance was evaluated using isopropanol decomposition under inert atmosphere, a well-established probe reaction for acid–base surface properties. The results revealed that calcination temperature strongly influences the crystallinity, textural features, and catalytic behavior of $Ni_3(PO_4)_2$. All samples displayed good catalytic activity, with variations in conversion and product selectivity directly linked to surface acid–base properties. These findings demonstrate that nickel phosphate can serve as an efficient and environmentally benign catalyst for alcohol transformations and potentially for a wider range of reactions in green chemistry.

**Keywords:** Nickel phosphate, Isopropanol decomposition, Propene selectivity, calcination temperature.

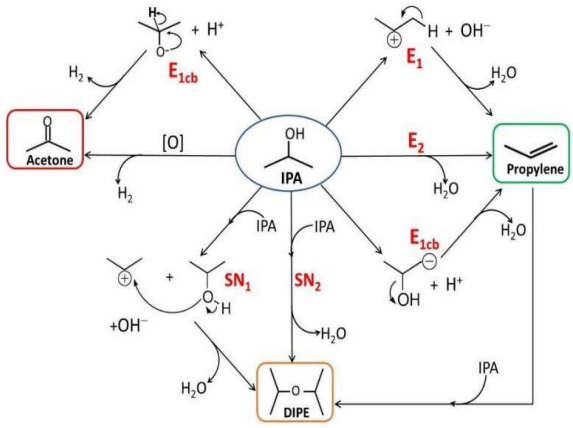


**Fig. 1:** Schematic representation of the possible isopropanol (IPA) reaction mechanisms (adapted from [3].

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*Wafaa EL KASITI*

*Wafa EL KASITI is a PhD candidate in Chemistry at the Faculty ofi Sciences, El Jadida, Morocco. Her research fiocuses on the synthesis and characterization ofi transition metal phosphates and related materials, as well as the study ofi their catalytic perfiormance. She is especially interested in understanding the effect ofi thermal treatments on structural properties and in developing efficient, environmentally firiendly catalysts fior green chemistry applications.*

***Corresponding author:** wafaelkasiti1234@ucd.ac.ma*

ID137

# Analysis of the relationship between the durability and performance of concrete engineering structures, and the application of market rules in rural areas of Morocco

Said Amouch [1*], Ahmed Akhssas[1], Soukaina Talha[1], Mohamed khamar[2], Saadia Haddoudi[2] and Oualid Besbou[2]

[1] *Laboratory of Applied Geophysics Engineering, Geotechnical and Environmental Geology, Mohammedia School of Engineers, Mohammed V University in Rabat, Morocco;*

[2] *Civil Engineering and Environment Laboratory (LGCE); Materials, Water and Environment Team; Higher School of Technology of Salé; Mohammed V University in Rabat, Morocco*

**Abstract :**

The reinforced concrete drinking water storage tanks are very important to protect the water from pollution; and to ensure favorable savings on investment and operation. Therefore, concrete can be formulated for an expected service life in a given environment during the design phase of a structure. The three main risks of deterioration to be taken into account are: reinforcement corrosion due to carbonation and chloride penetration (chemical attack), internal swelling reactions (alkali-reaction, internal sulfate reaction), and the effects of temperature change. The aim of this work is to contribute to formulating technical solutions for the sustainable development of buildings in contact with drinking water, by the improvement of building standards, which represents a major economic challenge for investors, managers, and users. By providing a clear explanation of the purpose of each standard, a follow-up of the normative stages of building a semi-underground tank with 500 m3 of capacity, in relation to the various indicators in a rural environment is illustrated. We draw conclusions to promote understanding that this approach can become a authentic methodology that can then be used and incorporated into the body of standards. This will constitute a prototype that can be generalized to all drinking water engineering structures, i.e. recovery station tanks, load breakers, surge tanks, balance chimney..., and applied to large-capacity structures exceeding 1,000 m3, especially in urban areas.

**Keywords:**

Engineering structures, Durability, Concrete, Indicators, Formulation.

**References:**

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[2] World Health Organization Geneva, Switzerland (2000). Operation and Maintenance of rural water supply and sanitation systems. 130 p.

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*1st Author Biography*

***Said Amouch, a Doctor in civil engineering at Mohammedia School of Engineers in Rabat. He actively contributes to publications and conferences, aiming to advance the understanding and applications of 2D semiconductor technologies.***

***Corresponding author:** saidmch@gmail.com*

ID138

# Enhancing Lithium-Ion Battery State of Charge Estimation Using Neural Networks

*Abdelhakim Tabine[1*], El Mehdi Laadissi[1,2], Abdelhadi El kake[1] and Abdelowahed Hajjaji[1]*

*[1] LabSIPE , National School of Applied Sciences, Chouaib Doukkali university, El Jadida, Morocco.*
*[2] University Mohammed VI Polytechnic (UM6P) Benguerir, Morocco.*

**Abstract :**
This study presents a neural network (NN) algorithm designed to accurately estimate the state of charge (SOC) of lithium-ion batteries, which is crucial for the range of electric vehicles and the performance of portable electronic devices. The proposed model utilizes real-time data, including current, voltage, and temperature, to account for dynamic changes during charging and discharging cycles. It was developed using experimental data obtained from a controlled laboratory setting and optimized using the Levenberg-Marquardt (LM) algorithm in MATLAB. Error analysis, conducted through histograms, evaluates the performance of both the LM and Bayesian Regularized (BR) algorithms. The comparison highlights the superior reliability of the LM model and the optimization potential of the BR model, underscoring their significance in enhancing battery management for applications such as electric vehicles and renewable energy storage systems. The findings demonstrate that the LM algorithm outperforms the BR model in terms of precision and stability. The LM model shows a high concentration of null errors and minimal error dispersion, achieving an accuracy of 97.8% on the training set, 96.4% on validation, and 94.1% on the test set. Conversely, the BR model, while still effective, exhibits higher error variability, with accuracy values of 94.5% on training, 92.1% on validation, and 88.7% on the test set, indicating lower generalization ability and greater sensitivity to data fluctuations.

**Keywords:**
Error Histograms, neural network (NN), Li-ion battery, Levenberg Marquardt algorithm (LM), Bayesian regulation algorithm (BR).

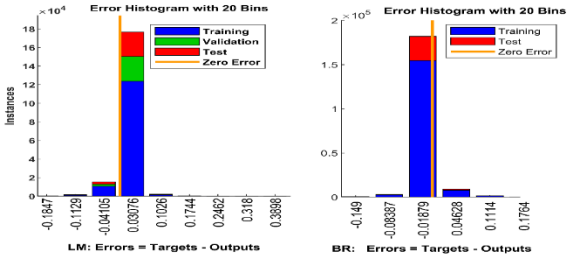


**Fig. 1** Histograms of errors for the LM (left) and BR (right) models, showing the error distribution across training, validation, and test.

**References:**

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[3] Q. Wu et al. "Progress and perspective of high-voltage lithium cobalt oxide in lithium-ion batteries," *J. of Energy Chemistry*, **74**, 283, 2022

*1st Author Biography*

*Abdelhakim TABINE: is obtained a specialized master's degree in electrical engineering with a specialization in automation, signal processing, and industrial computing (ATSII) from the Faculty of Sciences and Technology of Settat (FST-S) in 2012. Currently, he is a PhD student at the Laboratory of Engineering Sciences for Energy, Chouaib Doukkali University. His research interests include battery management systems for electric vehicles, effect of temperature on SOC and battery ageing and modelling, battery protection algorithms and methods, battery data acquisition. He is also a professor of physics at postgraduate level in Morocco.*

***Corresponding author:** tabine.a@ucd.ac.ma*

ID139

# Smart Phase-Transition Materials and AI Synergy for Next-Generation Photovoltaics

*Kamal FADIL [1], Khalid KANDOUSSI[2], Rabie EL OTMANI[3]*
*[1,2,3]Science Engineer Laboratory for Energy (LabSIPE) at National School of Applied Sciences, Chouaib Doukkali University, El Jadida, 24000, Morocco.*

**Abstract:**
This work introduces a novel paradigm for enhancing photovoltaic (PV) performance through the synergy of adaptive materials and artificial intelligence (AI). Vanadium-based phase-transition oxides ($VO_3$) and electrochromic coatings are engineered as self-regulating interfaces that dynamically adjust optical and thermal properties under varying climatic conditions. AI-driven predictive models anticipate fluctuations in irradiance, dust deposition, and temperature, enabling real-time material control and sustained efficiency. To evaluate robustness, we propose the Photovoltaic Adaptability Index (PAI), a new metric quantifying performance stability in harsh environments. By merging smart materials with intelligent simulation, this framework paves the way for resilient, high-efficiency solar technologies tailored to arid and desert regions, where conventional PV systems face critical limitations.

Keywords: (Five keywords maximum)
Phase-transition materials-Vanadium oxides ($VO_2$/$VO_3$)-Electrochromic Coatings-Artificial intelligence (AI)-Predictive Control-Adaptive photovoltaics- Smart energy materials

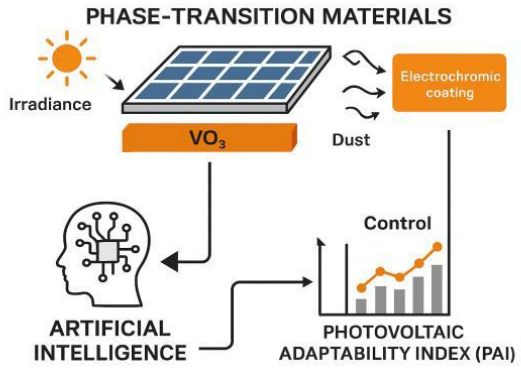


Fig. 1: AI-Guided Control of Phase-Transition Materials for Adaptive Photovoltaic Systems

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[4] Morin, F. J. "Oxides which show a metal-to-insulator transition at the Néel temperature." Physical Review Letters, 1959.

*1st Author Biography*

*Kamal Fadil: Ph.D. student at Chouaib Doukkali University (UCD) and ENSAJ, affiliated with the Science Engineer Laboratory for Energy (LabSIPE). His research focuses on photovoltaic cells, with particular emphasis on performance optimisation and the mitigation of dust accumulation on solar panels. With expertise in semiconductor physics, nanoelectronics, and advanced device modelling, he investigates strategies to enhance energy conversion efficiency and long-term reliability of PV systems. He actively contributes to scientific publications and conferences, aiming to bridge fundamental research with innovative applications in renewable energy technologies*

***Corresponding author:** fadil.kamal@ucd.ac.ma*

ID142

# From Nuclear to Thorium: The Energy Transition Discourse in Bangka Belitung

Ibrahim Ibrahim[1*], Ariandi Zulkarnain[2], and Irvan Anshari[3]

[1, 2, 3]*Political Science Department, Bangka Belitung University, Balunijuk-Merawang, Bangka, Indonesia, 33172*

**Abstract:**
Over the past two decades, the idea of constructing a nuclear power plant (PLTN) in the Bangka Belitung Islands has gained traction as Indonesia searches for a secure location to initiate its shift towards clean energy. The Bangka Belitung Islands were chosen because they are close to rare earth metals, a key component of the tin industry and a main industrial nuclear resource. However, the idea has faced strong opposition and has not yet been realized. The lengthy discussion has transformed into plans for a thorium-powered electricity plant (PLTT), which has gained momentum as potential investors have conducted studies on the subject. This study used qualitative research methods, such as interviews, document reviews, and observations, to find that the plan to build a nuclear power plant to transition to clean energy faces significant resistance from various groups, including environmental and social organizations. Nevertheless, support for the energy transition is growing with better socialization and literacy. Meanwhile, this study also found that the government's position is unclear, showing no indication of whether they will support the energy transition. This is also evident in the planning documents, which do not promote the energy transition as a long-term development design. Although the energy transition has shown some progress, the controversy surrounding it is ongoing and expected to continue as a sensitive long-term issue.

**Keywords:**
Discourse, energy transition, Nuclear, Thorium, Bangka Belitung.

*Ibrahim Ibrahim, is e senior lecturer at Faculty of Social and Political Sciences, Bangka Belitung University, Indonesia. His expertise is on political identity, democracy, and ecological policy. Currently, he leads the political science association of Bangka Belitung.*

***Corresponding author:** iim_babel@yahoo.com*

ID143

# Embedded AI for ECG Monitoring: Current Limitations and Emerging Perspectives

Hanane Elferdaoussi[1*], Wissam Jenkal[1], Mostafa Laaboubi[1,2] and Rachid Latif[1]
[1]*Laboratory of Systems Engineering and Information Technology LISTI, National School of Applied Sciences, Ibn Zohr University, Agadir 80000, Morocco*
[2]*Faculty of Applied Sciences, Ibn Zohr University, Ait Melloul, Morocco*

**Abstract :**
Artificial intelligence (AI) demonstrated robust advances in electrocardiogram (ECG) classification, enabling new opportunities for automated monitoring. However, moving from algorithms to real-time embedded systems remains difficult. This work reviews current limitations and outlines perspectives for embedded AI in ECG monitoring. At the data level, noise, patient variability, and lack of cross-dataset generalizability reduce robustness. At the model level, accuracy vs. complexity trade-off remains critical for lightweight 1D-CNNs, recurrent models, and Transformer models. At the hardware level, considerations of memory, latency, and power in FPGA and SoC platforms limit practical deployment. Clinically, absence of verification under real-world conditions inhibits uptake. We emphasize emerging directions such as adaptive noise-aware pipelines, pruned and quantized models for inference efficiency, and explainable AI for clinical trust. Such a rigorous perspective on current limitations and future prospects facilitates the formulation of next-generation embedded ECG systems that combine reliability, real-time functionality, and efficiency.

**Keywords:**
Embedded AI, ECG Classification, Lightweight Models, FPGA/SoC, Real-Time Monitoring

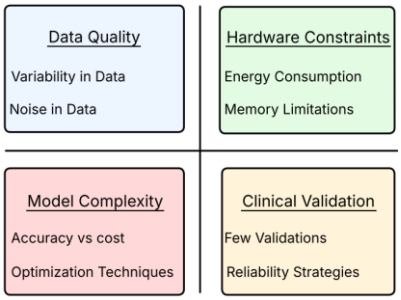


**Fig. 1:** Conceptual overview of embedded AI for ECG monitoring

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*1st Author Biography*

*Hanane El Ferdaoussi, is a PhD student at the National School of Applied Sciences (ENSA), Ibn Zohr University, Agadir, Morocco, affiliated with the LISTI Laboratory. Her research focuses on embedded biomedical signal processing, including FPGA-based architectures for ECG denoising and classification, hardware-aware optimization for low-power real-time systems.*

***Corresponding author:** hanane.elferdaoussi@edu.uiz.ac.ma*

ID146

# Efficiency Enhancement in PV Systems Using MPPT Techniques: A Comparison of IC, FL, and ANN

Hassane Latrach[1], Mohamed Chouiekh[1], Abdelkarim Ballouti[1], Ali Abad[1] and Alia Zakriti[1]

[1]*Abdelmalek Essaadi University, National School of Applied Sciences, Tetouan, Morocco.*

## Abstract :

As the use of photovoltaic (PV) systems increases as a sustainable energy solution, there is a pressing need for effective control strategies to enhance their performance amid varying environmental conditions. This study examines and contrasts three Maximum Power Point Tracking (MPPT) algorithms: Incremental Conductance (IC), Fuzzy Logic (FL), and Artificial Neural Networks (ANN), focusing on their effectiveness in maximizing power extraction. Each approach is implemented and evaluated within a MATLAB/Simulink environment, utilizing the same system setup and input variations. The simulation results reveal the advantages and drawbacks of each method. While IC is straightforward and quick, it faces stability issues near the power point. FL offers improved adaptability and performs better with dynamic changes. In contrast, ANN consistently achieves higher accuracy, quicker convergence, and better overall energy output across the board.

