International Association of Researchers
In Mechanics and Energy

Association Internationale des Chercheurs en Mécanique et Energie

ADVANCES IN Mechanics and Energy

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International Conference

ICME'2024

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ADVANCES IN MECHANICS AND ENERGY

ICME'2024 is the ninth edition of the International Conference on Mechanics and Energy. The main objective of this conference is to bring together academics, researchers and industry on different themes to discuss new scientific advances and technological innovations in several fields around mechanics and energy.

Based on the peer review process, the ICME2024 Scientific Committee will select conference papers for chapters in the book series indexed by Springer, SCOPUS. The subject areas include, but are not limited to the following fields:

- **Advanced Mechanics**
- **Energy and Smart Engineering**
- **Innovative Materials**
- **Fluids & Structure**
- **Applied Physics**
- **Technologies, Manufacturing, Product and Management**
- **Artificial intelligence for Engineering**

ICME'2024 conference organizers welcome interested researchers to submit their research work to the workshop "Artificial Intelligence in Engineering Applications". This workshop provides an opportunity to researchers and specialists in a specific theme to discuss their recent outcomes and exchange thoughts. AI-driven solutions empower engineers and researchers to tackle challenges more effectively, drive innovation, and achieve higher levels of operational excellence in the engineering and research domains.

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Editorial

On behalf of all members of the Organizing and Scientific Committees of the International Conference on Mechanics and Energy (***ICME'2024***), it is an honor for us to welcome all of you in Sousse, TUNISIA. As you will have the opportunity to see, Sousse is a nice city in board of the Mediterranean Sea.

ICME'2024 is a leading international Conference in all areas of Mechanics and Energy. This conference has been organized by the International Association of Researchers in Mechanics and Energy, which has set up a goal since its creation to contribute to the welfare of technology exchange and to create a fruitful environment between researchers of developing countries in the mainland and a broad other scientists from the international community to create the closer contacts and sharing experience in various sectors, preparation and implementation of experiments, processing of results and numerical simulations.

The International Conference on Mechanics and Energy (***ICME'2024***) is aimed to concretize these objectives and intended to attract the interest of specialists, academicians and researchers from the international community working in areas related to mechanics, energy, physics and fluids and structure.

The conference will to bring together innovative academics and industrial experts in the fields of mechanical and energy engineering to a common forum and to cater sessions on these fields, thus enabling even greater interdisciplinary knowledge sharing.

It is devoted to all innovative aspects and experimental methods used in the fields of mechanics and energy. Its aim is to bring together leading researchers who are interested in experimental and also theoretical work in these fields to initiate more careful consideration of these issues and to meet the share cutting-edge development in these areas.

Over the three days of the scientific conference, more than 162 scientific and technical papers on these subjects, several authors and 6 keynotes from Estonia, Turkey, North Africa, mainly Tunisia, Algeria, will present their work in parallel sessions. The conference offers an exceptional opportunity to assess the state-of-the-art of mechanical and energy engineering and its potential for future applications with different sessions covering the following topics:

Advanced Mechanics

Energy and Smart Engineering

Innovative Materials

Fluids & Structure

Applied Physics

Technologies, Manufacturing, Product and Management

Artificial intelligence for Engineering

Finally, we wish to express our gratitude for all your help in the results of the Conference.

A sincere thankfulness should be addressed to the Ministry of High Education and Scientific Research, the university of Sfax, the National School of Engineers of Sfax and all others sponsoring institutions who have actively, financially and morally contributed to the organization of the conference among academic, scientific and industrial communities. Our thanks are also due to municipality of Sousse.

And last, but not least, the Organizing Committee of the Conference is very recognized to all of you, members of the International and Tunisian Committees, contributors, speakers, chairpersons and all of our local assistants, for giving an international prestige to the Conference, as well as for the good work accomplished.

We hope that you all find an enjoyable environment for exchange of ideas and satisfying conditions to follow all the sessions of the conference that of interest to you. As you were informed in the site web of the conference, the selected papers will be presented to publish in different international journals and Books covering the general areas of mechanics and energy engineering.

Once again, you are welcome to the conference.

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Tarek Khoualdia (Algeria)

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Keynotes

Biomass Valorization with a Focus on Lignin: Challenges and Opportunities in Advanced Biorefineries

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Abstract: To achieve EU's ambitious aim of an 80% reduction in greenhouse gas emissions by 2050, it is crucial to decouple the transportation and chemical industries from fossil resources by transitioning to renewable, recyclable, and sustainable feedstocks. Lignocellulosic biomass (LCB), which comprises of cellulose, hemicellulose and lignin, holds potential for the production of biofuels, biochemicals, and biomaterials via greener technologies, such as biorefining. However, the process faces roadblocks, such as generation of a single product per process, high costs, as well as technological challenges in the development of marketable high-value materials. Efficient fractionation and complete utilization of all three fractions of LCB, instead of just the sugar components, would considerably lower the cost factor. Among these fractions, lignin is often considered as a barrier to efficient biomass processing due to its recalcitrant nature and complex aromatic structure. With advancements in biorefinery technologies, lignin can be transformed from a recalcitrant barrier into a valuable resource for the production of high-value chemicals and materials. This presentation explores the untapped potential of lignin and its extraction using advanced pretreatment technologies, such as ionic liquids for maximizing lignin yields while preserving other fractions. This path enhances resource efficiency in biorefineries by producing a spectrum of marketable products and addressing the above-mentioned challenges.

Keywords: lignin extraction, protic ionic liquids, biorefining, biomass valorization

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3D printing and tribological friction behaviour of Ti6Al4V implants

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Abstract: Additive manufacturing has gained importance in both industrial and academic fields due to its various advantages such as less maintenance cost, rapid production of parts, better tolerance, ease in manufacturing complex parts, minimum post processing, less need for supervision than conventional methods and operating temperature. Stereolithography (SLA) 3D printing is the most common resin 3D printing process and has become vastly popular for its ability to produce high-accuracy, isotropic, and watertight prototypes and end-use parts. The paper presents the results of contact strength and tribological property tests of spare parts made of a popular resin using a 3D SLA printing technology. It uses an ultraviolet laser to precisely cure photopolymer cross-sections, transforming them from liquid to solid. In this study, friction and wear characteristics of ABS (Like Photopolymer Resin) printed with the SLA New (Elegoo Mars 4 Ultra) apparatus were studied by using reciprocating pin on plate tribotest comparing friction and wear characteristics between ABS-like resin and Ti6Al4V grade 5 implant. Experimental results showed that further research on suitable lubricants is required to use 3D printed ABS-like resin parts as mechanical components. Friction tests presented almost similar coefficient of friction data. Friction and wear comparison is well determined, and the rubbed surfaces were analyzed through 2D-3D roughness digital optical microscopy, SEM-EDX and AFM analysis. As a result, the relative motion between the ABS-like resin and Ti6Al4V showed similar friction coefficient.

Keywords: 3D SLA printing; ABS-like resin; Friction; Ti6Al4V implant

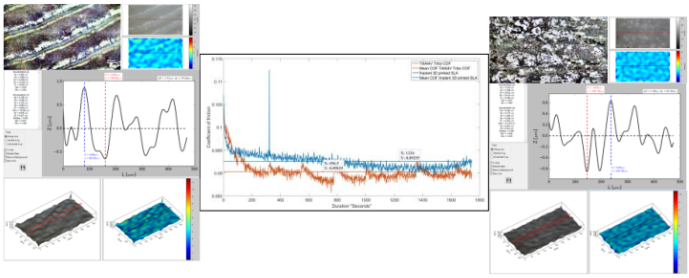

Figure 1. 2D-3D roughness digital optical microscopy of 3D printed with SLA method using ABS-like resin and Ti6Al4V grade 5 implant, Friction Coefficient plotting via time.

Graphical abstract

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Surface Treatments of Materials: Classification and Use (Case of Boriding Treatment)

Omar Allaoui [1] *, Sami Zidelmel [1]

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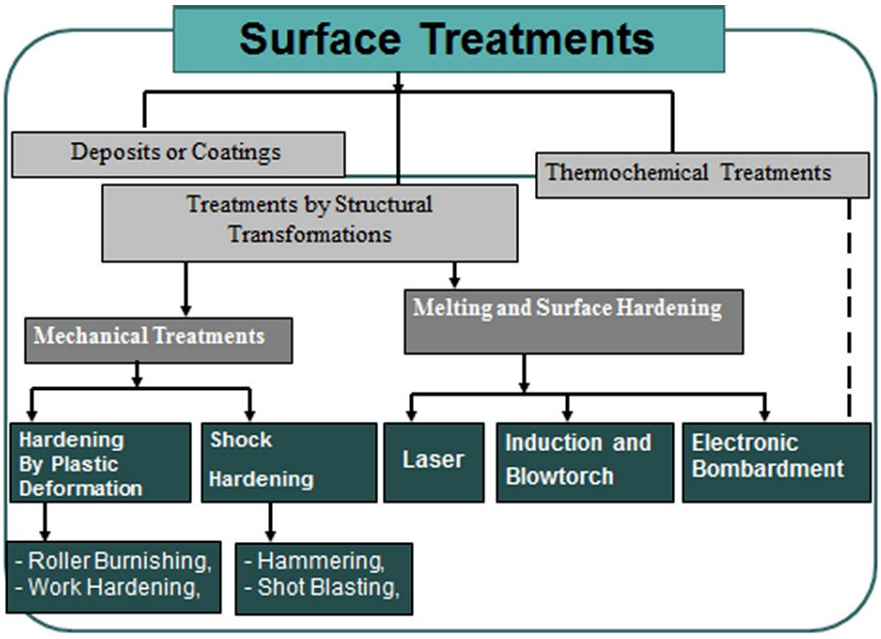
Abstract: A surface treatment is a mechanical, chemical, electrochemical or physical operation that results in modifying the appearance or function of the surface of metallic materials in order to adapt it to given conditions of use. This makes it possible to improve several types of properties of the parts such as: Hardness, Corrosion Resistance and wear, Aesthetic aspects (color, shine, etc.), or Surface conditions, Roughness, ... The aim of this work is to highlight the importance of surface treatments on an industrial scale and to try to give some classifications of surface treatments according to the processes for carrying out these treatments, according to the objectives sought, or by user sector. To do this, we must: know the interest and the different ways to do surface treatments, identify and know how to choose the parameters and the operating mode of surface treatments, and evaluate the influence of surface treatments on the different characteristics of the treated materials. At the end, we will present a case of these surface treatments, which is carried out at the Process Engineering Laboratory "LGP" of Laghouat University.

Keywords: Surface Treatments, Hardness, Corrosion resistance, wear resistance, Boriding treatment



Graphical abstract

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Experimental expertise of industrial metals using advanced analysis and characterization techniques

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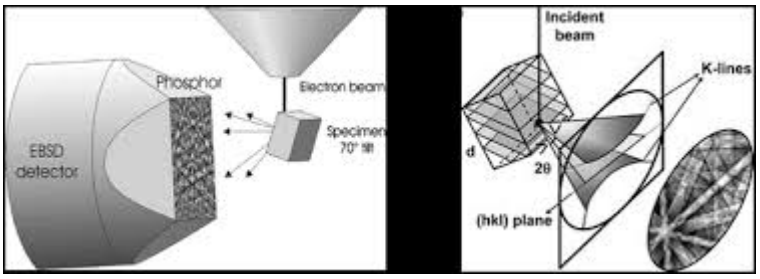
Abstract: Backscattered electron diffraction (in English Electron Back-Scatter Diffraction-EBSD or Backscatter Kikuchi Diffraction or BKD) is a technique installed in a scanning electron microscope widely used in particular in metallurgy to characterize and obtain quantitative microstructural information about the crystallographic nature of most crystalline materials. It determines the crystallographic orientation (Crystal orientation mapping), the grain size, the grain boundaries, the texture and the different phases of the material. The principle of measurement consists of focusing a beam of electrons on the grain whose orientation we wish to know. The backscattered electrons, in Bragg incidence with the surrounding reflector planes, will diffract according to two diffraction cones, for each reflector plane. The intersection of these cones with a detection screen forms hyperbolas comparable to straight lines. The whole constitutes the Kikuchi diagram. Indexing by reference to existing structures of the different lines makes it possible to determine the crystallographic orientation of the grain knowing its crystal structure. Orientation Imaging Microscopy (OIM) analysis is a technique based on the automated collection and analysis of electron backscatter diffraction (EBSD) patterns. These cartographic data provide orientation information: pole figures and inverse pole figures, distribution of local misorientation KAM (Kernel Average Misorientation), dispersion of orientations in a grain GOS (Grain Orientation Spread).....ect, OIM Analysis offers almost unlimited potential for interrogating the wealth ofinformation contained in OIM analyzes.

Keywords: EBSD; OIM software; Grain Orientation Spread; Kernel Average Misorientation; critallographic texture



Graphical abstract

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Valorization of Cellulosic Waste for Bioenergy Production

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Abstract: This study investigates the energy potential of industrial waste, focusing on the valorization of cellulose-based composite materials and other cellulosic waste for bio-oil, biochar, and biodiesel production via semi-continuous pyrolysis. The growing need for sustainable waste management solutions has spurred interest in using these waste materials as feedstocks for renewable energy. A comprehensive characterization of the materials was conducted to assess their suitability for energy production. The results showed that these materials had a volatile matter content ranging from 70% to 85%, low ash content (below 1%), and carbon content from 12% to 20%. Thermogravimetric analysis (TGA and DTG) indicated a two-phase mass loss, beginning with moisture removal followed by biomass decomposition. Pyrolysis experiments were carried out within a temperature range of 450 to 600 °C, yielding biochar, bio-oil, and non-condensable gases. Biochar yields ranged from 15% to 22%, bio-oil yields from 25% to 55%, and non-condensable gases from 20% to 60%. The bio-oil was characterized by a high proportion of oxygenated compounds such as phenols, organic acids, ketones, and alcohols, making it a promising feedstock for biodiesel production. The conversion of bio-oil into biodiesel was further explored, revealing that transesterification processes could produce high-quality biodiesel with significant energy content. The biodiesel derived from these cellulosic waste materials exhibited promising fuel properties, including good viscosity and combustion characteristics, making it a potential alternative to conventional fossil fuels. The biochar produced during pyrolysis also showed considerable energy potential, with lower heating values ranging from 24 MJ/kg to 28 MJ/kg. This work highlights the viability of producing biodiesel and other renewable bioenergy products from cellulosic waste materials, contributing to waste valorization and sustainable energy solutions.

Keywords: Cellulose-based composites, industrial waste, bio-oil, biochar, biodiesel, pyrolysis, renewable energy, waste valorization, energy production

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Advanced Cutting Technologies for Diverse Materials: Comparative Study and Development of Hydrogen-Based Solution

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Abstract: This study investigates the impact of various cutting processes on the surface roughness, thermal effects, and thermomechanical properties of different materials, including aluminum, steel, and stainless steel. The analysis covered a wide range of material thicknesses, from thin sheets (e = 1 mm, e = 2 mm) to massive pieces (e = 20 mm). Each cutting method was evaluated for its precision and its influence on the material's microstructure, hardness, and residual stresses, driven by thermal and mechanical interactions during the process. Additionally, the study introduces a novel cutting method using hydrogen-based technology, which offers promising results. This approach minimizes thermal effects and provides a cleaner and more sustainable alternative to conventional thermal cutting techniques. The findings contribute to optimizing cutting process selection based on material type, thickness, and desired surface and mechanical properties, while highlighting advancements in eco-friendly cutting technologies.

Keywords: Cutting processes, Optimisation, hydrogen-based technology

Graphical abstract

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Abstracts

Fluid structure interaction modelling of a new configuration of the blades of horizontal-axis wind turbine

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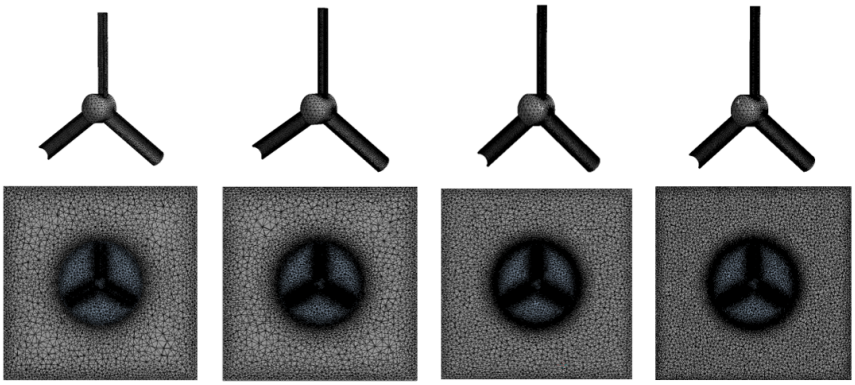
Abstract: The increasing size and flexibility of large wind turbine blades introduces considerable aero elastic effects, which are caused by FSI (fluid structure interaction). These effects might result in aeroelastic instability problems, such as edgewise instability and flutter, which can be devastating to the blades and the wind turbine. Therefore, accurate FSI modelling of wind turbine blades is crucial in the development of large wind turbines. The main objective of this study is to approve the FSI of a new configuration of the blades of a horizontal axis wind turbine. The aerodynamic loads are calculated using a CFD (computational fluid dynamics) model implemented in ANSYS FLUENT, and the blade structural responses are determined using a FEA (finite element analysis) model implemented in ANSYS Static Structural module. The interface of CFD and FEA is based on a one-way coupling, in which aerodynamic loads calculated from CFD modelling are mapped to FEA modelling as load boundary conditions. A comparative study between four configurations mesh is carried out using a blade deformation as well as means velocity profiles, the spatial distribution of the dynamic pressure and the turbulent characteristics.

Keywords: FSI, FEA, CFD, Horizontal axis wind turbine, Sliding Mesh, RANS, ANSYS



Graphical abstract

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Route Planning for multi-truck and multi-drone delivery problem using simulated annealing

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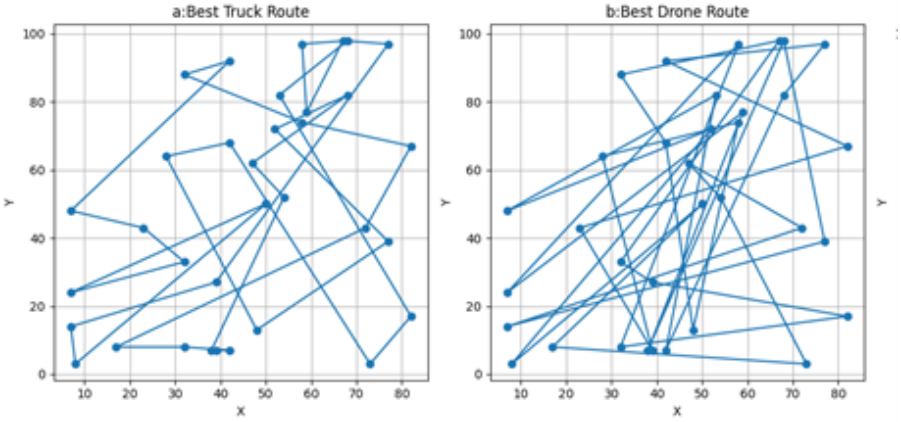
Abstract: Drone delivery has attracted lately a considerable number of research due to their efficiency in terms of time and energy consumption. Drone can be operated without direct human intervention and they avoid the congestion of road networks by flying over them [5]. The use of commercial drone for package delivery has grown tremendously. Drones' delivery solutions usually use an excessive number of drones under severe charging and battery constraints to transport limited loads. Besides after each de livery drone should return to the depot for charging which might lead to extra time and energy consumption. On the other side deliveries using trucks only suffer from traffic congestion resulting in additional energy consumption as well. To overcome the pitfalls of both approaches, we propose to use a heterogeneous fleet if vehicle to explore opportunities to use drone for making last mile delivery and trucks to coming large load. The trucks drone combination exhibits complementary features. It benefits from drone efficiency and trucks large capacities The problem generalizes the Vehicle Routing Problems; thus, it is NP- hard. This complexity motivates the development of simulated annealing to solve the problem. Results show the efficiency of the proposed approach. Using a combination of trucks and drone widen the delivery converge and allows drone to reach further destinations.

Keywords: Drone, Vehicle Routing Problems, NP- hard, simulated annealing.



Graphical abstract

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Machine learning-based Meteorological data (solar irradiation and wind speed) forecasting for PV-Wind systems

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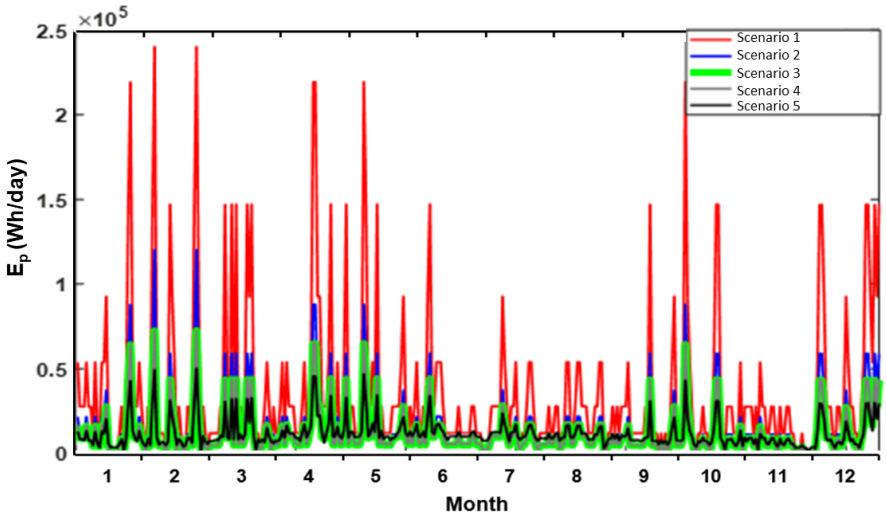
Abstract: Renewable energy systems (RES) leverage multiple renewable energy sources to optimize electricity generation and maximize energy efficiency. This study focuses on integrating a photovoltaic (PV) source into the RES, aiming to en-hance its performance through optimization techniques and advanced predic-tive modeling. The main objective is to identify the most effective machine learning (ML) model for predicting solar irradiance, a critical factor influenc-ing the performance of PV systems. Using experimental data on wind speed and temperature in the Sahara region of Tunisia (North Africa), we trained and tested various ML models to assess their predictive accuracy. Several nonlinear ML models were developed and compared based on their predictive performance. Experimental equipment was utilized to measure wind speed, temperature, and solar irradiation, allowing for a comprehensive evaluation of the RES's performance. The findings indicate that the Gradient Boosting Re-gressor (GBR) model delivers the most accurate solar irradiation predictions within the system.

Keywords: Artificial Intelligence, PV-Wind system; Renewable energy



Graphical abstract

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Reduction in stiffness of cracked metal/ceramic sandwich plates under hygro-thermo-mechanical conditions

Mohamed Khodjet kesba [1] *, Zineb Mouloudj [1], Billel Boukert [1], Amina Benkhedda [1]

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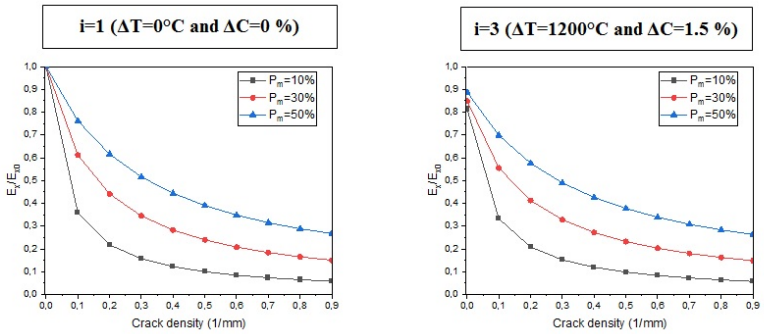
Abstract: This study examines the hygro-thermo-mechanical effects on the stiffness degradation of cracked metal/ceramic sandwich plates using an extended shear-lag model. The model incorporates the presence of an interlaminar adhesive layer and takes into account various environmental conditions, including fluctuations in temperature and moisture. Furthermore, the study explores the impact of different metal-to-ceramic ratios on the mechanical behavior of the material under various environmental conditions. The results indicate that a higher ceramic content enhances stiffness, while an increase in crack density significantly reduces stiffness, particularly under severe hygro-thermal conditions. Additionally, the effects of temperature and moisture on stiffness degradation were quantified, revealing that these factors substantially affect the mechanical performance of the material. This research advances our understanding of failure mechanisms in metal/ceramic composites and provides valuable insights for designing more resilient composite materials for aerospace and other high-performance applications.

Keywords: Metal ceramic, Stiffness, Shear-lag, Transverse cracking, Hygro-thermo-mecanical.



Stiffness degradation of metal/ceramic sandwich as a function of crack density and with different metal ratio percentage under i=1 (ΔT=0°C and ΔC=0 %) and i=3 (ΔT=1200°C and ΔC=1.5 %).

Graphical abstract

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Mechanical properties and Morphology of ATIG welded ferritic stainless-steel via binary fluxes

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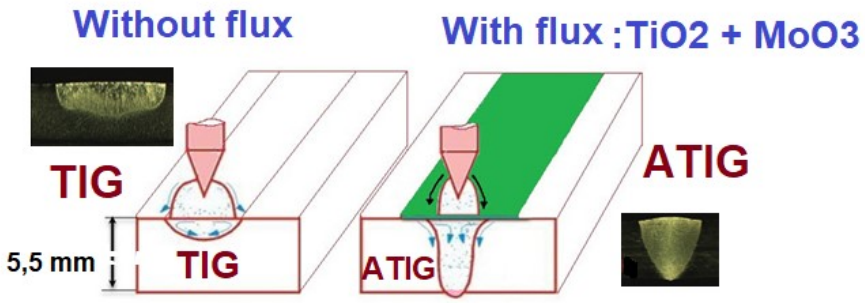
Abstract: Flux-activated tungsten inert gas (ATIG) welding is a variant of tungsten inert gas (TIG) welding process with high production efficiency, high quality, low energy consumption and low cost. The study of the flux activation mechanism by increasing the weld penetration has direct significance in the development of flux and welding process. This study was conducted on ferritic stainless steel alloy 430. The binary composition of the flux (50%MoO3+50%TiO2) allowed us to improve the morphology and mechanical properties of ATIG weld beads VS TIG welding. Therefore, the depth obtained is twice that obtained by conventional TIG welding. In addition, the mechanical properties were studied for TIG and ATIG welds in tensile, impact and hardness tests respectively.

Keywords: TIG-ATIG welding, activating fluxes, ferritic stainless steel, weld shape; mechanical properties.



Graphical abstract

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Analytical and Numerical Analysis of helical Gear of Gearbox in Tramway of Constantine Algeria

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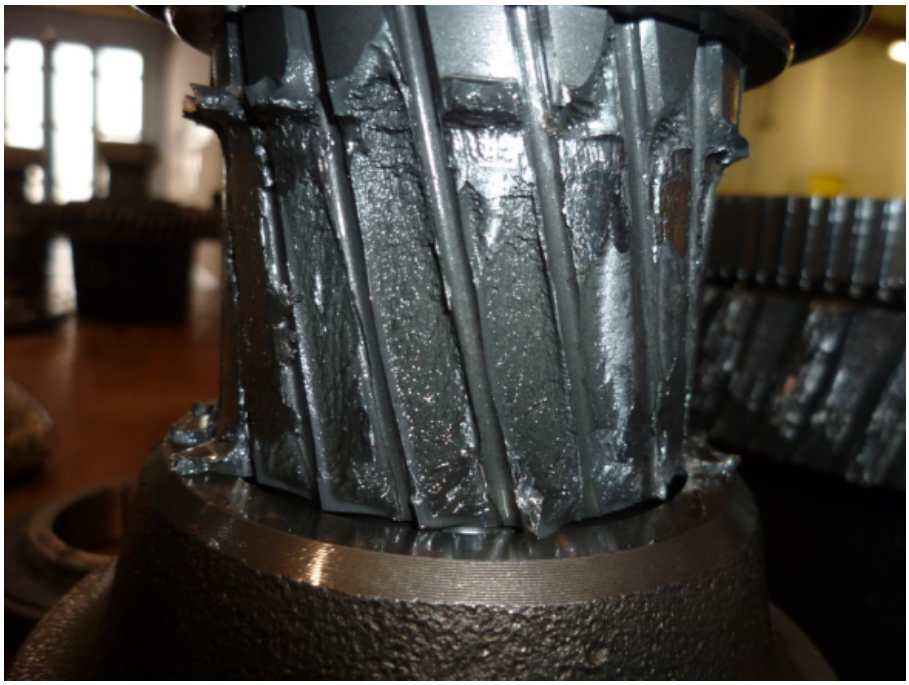
Abstract: Gears come in a wide variety of shapes and sizes and are used in almost every industry. It is a type of mechanical element that is difficult to size and build, and has various defects that limit its life. The objective of this research is to determine the influence of the defect size on the mechanical behavior of helical gear under dynamic load and the different mode shape of vibration of pinion-gear. The distribution of contact stresses, bending stresses was investigated using FEM and the obtained stresses are then compared with AGMA standard. The propagation of cracks in the most stresses area (tooth root) was determined according to several angles of inclination of the crack. The modeling of gears was performed using SOLID WORKS software and imported into the finite element code ANSYS.

Keywords: gearbox, analytical method, numerical method, ansys.