## Keywords:

Maximum Power Point Tracking (MPPT), photovoltaic (PV), Incremental Conductance (IC), Fuzzy Logic (FL), Artificial Neural Networks (ANN), MATLAB/Simulink.

## References:

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*1st Author Biography*

***Hassane Latrach, a Ph.D. student at Abdelmalek Essaadi University, specializes in electrical engineering. His research focuses on Improving the performance of hybrid renewable energy systems by optimizing controls via embedded electronic systems using artificial intelligence. With his expertise in electrical engineering and renewable energy, he actively contributes to publications and conferences with the aim of advancing understanding and applications of optimization using artificial intelligence.***

***Corresponding author: hassanlat2006@gmail.com***

ID147

# Optimization of Cesium Lead Iodide ($CsPbI_3$) Solar Cells for Enhanced Photovoltaic Performance

*Daruez Afonso[1,2]*, Oumaima Mesbahi[1,2,3], Amal Bouich[4,5] and Mouhaydine Tlemçani[1,2]*

[1]*Instrumentation and Control Laboratory- Center for Sci-Tech Research in Earth System and Energy – CREATE, Universidade de Évora*

[2]*Department of Mechatronics Engineering, University of Évora, Portugal.*

[3]*Cátedra CEiiA de Ciência e Tecnologia Aeroespacial, Universidade de Évora*

[4]*Laboratory of Advanced Materials and Process Engineering, PFaculty of Sciences, IbnTofail University, 14000, Morocco.*

[5]*Department of Applied Physics -ETSED, Universitat Politècnica de València, València, Spain*

**Abstract :**

Since the scientific community has become increasingly interested in photovoltaic solar technology based on perovskites, Cesium Lead Iodide ($CsPbI_3$) has become one of the most important inorganic halides owing to its high stability and, however, low efficiency when compared to other perovskites like organic-inorganic hybrids [1,2]. This investigation seeks to improve the performance of $CsPbI_3$ solar cells by optimizing the regular heterojunction planar with structure configuration FTO/$TiO_2$/$CsPbI_3$/Spiro-OMeTAD/Au, with $TiO_2$ as the electron transport layer (ETL), Spiro-OMeTAD as the Hole Transport layer (HTL) and $CsPbI_3$ as the active layer by SCAPS-1D simulator [3,4]. The results show that the lower thickness of HTL and ETL, in our case 40 nm for $TiO_2$ and 200 nm for Spiro-OMeTAD layer lead to higher conversion efficiency around PCE = 27.74%. However, their doping densities start increasing efficiency only when ND is around 1E+20 $cm^{-3}$ and NA is around 2E+19 $cm^{-3}$. The results obtained also present a rise in performance with a conversion efficiency of 30.93% in a 700 nm $CsPbI_3$ layer, and its doping density shows a peak at 1E+17 $cm^{-3}$ of 30.95% in PCE. The band gap of the $CsPbI_3$ absorber layer was also investigated, leading to 34.73% of conversion efficiency at 1.35 eV, while using a 700 nm $CsPbI_3$ absorber layer.

**Keywords:** *Optimization, $CsPbI_3$ perovskite, SCAPS-1D, $TiO_2$ and Spiro-OMeTAD, Solar cells*.

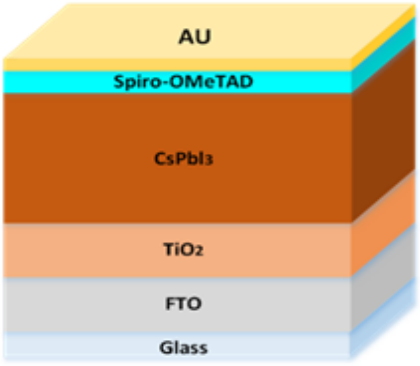


**Fig. 1:** Representation of the $CsPbI_3$-based perovskite solar cell

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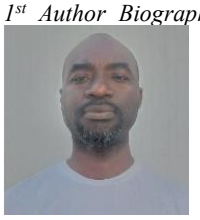

*Daruez Salé Afonso, PhD candidate in Mechatronics and Energy Engineering at the University of Évora, Portugal, Master's degree in Physics from Eduardo Mondlane University, Mozambique. Author and co-author of articles published in international journals and participant in international conferences.*

***Corresponding author:** y.daruez@gmail.com*

ID148

# Comparative study of the effectiveness of approximation and exact models for geometric deviation

*Jean Claude Hagabimana[1*], Abdelhak Nafi [1]*

[1] *Mechanics, Mechatronics and Control Laboratory, Moulay Ismail University, National School of Arts and Crafts Meknès, MOROCCO*

**Abstract:**

This research presents a comparative study of three models for compensating geometric errors for a three-axis linear kinematic chain: the exact model, the vector model, and the homogeneous simplified model. The objective is to evaluate their behavior under small random errors (from $10^{-12}$ to $10^{-5}$ m) in order to determine their relevance according to the required level of accuracy. Using a numerical simulation in MATLAB, the deviation between the nominal final position and that affected by the errors is calculated for each model. The results show that the exact model provides the most accurate reference measurement, while the vector and homogeneous models produce very close results. As the results provide practical guidance, the appropriate model can be selected based on the targeted accuracy in additive manufacturing applications. This proximity validates the use of simplified models in cases where errors are small and where computational speed is sought. This work serves as a basis for future experimental validations and demonstrates the importance of choosing the model adapted to the accuracy required in industrial applications. This research demonstrates a clear detection threshold for geometric error modeling approaches and highlights the trade-offs between model complexity and estimation accuracy.

**Keywords:**

Geometric errors, 3D printer, volumetric errors, kinematic model, homogeneous matrices.

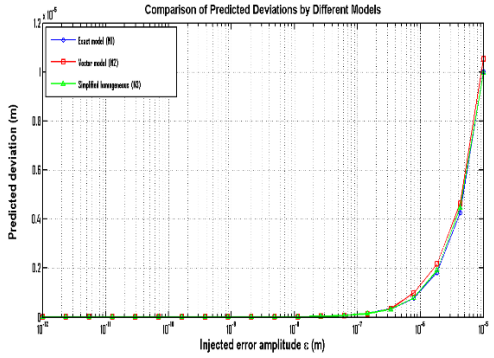


**Fig. 1:** Comparison of the evolution of the exact and approximate models as a function of the imposed error

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*1st Author Biography*

*Jean* Claude Hagabimana, *is a PhD student at ENSAM in Meknes, Moulay Ismael University, He is an engineer specializing in mechanical manufacturing. His research focuses on improving the accuracy of 3D printing applied to robotics and mechatronics. His interests include the geometric modeling of 3D printers, robotic manipulator arms, and machine tools.*

***Corresponding author:** j.hagabimana@edu.umi.ac.ma*

ID149

# Advanced Capacitive Deionization with Amino-Functionalized Manganese Oxide for Efficient Cr(VI) Electrosorption

Y. Slek, M. Salmi, Z. Zaroual, S. Elghachtouli

*Laboratoire de Chimie Organique, Matériaux, Electrochimie et Environnement, Faculté des Sciences Ain Chock, Université Hassan II, Casablanca*

**Abstract :**

Water pollution from industrial discharges represents a major environmental issue due to the presence of highly toxic contaminants such as hexavalent chromium [Cr(VI)]. This metal, which is extremely soluble in water, is known for its toxic effects. To address this challenge, various materials have been investigated for Cr(VI) removal, Among them, manganese oxides ($MnO_2$) have attracted increasing interest owing to their abundance, low cost, and unique oxidative properties. Their crystalline structure allows the reversible insertion/extraction of ions, while the presence of surface hydroxyl groups facilitates the attachment of functional groups, enabling targeted modification of the material and providing multiple advantages. In parallel, several wastewater treatment methods have been explored, such as chemical precipitation, ion exchange, adsorption, and electrosorption. More recently, Capacitive Deionization (CDI) has emerged as a promising alternative, based on the electrosorption of pollutant ions onto charged electrodes, offering simplicity, low energy consumption, and no additional filtration steps after treatment.

In this work, a CDI system was designed and evaluated for the removal of Cr(VI), using manganese oxide functionalized with amino groups as the working electrode. The functionalization creates new active sites, thereby enhancing the electrosorption of Cr(VI). The material was characterized using various spectroscopic techniques. The CDI performance was investigated under different conditions. Results demonstrated a high adsorption capacity, particularly at low pH (pH 2) and under an applied potential of 1 V. The system achieved a high removal efficiency while maintaining excellent material stability over multiple cycles.

**Keywords:**

Capacitive Deionization (CDI), Manganese oxides, Functionalization, Removal of Cr(VI)

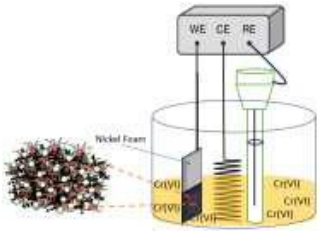


**Fig. 1:** Visualization Schematic of electrosorption Cr(VI) by functional manganese oxide materials.

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*1st Author Biography*

*Yassine SLEK, is a Ph.D. student at Hassan II University, specializes in environmental electrochemistry and advanced water treatment technologies. His research focuses on the removal of toxic pollutants such as hexavalent chromium [Cr(VI)] and organic dyes through adsorption and Capacitive Deionization (CDI) using manganese oxide materials.*

***Corresponding author:** s.elghachtouli@gmail.com ; slek.yassine@gmail.com

ID150

# Climate Change and Crop Adaptation in Sahelian Savana Region of Negeria

Isa Magaji Azare
Department of Environmental Management and Toxicology Federal University, Dutse, Jigawa State, Nigeria,

**Abstract:**
Understanding the potential impacts and consequences of climate risks on soil crop production is now a top priority for agronomists and policymakers around the world. This review specifically aims to fill in knowledge gaps regarding how certain climate changes affect agriculture in Nigeria, particularly in the Savanna region. Recent research has indicated that as temperatures rise, soil organic carbon (SOC) levels decrease, especially in areas with high initial SOC levels. The decrease in yields caused by higher temperatures is primarily due to a shorter growing season. Declines in residue, lower SOC levels, and reduced nitrogen availability pose a threat to crop yields in key agricultural regions globally. To counteract this risk, new adaptation strategies such as adjusting planting schedules, developing new crop varieties, using nitrogen fertilization, disease prevention, and pest control should be put into place.

**Keywords:**
Climate Change; Crop Development; Impact; Sahel Savanna; Yield;

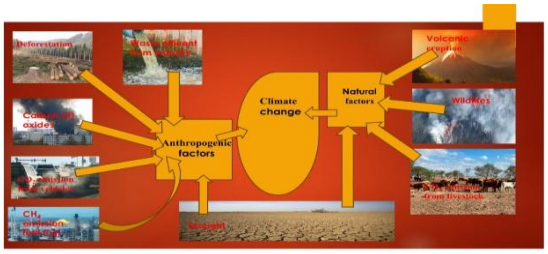


**Fig. 1:** Contributors to Climate Change

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*1st Author Biography*

FIsa Magaji Azare, is an Associate Professor in the Department of Environmental Management and Toxicology, Federal University Dutse, Jigawa Nigeria. His work involves research in climate studies related to crops, climate change and crops, desertification and soil erosion management. Azare hold master and doctor of philosophy in Agrometeorology from Modibbo Adama University, Yola. Adamawa. Nigeria. He taught several courses including introduction to climatology and biogeography, agrometeorology, environmental monitoring system and techniques, environmental pollution and control, oceanography, environment and poverty, integrated resources management and hazardous substance management for almost a decade. Dr. Azare has been the research supervisor for many undergraduate students specializes in environmental management and climatology.

***Corresponding author:** isamagajiazare@gmail.com*

ID152

# A conceptual Framework Using the Emotional Design Approach to Analyze Consumer Preference in Car Design

Pradipto Sugondo[1], and Ferric Limano[2]
[1,2]*Design Department, Binus Graduate Program - Master of Design Bina Nusantara University Jakarta, Indonesia*

**Abstract :**
Among the many reasons a person decides to purchase a car, one of significant is its design. The design of a car can evoke feelings of liking or disliking toward the vehicle itself. The purpose of this study is to understand the correlation between how individuals assess a car's design and how this assessment leads to their preference—whether they like or dislike the design. Currently, to obtain such information, business practitioners must conduct a design survey that typically takes three months, involves around 100 respondents, and costs about $50.000, as it requires importing the vehicle from its country of origin. The proposed framework can significantly reduce energy, time, and cost compared to conducting the design survey. To facilitate understanding, this study uses a SUV category vehicle as an example and includes a simulation of the proposed correlation framework in its application. This research employs a mixed-method approach, in which quantitative data obtained from questionnaires and vehicle dimension measurements, while qualitative data are gathered from interviews with selected respondents to confirm the validity of the quantitative findings. The results of this study reveal that, in Indonesia, there are at least four main factors influencing individuals' evaluation of car design: Proportion, Facia Expression (the appearance of the car's front face), Novelty, and Overall Design Harmony. The conclusion of whether a person likes or dislikes a car's design is determined by their consumer preference, which is influenced by their psychographic profile and past aesthetic experiences.

**Keywords:**
Car Design, Customer, Preference

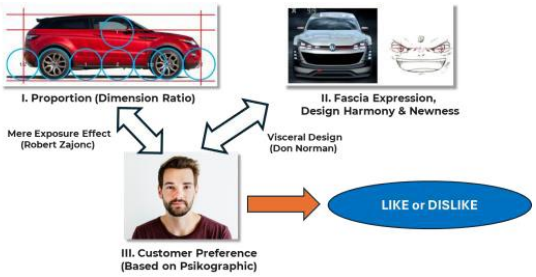


**Fig. 1:** Correlation Framework between Customer and Car Design

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*1st Author Biography*

*Pradipto Sugondo, a* Master of Design student at Bina Nusantara University, Jakarta, Indonesia, experienced in Indonesia automotive Industry for more than 30 years in the field of car designing and development.

***Corresponding author:** pradipto.sugondo@binus.ac.id*

ID153

# Transition metal doping for enhanced properties of CZTS material for photovoltaic applications

SafaeTorka[1, 2*], Naoufal Ennouhi[3], Imane Hamidenne[2] and Zouheir Sekkat[1, 2]

[1] *Laboratory of materials, nanotechnologies and environment, Department of Chemistry, Faculty of Sciences, University Mohammed V in Rabat, Rabat, Morocco.*
[2] *Optics and Photonics Centre, Moroccan Foundation for Advanced Science, Innovation and Research (MAScIR), University Mohammed VI Polytechnic (UM6P), Benguerir, Morocco.*
[3]*Applied Science and Artificial Intelligence Research Institute (ASARI), University Mohammed VI Polytechnic (UM6P), Laayoune, Morocco*

**Abstract:**
Kesterite (CZTS) solar cells have garnered significant attention as an absorber layer owing to their attractive optoelectronic properties, low-cost fabrication, non-toxic elements, and ease of manufacture. In this study, we investigated the effect of transition metal chlorides: silver chloride, indium chloride, magnesium chloride, manganese chloride, and titanium tetrachloride with a molar ratio of 2% using the Sol-Gel method via spin coating. The structural, morphological, and optical properties of the doped $Cu_2ZnSnS_4$ thin films were characterized and compared using scanning electron microscopy (SEM), X-ray diffraction (XRD), Raman spectroscopy, and UV–visible spectroscopy. These findings demonstrated that Magnesium and silver doping are the best dopant metals in terms of crystallinity, morphology, and optical properties. This work presents an attainable method to enhance the performance of CZTSSe-based solar cells by using transition metals.