Graphical abstract

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Synthesis and Charge Transport Properties of Emeraldine Base Poly (o-methoxyaniline)

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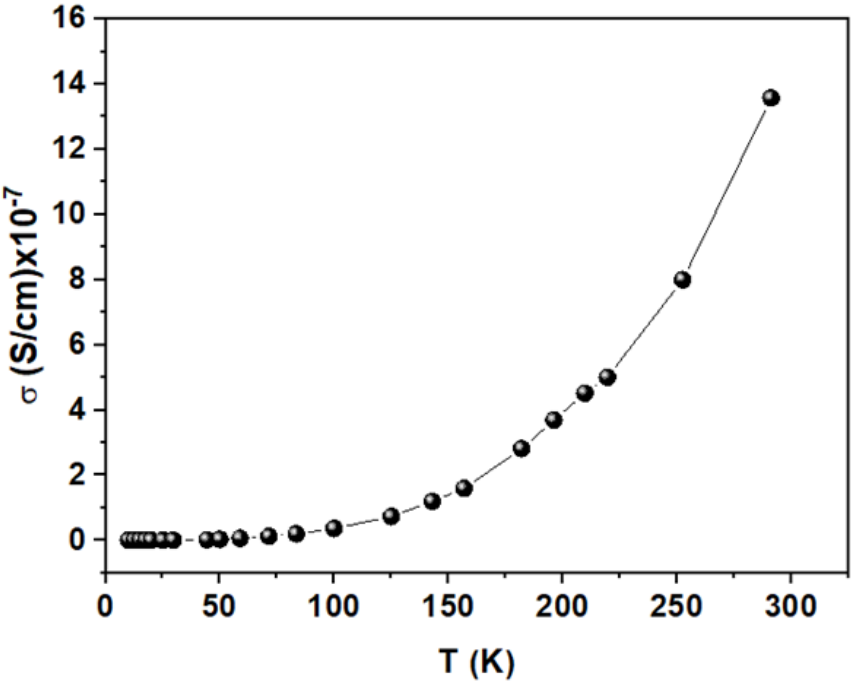
Abstract: Electrical conduction in conjugated polymers represents one of the keywords that have shown intense research over the last decades, but a proper description of which mechanism (or mechanisms) ruling the transport of charges is still an open question. Here, we report on the electrical characterization of chemically synthe-sized poly(o-methoxyaniline) (POMA) pellet in sandwich between Ag electrodes. In particular, we report the thermal variation of the electrical conductivity of POMA. The results revealed that the charge transport is a thermally activated process with an activation energy of 53.94 meV. Arrhenius, Mott's variable range hopping (VRH) and Kivelson models are checked and validated as mechanisms ruling the charge transport within the bulk of POMA. In particular, it is found that the charge transport over all the measuring temperature range of 20-291 K is ruled by the Kivelson power law with contributions by Arrhenius and VRH mechanisms in the temperature interval 125-291 K.

Keywords: Poly(o-methoxyaniline), charge transort, electrical conductivity



Graphical abstract

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Seismic isolation systems for box girder bridges

Mouloud Ouanani [1] *, Khaled Sandjak [2], Mourad Abdelouahab Khelafi [1], Boualem Tiliouine [3], Mohamed tamahloolt [3]

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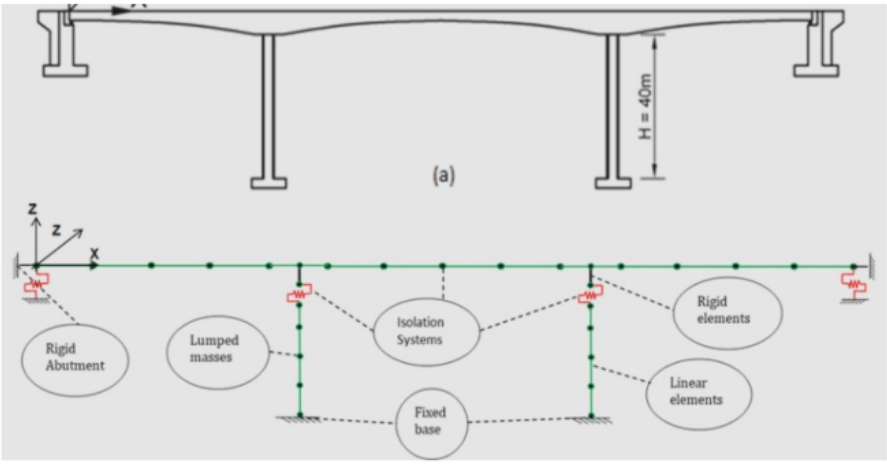
Abstract: : In this study, three seismic isolation systems bearing devices are analyzed to demonstrate their efficacy in the three-dimensional dynamic response of a box girder bridge, along with the intricacies of their modeling. The study examines energy dissipation mechanisms, including conventional neoprene bearings with box girder bridge, elastomeric bearings with High Damping Rubber (HDRB), and neoprene bearings with a Lead Core (LRB), aiming to enhance seismic design performance and optimize the sizing of this specific category of bridge structures. A 3-D FE numerical model of a typical bridge is developed for this purpose. Nonlinear dynamic analysis is conducted utilizing models depicting bilinear hysteretic behaviors of the anti-seismic isolators. The findings suggest that these isolators significantly influence seismic response in the longitudinal direction, effectively mitigating seismic demand in bridge structures.

Keywords: seismic isolation systems, box girder bridge, NRB, HDRB, LRB, Nonlinear dynamic analysis



Graphical abstract

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Effect of oxide on morphology and mechanical properties of ATIG on SS 316L austenitic stainless-steel welds

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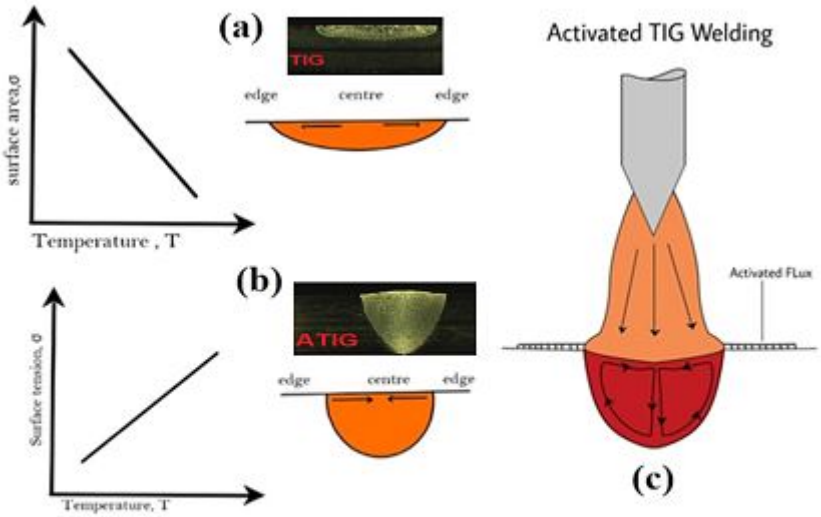
Abstract: The abstract TIG welding is a preferred process in sectors as varied as nuclear, aeronautics, chemical and food industries. However, this TIG process suffers from low bath penetration accessible in a single pass, exceeding 3 mm in thickness welding requires preparation of the edges t to weld in multiple passes with a filler metal to fill the void between the edges. This implies cumulative risks of defects, the low deposition rate in TIG welding cannot make this process competitive vis-à-vis other processes such as MIG. To overcome this problem, the new ATIG (Actived Tungsten Inert Gas) welding technique is required using an activating flux. In the present paper, using the same equipment of the TIG process with the addition of a thin layer of activating flux deposited using a brush on the edges of the parts before welding. In this case, fives fluxes of oxide types were used to make melting lines in full Austenitic stainless-steel SS 316L sheet, 6 mm of thickness. Filler-free fusion lines with a welding current of 180 amperes were used to study the effect of oxide type activating fluxes on the morphology of beads welded with the ATIG process.

Keywords: TIG-ATIG welding activating fluxes, weld shape, mechanical properties, austenitic stainless-steel SS 316L



Mode in weld pool of Marangoni convection (a) outwards (b) inwards, (c) weld penetration mechanism of A-TIG welding.

Graphical abstract

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Analyzing the acoustic properties of AlxIn1-xP

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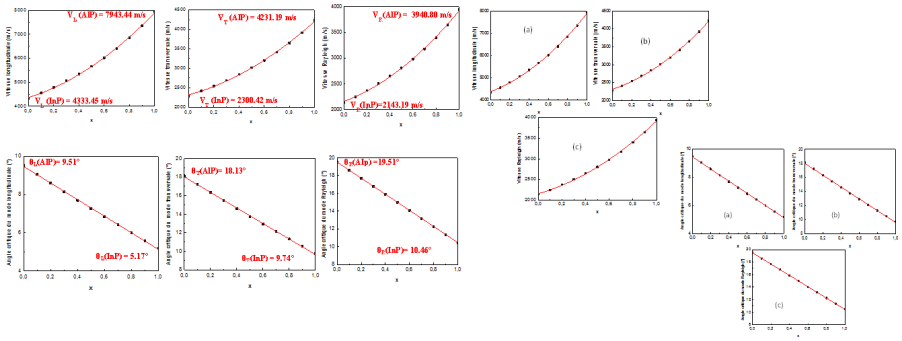
Abstract: Abstract. This work is based on the study of the properties of AlxIn1-xP ternary al-loys, which belong to the family of semiconductors and group the elements in col-umns III and V of the periodic table of Mendeleev. The main objective of this study is to analyze the structural, optical and electrical properties of this alloy with its binary components InP and AlP. The results obtained showed remarkable con-sistency with the laws of Vegard I and II, as confirmed by calculations made using a method of calculation linked to the molar fraction parameter, x. In addi-tion, we focused our attention on the acoustic properties of this ternary alloy, in-cluding the longitudinal, transversal and Rayleigh speeds and their critical angles of each mode, by linking them to the property of binary materials InP and AlP.

Keywords: Keywords: Semi-conductors III-V, AlP, InP, AlxIn1-xP ternary alloy, elastic prop-erties, acoustical properties.



Graphical abstract

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CFD Investigation of a Plate Heat Exchanger PHE with Capsule-Inspired Bionic Ribbed Labyrinth Patterns

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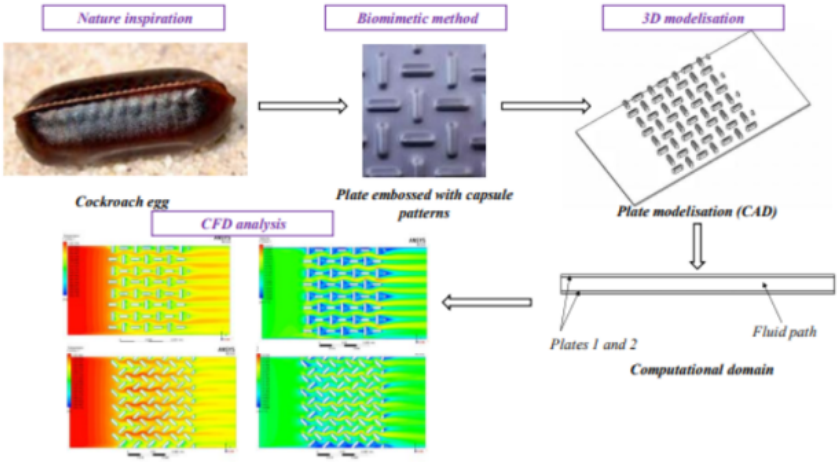
Abstract: Based on the biomimetic approach, an innovative plate heat exchanger (PHE) design that integrates bionic ribbed labyrinth patterns inspired by capsules, was performed and investigated numerically. The paper aims to focus on the impact of the obstacles arrangement types (straight ? = 90° and inclined ? = 45°) on its flow behavior and thermal effectiveness under a Reynolds number Re between 500 and 2500. To prove the correctness and accuracy of the CFD approach, a mesh independence investigation was conducted using Ansys Fluent. The k-? standard model of turbulence was chosen. To verify agreement with previous experimental research, the computational results were compared. In terms of thermal effectiveness ?, the novel design enhanced its thermal performance over the conventional chevron-type PHE by 12%.

Keywords: biomimetic, PHE, labyrinth, capsule, CFD, thermal effectiveness ?.



Graphical abstract

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Characterization of swirling flow using Artificial Intelligence

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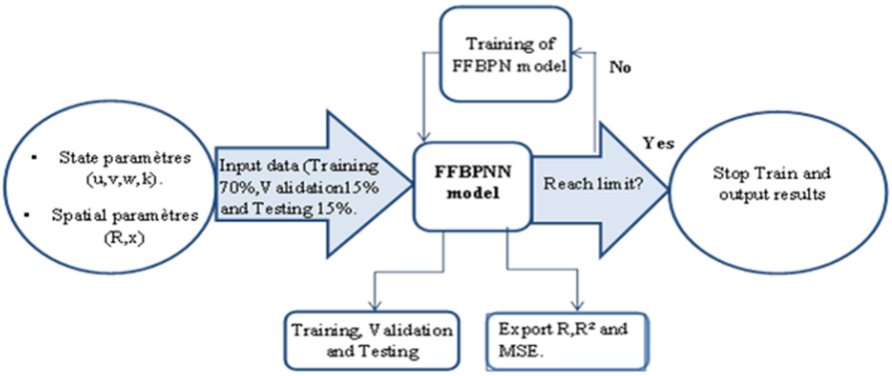
Abstract: Since ancient times, humans have sought to improve transportation and energy consumption to increase efficiency and reduce pollution. This pursuit has led to continuous advancements in combustion industries. One significant discovery of the past century is vortex flow, which has contributed to the development of combustion technologies. Current research focuses on studying vortex flow characteristics. This study aims to evaluate the ability of artificial intelligence to predict these characteristics using experimental data. The results show that the model accurately predicts velocity distribution and the vortex center's position, with strong generalization ability to predict new, unseen data

Keywords: Swirling flow, recirculation zone, neural network, training, validation and prediction



FFBPN approach workflow

Graphical abstract

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Influence Of The Length And Openings Of Cellular Beams On Their Behavior

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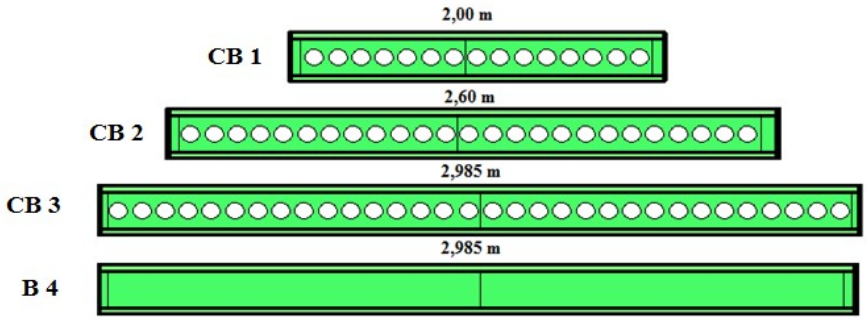
Abstract: Cellular beams, characterized by their hollow or perforated sections, have gained significant traction in metal construction. Their ability to achieve structural integri-ty while reducing material usage and floor thickness has made them an attractive option for various applications. However, to ensure their safety and performance, it is imperative to understand their behavior under different loading conditions. This study investigates the influence of length and cutout patterns on the behav-ior of IPE A 100 cellular beams. By subjecting these beams to concentrated loads, we conducted both experimental and theoretical analyses. Our findings demon-strate that the vertical displacement induced by transverse compression is closely related to these factors. While the presence and arrangement of cutouts do not significantly affect the beam's stiffness and load-carrying capacity, the location of the concentrated load plays a pivotal role in determining the critical buckling load and mode of failure

Keywords: Cellular beams, length, IPE A, load , vertical displacement



Graphical abstract

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Use of the response surface method for the best recovery of polystyrene waste in construction mortars

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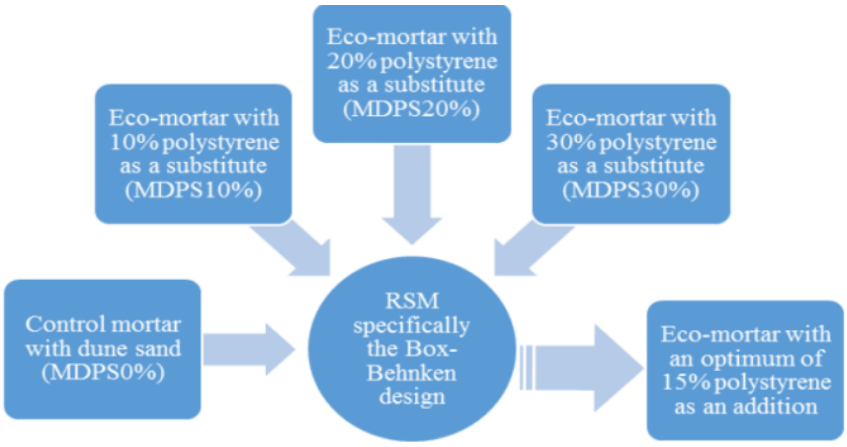
Abstract: Polystyrene, commonly found in marine environments and on Algerian beaches, is rarely recycled due to its low profitability. This study explores using the response surface methodology (RSM), specifically the Box-Behnken design, to optimize polystyrene waste incorporation into eco-friendly construction mortars. By replac-ing dune sand with 10, 20, and 30% polystyrene waste while keeping cement con-stant, the results indicate that partial addition of polystyrene waste improves mor-tar properties. The RSM method identified an optimal mixture with high R^2 val-ues, demonstrating the potential for economic and environmental benefits.

Keywords: : eco-mortar, polystyrene, substitution, RSM, absorption, resistance.



Graphical abstract

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Parametric study of the cylindrical shell structures

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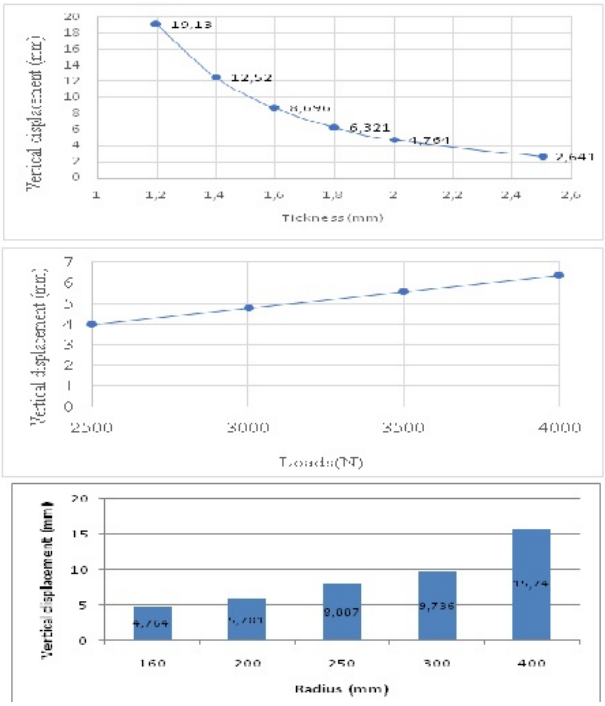
Abstract: Cylindrical shells play a crucial role in many engineering applications owing to their high structural strength and efficiency. They are widely used in fields such as aerospace, the oil and gas industry, and shipbuilding. This study aims to analyze the behavior of cylindrical shells using the advanced finite element simulation software, ABAQUS. The main objective is to understand the structural response of these structures and explore the effects of different parameters on their behavior. Structural analysis provides essential information for optimizing the shell design for various engineering applications. The results contribute to a better understanding of cylindrical shells and guide the design of efficient and reliable structures.

Keywords: Cylindrical shells, finite element simulation , parameters, Structural analysis, behaviour.



Graphical abstract

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Optimization of waterjet-peening process parameters using finite element simulations

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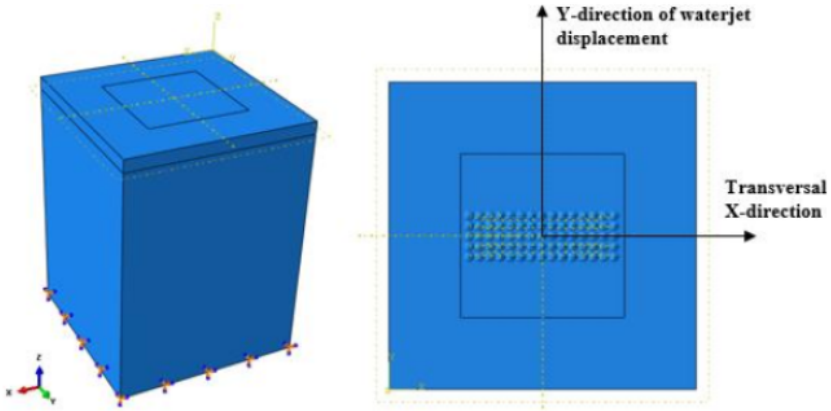
[2] *Laboratory of Mechanics, Materials and Processes (LMMP, LR99ES05), Institute of Applied Sciences and Technology of Sousse (ISSATSo), University of Sousse, Sousse, Tunisia*

Abstract: The purpose of this this study is to develop a numerical methodology, which allows simulating waterjet peening (WJP) process and optimizing the pro-cess parameters on the induced surface integrity including residual stresses, plastic strains, surface roughness and superficial damage. The proposed finite element (FE) model considers multi-sets of water droplets presenting an exponential distri-bution of an impact velocity, which depends on the principal parameters of the WJP process. The effects of the principal process parameters (supply pressure (Ps), standoff distance (SOD), nozzle diameter (dn)) are predicted by using the de-sign of experiments (DOE) method. The optimization of WJP process consists to maximize compressive residual stress and equivalent plastic strain, and further-more to minimize superficial damage and roughness of waterjet peened parts in order to reach a higher effect on fatigue life performance. The proposed method-ology has been developed and validated in the case of waterjet peened Al7075-T6 aluminum alloy

Keywords: FE simulation, Optimization, waterjet peening



Graphical abstract

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Edge AI for Water Quality Monitoring: A TinyML Approach

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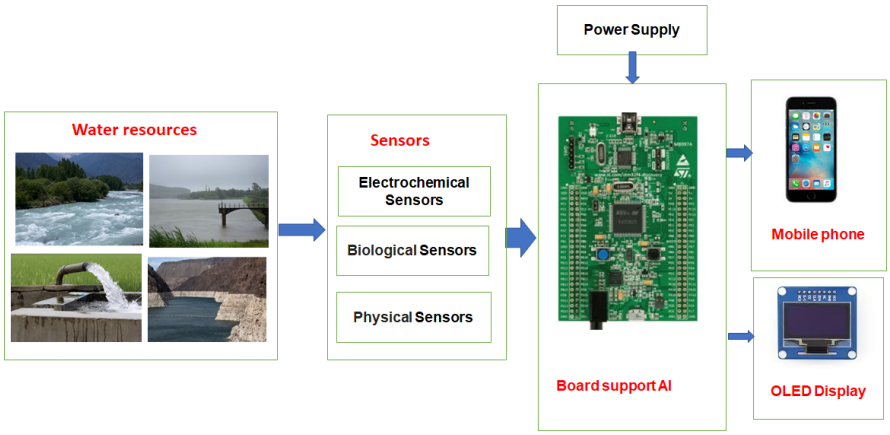
Abstract: Water, essential for sustaining life, is increasingly threatened by population growth and rising temperatures. These challenges pose significant risks to all living organisms on the planet, making effective water quality management crucial. The rapid advancement of IoT systems has sparked interest in remote water quality monitoring solutions in both academic and industrial circles. Typically, such monitoring systems utilize Artificial Intelligence (AI) models for predictive analysis, which are often run in the cloud or on high-performance servers due to their computational requirements. However, this cloud-based approach can introduce issues like security vulnerabilities, la-tency, and bandwidth limitations. In this paper, we used TinyML that is con-sist of deploying the AI model at the edge, removing the dependency on cloud processing. This edge computing approach allows for real-time decision-making locally. Additionally, we employ Nano edge studio tool to generate automatically optimized models, streamlining the process and reducing the need for manual coding. Then, STM32CubeIDE was used for deployment on the STM32F407-DISCO board. The experimental results show the effective-ness and performance of our system

Keywords: TinyML, Water quality, edge, AI model, deployment, Nano edge AI studio.



Graphical abstract

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Rotor unbalance default analysis through Daubechies discrete wavelet and Morlet continuous wavelets

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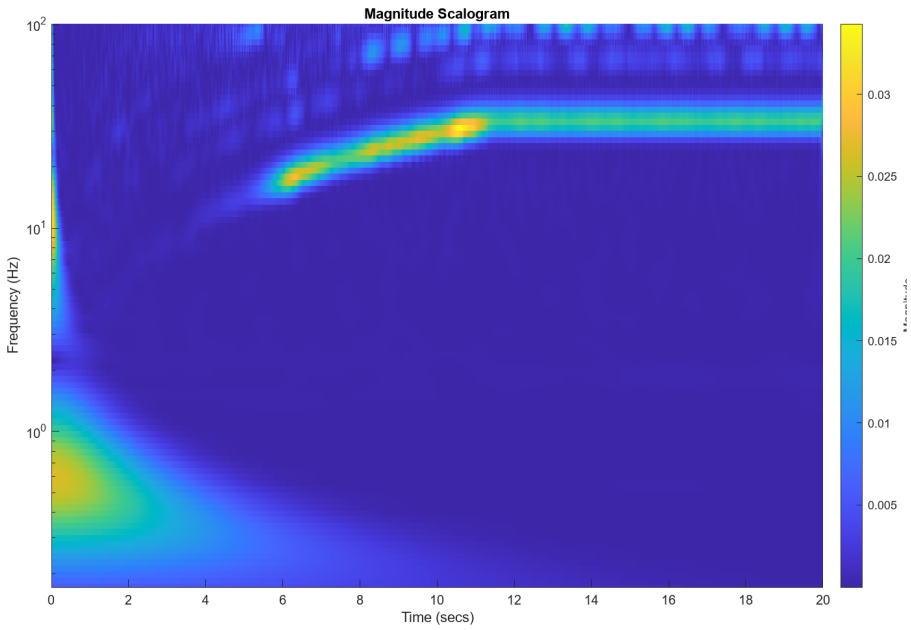
Abstract: This paper proposes a practical study of rotor unbalance defect and its effect dur-ing start-up. The analysis of this defect is made by means of the discrete wavelet method of Daubechies and the continuous wavelet method of Morlet. Knowing that the start-up phase of a rotor is the most crucial. Indeed, the rapid change from the stop to the permanent operating regime of the rotor generates natural frequencies of the machine as well as the possibility of the rotor passing through critical frequencies. The presence of an unbalance defect can amplify the effect of natural frequencies and critical speeds and can reduce the life time of the struc-ture. The use of two known analysis methods, in addition to spectral analysis, gives us an idea of which of them is more adequate in such a situation. For this purpose, we use a rotor of a vibration simulator and measure the vibrations gen-erated by the unbalances over the period from start-up to steady state.

Keywords: Daubechies wavelet, Morlet wavelet, vibration analysis, rotor unbalance, spectral analysis.



Graphical abstract

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Mechanical properties of hybrid composites reinforced with plant fibers

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[2] *Laboratory of Process Engineering, University of Amar Telidji, Laghouat, Algeria*

Abstract: The incorporation of plant fibers into the matrix plays an interesting role. Natural fibers have been widely used as reinforcements in polymer matrix composites. Among all reinforcing fibers, natural fiber-based hybrid composites have attracted the attention of researchers as high-potential reinforcing materials for composite materials. These fibers are easily available in the form of agricultural products. Natural fibers are inexpensive, durable and lightweight materials for composite applications. In this experimental work, sisal fibers and date palm fibers were used as reinforcement in different ratios to fabricate hybrid composites by compression molding technique while maintaining a total fiber loading of 20 % by weight. Tensile tests, flexural tests, and impact tests were carried out, water absorption was also determined. The results obtained show that the composite composed of a combination of 16% sisal fibers and 8% date palm fibers has better tensile properties with a stress value of 6.88 N/mm2 and a value of Izod impact of 43.218 J/m. As well as both composites showed a better bending stress value of 67.29 N/mm2, the water absorption test was carried out for four days with 120 hours analysis. This research focuses on the fact that specimen-2 containing 16% sisal and 8% date palm fibers absorbs less water than other composites.

Keywords: Natural fibers, Date palm fibers, Hybrid Composites, Sisal Fiber, Flexural strength, water absorption

Graphical abstract

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Microstructural and Mechanical Effects of TIG Welding Parameters on Austenitic Stainless Steel Joints

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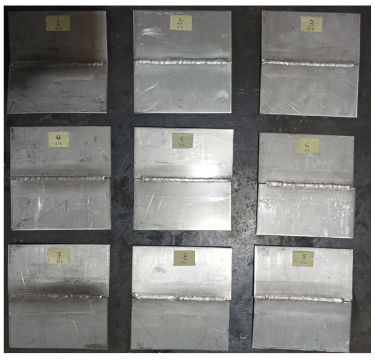
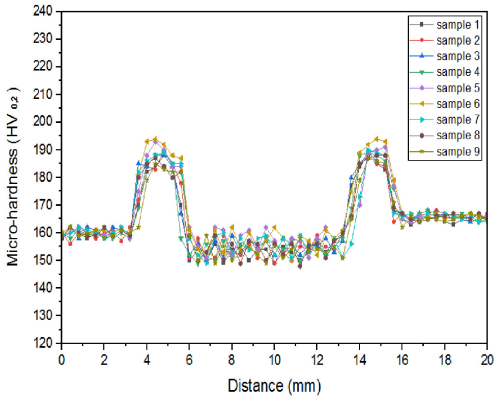
[2] *Laboratory of Process Engineering, University of Amar Telidji, Laghouat, Algeria*

Abstract: This study explores the impact of tungsten inert gas (TIG) welding parameters on the mechanical properties and microstructure of homogeneous welds in AISI 316 austenitic stainless steel. Given the growing industrial demand for this material, the research focuses on optimizing welding current, shielding gas flow rate, and voltage to enhance tensile strength, hardness, and impact toughness. Using the L9 orthogonal array based on Taguchi's methodology, the experiments revealed that relatively high currents and voltages significantly improved the ultimate tensile strength (up to 673.67 MPa) and impact energy absorption (up to 36.5 J). Microstructural analysis indicated refined grain structures in the heat-affected zones, with pronounced grain growth in the weld zone due to the thermal sensitivity of AISI 316. The micro-hardness analysis showed that the highest hardness occurred in the heat-affected zone, with samples 5 and 6 exhibiting the optimal hardness profile, reflecting the most favorable welding parameters. The study concludes that a current range of 80-90 A, a voltage range of 10-11 V, and a shielding gas flow rate of 12-16 L/min provide optimal welding conditions, offering robust guidelines for industrial applications requiring high-performance welds.