**Keywords:**
Transition metals; doping; kesterite; thin films; solar energy.

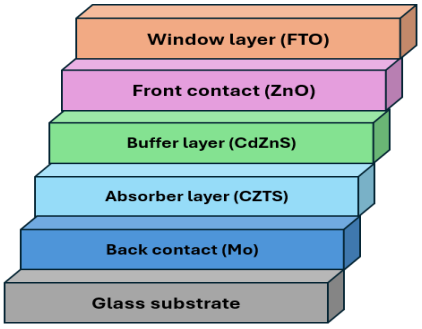


**Fig. 1:** Basic structure of CZTS solar cell.

**References:**

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*1st Author Biography*

*Safae Torka, a Ph.D. student at Mohammed V University, Rabat, specializes in photovoltaic and molecular photonics. Her research focuses on the development and optimization of kesterite thin films for photovoltaic applications, with particular interest in solvent engineering, doping, and alloying. She has expertise in the fabrication of thin films using the sol–gel method via spin coating, chemical bath deposition, and PVD technique. She also has solid knowledge of characterization methods, including UV–Visible spectroscopy, Raman spectroscopy, atomic force microscopy, and X-ray diffraction.*

***Corresponding author:** safae.torka@um5r.ac.ma*

ID154

# Development of a new nanomaterial derived from the intercalation of Remazol Red 198 into zinc–aluminium layered double hydroxide through the memory effect

*Hind Tabia[1*] , El Khattabi El Hassan[1] , El Hadiri Najat[1]*

*[1]Laboratory of Materials Sciences and Process Optimization, Faculty of Sciences Semlalia, University Cadi Ayyad, Marrakech, Morocco*

**Abstract :**

The continuous release of synthetic dyes from industrial sources poses a serious threat to environmental and public health. Among these pollutants, Remazol-type azo dyes are particularly persistent due to their strong chemical stability and low biodegradability. Layered double hydroxides (LDHs) have emerged as promising adsorbents for dye removal thanks to their lamellar structure, anion-exchange capacity, and the ability to regenerate their layers through the memory effect. In this study, $Zn_2$–Al–$CO_3$ LDHs were synthesized by coprecipitation under controlled pH conditions, then calcined to obtain mixed oxides with higher surface area and porosity. The calcined phases were rehydrated in the presence of Remazol Red 198 (RR198), allowing the intercalation of dye anions through the memory effect. Structural and spectroscopic analyses (XRD, FTIR, SEM, and TGA/DTA) confirmed the successful reconstruction of the LDH structure and the incorporation of the dye. Optimization of parameters such as pH, dye concentration, and contact time revealed that calcination enhances adsorption efficiency and promotes stable intercalation. The resulting $Zn_2$–Al–RR198 hybrid material shows strong potential for the effective removal of azo dyes from wastewater.

**Keywords:**

Layered double hydroxides (LDHs), memory effect, dye intercalation, adsorption, azo dyes, water treatment.

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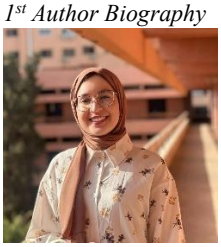
*1st Author Biography*



*Hind Tabia, a second-year Ph.D. student at the Laboratory of Physics, Chemistry of Materials and Environment, Faculty of Sciences Semlalia, Cadi Ayyad University, focuses her research on the synthesis and characterization of layered double hydroxides (LDHs) and their application in environmental remediation. Her work explores dye intercalation, adsorption mechanisms, and the development of nanomaterials for water treatment*

***Corresponding author:** h.tabia.ced@uca.ac.ma*

ID155

# Energy Recovery from Cashew Waste: Advancing Circular Economy Practices in Burkina Faso

Marie SAWADOGO[1], Lauriane Mena-kintima BONGO[2], Fernand ZOMA[1], Anselme BAGORO[1]

[1] *Institut International d'Ingénierie de l'Eau et de l'Environnement, Burkina Faso*
[2] *Pan African University -Institute of Water and Energy Sciences including climate change, Algeria*

**Abstract:**
The cashew processing industry in Burkina Faso generates substantial quantities of lignocellulosic residues mainly composed by cashew nutshells (CNS) about 70-75%, which remain largely unexploited. Households and Small and Medium-sized Enterprises (SMEs) in the agro-industrial sector of Burkina Faso are struggling to meet their energy needs, relying on unconventional sources that contribute to deforestation and climate change. This study assesses the energetic valorization of cashew nutshell into biofuel, within the framework of a circular economy. Twelve circular economy scenarios have been assessed including close loop recovery and open loop scenario. In the closed loop scenario, SMEs produce their own byproducts (CNS) and convert it locally to biofuel (biochar or briquettes) that they will use. In the opened loop scenarios, CNS are produced by SMEs and sold to others for their energy supply. A multicriteria decision making approach based on hybrid Analytical Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods have been developed to assess the scenarios based on economic, environment and social criteria. The findings revealed that profit was the most influential criterion (49.6%) in selecting the best scenario, followed by production cost (27.8%), carbon footprint (16.0%), and job creation (6.7%). The best-case scenario, based on these four criteria, involved recovering Cashew Nut. Thus, the findings underscore the strategic role of cashew residue valorization in advancing the national transition toward sustainable energy pathways.

**Keywords:** Circular Economy, Cashew Nutshell Waste, Burkina Faso, AHP-TOPSIS, waste-to-energy

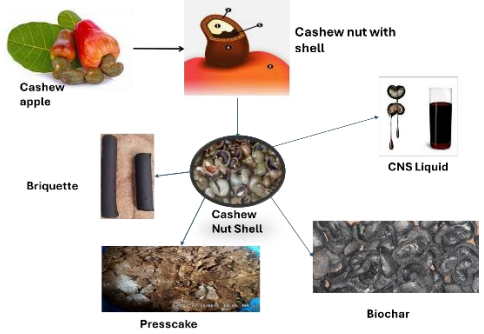



**Fig. 1:** Products from cashew sector

**References:**

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[3] Sawadogo, M., Tchini Tanoh, S., Sidibé, S., Kpai, N., & Tankoano, I. (2018). Cleaner production in Burkina Faso: Case study of fuel briquettes made from cashew industry waste. Journal of Cleaner Production, 195, 1047–1056.

*1st Author Biography*

*Dr. Marie SAWADOGO is an Associate Professor in Industrial Engineering at 2iE Institute (Institut International d'Ingénierie de l'Eau et de l'Environnement Her research and expertise focus on renewable energy, sustainability assessment of energy production systems, bioenergy, supply chain optimization, and industrial systems optimization. She has led numerous projects and expert missions on energy recovery from agro-industrial residues and the assessment of industrial greenhouse gas emissions, among others.*

***Corresponding author:** marie.sawadogo@2ie-edu.org

ID156

# Valorization of clay for the development of geopolymers in civil engineering

Halima Brout[1,2*], Mohammed El Bachri[1,2], Zouhair El Jouad[1] and Redouane Mghaiouini[1,2]
[1]*Department of Physics, Condensed Mater Laboratory, Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco*
[2]*Advanced Systems Engineering Laboratory, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco*

**Abstract :**
This study examines the impact of industrial waste, such as clay, on the performance and properties of geopolymer concrete. By incorporating calcined clays (after heat treatment) that act as a filler, reducing permeability and water absorption and thus increasing the density of the matrix. The analysis in this study indicates the effect of temperature and curing time, as well as the percentages of silica and alumina (aluminosilicates) used, on the strength growth of geopolymers. The results show improved mechanical properties and reduced carbon emissions, durability, and resistance to extreme environmental conditions. This research offers a sustainable and viable alternative to traditional cementitious binders for various engineering applications.

**Keywords:**
Clay, geopolymer, sustainable material, calcination

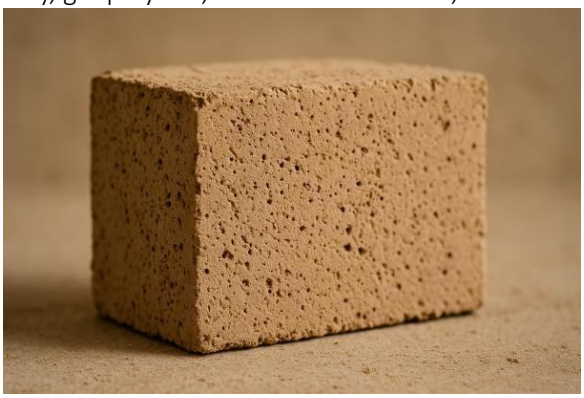

**Fig. 1:** Geopolymer concrete based on clay

**References:**

[1] Khan, R., Iqbal, S., Soliyeva, M., Ali, A., & Elboughdiri, N. (2025). Advanced clay-based geopolymer: influence of structural and material parameters on its performance and applications. RSC advances, 15(16), 12443-12471.
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*1st Author Biography*

*Halima Brout, a Ph.D. student at Chouaib Doukkali University, specializes in civil engineering. Her research focuses on elaboration of geopolymers based on industrial waste such as clay. With expertise in concrete and cement formulation, she actively contributes to publications and conferences, aiming to advance the understanding and applications of industrial waste in the formulation of geopolymer.*

***Corresponding author:** halimabrout@gmail.com*

ID157

# Theoretical Modeling and Simulation of an All-Optical Full Adder Based on Mach-Zehnder Interferometers

Noureddine Ennadi[1*], Said Amrane[1], Khalid El Khadiri[1], Said Dlimi[1], and Mostafa Abouricha[2]

[1]*LSTIC, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[2]*LPTHE, Department of Physics, Faculty of Sciences, Ibnou Zohr University, Agadir, Morocco.*

**Abstract :**
The escalating demand for increased bandwidth and reduced power consumption in computing systems necessitates exploration beyond traditional electronic paradigms. This research presents the design, optimization, and performance evaluation of high-efficiency optical logic circuits utilizing Mach-Zehnder Interferometers (MZIs) and the electro-optic effect in non-linear materials to achieve ultrafast phase modulation. Through theoretical modeling and circuit simulation, we develop optimization techniques that minimize energy dissipation while maintaining stability, reliability, and signal fidelity. Our approach demonstrates significant improvements in energy efficiency compared to existing electronic and photonic architectures. These results establish a critical foundation for developing next-generation, low-power optical computing systems with enhanced computational throughput.

**Keywords:** Optical logic circuits, Mach-Zehnder interferometer, Electro-optic modulation, Energy-efficient computing, Circuit optimization, Photonic components.

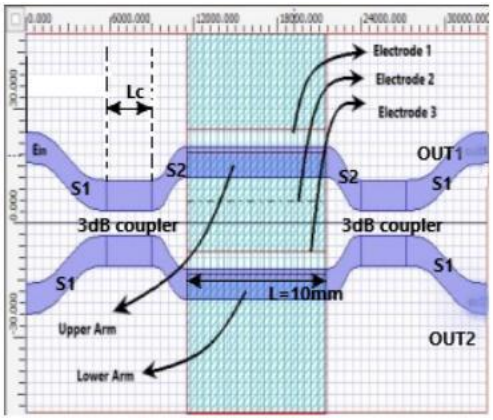


**Fig. 1:** Single stage Mach-Zehnder Interferometer with 3dB couplers at the input and output

**References:**

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[3] A. Kotb, Z. Wang, K. E. Zoiros, « High-Performance All-Optical Logic Gates Based on Silicon Racetrack and Microring Resonators », Electronics, vol. 14, no. 15, 2961, 2025.
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*1st Author Biography*

*Noureddine Ennadi, a Ph.D. student at Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco, specializing in electronic physics, information processing, and integrated photonic systems. His research focuses on the design and optimization of high-efficiency optical logic circuits. He aims to develop next-generation photonic architectures that are energy-efficient and ultrafast, for advanced optical computing systems*

***Corresponding author:** nour.ennadi@gmail.com*

ID158

# Creation and evaluation of fly ash-based geopolymers for creative and sustainable building

Mohammed El Bachri[1,2], Halima Brout[1,2], Zouhair El Jouad[1] and Redouane Mghaiouini[1,2]

[1]*Department of Physics, Condensed Matter Laboratory, Faculty of Science, Chouaib Doukkali University, El Jadida, Morocco*
[2]*Advanced Systems Engineering Laboratory, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morroco.*

**Abstract :**
The creation of fly ash-based geopolymer materials that are effective and sustainable alternatives to traditional cement is the aim of this research. These materials are made by reacting silica and alumina-rich source materials with alkaline activators to create materials with exceptional mechanical properties and corrosion and heat resistance. This study examined a variety of materials and how they affected the characteristics of geopolymers, including the kind of ash utilized, the amount of alkaline solutions present, and the circumstances surrounding heat treatment. To enhance performance, other methods were also implemented, such as the use of mineral supplements. The findings demonstrated that these materials are not only a viable option for lowering carbon emissions, but they also offer superior mechanical strength and thermal insulation, making them appropriate for environmentally friendly building in challenging conditions. By recycling industrial waste in the building industry, this study contributes to the development of a circular economy.

**Keywords:** Geopolymer, Fly ash, Aluminosilicate, Alkaline activating

**Fig. 1:** Geopolymer concrete based on fly ash

**References:**

[1] *C. Bai, P. Colombo, Processing, properties and applications of highly porous geopolymers: A review, Ceramics International. 44 (2018) 16103–16118.*
[2] *D. Panias, I.P. Giannopoulou, T. Perraki, Effect of synthesis parameters on the mechanical properties of fly ash-based geopolymers, Colloids and Surfaces A: Physicochemical and Engineering Aspects.*
[3] *D.J. Davidovits, 30 Years of Successes and Failures in Geopolymer Applications. Market Trends and Potential Breakthroughs., J Therm Anal. 37:1633 (1991) 1*

*1st Author Biography*

*Mohammed El Bachri, a Ph.D. student at Chouaib Doukkali University, specializes in condensed matter physics. His research focuses on developing geopolymers from industrial waste such as ash. Thanks to his expertise in this field, he actively contributes to publications and conferences, with the aim of promoting understanding of how industrial waste can be used in the composition of geopolymers.*

***Corresponding author:** mohammedelbachri2@gmail.com*

ID159

# Impact of Noise on Quantum Tunneling in Graphene

Kamal Azaidaoui[1], Ahmed Jellal[1]

[1] *Laboratory of Theoretical Physics, Faculty of Sciences, Chouaib Doukkali University, PO Box 20, 24000 El Jadida, Morocco*

**Abstract:**
Graphene is a 2D gapless material, where low-energy charge carriers behave as relativistic massless Dirac fermions. This makes this material a very exotic platform for the study of transport properties. In this work, we investigate the effect of noisy fluctuations on the tunneling properties of graphene. In the absence of this noise, the chirality in graphene exhibits the Klein tunneling phenomenon, that is, perfect transmission at normal incidence through an electrostatic barrier regardless of its height or width. This emphasizes the difficulty of manipulating electrons in graphene-based devices and limits the design of efficient switch-on/switch-off elements. Our results show that tunneling across a stochastic, time-varying barrier induces decoherence, leading to absorption and energy dissipation. The transmission probability decreases at both normal and non-normal incident angles, resulting in the suppression of the ideal Klein tunneling regime. These findings highlight that engineering of controllable noise can be used as a useful tool for tuning transport properties in Dirac materials.