Keywords: Austenitic stainless steel, TIG Welding, Taguchi Method, Hardness Test, Parameter Optimization.





Graphical abstract

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The pressure influence on structural parameters and mechanical properties of GaAs compound

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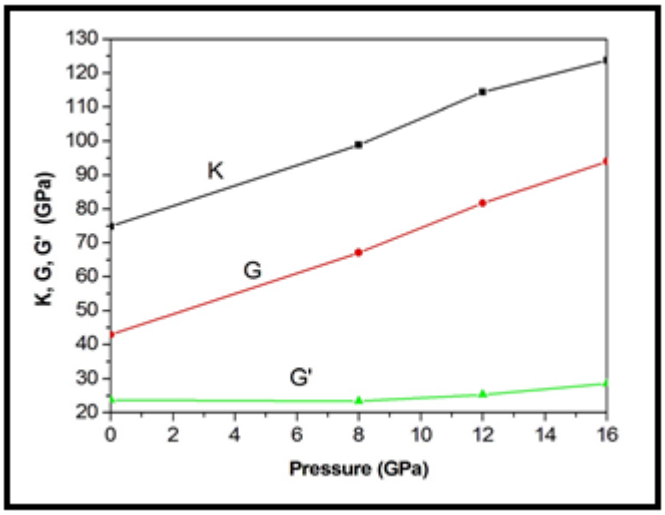
[3] *Laboratory of Process Engineering, University of Amar Telidji, Laghouat, Algeria*
[4] *Laboratory of Materials and Electronic Systems (LMSE), University Mohamed El Bachir El Ibrahimi of Bordj Bou Arreridj, El-Anasser 34030, Algeria*

Abstract: We present first-principles studies of structural and mechanical properties of zinc blende GaAs using the pseudopotential plane-wave method within the local density approximation. The effect of hydrostatic pressure on investigated properties has been examined and discussed. At zero pressure, our results are found to agree reasonably well with those reported in the literature. The generalized elastic stability criteria showed that the material of interest is mechanically stable in all the studied pressure ranges (0-16 GPa). Calculated elastic constants were used to compute the mechanical properties such as anisotropic, brittle characteristics, stiffness and many others. All the results were compared with available theoretical and experimental records.

Keywords: GaAs, Pressure, Structural properties, Mechanical properties.



Graphical abstract

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Deposition of Successive Metal Droplets onto Tilted Substrate

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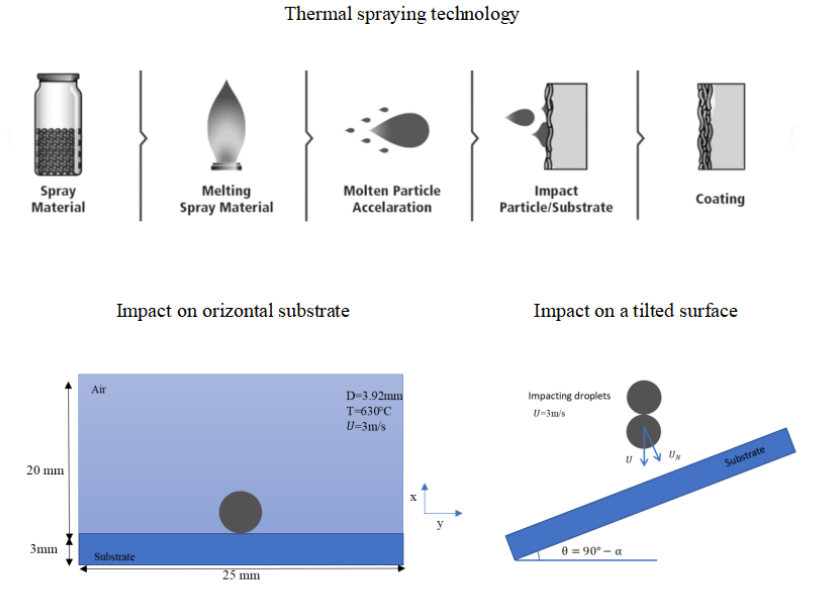
[2] *Laboratory of Renewable Energies and Materials-LERM, Mechanical Engineering Department, University of Médéa, Algeria*

Abstract: Thermal spraying is a technique within the field of surface treatment processes, where molten or semi molten metal droplet are heated and propelled onto a solid substrate. The deposition of the droplets results in the formation of a splats, which progressively accumulate to form the coating. Therefore, it is crucial to understand the dynamics of droplets impingement, spreading and solidification in order to improve coatings quality. The current study simulates the deposition of successive aluminum droplets on a tilted stainless-steel substrate during the formation of metallic lamella using Ansys code. The volume of fluid method (VOF) is employed to track the free surface of the droplets. In addition, the incompressible Navier–Stokes equation is applied to capture the dynamics of the droplets motion. The main findings reveal that the impact of droplets onto the inclined substrate shows asymmetrical spreading, the droplets tilt to gravity direction resulting in undesired shape of lamella.

Keywords: Thermal spraying , Deposition, VOF, Tilted substrate, Lamella.

GRAPHICAL ABSTRAC



Graphical abstract

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Enhancing Surface Quality of AISI 1035 Steel Through Optimized Burnishing Parameters

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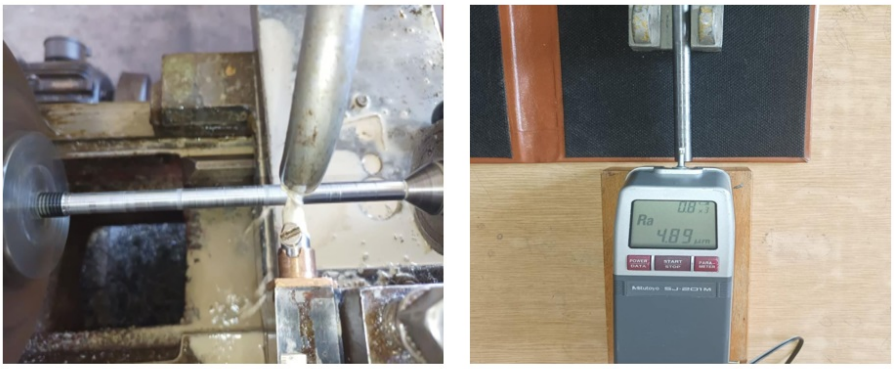
Abstract: The paper Statistical analyses of mechanical component failures reveal that, in most cases, failure originates from surface-initiated fractures. As such, surface quality plays a critical role in maintaining the mechanical integrity of structures. Mechanical surfaces are often exposed to harsh environments, such as air, which leads to oxidation, and other corrosive conditions. Given these unfavorable factors, the surface of mechanical components is particularly vulnerable, attracting the attention of both mechanical engineers, in terms of design, and materials scientists aiming to improve mechanical performance. Furthermore, materials in their as-received condition frequently exhibit baseline properties that are inadequate for providing sufficient resistance to wear, corrosion, and fatigue. This study investigates the burnishing process applied to AISI 1035 semi-hard steel, aiming to assess its suitability for surface plastic deformation (SPD) by varying the feed rate (f) and burnishing force (Py). The effects of these process parameters on surface roughness indicators (Ra, Rz, Rt) were evaluated. Experimental design and numerical modeling were employed to predict surface roughness, with the results thoroughly analyzed. The findings demonstrate that burnishing significantly improves surface roughness (Ra, Rz, Rt), irrespective of the applied force (Py) or feed rate (f), providing a beneficial effect across a range of processing conditions.

Keywords: Burnishing, Surface, Roughness.



browning roughness

Graphical abstract

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The reliability of temperature measurements in natural gas pipelines

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Abstract: The accuracy of temperature measurement in natural gas flows within closed pipelines is a highly debated topic due to the complexity of the measurement process and its economic impact. Specific thermo-fluid dynamics issues arise from the differences between the gas flow temperature, the external ambient temperature, and the average radiant temperature inside the pipeline. Furthermore, the conditions of sensor installation (e.g., immersion length) play a crucial role. This study proposes a method for measuring temperature within the pipeline by immersing a temperature sensor. The sensor provides an analog voltage corresponding to the temperature inside the gas-carrying pipe. This temperature is influenced by radiant temperature effects, necessitating an analysis of the reliability of the measured temperature in natural gas networks. The study evaluates the impact of various parameters—external temperature, pressure, gas flow velocity, and sensor immersion length—to better approximate the actual temperature of the gas flow within the pipeline.

Keywords: Natural gas, Pipeline, Temperature sensor, Temperature measurement, Accuracy, Reliability.

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Mixed convection study of hybrid nanofluid flow in a trapezoidal cavity with a hot cylinder inside

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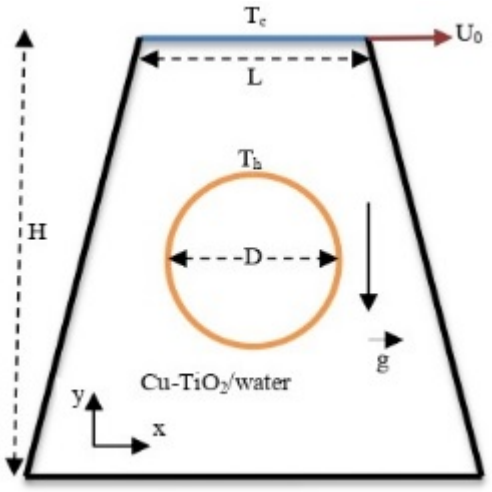
Abstract: This study aims to examine heat transfer and fluid flow around a heated solid cylinder in a lid-driven trapezoidal cavity filled with a hybrid TiO2-Cu/water nanofluid. The upper wall is maintained at uniform temperature and moves at a constant velocity U0. The solid cylinder located in the center of cavity is kept at a higher temperature than the top wall, while the remaining walls are kept insulated. The hybrid nanofluid flow is considered to be Newtonian, laminar, and incompressible. The Richardson number's impact is analyzed by keeping the Reynolds number constant at 20 and adjusting the Richardson number between 0.1 and 10. The volume fractions of each nanoparticles range from 0% to 6%. The results are presented in terms of streamlines, isotherms, and profiles of the average Nusselt number. Numerical data indicates that clockwise rotating cells are formed inside the trapezoidal container as a result of the combined influence of natural and forced convection. The presence of Copper and TiO2 hybrid nanoparticles in the receiving fluid enhances heat transfer by increasing the total thermal conductivity of the hybrid nanofluids. Higher Richardson values correspond to more significant changes in heat transfer and Nusselt number. Increasing the Richardson number from 0.1 to 10, due to heightened buoyancy effect, results in a 35.25% increase in the Nusselt number.

Keywords: Richardson number, trapezoidal cavity, Nusselt number, nanoparticles.



Graphical abstract

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Numerical Modeling of Thermal Distribution of Metallic Powders during Plasma Projection.

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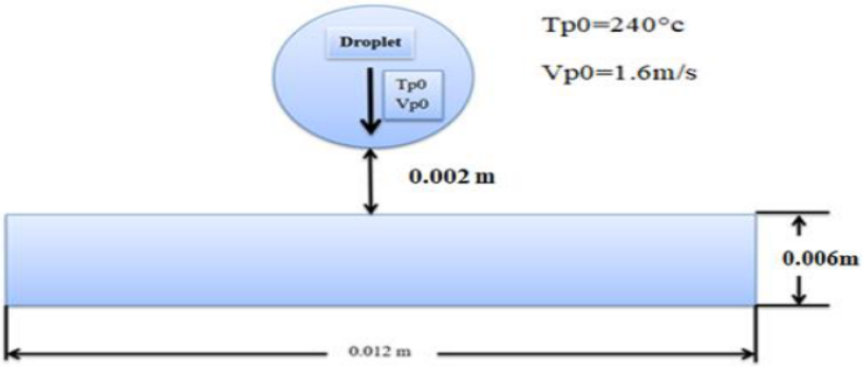
Abstract: This research presents a thermal spraying process in which a single tin particle is deposited and flattened through dynamic modeling and simulation. The analysis is performed using Abaqus software for numerical evaluation. In this approach, the thermomechanical properties of both the particle and the substrate are considered temperature-dependent. The focus is exclusively on heat transfer via conduction, utilizing variable thermal contact conductance. We first compare our model with experimental and numerical data available in the literature. During the particle impact, we examine the temporal changes in temperature and the flattening factor. Our model, which incorporates both thermal and mechanical factors, enhances the understanding of lamella formation mechanisms and heat transfer during the spraying process.

Keywords: thermal spray, numerical simulation, impact, dynamic explicit, heat transfer.



Graphical abstract

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Energy Consumption and Emissions Reduction: A Fuzzy Logic and V2I Eco-Driving Approach for Conventional Buses

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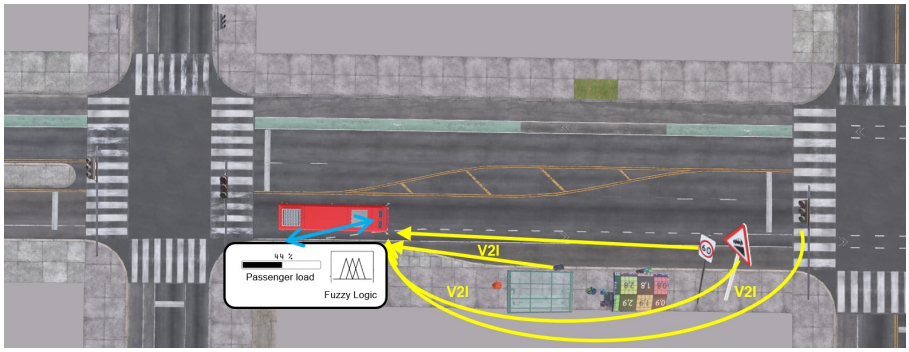
[3] *Taibah University, Department of Civil Engineering, Medina, Saudi Arabia*

Abstract: Diesel buses often encounter issues such as elevated fuel consumption and increased emissions, which are affected by various factors such as passenger load, road slope, and traffic lights, which play a significant role in assessing a bus's energy efficiency and environmental effects. This research introduces an eco-driving methodology using Fuzzy Logic (FL) and Vehicle-to-Infrastructure (V2I) communication technology to decrease energy usage and emissions in diesel buses. The FL system optimizes bus velocity by considering variables such as traffic signal conditions, road gradient, speed restrictions, and passenger load. Simulations were conducted using SUMO and Python at Sousse, Tunisia, to assess the performance of both equipped and unequipped buses at controlled and uncontrolled intersections. Results indicated that buses fitted with the FL system realized a fuel consumption reduction of up to 23.05% and a 22.56% decline in emissions relative to buses without the system. These results outperform similar research and il-lustrate the potential of integrating FL and V2I technologies to enhance sustainability and efficiency in public transportation by diminishing the public transportation environmental impacts and facilitating the shift towards more sustainable transportation networks

Keywords: Diesel buses, Fuel consumption, Fuzzy Logic, V2I, Eco-driving



Graphical abstract

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Investigation of the structural and magnetic studies of ball milled asprepared Fe75Ni25 alloys at different time of milling

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Abstract: In this paper, we investigate the structural, magnetic, behavior of as-milled Fe75Ni25 alloy. iron-transition metal-based binary alloys have attracted great attention due to their relevant mechanical, electrical, and magnetic properties. these alloys were produced by the planetary ball milling, using a powder-to-ball ratio of 14:1. after different milling time A structural study reveals that both Fe75Ni25 compounds have stabilized in ? and ? mixed phase within the cubic crystal structure. The alloyed compounds are further characterized by scanning electron microscopy (SEM),which confirms the mixing of both metals in the alloying process. the field-dependent magnetization study demonstrates the ferromagnetic nature with small hysteresis in both compounds. Fe75Ni25 exhibit a slightly higher value in comparison to Fe75Si25 .Furthermore, the average particle size value and the coercive field Hc decreased with increasing grinding time.

Keywords: structural properties; magnetic properties ,nanomaterials, ball milling

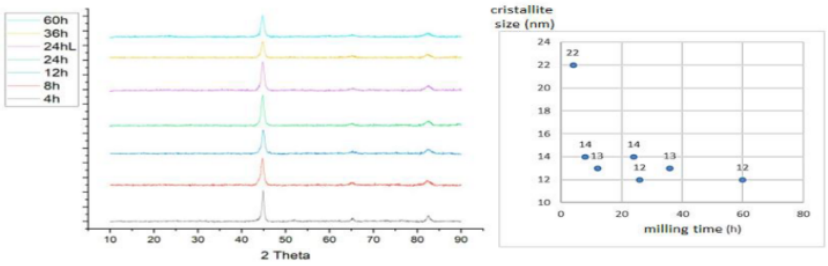

Figure01: X-ray difraction "XRD"curves and crystallite size of Fe78Si13B9 powders ground with a ball mill from 4 to 60 h

Graphical abstract

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Kinematic modeling and analysis of positioning errors of the Print Head in FDM 3D Printers

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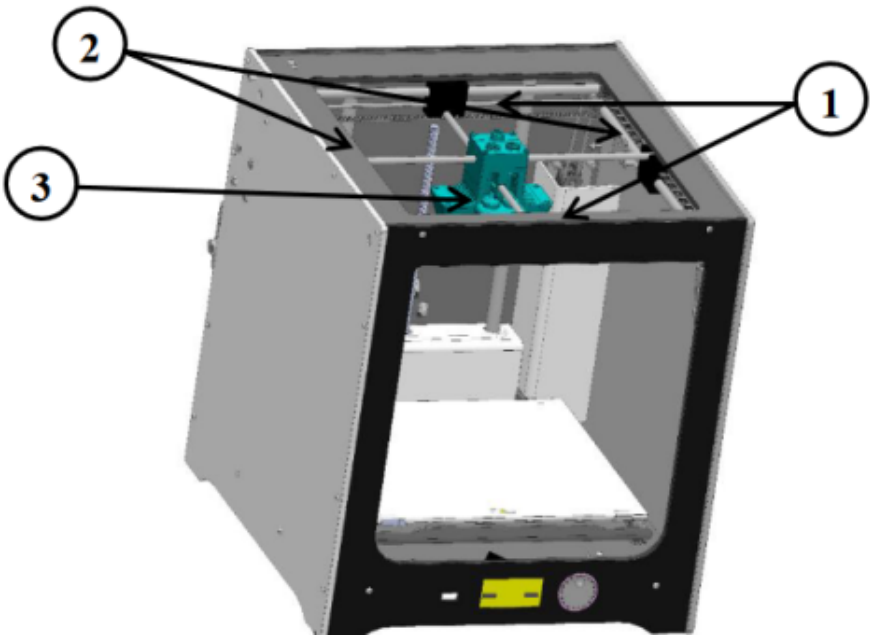
Abstract: This paper presents a kinematic modeling approach to evaluate the impact of joint clearances on the positioning accuracy of print heads in an Ultimaker-style FDM 3D printer. A geometric artifact was designed using CAD software, printed, and measured with a Coordinate Measuring Machine (CMM) to assess the posi-tional deviations between the printed model and the CAD reference. The experi-ments revealed that radial clearance in cylindrical joints leads to significant errors. The findings indicate that the clearances in mechanical joints can considerably affect the volumetric accuracy of 3D-printed parts.

Keywords: FDM machines, joint clearances, positional errors, 3D printing accuracy, print head deviation



Graphical abstract

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QSPR and MLP-ANN Methods to Predict Boiling Point and Compressibility Factor (Zc) of Pure Hydrocarbon Compounds

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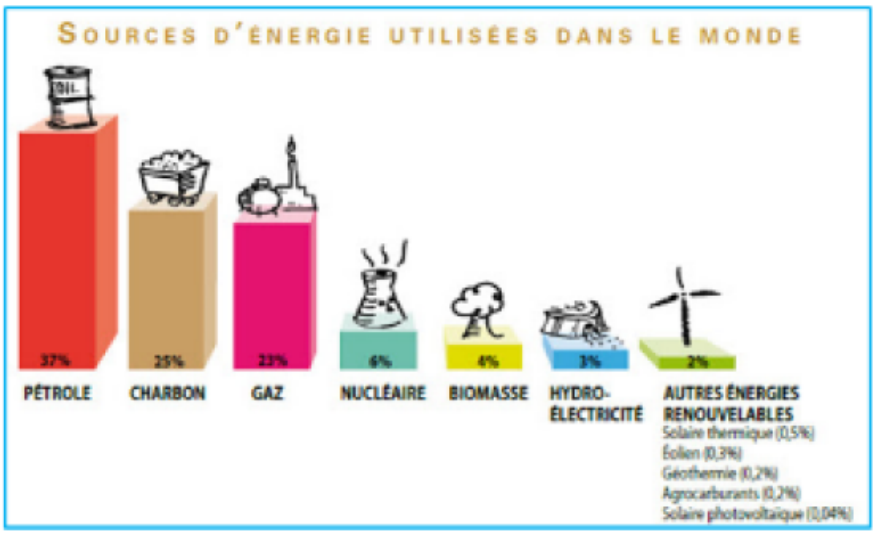
Abstract: This paper aims to develop accurate models for predicting three key properties of pure hydrocarbons—boiling point (Tb) and critical compressibility factor (Zc)—using QSPR methodology and MLP-ANN. The development process involved compiling a comprehensive database of 1314 to 1759 pure hydrocarbons, processing 5666 molecular descriptors, and selecting optimal parameters. We tested various iteration counts and dataset partitions for training, testing, and validating the models. The optimal configuration for the initial models was determined to be an 80-10-10 split with 2000 iterations for Tb and an 80-20-20 split with 3000 iterations for Zc. The models obtained demonstrated high R^2 values (ranging from 0.9931 to 0.9975 for Tb and from 0.9878 to 0.9975 for Zc) and low MAPE values (ranging from 2.4110 to 0.6119 for all three properties). Comparisons between the initial and refined models showed marginal improvements or minor trade-offs in performance metrics.

Keywords: QSPR Method, MLP-ANN Method, Boiling Point, Compressibility Factor



Graphical abstract

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Numerical investigation of heat transfer enhancement by the (Al2O3-Cu) - H2O Hybrid Nanofluid traversing a Heated Shallow Cavity

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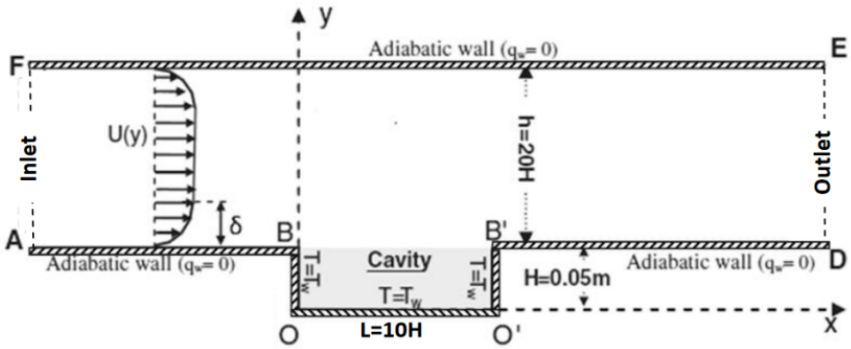
Abstract: A numerical study is conducted to check heat transfer performance by a hybrid nanofluid ((Al2O3-Cu) / H2O) through a shallow heated cavity. The governing equations are solved by the finite volume method using one point closure turbulence model. Maxwell-Garnetts (MG) and Brinkman models are applied respectively for the computation of the conductivity and viscosity of the nanofluid. The results are specifically for turbulent flows for Reynolds number Re ranging between 2.104 and 6.104 and volume fraction of the nanoparticles between 0 and ? =5%. Heat transfer along the cavity bottom wall is strongly influenced by Reynolds number and the volume fraction of all types of nanofluids. The high thermal conductivity of hybrid nanofluids, justifies their efficiency in comparison with single nanofluids for heat transfer processes. Local Nusselt number is least in all recirculation zones, reaches peak values at stagnation points. Nusselt number augments with Reynolds number and volume fraction of all types of nanofluids (single or hybrid). Hybrid nanofluids improve heat transfer more than single nanofluids.

Keywords: Forced convection; Cavity; Heat transfer enhancement; Hybrid nanofluids.



Graphical abstract

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Experimental indentation analysis to examine the hardness of ceramic materials intended for dental implants

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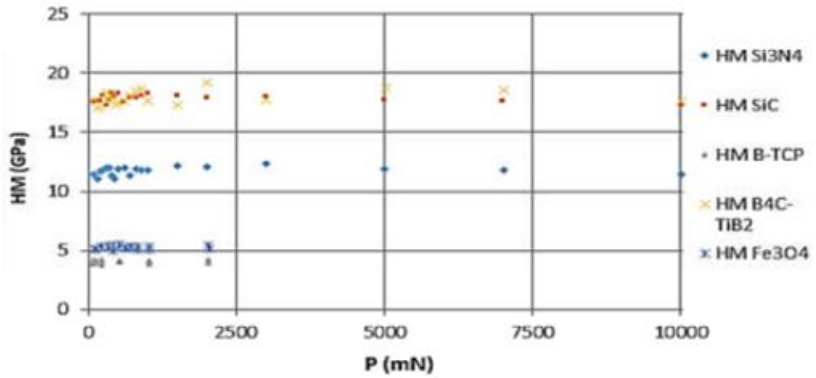
Abstract: The exploitation of indentation experiments allowed examining the Martens hardness of ceramics: silicon nitride, silicon carbide, beta tricalcium phosphate, B4C-TiB2 and magnetite. The characteristic force-displacement curves, P-h, resulting from instrumented microindentation tests performed on five ceramics were analysed. Martens hardness expressed as a function of indentation load was found is constant for the materials studied. A semi-empirical approach is proposed to determine this hardness independent of loading from the P-h characteristic

Keywords: dental implants ,Microindentation; characteristic curves; Martens hardness; loading; independent.



Graphical abstract

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Inverse Problem Using PINNs for Determining Diffusion Coefficients of Boron in Austenitic Stainless Steel 316 L

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Abstract: This presentation highlights the application one of the inverse problem methodologies to accurately determine diffusion coefficients in the case of boriding Austenitic stainless steel 316 L. diffusion coefficients are crucial for understanding material behaviour, yet their precise measurement, presents a formidable challenge. The process begins with comprehensive data acquisition, encompassing composition and temperature profiles, serving as the foundation for the inverse problem formulation. A suitable mathematical model describing the diffusion process is developed, integrating relevant thermodynamic and kinetic factors. Inverse problem techniques, such as PINN physical informed neural network and optimization algorithms, is employed to minimize the discrepancy between model predictions and experimental data. This abstract highlight the potential of inverse problem methodologies as a valuable tool in materials research, enabling the accurate determination of diffusion coefficients and furthering the ability to engineer materials with tailored properties and performance characteristics.

Keywords: boron diffusion, diffusion coefficient, Inverse problems, PINN, Neural networks

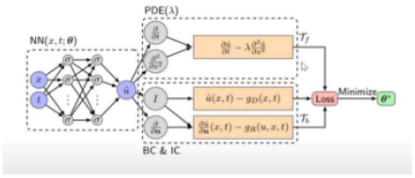

Figure 1. Physics-Informed Neural Network

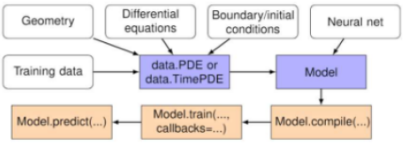

Figure 2. PINN implementation

Graphical abstract

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Non-linear analysis of cold-formed steel double-sigma profile columns under compression loading

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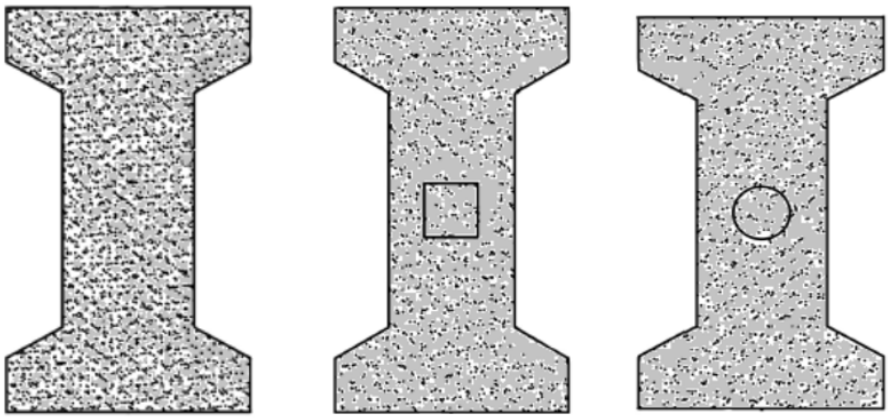
[4] *Civil Engineering department, Faculty of Technology, Badji Mokhtar, Annaba University, P. O. Box 12, Algeria*

Abstract: The majority of thin-walled cold-formed structural elements with open sections, subjected to axial or flexural loads, are susceptible to three main instability modes: local, distortional, and global. These modes, known as "pure instability modes," frequently appear interactively. In modern design codes, sizing is primari-ly based on determining the elastic critical loads of these failure modes. The ob-jective of our study is to examine the compressive strength of cold-formed steel sections in a double-sigma shape, welded together to form 5-meter-tall columns. Square and round tubes, combined with concrete infill in various configurations, were integrated into the middle section of the columns. These models were simu-lated using the finite element method in Abaqus, focusing on the nonlinear analy-sis of the compression behavior and instability modes of the composite columns. The numerical results showed a significant increase in the critical load for all models, with a reduction in deformations, reaching up to 30% compared to empty models.