**Keywords:** Graphene; Klein tunneling; Noise; Quantum transport; Dirac materials.

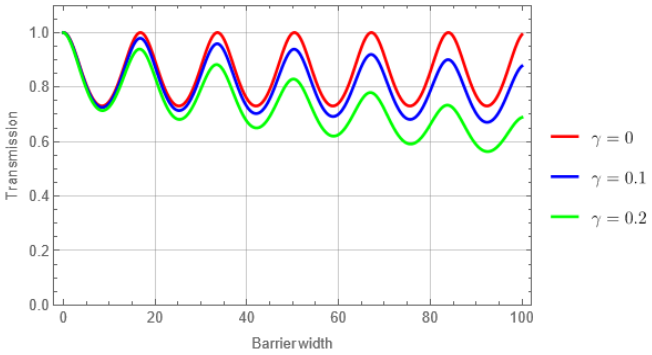


**Fig. 1:** Transmission probability versus barrier width for different noise strengths.

**References:**

[1] M. I. Katsnelson, K. S. Novoselov & A. K. Geim, Nature Physics 2, 620–625 (2006).
[2] A. A. Balandin, Nature Nanotechnology 8, 549–555 (2013).
[3] M. Mekkaoui, A. Jellal & H. Bahlouli, Solid State Communications 358, 114981 (2022).

*1st Author Biography*

*Kamal Azaidaoui, a Ph.D. student in theoretical physics at Chouaib Doukkali University, El Jadida, Morocco. His research focuses on quantum transport and open quantum systems in low-dimensional materials, particularly in graphene. He studies how noise, decoherence, and disorder affect tunneling and electronic transport, combining analytical modeling with numerical simulations. He actively participates in conferences and aims to contribute to the development of graphene-based quantum and nanoelectronic devices.*

***Corresponding author:** azaidaoui.k065@ucd.ac.ma*

ID160

# Artificial Intelligence Approaches for Processing and Analysis of Optical Coherence Tomography (OCT) Images Applied to Early Disease Diagnosis

Hind Sajid[1*], Said *Amrane[1], Khalid El Khadiri[1], Said Dlimi[1], Mostafa Abouricha[2], and Aziz Dkiouak[1]*
*[1]LSTIC, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
*[2]LPTHE, Department of Physics, Faculty of Sciences, Ibnou Zohr University, Agadir, Morocco.*

## Abstract:
Optical Coherence Tomography (OCT) is a non-invasive imaging technology that provides high-resolution visualization of biological tissues, particularly retinal microstructures. While highly valuable for clinical diagnosis, interpreting OCT images is time-consuming and complex, limiting their full potential in healthcare. This research investigates the use of deep learning and artificial intelligence (AI) to automate OCT image analysis, enabling fast and accurate detection, segmentation, and classification of ocular, neurological, and cardiovascular pathologies. By combining AI-based processing with clinical insights, the approach aims to improve diagnostic accuracy, accelerate decision-making, and support early intervention, ultimately enhancing patient care and facilitating the integration of intelligent imaging technologies into routine practice.

## Keywords:
Optical Coherence Tomography (OCT), Artificial intelligence, Medical Image Classification, Early Diagnosis, Deep Learning.

## References:
[1] R. G. A. van der Waerden, R. H. J. A. Volleberg, T. J. Luttikholt, P. Cancian, J. L. van der Zande, G. W. Stone, N. R. Holm, E. Kedhi, J. Escaned, D. Pellegrini, G. Guagliumi, S. R. Mehta, N. Pinilla-Echeverri, R. Moreno, L. Räber, T. Roleder, B. van Ginneken, C. I. Sánchez, I. Išgum, N. van Royen, and J. Thannhauser, "Artificial intelligence for the analysis of intracoronary optical coherence tomography images: a systematic review," Eur. Heart J. – Digital Health, vol. 6, no. 2, pp. 270-284, Mar. 2025, doi: 10.1093/ehjdh/ztaf005.

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[3] M. B. Djulbegovic, H. Bair, D. J. T. Gonzalez, H. Ishikawa, G. Wollstein, and J. S. Schuman, "Artificial intelligence for optical coherence tomography in glaucoma," Translational Vision Science & Technology, vol. 14, no. 1, p. 27, 2025, doi: 10.1167/tvst.14.1.27.

*Hind Sajid, Ph.D. student at Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco, specializing in biomedical imaging and radiological analysis. Research focuses on applying deep learning and artificial intelligence to automate Optical Coherence Tomography (OCT) image analysis for the early detection and classification of ocular, neurological, and cardiovascular pathologies. Passionate about leveraging technology to enhance healthcare outcomes, developing expertise in medical image processing and AI-based diagnostics, with the aim of contributing to more accurate and efficient diagnostic solutions.*
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***Corresponding author:** sajidhind16@gmail.com*

ID161

# Physicochemical and isotopic characterization and vulnerability mapping of the Sahel Doukkala groundwater aquifer using the susceptibility index (SI) method

Fatima Ezzahra Afri [1], Ilham Chennak[2,3], Mohammed taibi[1]

[1] *Laboratory of Geosciences and Applications, Department of Geology, FS, Ibn Tofail University, 14000 Kenitra, Morocco.*
[2] *Laboratory of Water and Environment, Department of Chemistry, FS, Chouaïb Doukkali University, 24 000, El Jadida, Morocco.*
[3] *Laboratory of Health and Environment, Department of Biology, FS Ain Chock, Hassan II, 20 470 Casablanca, Morocco.*

## Abstract:

This study assesses the quality and vulnerability of the Sahel Doukkala groundwater aquifer in Morocco through an integrated approach combining physicochemical analyses, stable isotopes ($^{2}H$, $^{18}O$), and tritium ($^{3}H$), alongside intrinsic vulnerability mapping using the susceptibility Index (SI) method. fifty groundwater samples were collected and analyzed to determine major chemical parameters and isotopic signatures. The hydrochemical results reveal a high degree of mineralization, mainly linked to the dissolution of carbonate formations, agricultural intensification, and, in some areas, seawater intrusion. stable isotope analyses provided key insights into the origin, recharge processes, and hydrodynamics of the aquifer, while tritium concentrations allowed the differentiation between recently recharged waters and older, poorly renewed groundwater. The SI-based vulnerability assessment highlights zones of moderate to high susceptibility, particularly in areas characterized by shallow groundwater levels, permeable lithology, and intensive farming activities. The spatial coherence between SI vulnerability classes and observed nitrate and tritium distributions further validates the method. The combined use of geochemical indicators and isotopic tracers proves to be a highly effective tool for understanding groundwater processes and identifying the impact of both natural and anthropogenic pressures on water quality. the findings of this study provide essential scientific support for developing sustainable groundwater protection and management strategies in the Sahel Doukkala region.

**Keywords:** groundwater; isotopes; hydrochemistry; vulnerability; Susceptibility Index.

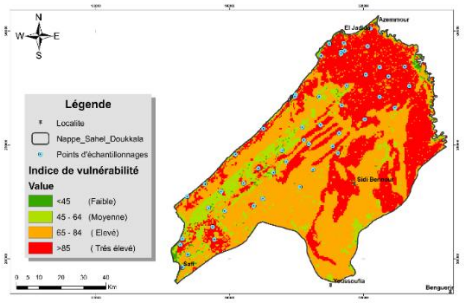


**Fig. 1:** Final vulnerability map of the Sahel Doukkala phreatic aquifer using the SI method

## References:

[1] Mohammadi et al. (2009). Groundwater pollution has become a growing global concern.
[2] Jourda et al. (2007). The SI index is expressed as a numerical value ranging from less than 45 to 100, representing the degree of vulnerability. Higher values indicate greater susceptibility to contamination.
[3] Smida et al. (2004). he movement and dispersion of a contaminant within the saturated zone depend on the texture and lithological arrangement of the aquifer layers.

*1st Author Biography*

*Fatima Ezzahra Afri, is a PhD student in Hydrogeology at the Laboratory of Geosciences and Applications, Faculty of Sciences, Ibn Tofail University, Kenitra. My research focuses on assessing groundwater quality and aquifer vulnerability in the Sahel Doukkala region through physicochemical analyses, isotope techniques ($^{2}H$, $^{18}O$, $^{3}H$), and GIS-based modeling. I apply the susceptibility Index (SI) method to identify areas at risk of contamination and study the influence of agricultural practices, seawater intrusion, and natural processes on groundwater resources. my work aims to support the development of effective strategies for groundwater protection and environmental management.*

***Corresponding author:** fatimaezzahra.afri@uit.ac.ma*

ID162

# Quantum Tunneling Phenomena in Rarita–Schwinger Semimetals

Otman Bouladiane[1*], Ahmed Jellal [1]

[1] *Laboratory of Theoretical Physics, Faculty of Sciences, Chouaib Doukkali University, PO Box 20, 24000 El Jadida, Morocco*

**Abstract:**

The spin-3/2 Rarita-Schwinger system is a new class of topological materials with a quasiparticle band structure consisting of four linearly dispersing bands (E±3/2), (E±1/2) that maintain symmetry across all spatial directions. In this work, we analytically solve the time-independent Schrödinger equation for the low-energy effective linearized Hamiltonian $k.p$ around such a point described by spin-3/2 fermions and study the tunneling phenomena through a potential barrier, present uniformly in a finite region along the transmission axis. We determine the transmission coefficients. Analogously to Dirac and Weyl semimetals, Klein tunneling and resonance effects are observed numerically in the transmission probability. These results demonstrate how fermions with spin-3/2 transport in Rarita-Schwinger semimetals. This work contributes to the fundamental understanding of electronic transport mechanisms in spin-3/2 systems.

**Keywords:**

Rarita-Schwinger semimetals, topological materials, tunneling phenomena, transmission coefficients.

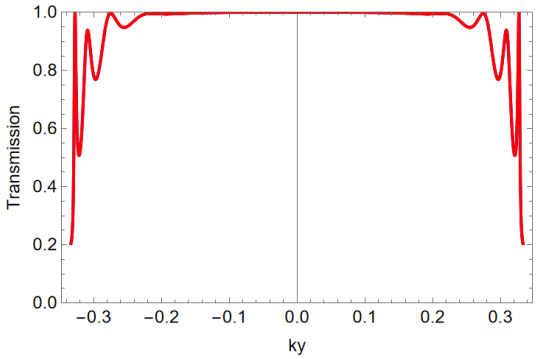


**Fig. 1**: Transmission probability as a function of the transverse wave vector ky, through a potential barrier.

**References:**

[4] Julia M. Lien, I. Boettcher, F. Herbut Phys. Rev. B 101, 184503 (2020).
[5] I. Boettcher, Phys. Rev. Lett. 124, 127602 (2020).
[6] Ipsita Mandal Physics Letters A 384 (2020) 126666.

*1st Author Biography*

*Otman Bouladiane, a Ph.D. student at Chouaib Doukkali University, specializes in theoretical physics, specifically in condensed matter physics, with a focus on quantum transport phenomena in 2D materials, particularly in semimetals and semiconductors. His research explores electronic transport under external influences such as electric and magnetic fields, aiming to understand the fundamental mechanisms governing charge and spin dynamics in low-dimensional systems. With expertise in quantum tunneling and device simulation, he contributes to advancing the theoretical understanding and technological applications of next-generation 2D materials.*

***Corrsponding Author:** bouladiane.o873@ucd.ac.ma*

ID163

# Analytical Framework for the Solvability of Nonlinear Integro-Differential Systems

Meryenne Hmamed [1], Mohammed Shimi [1], Youssef Akdim[1]

*[1]Modeling, Applied Mathematics and Intelligent Systems Laboratory (LM²ASI) Faculty of Sciences – Dhar El Mehraz (FSDM), Sidi Mohamed Ben Abdellah University (USMBA), Fez, Morocco*

## Abstract

This paper investigates the analytical solvability of nonlinear integro-differential systems characterized by nonlocal and memory-dependent operators. The main goal is to establish new existence and stability conditions for the solutions in Banach and Hilbert spaces. By employing Schauder and Banach fixed point principles, the study develops a comprehensive framework to analyze the well-posedness of complex nonlocal models. The results provide general criteria applicable to a broad class of physical and biological systems where integral terms govern hereditary or delayed interactions. This theoretical approach enhances the understanding of nonlinear dynamics driven by integro-differential structures and paves the way for further studies on nonlocal phenomena.

## Keywords:

Nonlinear integro-differential systems, solvability, stability analysis, nonlocal operators.

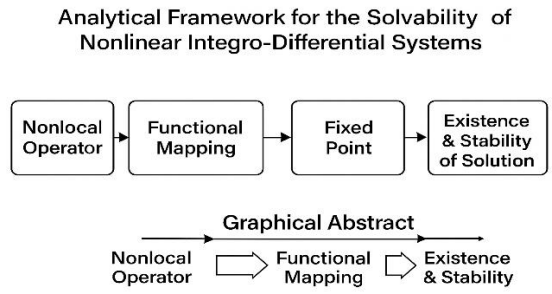


Fig. 1: **Analytical Process**

## References:

[1] *Benchohra, M., Salim, A., & Zhou, Y. (2024). Integro-Differential Equations: Analysis, Stability and Controllability. Walter de Gruyter GmbH & Co KG.*

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*1st Author Biography*

*Hmamed Meryenne est une Doctorante spécialisée en analyse fonctionnelle et modélisation mathématique. Ses recherches portent sur l'étude de la solvabilité et de l'analyse de stabilité des systèmes intégro-différentiels non linéaires impliquant des opérateurs non locaux. Elle utilise principalement les théorèmes de point fixe comme outil fondamental pour ses travaux.*

***Corresponding author:** meryem.hmamed9@gmail.com*

ID164

# Vulnerability Mapping of the Sahel Doukkala Aquifer Using the SI Method

Fatima ezzahra Afri [1], Ilham Chennak[2,3], Mohammed Taibi[1]

[1] *Laboratory of Geosciences and Applications, Department of Geology, FS, Ibn Tofail University, 14000 Kenitra, Morocco.*
[2] *Laboratory of Water and Environment, Department of Chemistry, FS, Chouaïb Doukkali University, 24 000, El Jadida, Morocco.*
[3] *Laboratory of Health and Environment, Department of Biology, FS, Ain Chock, Hassan II, 20 470 Casablanca, Morocco.*

**Abstract:**
This work presents the assessment of groundwater vulnerability in the Sahel Doukkala aquifer using the susceptibility index (SI) method. the approach integrates key hydrogeological parameters, including depth to water table, recharge, soil characteristics, and the influence of land use, to generate a spatial vulnerability map. the SI index allowed differentiating four vulnerability classes: very low, low, moderate, and high. the results show that the majority of the aquifer exhibits moderate vulnerability, reflecting the combined effects of shallow water levels and intensive agricultural activity. highly vulnerable zones are mainly located in the central and southwestern sectors, where nitrate concentrations and agricultural pressures are significant. conversely, areas with greater protective soil thicknesses and deeper water tables show low to very low vulnerability. the spatial distribution of the SI index highlights the sensitivity of the aquifer to potential contamination, particularly from agricultural inputs. This mapping provides essential guidance for groundwater management, emphasizing priority zones where protective measures and pollution-control strategies should be strengthened to ensure sustainable use of the resource.

**Keywords:** groundwater; isotopes; hydrochemistry; vulnerability; Susceptibility Index.

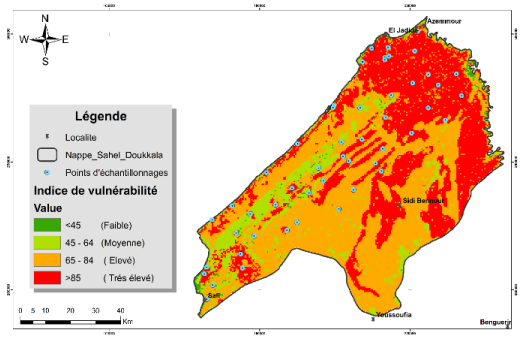


**Fig. 1:** Final vulnerability map of the Sahel Doukkala phreatic aquifer using the SI method

## References:

[1] Mohammadi et al. (2009).
[2] Jourda et al. (2007). The SI index is expressed as a numerical value ranging from less than 45 to 100, representing the degree of vulnerability. Higher values indicate greater susceptibility to contamination.
[3] Smida et al. (2004).