Keywords: Cold-formed steel, slenderness, non-linear, finite elements.



Graphical abstract

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Sliding Mode Control of a Five-Phase Series-Connected Two-Motor Drive

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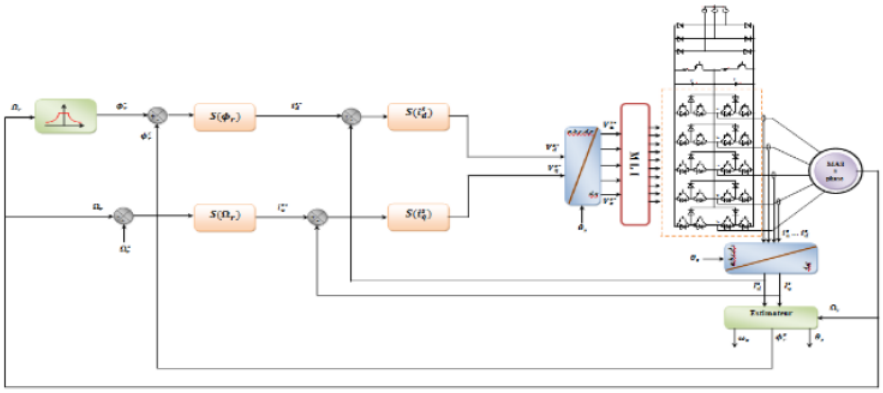
Abstract: In this work, we study sliding mode control of series-connected five-phase two asynchronous machines supplied with a three levels inverter. After presentation of multiphase machines, we worked out the mathematical model of five phase asynchronous machine supplied with voltage inverter. Application of Park transformation reduces considerably the mathematical model of machine. After, we applied sliding mode control to the five-phase induction machine. After that, we study a multi-machine system which comport five-phase two asynchronous machines supplied with a single voltage inverter.In the last, we had the sliding mode control of series-connected five-phase two asynchronous machines. We observe that an appropriate transposition of phase's order permits an inde-pendent control of two machines.

Keywords: Five-phase, asynchronous machine, multi-machine systems, phase's transposition, vector control, sliding mode control



Graphical abstract

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Thermal Performance of an Evacuated Tube Heat Pipe Solar Collector

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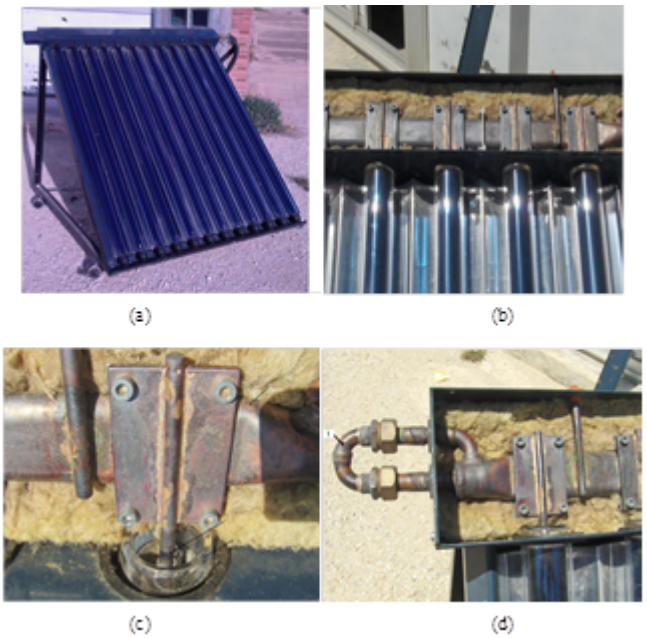
Abstract: In the present work, a mathematical model is developed to assess the thermal performances of an Evacuated Tube Heat Pipe Solar Collector (ETHPSC). The model can predict the outlet water temperature, the heat pipe evaporator, con-denser temperatures, the useful power, the instantaneous, and the thermal ef-ficiencies of the ETHPSC. Besides, the thermal performances of the ETHPSC under different operating parameters such as solar irradiation, water mass flow rate, and inlet water temperature are determined. The modeling results are validated using experimental data and a good agreement is obtained.

Keywords: Heat pipe, Solar collectorn Evacuated tube, Solar energy



Graphical abstract

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Exploration of the Response Surface Method for Numerical Modeling and Optimization of Retaining Walls in Deep Excavations

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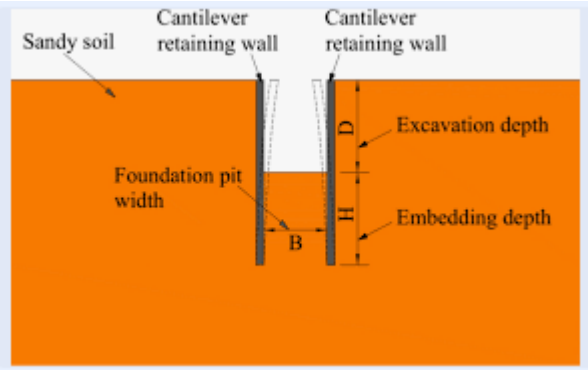
[2] *Department of Civil Engineering, Laboratory (LGCH), Institute of Science and Technology, University center of Abdelhafid Boussouf-Mila, Algeria*

Abstract: Excavation projects, such as those for sanitation, metro stations, and tunnels, are associated with a high risk of serious or fatal accidents due to collapses or landslides. As excavations deepen, the complexity of the required support structures increases. This paper investigates the numerical modeling of ground movements during deep excavation operations, focusing on creating a reference geotechnical model and developing a numerical model to simulate the behavior of reinforced diaphragm walls equipped with anchoring systems and buttons. The study employs Response Surface Methodology (RSM) to analyze the influence of key geotechnical parameters on stability, specifically the rigidity modulus (E?) for compressible soil, (E?) for rigid soil, as well as the friction angle (??) for compressible soil and (??) for rigid soil, on horizontal displacements (Ux) and the safety factor (Fs). Results demonstrate a significant impact of geotechnical, modeling, and interface parameters on the outcomes, with coefficients of determination (R^2= 99.43% for Ux and R^2= 99.01% for Fs), underscoring the importance of the proposed model. These findings demonstrate the effectiveness of the RSM approach in analyzing and optimizing deep retaining walls, streamlining the numerical modeling process.

Keywords: Box-Behnken, Deep excavation, Diaphragm wall, Numerical modelling, Optimization, RSM



Graphical abstract

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Analysis of Turbulent Methane Combustion Behavior in Aeronautical Can Combustors

Rachid Renane [1] *, Rachid Allouche [1], Ahmed Neche [1], Hamama Remmal [1], Maamar Bouziane [1]

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Abstract: ?Abstract: This study focuses on the numerical simulation of turbulent methane combustion in channel-type burners, utilizing ANSYS Fluent software. The mathematical framework integrates the Navier-Stokes equations with the RANS k-? realizable turbulence model, allowing for a thorough analysis of the combustion dynamics. We compare two burner designs: a conventional combustor and a reverse air combustor that employs a non-premixed combustion method. Key parameters of the turbulent combustion flow field are scrutinized, including static temperature, pressure, density, mass fraction, and preheating temperature. Additionally, this research addresses various challenges, such as the complexity of combustion chamber design, flammability limits, and issues related to instability and convergence. Our primary objectives are to enhance stability, improve performance, and boost efficiency while concurrently aiming to reduce pollutant emissions. The results obtained are validated against existing literature, showing strong agreement and revealing significant advancements in crucial combustion characteristics. These findings emphasize the potential for optimizing burner designs to achieve greater operational efficiency and lower environmental impact in industrial applications.

Keywords: Keywords: Methane, Turbulent non-premixed combustion; Preheat temperature; Flame speed; Numerical simulation.

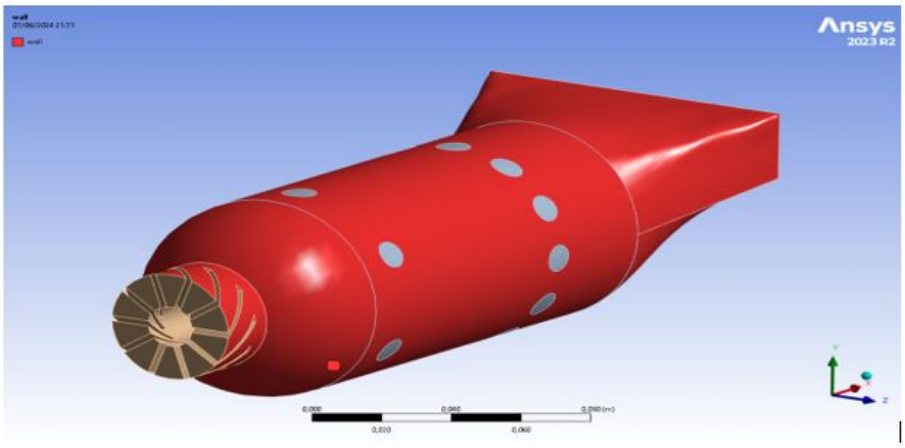

Fig. 1 conventional combustor.

Graphical abstract

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Experimental and numerical analysis of solar water heater with and without Phase Change Materials

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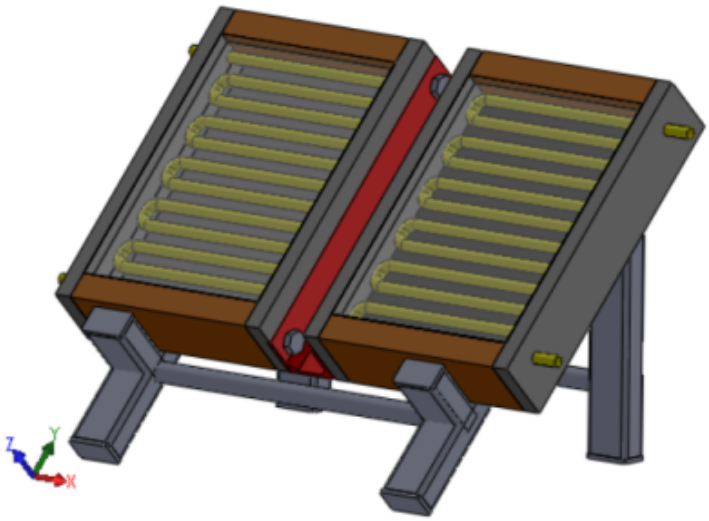
Abstract: By examining the possibility of phase change materials to store solar energy through the latent heat of a phase change material in a solar water heater, this work aims to investigate the significance of these materials both numerically and experimentally. Presenting the thermal behavior of solar water heaters with a Phase Change Material (PCM) is the study's main goal. The mathematical model of this new composite material (Paraffin/Expanded Perlite) was simulated using ANSYS Fluent. A comparison between the numerical predictions and the analytical solution was used to validate the suggested model. The findings demonstrate how much solar energy the PCM stores.

Keywords: Thermal energy storage, Phase Change Material, Charging and discharging process, CFD modeling, solar water heater



Graphical abstract

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Flux decline in ultrafiltration: numerical study and modeling of membrane fouling

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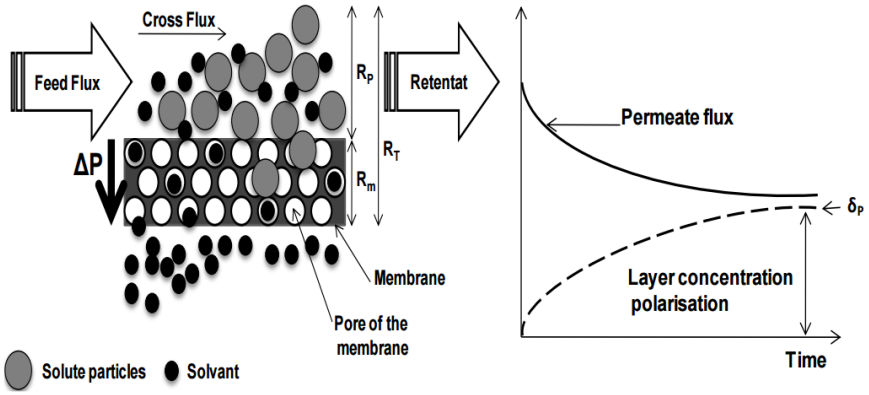
Abstract: Abstract – A numerical study was carried out describe the concentration polarization development on the membrane tubular surface during the ultrafiltration of a filler containing solid particles flowing tangentially to a porous wall in a laminar regime. This model is based on the combination of the continuity equation, the Darcy's law (resistances- in- series model) and the two-dimensional convection-diffusion equation in Cartesian coordinates. The numerical simulation is carried out by the use of Comsol, the Finite Element Method. The simulation results show that the permeate flux decreases as a function of time until reaching a constant value. On the other hand, the concentration of solid particles on the membrane surface increases rapidly with increasing time, and after a certain time this concentration becomes constant. Also, the effect of the crowsflow velocity and feed concentration on the concentration polarization model can be studied.

Keywords: Ultrafiltration, Membrane, Numerical simulation, Fouling.