*1st Author Biography*

**Fatima Ezzahra Afri**, is a PhD student in Hydrogeology at the Laboratory of Geosciences and Applications, Department of Geology, Faculty of Sciences, Ibn Tofail University, Kenitra.
My research focuses on assessing groundwater quality and aquifer vulnerability in the Sahel Doukkala region through physicochemical analyses, isotope techniques ($^{2}H$, $^{18}O$, $^{3}H$), and GIS-based modeling. I apply the susceptibility Index (SI) method to identify areas at risk of contamination and study the influence of agricultural practices, seawater intrusion, and natural processes on groundwater resources. my work aims to support the development of effective strategies for groundwater protection and environmental management.

***Corresponding author:** fatimaezzahra.afri@uit.ac.ma*

ID165

# Modeling Light Scattering by Capsule-Shaped Particles in the WKB Approximation

Redouane Lamsoudi
[1]*Department of Physics Chemistry ; CRMEF Casa-Settat Section Provincial El-Jadida, Morocco*
[2] *Laboratory of Condensed Matter Physics, Department of Physics, Faculty of Sciences, Chouaib Doukkali, University, El-Jadida, Morocco*

**Abstract :**
This study presents an advanced modeling approach for light scattering by capsule-shaped particles using the Wentzel–Kramers–Brillouin (WKB) approximation, with the aim of improving characterization techniques for biomaterials and biological tissues [1-2]. Cylindrical geometries with ellipsoidal or conical ends provide a relevant representation of numerous biological microstructures, including fibers, elongated cells, viruses, and microcapsules used in tissue engineering and controlled drug delivery[3]. Analytical expressions for the form factor and scattering amplitude are derived, and numerical evaluations are conducted to assess the influence of refractive index contrast, size parameter, and geometry on the phase function. The results reveal strong forward-scattering anisotropy and high sensitivity to morphological variations, confirming the relevance of the capsule model for non-invasive optical detection[4]. Compared with classical cylindrical and spheroidal models, the capsule geometry offers a more realistic representation of complex biological structures. This work contributes to the development of fast and accurate optical tools for biomaterial analysis, biomedical imaging, optical diagnostics, and emerging non-invasive “optical biopsy” technologies.

**Keywords:**
Light scattering, WKB approximation, Capsule-shaped particles, Biomedical optics

**References:**

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*1st Author Biography*

*Redouane Lamsoudi. is a researcher at the Regional Center for Education and Training (CRMEF) in El Jadida, Morocco. His research focuses on light scattering by complex particles, with particular interest in optical modeling, electromagnetic wave propagation, and the development of analytical methods for scattering in the WKB approximation.*

***Corresponding author:** lamsoudil@ucd.ac.ma*

ID166

# Hall Conductivity behavior in multi-Weyl semimetal

Zakariae Jellal[1], Rachid Ahl Laamara[1]

[1]*LPHE-Modeling and Simulation, Faculty of Science, Mohammed V University in Rabat, Morocco.*

**Abstract:**
In this work, we study the quantum transport properties of multi-Weyl semimetals subjected to a uniform magnetic field. Starting from a Hamiltonian describing an anisotropic multi-Weyl semimetal, characterized by an anisotropy parameter controlling the dispersion in the plane, we analyze the structure of the Landau levels and their consequences on the Hall conductivity. In the zero-anisotropy limit, this model reduces to an isotropic Hamiltonian, allowing a direct comparison between the isotropic and anisotropic cases. Using Kubo's general formula, we calculate the Hall conductivity σ_xy for different orders of topological charge and different values of the chemical potential. We show that the quantized Hall conductivity σ_xy relative to the reduced chemical potential μ(r) exhibits a plateau structure: the staircase reflects the filling of the Landau level, with a central step enlarged from the zero modes of cubic Dirac fermions. This amplified central step and the non-trivial dependence of the plateaus on anisotropy are a clear signature of the multi-Weyl nature of the semimetal, and provide an experimental criterion for distinguishing these exotic topological phases from cubic or linear Dirac semimetals.
**Keywords:** Multi-Weyl semimetals; Landau levels; Hall conductivity; Dirac materials.

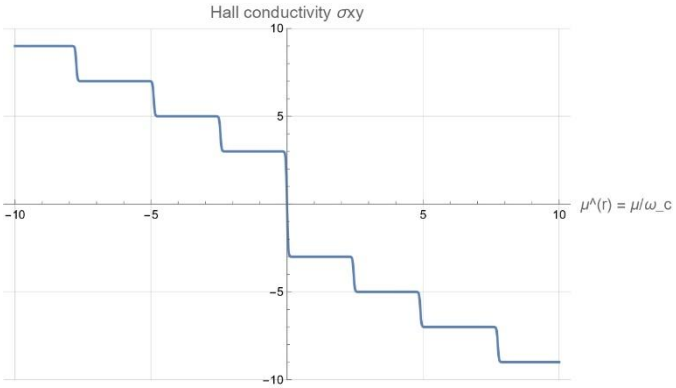


**Fig. 1:** Quantized Hall conductivity σxy vs. reduced chemical potential μ(r ).

## References:

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*1st Author Biography*

Zakariae Jellal, *a Ph.D. student in theoretical physics at Mohammed V University in Rabat, Morocco. His research focuses on quantum transport and topological phases in multi-Weyl semimetals and related Dirac materials under external fields. He studies how anisotropy, Landau quantization, and disorder affect Hall conductivity and other transport coefficients, combining analytical approaches such as the Kubo formalism with numerical simulations. His work aims to deepen the understanding of exotic fermionic quasiparticles and to contribute to the development of novel quantum and nanoelectronic devices based on topological semimetals.*

***Corresponding Author:** zakariae_jellal@um5.ac.ma*

ID167

# Imidazole as a corrosion and biocorrosion inhibitor on archaeological steel associated with wood in Water-10% PEG-200 solutions

Fatima Ezzahra Belharcha[1], Mohamed Ebn Touhamia[1]

[1]*Laboratory of Advanced Materials and Process Engineering, Faculty of Science, Ibn Tofail University, BP. 133, 14000, Kenitra, Morocco*

**Abstract :**

Combined wood/iron archaeological objects undergo accelerated decomposition as iron corrosion products degrade and mineralize the wood closest to the iron. However, these composites are often difficult, if not impossible, to dissociate without destroying a large part of the object [1-3]. In this work, Imidazole (IMZ) is evaluated as a corrosion inhibitor for archaeological steel associated with wood in 10% PEG-200 solution. Inhibitory properties were characterized by electrochemical measurements and morphological analysis, while fungicidal power was monitored by natural aging. The results showed that IMZ is a mixed-type inhibitor with an efficacy of 99.5%, which improves with time, of which 32 °C proved to be the optimum temperature. In impregnation, IMZ preserved the original appearance of the nail while minimizing wood mineralization, although its biocidal power remained insufficient

**Keywords:**

Imidazole, composite, biocorrosion, intensity-potential, electrochemical impedance spectroscopy,

**Fig. 1:**

**References:**

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*1st Author Biography*

*Fatima Ezzahra Belharcha, a Ph.D. student at Ibn Tofail University,* specializes in Chemistry Physic and environnement. Her research focuses on the protection of metals in corrosive environments, particularly the protection of archaeological heritage objects. She actively contributes to publications, patents, and conferences with the aim of developing effective formulations suitable for the complex environment of preservation treatment.

***Corresponding author:** f.ezzahra.belharcha@uit.ac.ma*

ID169

# Structural and optical properties of cesium doped potassium niobate KNbO3

O.Zahot[1], T.Garmim[1] , L.Soussi[2], C.Louardi[1], M.Bouzidi[1], S.Benbouzakri[1], N.Benaissa[3], M. El Hammoumi[1], A. El Bachiri[1], A.Louardi[4]

*[1]Interdisciplinary laboratory of fundamental and applied sciences (LISFA), Higher Normal School, Hassan II University, Casablanca, Morocco.*
*[2]Laboratory of Materials Physics & Subatomic, Ibn Tofail University, Kenitra, Morocco.*
*[3]Laboratory of condensed Matter Physics (LMPC), Department of Physic, Faculty of Sciences, Chouaib Doukkali University, El-jadida, Morocco.*
*[4]Laboratory of Industrial Thechniques, Department of Industrial Engineering, Faculty of Sciences and Techniques,Sidi Mohamed Ben Abdellah University, Fez, Morocco.*

**Abstract :**
Potassium niobate (KNbO3) is a functional material with highly interesting electrical and dielectric properties. In this experimental study, ferroelectric ceramics, obtained by solid-state synthesis, were analyzed. X-ray diffraction (XRD) spectra analysis and scanning electron microscopy (SEM) are used to characterize its crystalline structure for analysis. From an optical point of view, our studied material has remarkable optical properties which are evaluated by UV-visible spectroscopy such as a large absorption coefficient and an adjustable band gap. These properties make it ideal for photovoltaic applications and light emitters.

**Keywords:**
Potassium Niobate, chemical composition, experimental study, ceramic materials.

**References:**

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*1st Author Biography*

***Omar Zahot**, a Ph.D. student at Interdisciplinary laboratory of fundamental and applied sciences (LISFA), Higher Normal School, Hassan II University, Casablanca, Morocco, specializes in dielectric materials physics. I work on the elaboration, characterization, and modeling of the physical properties of composite materials*

***Corresponding author:**
zahot.omar@gmail.com

ID171

# A Predictive Parametric and CFD Modeling Framework for the Optimization of Archimedes Screw Turbines in Sustainable Low-Head Hydropower

Chouaib Syaghi[1*], Mohammed Remaidi[1,2], HichamMastouri[1,2], Mohamed El Jouad[1], Amine Ennawawi[1,2], Chouaib Ennawawi[1,2]

[1]*Chouaib Doukkali University, National School of Applied Sciences (ENSA), Science Engineering Laboratory for Energy (LabSIPE), Avenue Jabrane Khalil Jabrane, 24000 El Jadida, Morocco*
[2]*Mohammed VI Polytechnic University (UM6P), Energy4Water Research Center (E4W), Lot 660 Hay Moulay Rachid, 43150 Benguerir, Morocco*

**Abstract :**
Archimedes screw turbines constitute a robust and environmentally friendly solution for decentralized hydropower generation in low-head conditions. This work presents a predictive modeling framework that combines advanced geometric parameterization with multiphysics CFD simulations to investigate the influence of turbine geometry on hydraulic performance. The proposed approach enables a detailed analysis of flow behavior, leakage phenomena, internal dissipation mechanisms, and torque generation across a wide range of operating conditions. The analytical model establishes explicit relationships between geometric features and key performance indicators, while the CFD simulations provide an in-depth understanding of the complex interactions between the fluid and the structure. This integrated framework makes it possible to identify design trends that enhance hydraulic efficiency and flow stability.

**Keywords:**
Turbine à vis d'Archimède, Modélisation paramétrique, Simulation CFD, Optimisation hydroélectrique, Energie renouvelable

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*1st Author Biography*

*Chouaib Sayaghi, a Ph.D. student at Chouaib Doukkali University, conducts his research within the Science Engineering Laboratory for Energy (LabSIPE). His work focuses on the optimization of low-head hydropower systems, numerical modeling, and the analysis of complex flow phenomena. He is involved in several research projects and scientific communications in the field of renewable energy.*

***Corresponding author:** sayaghi.chouaib@ucd.ac.ma*

ID172

# Modeling, Simulation and Control of a Photovoltaic System

*Mehdi Aouda[1,]*, Said Dlimi[1]*

[1]*Laboratory of Sciences and Technologies of Information and Communication, Physics Department, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

## Abstract

This paper presents a comprehensive approach to the modeling, simulation, and control of a photovoltaic (PV) energy conversion system. A detailed mathematical model of the PV generator is developed using the single-diode representation, enabling accurate estimation of the system's electrical behavior under varying environmental conditions. The complete energy conversion chain—comprising the PV array, DC–DC converter, and load—is simulated to evaluate dynamic performance and energy efficiency. A Maximum Power Point Tracking (MPPT) strategy, based on the Perturb and Observe algorithm, is implemented to ensure optimal operating conditions despite irradiance and temperature fluctuations. Simulation results demonstrate the effectiveness of the proposed control strategy and validate the accuracy of the PV model. The study provides a robust framework for analyzing PV systems and supports the design of efficient solar energy conversion architectures.

***Key words***: Photovoltaic system; PV modeling; MPPT; Perturb and Observe; DC–DC converter; renewable energy; system simulation; control strategy.

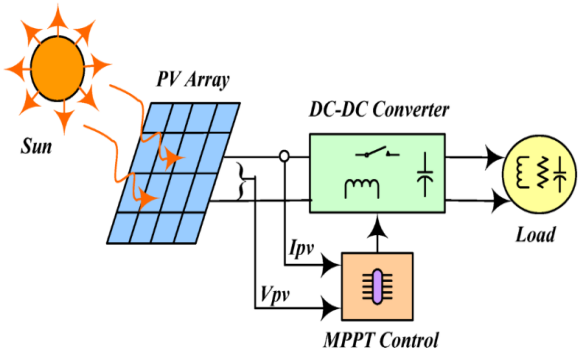


**Fig. 1:** Schematic of a PV System with MPPT controller

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*1st Author Biography*

***El Mehdi Aouda** , is a Ph.D student at Chouaib Doukkali University, affiliated with the Laboratory of Sciences and Technology of Information and Communication. He holds a Master's degree in Instrumentation, Networks, and Renewable Energies. His current research focuses on power electronics and renewable energy systems. He has experience at IMACID, where he worked on turbo-alternator systems and industrial regulation processes. He also contributed to projects involving smart home simulation and photovoltaic pumping systems. His technical background includes automation, power electronics, and energy efficiency. He is motivated by innovation in renewable energy technologies. His work aims to support sustainable and efficient energy solutions.*

***Corresponding author:** aouda.elmehdi@gmail.com*

ID173

# Design and Implementation Strategies for Heavy-Current Electrical Installations

El Mostafa Bouhafs[1*], Khalid Elkhadiri[1] and Said Dlimi[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**

The design and implementation of electrical installations in heavy-current systems are key factors in ensuring the safety, energy performance, and long-term reliability of modern infrastructures. This paper presents a structured analysis of current design methodologies, from functional requirements assessment to network sizing and equipment selection. It highlights best practices for on-site implementation, particularly regarding standards compliance, protection optimization, risk management, and the integration of emerging technologies. Insights drawn from several industrial and commercial projects illustrate the challenges encountered and the technical solutions adopted. The objective is to provide a clear and practical reference framework for professionals involved in the development of heavy-current electrical systems, thereby enhancing the overall reliability, safety, and efficiency of these installations.

**Keywords:**

Design and implementation of electrical installations, Heavy-current systems, Electrical safety, System sizing, Energy performance, Standards compliance.

**References:**

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*1st Author Biography*

*El Mostafa Boyhafs, is a Ph.D. student specializing in electrical grid optimization, renewable energy integration, and emerging smart-grid technologies. His research focuses on improving grid stability, energy efficiency, and system resilience through advanced load management and intelligent control strategies. He also investigates the optimal integration of solar and wind energy supported by automation, energy-storage systems, and smart monitoring tools. His goal is to contribute to the development of modern, sustainable, and high-performance electrical networks using next-generation technologies.*

***Corresponding author:** mostafa.bouhafs@gmail.com*

ID174

# Integration of Micro-Hydropower Units for Energy Recovery in High-Flow Seawater Systems

Mustapha Elghyati[1*], Khalid Elkhadiri[1] and Said Dlimi[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

## Abstract :

With growing industrial energy demand and the increasing urgency of the global energy transition, enhancing energy efficiency requires not only reducing consumption but also recovering energy currently lost in industrial processes. At the OCP Jorf Lasfar site, large volumes of seawater are pumped for cooling applications, generating high-flow and high-pressure hydraulic streams within an extensive network of pipelines and underground tunnels. These flows carry substantial kinetic and potential energy that remains entirely unexploited. This study investigates the feasibility of integrating micro-hydropower systems into the existing seawater circuit to harness this unused hydraulic potential and generate electricity without disrupting operational processes. The analysis includes the identification of suitable turbine technologies, hydraulic modeling of the seawater network, estimation of recoverable electrical power, and an evaluation of economic and environmental performance. The results aim to determine whether the recovery of currently dissipated hydraulic energy can contribute meaningfully to improving the site's overall energy efficiency and reducing its electrical consumption.

## Keywords:

Energy recovery; Micro-hydropower; Industrial energy efficiency; Seawater cooling systems; Renewable electricity.

## References:

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*1st Author Biography*

*Mostafa Elghyati, is a Ph.D. student at Chouaib Doukkali University, specializes in renewable energy and smart systems. His research focuses on developing intelligent energy-management strategies for hybrid microgrids. His work aims to design advanced control approaches that enhance reliability, optimize power flow, and improve the overall efficiency of multi-source energy systems. With a strong interest in smart grids, optimization algorithms, and modern control techniques. As a young researcher, he is building skills in optimization, control systems, and smart grid technologies while contributing to the study and development of modern energy management approaches.*

***Corresponding author:** elghyati.m504@ucd.ac.ma*

ID175

# AI-Driven Environmental Sustainability Assessment of Desalination Technologies via Automated Literature Mining

Doha Ben Rouane[1*], Redouane Mghaiouini[1,2], Ahmed Ait Errouhi[1]

[1] *Advanced Systems Engineering Laboratory, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco*

[2] *Department of Physics, Condensed Matter Laboratory, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract:**

The growing global need for freshwater has led to greater dependency on seawater desalination. This field has often been criticized for its high energy use and environmental concerns. Various desalination methods have been developed, including membrane, thermal and hybrid systems; however, their environmental impacts differ from situation to situation[1]. This paper puts forward a framework for the first time utilizing Artificial Intelligence (AI) to analyze to evaluate and classify the various methods of desalination technologically using vast amounts of scientific literature. With the use of Natural Language Processing (NLP), machine learning, and automated data mining, the framework captures the main operational parameters, energy consumption, and environmental consequences within over twenty years of research. The data are then subjected to AI-aided multi-criteria decision-making to evaluate each technique and classify it by its environmental sustainability. The findings prove, i.e. on the highly heterogeneous and heavily biased environmental data that AI improves the precision, efficiency, and neutrality of environmental assessments[3]. This research provides a template and a basis for extensive automated Artificial Intelligence; it also improves the efficiency of environmental assessment and optimization of desalination systems.

**Keywords: Machine Learning, Data Mining, Sustainable Desalination, Brine Management.**

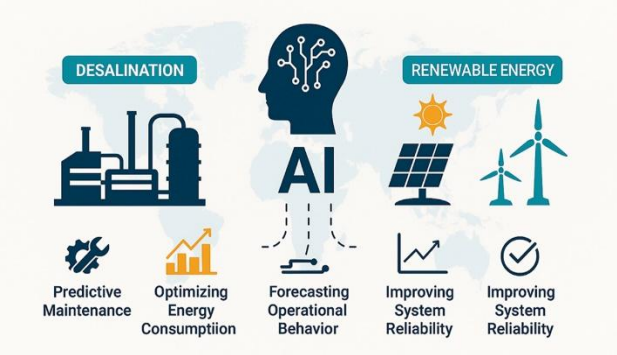


**Fig. 1:** Applications of Artificial Intelligence in the Sustainable Operation of Desalination and Renewable Energy Systems

**References:**

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*1st Author Biography*

*Ben Rouane Doha, a Ph.D. student at the Advanced Systems Engineering Laboratory, National School of Applied Sciences (ENSA), Ibn Tofail University, specializes in thermal and energy engineering with a focus on environmental sciences. Her work centers on desalination technologies and their environmental impacts, integrating AI-driven approaches and automated literature mining to evaluate and improve the sustainability of desalination systems.*

***Corresponding author:** doha.benrouane@uit.ac.ma*

ID176

# Molecular Dynamics of Water Desalination Through Sub-Nanometer Graphene Nanopores

Nour El Haq El Macouti[1*], Mohamed El bouanounou[1], El-Kebir Hlil[2], Yahia Boughaleb[1], Adelowahed Hajjaji[1], Said Laasri[1,c]

*1 Energy Science Engineering Lab, ENSA, Chouaib Doukkali University, El Jadida, Morocco*
*[2]Institut Néel, CNRS, Université J. Fourier, B. P. 166, 38042 Grenoble, France*
*[3]Polydisciplinary Faculty of Sidi Bennour, Chouaib Doukkali University, El Jadida, Morocco*

**Abstract :**
Freshwater scarcity motivates membranes that simultaneously deliver high water flux and near-complete salt rejection. Here we use all-atom molecular dynamics (MD) to investigate pressure-driven desalination across monolayer graphene containing sub-nanometer pores with controlled edge chemistry. We systematically vary pore diameter (0.5–1.0 nm), geometry, and functionalization (H, OH, COOH) to map the flux–selectivity trade-off and identify design windows for optimal performance. Simulations of saline feed solutions (monovalent and divalent salts) quantify water permeability from steady-state volumetric flux and ion rejection from translocation statistics. Free-energy profiles (potential of mean force) and hydration analyses reveal the mechanisms governing selectivity: ions experience a large dehydration penalty at constrictions, which is modulated by edge polarity and charge; in contrast, water benefits from low interfacial friction and the atomically thin transport length of graphene. We find that pores near the dehydration threshold (~0.7–0.9 nm) with mild polar functionalization maximize selectivity while maintaining high throughput, whereas strongly charged edges enhance ion exclusion but reduce flux due to increased water structuring. Mechanical responses under transmembrane pressure confirm pore stability within the operating range. The results provide quantitative guidelines for tailoring pore size and chemistry to achieve near-complete salt rejection with high permeability, and they clarify when graphene outperforms thicker polymeric membranes. These insights support the rational design of next-generation, two-dimensional desalination membranes and suggest experimental targets for scalable fabrication.

**Keywords:** Graphene; nanoporous membrane; molecular dynamics; desalination; reverse osmosis

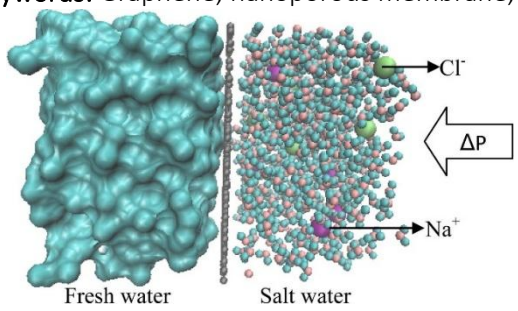


**Fig. 1:** Water flows through a nanoporous membrane from salt water to fresh water, while $Na^+$ and $Cl^-$ ions are blocked.

**References:**

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[2] J. Abraham et al. (2017). Tunable sieving of ions using graphene oxide membranes. Nature Nanotechnology, 12, 546–550.

*1st Author Biography*


*Nour El Haq El Macouti, a Ph.D. student at Chouaib Doukkali University, specializing in computational materials science and energy-related materials. His research focuses on understanding ionic transport in solid-state electrolytes and optimizing perovskite structures for next-generation batteries and photovoltaic devices. With expertise in molecular dynamics, density functional theory (DFT), and machine-learning-assisted simulations.His work aims to enhance the performance, stability, and design of advanced materials for sustainable energy technologies.*

***Corresponding author:** elmacouti.nourelhaq@ucd.ac.ma*

ID177

# Investigation thermal performance of an emitter coated with Radiative cooling paint across different Climates Conditions in Morocco

*Cherqi Oumayma[1*], Kardellass Said[1], Malha Mustapha[1]*
*[1]Thermal and Energy Research Team (ERTE), ENSAM Rabat,university Mohamed V RABAT, Morocco*

**Abstract :**
Radiative cooling paints (RCPs) is an effective, scalable, and low-cost technology to address the growing energy consumption for space cooling and to ensure energy-free cooling. this study aims to investigate an emitter coated with RCP have been mathematically described by governing heat transfer equations and numerically computed using COMSOL Multiphysics Software to evaluate their thermal behavior compared to air environment temperature and the unpainted baseline, as well as to determined their daytime and nighttime net power cooling over different climates of Morocco namely: Casablanca, Oujda, Tetouan, Tata and Errachidia. The simulation results show that the painted emitter in Tata achieved the highest subambient cooling temperature reduction (8.7°C) rather than that of Oujda, Errachidia. Tetouan and Casablanca, with temperature diminution of 8.6 °C,7.7°C, 4.7°C and 4°C, respectively. However, the unpainted emitter remained nearly aligned with the ambient temperature across all studied climates. Additionaly, Tata was found to be significantly the greatest net cooling power 111 $W \cdot m^{-2}$ at night and 86.5 $W \cdot m^{-2}$ during the day. This work offers key insights into application of such material to building envelopes particularly under Arid and semi-arid conditions.

**Keywords:** Radiative cooling, thermal behavior of RC sample, sub-ambient temperature, emissivity, reflectivity

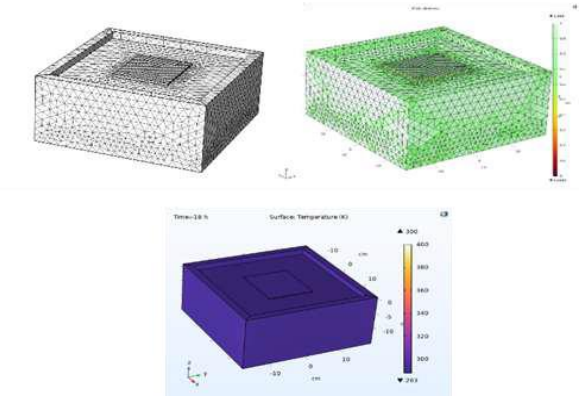

**Fig. 1:** Visualization of an emitter painted with Radiative cooling paint embedded in Cubic Box

**References:**

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*1st Author Biography*

***Oumayma Cherqi**, a Ph.D. student at ENSAM University Mohamed V Rabat, specializes in radiative cooling materials. Her research focuses on the development of advanced materials and performance optimization. With expertise in thermal modeling, she actively contributes to publications and conferences, aiming to advance the understanding and applications of passive cooling technologies.*

***Corresponding author:** oumayma_cherqi@um5.ac.ma*

ID177

# Improvement and optimization of lead-free and eco-friendly InGeCl3 based perovskite solar cells: From first principal calculation to SCAPS-1D simulation

T. Garmim[1*], N. Benaissa[2], L. Soussi[3], O. Zahot[1], Z. El Jouad[2], A. El Bachiri[1], A. Louardi[4], M. Monkade[2]

[1]*Interdisciplinary Laboratory for Fundamental and Applied Sciences, Higher Normal School, Hassan II University, Casablanca, Morocco.*
[2]*Laboratory of condensed Matter Physics (LPMC), Department of Physics, Faculty of Sciences, Chouaïb Doukkali University, El-Jadida, Morocco.*
[3]*Laboratory of Material Physics and Subatomic, Faculty of Sciences, Ibn-Tofail University, BP 242, 14000, Kenitra, Morocco.*
[4]*Laboratory of Industrial Techniques, Department of Industrial Engineering, Faculty of Sciences and Techniques, Sidi Mohamed Ben Abdellah University, Fez, Morocco.*

**Abstract :**
In response to the limitations of lead-based PSCs, lead-free germanium-based versions are emerging as potential solutions, combining high performance with increased durability. In this study, density functional theory (DFT) was used to analyze the structural, optical, and electronic properties of a new lead-free and eco-friendly halide InGeCl3. This material exhibits semiconducting behavior and crystallizes in a stable cubic phase, with a direct band gap of 1.76 eV and a lattice parameter a=5.46 Å. significantly high absorption in the visible spectrum range, as evidenced by its absorption coefficient greater than 1015 cm-1, a value significantly higher than that of many conventional semiconductors for photovoltaic applications as an absorber. An initial solar cell structure based on InGeCl3 (Al/FTO/ETL/InGeCl3/ HTL /Ag) is proposed and simulated using SCAPS-1D software. This simulation is based on the electronic properties of InGeCl3, obtained from DFT calculations. Several solar cell architectures have been studied using NiO, SnO2, CdS, and WS2as electron transport layers (ETL) and spiro-OMeTAD, NiO, Cu2O, CuI, and CuSCN as hole transport layers (HTL). The optimal configuration identified, Al/FTO/TiO2/InGeCl3/ CuSCN /Ag, is the most efficient. The thickness, dopant concentration NA and defect density Nt of the absorber layer, the ETL/absorber and HTL/absorber interface defects, the series Rs and shunt resistance Rsh, and the operating temperature have been optimized. Simulations of our structure after optimization revealed very promising performance, with a short-circuit current density ($J_sc$) of 16.37 mA/cm², an open-circuit voltage ($V_oc$) of 1.17 V, a fill factor (FF) of 88.55% and conversion efficiency (PCE) of 17.01%. Analysis of the results suggests that it is possible to develop highly energy-efficient perovskite cells using non-toxic materials such as InGeCl3, paving the way for high-performance, environmentally friendly photovoltaic devices.

**Keywords:** InGeCl3 perovskite, DFT, SCAPS-1D, ETL, HTL

*1st Author Biography*

***Taoufik Garmim**, is a University Professor at Hassan II University, specializes in material physics and energy. This work aims to enhance the photovoltaic performance of lead-free $InGeCl_3$ perovskite. Using a combined DFT analysis and SCAPS-1D device simulation, we propose an innovative defect-engineering strategy that improves electronic properties and carrier transport. The results reveal significant gains in band alignment, reduced recombination, and higher predicted device efficiency.*

***Corresponding author:** t.garmim@enscasa.ma*

ID179

# Embedded Electronic System for ECG Signal Processing in Driver State Monitoring for Connected Vehicles

Abdelhafid El Farnane[1*], Brahim Moudoud[1], Aziz Dkiouak[2], Omar Chahir[1], El Hanafi Arjdal[1], Mustapha Elyaqouti[1]

[1]*Faculty of sciences, University Ibn Zohr*
[2]*Faculty of Sciences, Chouaib Doukkali University*

**Abstract :**
A fundamental component of ECG analysis is the accurate identification of QRS complexes, which provide crucial information for heart rate monitoring and heart rate variability (HRV) assessment. These parameters are not only essential for clinical applications but can also be used to evaluate a driver's physiological state, such as detecting stress, fatigue, or abnormal cardiac conditions. However, real ECG signals are often corrupted by noise, baseline wander, motion artifacts, and electrical interference, complicating real-time detection, particularly on low-power, embedded devices. This study presents an embedded real-time QRS detection algorithm optimized for mobile health (mHealth) and driver monitoring applications. The proposed method combines band-pass filtering, derivative-based energy extraction, squaring, moving average integration, adaptive thresholding, and robust decision criteria to enhance QRS features while minimizing false detections. Implemented in MATLAB/Simulink and designed for microcontrollers and FPGAs, the algorithm achieves low computational complexity and minimal latency. The resulting system provides reliable real-time heart rate monitoring, enabling prompt detection of driver fatigue or stress and allowing for appropriate corrective actions to ensure driving safety.

**Keywords:**
ECG signal, QRS detection, embedded Electronic systems, real-time processing, driver monitoring.

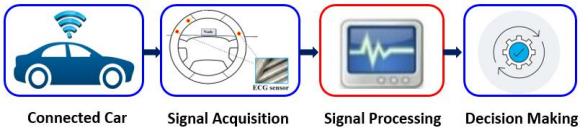


**Fig. 1:** Global detection system

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*1st Author Biography*

*Abdelhafid El Farnane, received his Ph.D. degree in Electrical Engineering and Embedded Systems from the Faculty of Sciences and Technologies at Hassan I University in 2023. He is currently a Professor of Electronics and Embedded Systems at the Faculty of Sciences, Ibn Zohr University, Agadir, Morocco. His research interests include embedded systems, self-driving cars, and robot control.*

***Corresponding author:** a.elfarnane@uiz.ac.ma*

ID180

# Impact of Uniaxial and Biaxial Constraints on the Structural, Thermodynamic, and Hydrogen Storage Properties of Mg2NiH4

Abdelmajid Assila [1,*] Ikram Belkoufa [1], Amine Alaoui Belghiti [1], Said Laasri [1,2], El-kebir Hlil [3,] Abdelowahed Hajjaji[1]

[1]*Chouaib Doukkali University of El Jadida, National School of Applied Sciences, Energy Science Engineering Lab, El Jadida, Morocco.*
[2]*Polydisciplinary Faculty of Sidi Bennour, Chouaib Doukkali University, El Jadida, Morocco*
[3]*Univ. Grenoble Alpes, CNRS, Grenoble INP, Institut N´eel, 38000, Grenoble, France*

**Abstract :**
In this study, the structural, mechanical, diffusion kinetic, ionic conductivity, and electronic properties of the hydride Mg2NiH4 were investigated using density functional theory (DFT) under uniaxial and biaxial tensile and compressive strains. The results indicate that the Perdew-Burke-Ernzerhof solid-state generalized gradient approximation (GGA-PBEsol) reliably reproduces the thermodynamic, structural, and electronic properties when compared with literature data. The activation energy under uniaxial and biaxial strain varies from 0.38 to 0.45 eV. Mechanical analysis reveals that Mg2NiH4 exhibits brittle behavior. Strain significantly affects ionic conductivity: under uniaxial tensile/compressive strain, conductivity ranges from 1.18 to 25.5 S/m, while under biaxial tensile/compressive strain, it ranges from 12.3 to 18.3 S/m. Structural analysis further shows that Mg2NiH4 maintains its metallic character under all applied strains.

**Keywords:**
Ionic conductivity, mechanical properties, thermodynamic properties, hydrogen storage.

*1st Author Biography*

*Abdelmajid Assila, PhD in Energy and Materials Physics at the Laboratory of Engineering Sciences for Energy (LabSIPE) at Chouaib Doukkali University, I conduct research focused on energy technologies. My work mainly focuses on the study of metal hydrides for solid-state hydrogen storage, using ab initio calculations based on density functional theory (DFT).*

***Corresponding author:** assila.a@ucd.ac.ma*

ID181

# First-Principles Investigation of the Structural, Electronic, Optical, and Photovoltaic Properties of Lead-Free Halide Perovskites $Ba_3XI_3$ (X = As, Bi, Sb)

*Mohamed El bouanounou[1,]*, Nour El Haq El Macouti[1], Abdelmajid Assila[1], El-kebir Hlil[2], Yahia Boughaleb[1], Abdelowahed Hajjaji[1], Said Laasri[1,]*

[1] *Chouaib Doukkali University, National School of Applied Sciences, Energy Science Engineering Lab, El Jadida, Morocco*
[2] *Univ. Grenoble Alpes, CNRS, Grenoble INP, Institut Néel, 38000, Grenoble, France*

## Abstract

This study presents a comprehensive ab initio investigation of the structural, electronic, optical, and photovoltaic properties of lead-free halide perovskites $Ba_3XI_3$ (X = As, Bi, Sb) utilizing density functional theory (DFT) within the meta-GGA R²SCAN approximation. The optimized structural analysis shows that all of the compounds crystallize in a cubic Pm-3m structure. The calculated lattice parameters are 6.8768 Å ($Ba_3AsI_3$), 7.2438 Å ($Ba_3BiI_3$), and 7.1098 Å ($Ba_3SbI_3$). This shows that the structure gets a little bigger as the atomic radius of the pnictogen element gets bigger. The electronic band structures reveal direct band gaps of 0.94 eV, 1.03 eV, and 1.04 eV for $Ba_3AsI_3$, $Ba_3BiI_3$, and $Ba_3SbI_3$, respectively—values that fall within the optimal range for photovoltaic applications. The optical analysis shows that the material absorbs a lot of light in the visible range and has high refractive indices, which is what you would expect from something that collects light well. The estimated short-circuit current densities (Jsc) for $Ba_3AsI_3$, $Ba_3BiI_3$, and $Ba_3SbI_3$ are 25.56 mA $cm^{-2}$, 26.68 mA $cm^{-2}$, and 24.91 mA $cm^{-2}$, respectively. This shows that these materials could be good for next-generation lead-free perovskite solar cells.

***Key words***: $A_3MX_3$ halides, $Ba_3XI_3$ (X = As, Bi, Sb), Photovoltaic performance, DFT calculations.

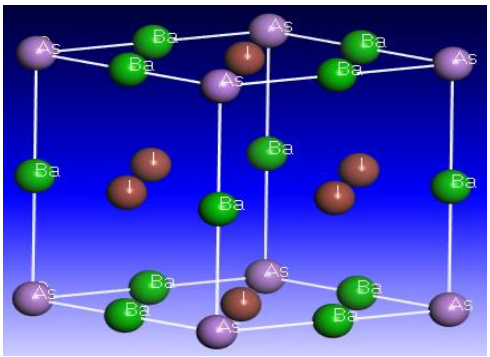


**Fig. 1:** Figure 1. A three-dimensional view of the best crystal structure of $Ba_3AsI3$

## References:

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*1st Author Biography*

***Mohamed El Bouanounou**, a Ph.D. student at Chouaib Doukkali University, specializes in semiconductor physics and nanoelectronics.*

***Corresponding author:** elbouanounou.mohamed@ucd.ac.ma*

ID182

# Geospatial analysis of the Khorezm oasis in terms of its vegetation cover and the impact of vegetation criteria on the desertification process

Rifat Boymurodov[1], Muzaffar Matchanov[2], Q. Tajiyev[3], S. Dusanova[1] , A. Rahimov[4] and D. Amandurdiyev[5]

[1] *Department of Geography, Faculty of Natural and Agricultural Sciences, Urgench State University named after Abu Raykhan Beruniy, 220100 Khorezm, Uzbekistan*

[2] *Department of Geodesy, Cartography, Cadastre, Technical faculty, Urgench State University named after Abu Raykhan Beruniy, 220100 Khorezm, Uzbekistan*

[3]*Department of History and Geography, Faculty of Philology and History, Urgench State Pedagogical Institute, 220100 Khorezm, Uzbekistan*

[4]*Academic Lyceum of Urgench State University named after Abu Raykhan Beruniy, 220100 Khorezm, Uzbekistan*

[5]*Department of Geodesy, Cartography and Natural Resources, Faculty of Geography and Natural Resources, Karakalpak State University, 230100 Nukus, Uzbekistan*

**Abstract :**

Desertification is a serious menace to arid and semi-arid ecosystems and human livelihood. This research focused the case of the Khorezm oasis, examining the contribution of vegetation cover to reducing desertification processes. Vegetation is one of the main indicators of ecosystem health, affecting soil stability, water retention, and microclimate regulation. The study employs geospatial analysis from remote sensing data and vegetation indices of NDVI, SAVI, EVI, and LAI to assess vegetation quality and its impact on desertification. A Vegetation Quality Index (VQI) was applied, considering parameters of fire hazard, erosion control, drought resistance, and vegetation cover. The research indicated that a significant portion of the Khorezm oasis is endangered, and 16.07% of the buffer zone and 4.71% of the oasis are at a "very dangerous level" by vegetation density. Drought tolerance assessment indicated 40.17% of the oasis is moderately vulnerable, requiring actions for enhancing drought tolerance. Erosion resistance and fire hazard were also examined, with findings showing 41% of the surveyed area is exposed to a high risk of erosion, but fire hazard is very low, with only 3.2% of the oasis being at a "very dangerous level." The study emphasizes how imperative vegetation cover is to combat desertification and calls for sustainable land use practices to preserve the ecological equilibrium in the Khorezm oasis.

**Keywords:** Remote sensing, (VQI), Soil degradation.

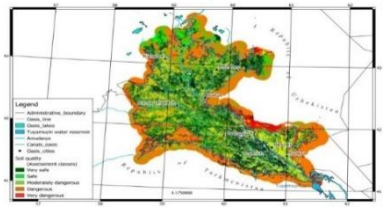

**Fig. 1: .** Map of soil quality assessment of the Khorezm oasis's vulnerability to desertification

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*1st Author Biography*

*Rifat Boymurodov is a PhD student at the Urgench State University named after Abu Rayhon Beruni, specializing in remote sensing and GIS. His research actively contributes to publications and conferences focused on Geospatial analysis of the Khorezm oasis in terms of its vegetation cover and the impact of vegetation criteria on the desertification process.*

*Corresponding Author: boymurodovrifat@gmail.com*

ID183

# Digital Twin-Driven Optimization of Instrumentation for Steam Networks and Water Quality Assurance

Mouhsen Dani[1*], Aziz Dkiouak[1] and Khalid El khadiri[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**

With the imperative to maximize the efficiency of cogeneration systems, ensuring the longevity of critical industrial assets requires precise resource accounting and rigorous fluid quality monitoring. At the OCP Jorf Lasfar thermoelectric power plant, the management of steam loops and treated water supplies is vital for the stability of electricity generation and downstream chemical processes. Currently, the reliability of these operations hinges on the accuracy of the instrumentation chain used to track utility consumption and detect physicochemical deviations. This study investigates the technical and economic optimization of measurement instruments dedicated to utility accounting and water quality control, specifically targeting conductivity levels required by turbine manufacturers. The analysis includes a comprehensive mass and energy balance of the facility, a critical evaluation of existing sensor technologies, and the design of an upgraded instrumentation mapping. The results aim to define a cost-effective modernization strategy that ensures compliance with technical standards, thereby securing equipment durability and improving the site's overall energy management.

**Keywords:**

Water quality monitoring; Advanced industrial instrumentation; Cogeneration systems; Renewable electricity production; Green hydrogen technologies.

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*1st Author Biography*

*Mouhsen Dani, a PhD student at Chouaib Doukkali University, specializes in Renewable energy and smart systems. His research focuses on developing intelligent energy-management strategies for hybrid microgrids. His work aims to design advanced control approaches that enhance reliability, optimize power flow, and improve the overall efficiency of multi-source energy systems. With a strong interest in smart grids, optimization algorithms, and modern control techniques, As a young researcher, he is building skills in optimization, control systems, and smart grid technologies while contributing to the study and development of modern energy management approaches.*

***Corresponding author: mouhsendani@gmail.com***

ID184

# Numerical analysis and heat dissipation of mid-infrared tellurite fiber Raman laser

Hamid JOUAH[1*], Mohamed ZAKI[1], Mostafa ABOURICHA[1], and Said AMRANE[2]

[1]*LPTHE, Department of Physics, Faculty of Sciences, Ibnou Zhor University, Agadir, Morocco.*
[2]*STIC, Department of Physics, Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco.*

**Abstract :**
Nonlinear coupling equations and heat dissipation equations were developed based on the Raman laser structure of tellurite fibers in mid-infrared. The effects of pump power, fiber length, output coupler reflection, and fiber loss coefficient on laser performance were numerically analyzed. The results also show that a Raman laser for tellurite fibers pumped at 2 μm using optimized structure coefficients can operate with high efficiency. According to the heat dissipation equations, the temperature distribution along the axial and radial directions of the tellurite fiber, and the maximum temperature versus the pump power, were calculated. The results show that the maximum temperature in tellurite fibers increases significantly with increasing pump power. The results obtained can be used to improve the design of a practical Raman laser for tellurite fibers.

**Keywords:**
Mid-infrared fiber laser, Raman laser, Tellurite fiber, Nonlinear coupled equations, Heat equations.

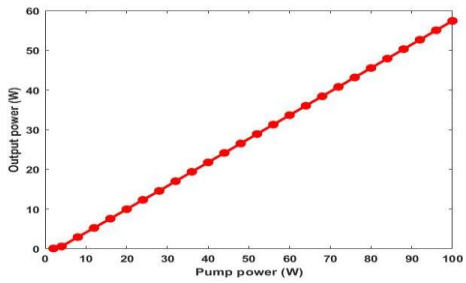


**Fig. 1:** Output power versus pump power with fiber length is 0.5 m

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*1st Author Biography*

*Hamid JOUAH, a Ph.D. student at Ibnou Zhor University, specializes in fiber-laser physics and advanced photonic systems. His research focuses on optimizing fiber laser systems under various external constraints, such as thermal load and nonlinear optical effects. With expertise in light propagation, gain dynamics, and advanced laser modeling, he actively contributes to publications and conferences, aiming to advance the understanding and performance of next-generation fiber-based photonic technologies.*

***Corresponding author:** hamid.jouah.78@edu.uiz.ac.ma*

ID185

# AI-Driven Personalized Video Generation for Enhanced Digital Marketing Campaigns

Rachida Ferras[1*], Dounia Elidrissi[1], Khalid El khadiri[1] and Said Amrane[1]

[1]*Laboratory of Sciences and Technologies of Information and Communication, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**

The evolution of digital marketing has intensified the need for intelligent personalization to increase engagement and brand visibility. This study presents the design and implementation of a connected SaaS platform that integrates artificial intelligence to automate and personalize advertising videos for marketing campaigns. The system combines several open-source AI models, including *Whisper* for automatic speech recognition, *Coqui TTS* for high-quality text-to-speech synthesis, and *MoviePy* for intelligent video editing. These components work together to dynamically adapt both audio and visual content to each target audience, enabling large-scale hyper-personalization. The backend is implemented using *Spring Boot* and *Flask* microservices, ensuring scalability, interoperability, and secure data exchange through *Keycloak* authentication. Experimental evaluation showed significant improvements in user engagement, content relevance, and automation efficiency compared to traditional campaign models. The results confirm that AI-based video generation can transform marketing communication into a more humanized, data-driven, and impactful experience.

**Keywords:**

Artificial Intelligence; Video Personalization; SaaS; Marketing Automation; Microservices; Voice Cloning; Speech Recognition

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*1st Author Biography*

*Rachida Ferras, a Ph.D. student at Chouaib Doukkali University, specializes in cybersecurity and artificial intelligence. Her research focuses on the modeling of intrusion detection techniques in encrypted network communications using Machine Learning and Deep Learning approaches. With strong expertise in network security, data analysis, and intelligent systems, she actively contributes to scientific publications and international conferences, aiming to advance research in AI-driven cybersecurity and enhance the protection of modern communication systems.*

**Corresponding author: rachida.ferras@gmail.com*

ID186

# IoT System Based on LoRaWAN for Early Wildfire Detection and Prediction

Hamza Ben Rahma[1*], Asmaa Kassid[1], Khalid El Khadiri[1] and Aziz Dkiouak[1]
[1]*Laboratory of Sciences and Technologies of Information and Communication,IT Department, Faculty of Sciences, Chouaib Doukkali University, El Jadida 24000, Morocco*

**Abstract :**
In Morocco, public policies such as the Green Morocco Plan have strongly supported the modernization of the agricultural sector and the sustainable management of natural resources. In this context, the preservation of forested areas—crucial for biodiversity, erosion control, and climate regulation—has become a national priority, further reinforced by the country's international commitments, notably during COP22. Aligned with these strategic objectives, this project introduces an innovative technological solution for environmental monitoring and wildfire prevention. The proposed architecture is based on a LoRaWAN-enabled IoT network designed to collect real-time environmental data from remote forest areas. Sensors measuring temperature, humidity, luminosity, and GPS coordinates are deployed on field nodes that communicate with a LoRa gateway integrated into a Raspberry Pi. The transmitted data is processed through a Node-RED workflow and stored in an InfluxDB database to enable continuous monitoring. The final phase of the project focuses on developing a Machine Learning model capable of predicting early wildfire occurrences based on the collected data. By combining long-range communication, real-time supervision, and predictive analytics, this solution provides an effective decision-support tool to enhance the management, protection, and long-term sustainability of Morocco's forest ecosystems.

**Keywords:**
Machine Learning; IOT, Data Visualization, WildFire Detection, Lorawan.

**References:**

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*1st Author Biography*

*Hamza Ben Rahma, a Ph.D. student at Chouaib Doukkali University, specializing in cybersecurity and artificial intelligence. His research focuses on the modeling of adaptive security policies based on artificial intelligence to enhance cybersecurity.*

***Corresponding author:** hamzabenrahma95@gmail.com*

ID187

# Advances in Water Electrolysis Technologies for Cost-Effective Green Hydrogen Production

Najat Mousabah[1], Youssef Naimi[2], Abdelhadi Kotri[1], Youssef Belkassmi[3]

[1]*Sciences and Technologies team (ESTE), ENSAJ, Chouaib Doukkali University, El-Jadida, Morocco.*
[2]*Laboratory of Physical Chemistry of Materials, Faculty of Sciences Ben M'sick, Hassan II University of Casablanca, Morocco.*
[3]*Laboratory PETI, Ibnou Zohr University, FPO, Ouarzazate, Morocco.*

**Abstract :**

Green hydrogen has emerged as a key pillar of global decarbonization strategies, yet its large-scale deployment remains constrained by the high costs and technical limitations of water electrolysis. This paper presents an updated review of recent advances in electrolysis technologies aimed at improving efficiency, reducing capital and operational costs, and enhancing system durability. Proton Exchange Membrane (PEM), Alkaline (AEL), and Solid Oxide Electrolysis (SOEC) technologies are compared in terms of performance, material innovations, and integration with variable renewable energy sources. The study highlights breakthroughs in catalyst development—particularly the substitution of critical materials such as platinum group metals—advanced membrane designs, and high-temperature operation strategies that significantly improve hydrogen yield. Furthermore, system-level innovations such as digitalized control, modular design, and hybrid renewable-electrolyzer configurations are analyzed for their potential to scale production. The findings demonstrate that ongoing technological progress, combined with declining renewable energy costs, positions electrolysis as a competitive and sustainable pathway for green hydrogen production in the coming decade.

**Keywords:**

Green hydrogen, Water electrolysis, PEM electrolyzer, Alkaline electrolysis, Solid oxide electrolysis, Catalyst innovation, Renewable energy integration, Hydrogen production cost, Energy transition.

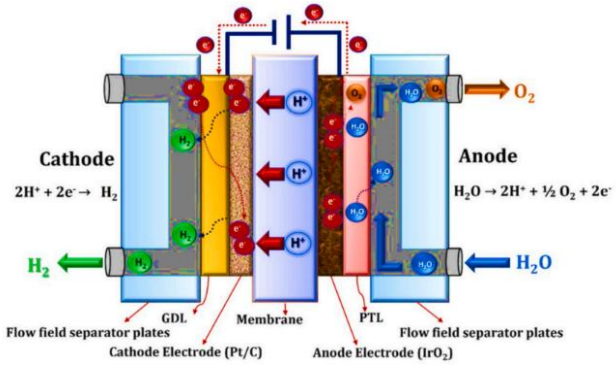


**Fig. 1:** Working Mechanism of Proton Exchange Membrane (PEM) Electrolyzers

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*1st Author Biography*

Najat Mousabah, a PhD Candidate (First year), National School of Applied Sciences (ENSAJ), Chouaib Doukkali University, El Jadida, Morocco, conducting research on the development of green hydrogen in Morocco, with a focus on its opportunities, challenges, and future perspectives.

*Corresponding author: mousabah.najat@gmail.com

ID188

# Full-Kubo Electromagnetic Modeling of a Free-Standing Single Layer Graphene

Mohamed Moumou[1*], Khalid Mounirh[1], Soufiane El Adraoui[1], Mohammed Kanjaa[1], and Mohsine Khalladi[1]

[1*] *Intelligent System Design (ISD)Laboratory, Faculty of sciences Tetouan, Abdelmalek Essaadi University, Morocco*

## Abstract :

In this paper, a Transmission Line Matrix (TLM) method is modified to simulate a free-standing single-layer graphene sheet using the full Kubo conductivity model. In this approach, both the intraband and interband contributions of graphene are fully considered through the complete Kubo formula. To efficiently incorporate the interband conductivity—which exhibits a complex dependence on the angular frequency—a Padé approximant fitting technique is employed. This approximation is then integrated into the TLM scheme using an Auxiliary Difference Equation (ADE). An infinite graphene sheet is simulated with the proposed Full-Kubo-based TLM technique, and the numerical results are compared with both analytical theoretical values and the circuit equivalent model. The comparison confirms that the method provides excellent computational accuracy. Furthermore, the numerical analysis demonstrates that the interband contribution predicted by the Full-Kubo model has a significant impact on the electromagnetic response at high frequencies.

**Keywords:** Graphene, Full Kubo conductivity model, Interband conductivity, Padé approximant, Auxiliary Difference Equation (ADE), Transmission Line Matrix (TLM) method, Free-standing graphene sheet

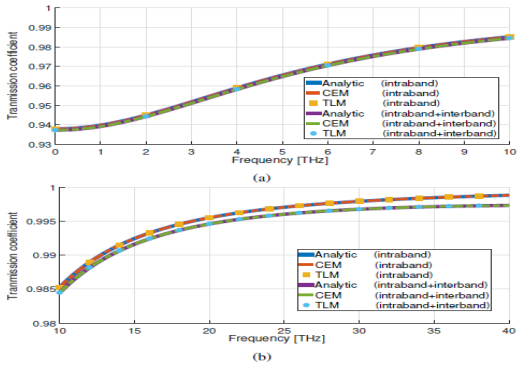


Fig. 4: The transmission coefficients of the graphene sheet in the frequency band (a) 0∼10THz (b) 10∼40THz.

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*1st Author Biography*

*Mohamed Moumou (Ben TIJANI) is a Supervisor in the Vessel Traffic Service (VTS) in Tangier. He was born on September 9, 1974, in Douar Draid, located 25 km from the city of Agadir, Morocco. He is presently working toward a PhD in Electronics and Telecommunications at the Faculty of Sciences, Abdelmalek Essaadi University. His research interests focus mainly on the electromagnetic modeling of materials, particularly structures based on graphene. He is the author of several papers published in international refereed journals and presented at international conferences in the fields of antennas and telecommunications.*

***Corresponding author:** mohamed.moumou@etu.uae.ac.ma

ID189

# Dielectric and Electrical Characterization of Hexavalent Chromium Removal Efficiency Using a Ceramic Ultrafiltration Membrane System

E. Chahid[1*], A. Mortadi[2], B. Lizoul[1], E. El Hafidi[3], R. Mghaiouini[4], R. El Moznine[2] and M. Monkade[2]

[1]*Polydisciplinary Faculty of Sidi Bennour, El Jadida, Chouaïb Doukkali University, Morocco.*
[2]*Laboratory Physics of Condensed Matter (LPMC), Faculty of Sciences, Chouaïb Doukkali University El Jadida.*
[3]*National School of Applied Sciences, Chouaib Doukkali University, El Jadida, Morocco.*
[4]*Ibn Tofail University's Advanced Systems Engineering Laboratory in Kenitra, Morocco.*

**Abstract :**
In this work, we used impedance spectroscopy to study the monitoring of hexavalent chromium Cr(VI) retention by an ultrafiltration membrane based on $ZnAl_2O^{4-}TiO_2$. The results show that this membrane carries a residual charge that depends strongly on the pH. The effect of concentration on the retention rate of filtered species was investigated. The retention of the ionic species is due to a mechanism based on the electrostatic interactions between the membrane charge and the ions. An alkaline pH is favorable for good retention because the membrane charge becomes less positive, and chromium is in the form of $CrO_4^{2-}$. To deepen and complete the study, impedance measurements were conducted in the frequency range from 100 mHz to 100 kHz to monitor treatment. The complex conductivity spectra analysis showed two Cole-Cole relaxation behaviors and an equivalent circuit was developed to extract the main parameters and investigate both relaxation processes further. The results of the electrical parameters deduced from the impedance spectra showed a good correlation with the parameters obtained by the ultrafiltration membrane.
**Keywords:** Membrane, Ultrafiltration, relaxation; dielectric dispersion, electrical conductivity.

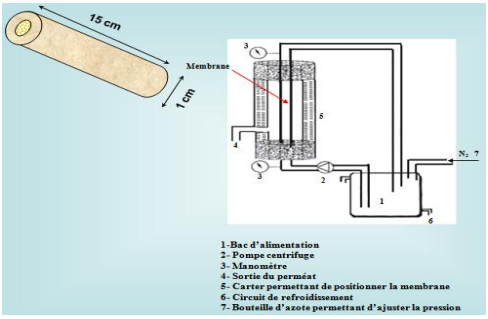


**Fig. 1:** Visualization of Ultrafiltration Membrane

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*1st Author Biography*

*El Ghaouti Chahid is a Professor of Physics and Researcher at the Chouaib Doukkali University, El Jadida, Morocco. His research work is conducted on the development of advanced materials and renewable energies for water treatment and desalination using impedance spectroscopy as a low-cost, fast and in-situ analysis technique facilitating research work.*

***Corresponding author:** chahidoo@yahoo.fr*

ID190

# Numerical Method for Simulating a Patterned Graphene Monolayer and its Lumped Element Model

Mohamed Moumou[1*], Khalid Mounirh[1], Soufiane El Adraoui[1], Mohammed Kanjaa[1], and Mohsine Khalladi[1]

[1*]*Intelligent System Design (ISD)Laboratory, Faculty of sciences Tetouan, AbdelmalekEssaadi University, Morocco*

Abstract :

A physical time-domain Transmission Line Matrix (TLM) numerical method is used to simulate and analyze a patterned graphene monolayer in the terahertz (THz) regime. The structure, consisting of a periodic array of graphene patches, is described using an analytical surface admittance. A lumped element model (LEM) of the graphene patches is also employed to derive expressions for the input impedance of the proposed structure. The time-domain TLM approach has been implemented in MATLAB to model the performance of the patterned graphene monolayer. To validate the method, the TLM results are compared with those obtained from the LEM, showing excellent agreement. The study demonstrates that the time-domain TLM method provides high computational accuracy, indicating that patterned graphene monolayer can serve as a promising platform for future THz devices and systems, including sensing, imaging, detection, and modulation applications.

Keywords: Transmission Line Matrix (TLM), time-domain simulation, patterned graphene monolayer, terahertz (THz) regime, periodic graphene patches, lumped element model (LEM), THz devices.

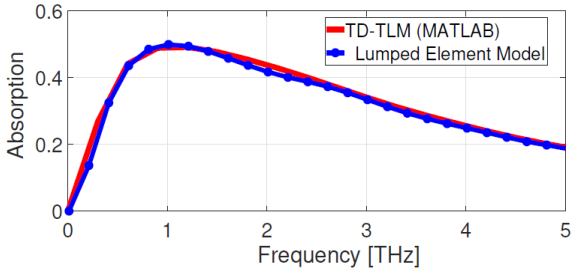


Fig. 1: Absorption spectra of a periodic array of graphene patches as a function of frequency.

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*1st Author Biography*

*Mohamed Moumou (Ben Haj TIJANI) is a Supervisor in the Vessel Traffic Service (VTS) in Tangier. He was born on September 9, 1974, in Douar Draid, located 25 km from the city of Agadir, Morocco. He is presently working toward a PhD in Electronics and Telecommunications at the Faculty of Sciences, AbdelmalekEssaadi University. His research interests focus mainly on the electromagnetic modeling of materials, particularly structures based on graphene. He is the author of several papers published in international refereed journals and presented at international conferences in the fields of antennas and telecommunications.*

***Corresponding author:** mohamed.moumou@etu.uae.ac.ma

ID191

# Laser-induced modulation of conductance in graphene with magnetic barriers

Rachid El Aitouni[1*], Miloud Mekkaoui[1], Pablo Diaz[2], David Laroze[3], and Ahmed Jellal[1]
[1]*Laboratory of Theoretical Physics, Faculty of Sciences, Chouaïb Doukkali University, PO Box 20, 24000 El Jadida, Morocco*
[2] *Departamento de Ciencias Fisicas, Universidad de La Frontera, Casilla 54-D, Temuco 4811230, Chile*
[3]*Instituto de Alta Investigación, Universidad de Tarapacá, Casilla 7D, Arica, Chile*

**Abstract:** We investigate electron transmission through graphene in the presence of two magnetic barriers separated by a laser-illuminated region. Using Floquet theory combined with the transfer matrix method, we calculate the transmission probabilities and the corresponding conductance. Our analysis focuses on the central (ε) and side (ε±lϖ) energy bands, which represent transmission channels with and without photon exchange, respectively. As the laser intensity increases, non-photonic transmission is progressively suppressed while photon-assisted channels become dominant. Strong magnetic fields produce Fano-type resonances, which are signatures of non-adiabatic pumping, and effectively block low-energy carriers. Interestingly, we discovered conditions under which perfect transmission occurs for specific inter-barrier separations. Complete reflection (anti-resonances) emerges at certain incident angles, which is a unique effect of this hybrid magnetic-laser configuration

Keywords:
Graphene, laser fields, magnetic field, transmission channels

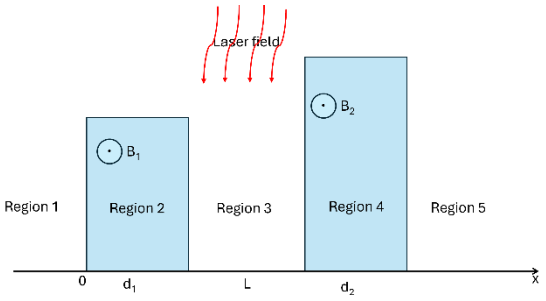


Fig. 1: *Schematic of a graphene sheet divided into 5 regions, where regions 1 and 3 are controlled by two magnetic fields of different amplitudes and region 2 is irradiated by a linearly polarized laser field*

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*1st Author Biography*

*Rachid El Aitouni, PhD in Physics, specialized in Theoretical Physics, member of the Theoretical Physics Laboratory (LTP) at the Faculty of Sciences, Chouaib Doukkali University, El Jadida, Morocco. My research mainly focuses on the study of two-dimensional materials, such as graphene, molybdenum disulfide, and tungsten diselenide, subjected to external fields such as lasers, magnetic fields, and* electric *fields.*

***Corresponding author:** Elaitouni.r@ucd.ac.ma