Graphical abstract

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Material model validation for waterjet peening process simulation

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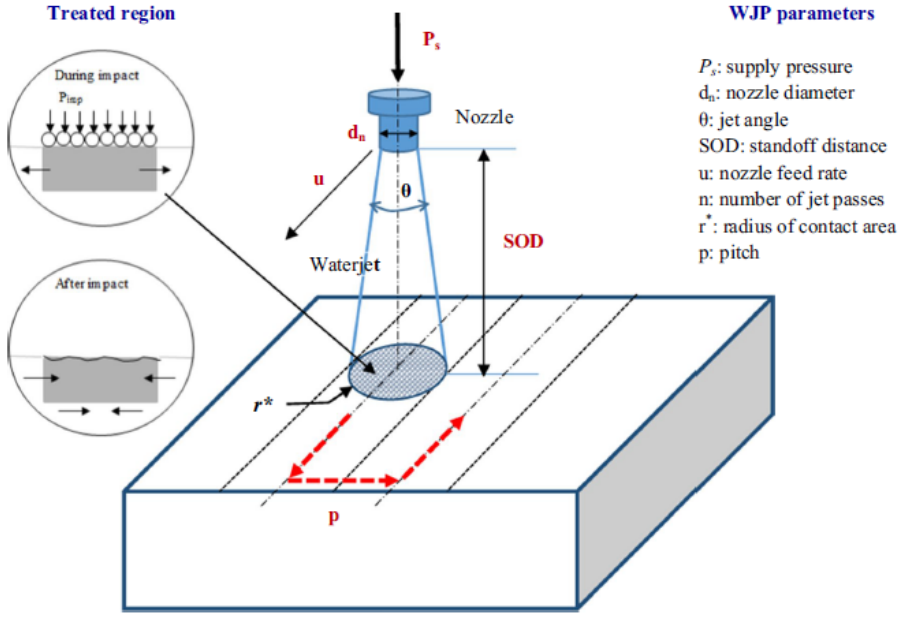
Abstract: This paper applies a finite element model of water (liquid) droplets impact on an Al 7075-T6 aluminum alloy surface to simulate waterjet peening process. Water droplets with a spherical shape are used. This simulation allows predicting the main surface properties (residual stresses, plastic strains, surface roughness and superficial damage) induced with high velocity water droplets. The finite-element (FE) model considers an impingement of one set of droplets, which strike the treated surface at high-velocities. The simulation based on the impact of one set of adjacent droplets focuses on investigating the effect of multiple material models for representing the elastic–plastic behavior of Al 7075-T6 material on the induced surface properties. Application is carried out on a waterjet- peened Al 7075-T6 to choose the suit-able material behavior and validate it.

Keywords: Waterjet peening, water droplets, surface properties, material behavior



Graphical abstract

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Comparative Analysis of Linear and Non-Linear Machine Learning Models for Predicting Mechanical Properties of PLA-SCRF

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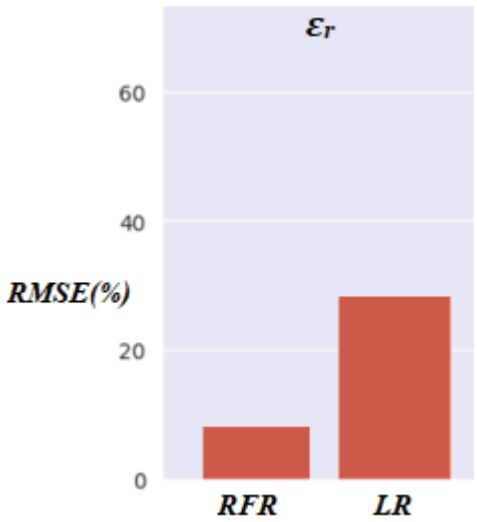
Abstract: This study investigates the mechanical properties of short carbon fiber reinforced polylactic acid (SCFR-PLA) composites through experimental tensile tests, focusing on how various Fused Deposition Modeling (FDM) parameters influence these properties. Using a composite filament with a diameter of 1.75 mm, we analyze key process variables, including carbon reinforcement percentage, raster angle, and print speed, which significantly affect the mechanical performance of the 3D printed samples. To model the relationship between these variables and the mechanical properties, we employed both linear and non-linear machine learning models. The results demonstrate that the evolution of mechanical parameters is inherently non-linear, with the non-linear regression model exhibiting greater accuracy in predictions compared to the linear model. This comparative analysis underscores the importance of selecting appropriate modeling techniques to accurately predict the mechanical behavior of advanced composite materials in 3D printing.

Keywords: PLA-SCRF, Experimental analysis, ML models



Graphical abstract

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Hybrid Composite Behaviour Analysis in Hygrothermal Environment

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Abstract: Polymer matrix composites are the ideal materials for aeronautical and aerospace applications, due to their high specific properties. During service cycles, the material is exposed to variable and extreme environmental conditions in terms of temperature and humidity, the hygrothermal environment causes residual stresses in composite materials, which need to be taken into account during the design and dimensioning of composite structures working in humid environments, the present study evaluates the hygrothermal behaviour of hybrid composites in terms of stresses, aging is taken into account, aged mechanical properties are evaluated as a function of temperature, concentration profile and time for variable environments, The aging model used is the Tsai transient model, developed for the study of a composite structure in the absorption phase, the effect of the hybrid composite is studied by simulating the behaviour of a composite made from two types of composite material, the thickness of the outer layer is modified to see the influence on the behaviour of the inner layers, hygrothermal characteristics play a central role in protecting the inner layers from moisture penetration.

Keywords: Hybrid composite, hygrothermal stress, Aging composite.

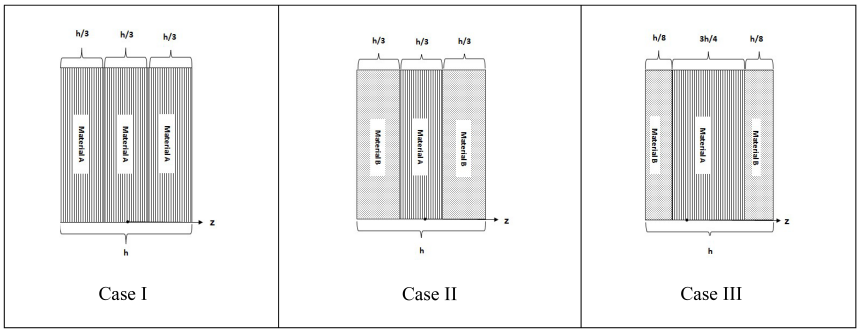

Figure 1. simple and hybrid laminates

Graphical abstract

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Numerical analysis of Hydrogen Enrichment in ammonia/heptane combustion in Internal Combustion Engines

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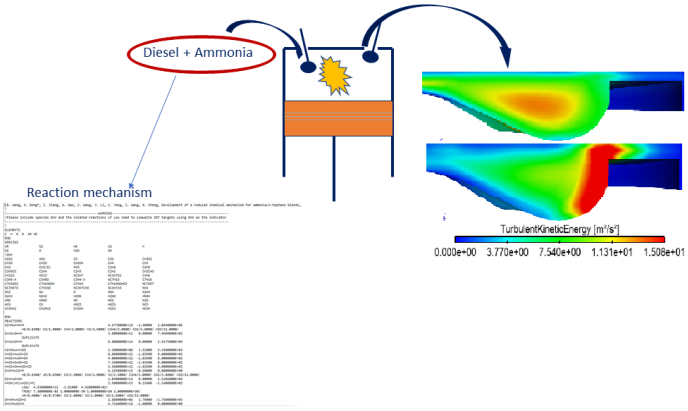
Abstract: Probably the strongest reason in favor of hydrogen, compared to fossil fuels energy sources, is its zero-carbon footprint. This paper explores the impact of hydro-gen-enrichment on ammonia/heptane combustion. Here, heptane represents diesel. The onset of hydrogen and ammonia come through intake valve. Heptane is injected, afterwards, when the piston reaches the top dead center during the compression stroke. Two simulations, Ammonia/heptane and ammonia-hydrogen/heptane, are performed. Ammonia/heptane combustion is used as reference to evaluate the impact of hydrogen. The first simulation is 40% ammonia and 60% heptane. In the second simulation, 15% of total energy substitutes the 60% of heptane, where ammonia energy kept similar. Hydrogen is joined to tackle ammonia difficulties e.g.; poor ignition quality, low flame speed, high latent heat of vaporization. The combustion is evolved partially premixed. The study is performed through RANS using the RNG K-epsilon model. The finding results re-port that both combustion phasing and combustion duration are improved. Hydrogen, with 15% of total energy, does not impact ignition.

Keywords: Hydrogen/ammonia; CFD; RANS; Dual fuel; IC engine



Graphical abstract

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Active Flutter Suppression for a Nonlinear Flexible Flying-Wing Drone using Adaptive Sliding Mode Controller via RBF Neural Network

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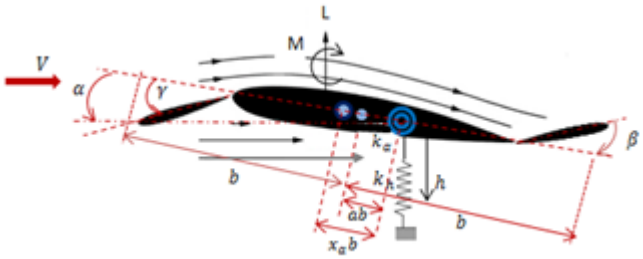
Abstract: Modern flying wing drones are manufactured to be lighter in weight to consume less power and ensure long endurance. Due to this trend, these air vehicles become more flexible and, as a result, exhibit a variety of aeroelastic instabilities such as flutter and limit cycle oscillations (LCOs) that can lead to catastrophic failure. This work presents the study of an adaptive sliding mode controller using radial basic function neural network (ASMCRBFNN) to remove these instabilities occurred on the flying wing and improve its performance. The strategy of the designed controller is to offer the possibility to rapidly damp the LCOs and enhance the flight conditions beyond the open-loop critical flutter speed. The proposed controller can even be used to estimate the dynamics of the model and its nonlinearities. The selected model describes the pitch and plunge motion of the flying wing actuated by leading- and trailing edge control surfaces (LEC and TEC) and subject to quasi-steady aerodynamic loads and structural stiffness nonlinearities. Numerical simulations show the plunge and pitch behavior of the system in open and closed loop and demonstrate the controller's ability to suppress LCOs in the subcritical flight speed range and maintain smooth wing flight despite uncertainties and environmental disturbances.

Keywords: Aeroservoelasticity, Flutter, Sliding Mode Control, radial basic function neural network



Graphical abstract

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Green formulation of Water-Based drilling Mud (WBM) with low cost: Substitution of polymers by agricultural wastes Locust Bean Gum LBG

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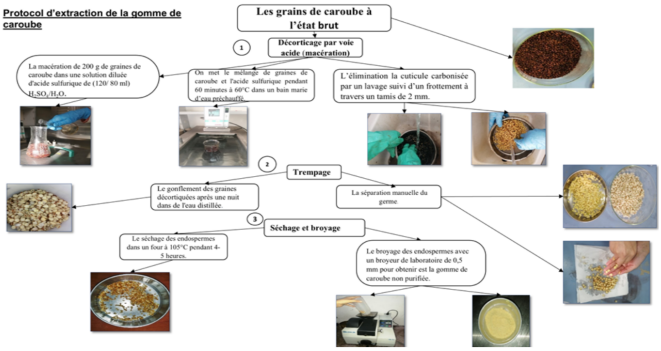
Abstract: Currently in the field of oil well drilling, research tends to use new technologies including alternative components for drilling fluids. Among the compounds that can be used in drilling fluids, carob nuts. The aspect of this project has been inserted into a section for the recovery of agricultural waste in order to minimize the degradation of the natural environment. This part of the work focused on the development of a biopolymer derived from carob nuts because of its techno-functional properties (stabilizer, thickener, binder and gelatinizer). In order to enhance the carob grains, preliminary treatments were carried out: Acid shelling (maceration), washing, soaking, drying and grinding operations. During this work, we wanted to check the conformity and study the performance of locust bean gum, which is a biodegradable biopolymer of plant origin derived from biomass, obtained locally, that we are substituting for other conventional products in the field of water-based Muds drilling fluids. In particular we have studied the effect of carob gum as a filtrate reduction instead of polyanionic cellulose (PAC LV), and as a viscosifying instead of Xanthane gum which are imported biopolymers. These polymers often increase the cost price of a drilling operation. Finally a water-based drilling mud formulated using environmentally friendly and low-cost locust bean gum has been developed by substituting total and partial biopolymer of Xanthan Gum (PAC LV) giving better rheological properties and flow control. Fluid loss requirements necessary for proper oil well drilling operation.

Keywords: Drilling, Drilling fluid, Biopolymers, Rheological



Graphical abstract

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Energy production from the brown Tunisian seaweed Halopteris scoparia

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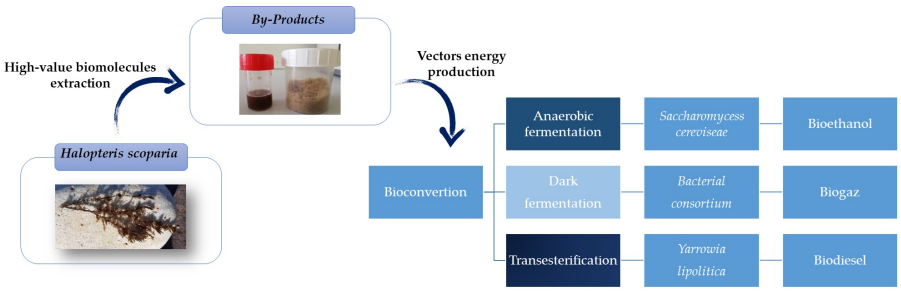
Abstract: The current fossil fuel reserves are not sufficient to meet the increasing demand and very soon will become exhausted. Pollution, global warming, and inflated oil prices have led to the quest for renewable energy sources. Macroalgae is gaining popularity as a viable and promising renewable source for biofuel production. Numerous researches have been conducted to assess the potential of macroalgae for generating diverse bioproducts such as biofuels. The existence of components such as carbohydrates, lipids and the lack of lignin create macroalgae a desirable feedstock for biofuel generation. Halopteris scoparia is one of the Tunisian brown seaweed used as a feedstock for energy conversion and producing renewable bioethanol, biogas, and biodiesel. Thus, without an optimal run and specific pretreatment, it was possible to produce 0.35 g ethanol/g DW after fermentation using Saccharomyces cerevisiae. Biohydrogen (1.3 mL H2/g DW), volatile fatty acids (612 mg butyrate/L, 225 mg acetate/L, 11mg propionate/L) and a small quantity of lipids (30.5 g/L) were produced also from the raw macroalgae after dark fermentation using bacterial consortium and Yarrowia lipolitica. In conclusion, this work contributes to the current investigations in Tunisia to make alternative energies from algae and to find new solutions to the current energy situation and environmental challenges.

Keywords: Halopteris scoparia, By-product, Ethanol, Bio-hydrogen, Lipid



Graphical abstract

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Synthesis and Characterizations of Copper modified bentonite nanocomposites as a dependable Substitute for the Catalytic Degradation of Dyes

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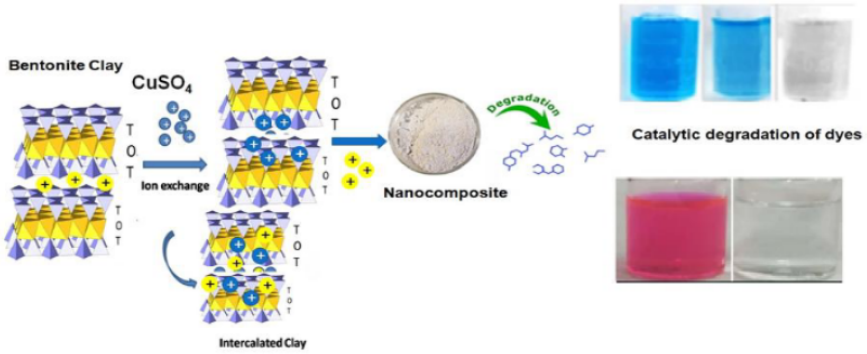
Abstract: Nanotechnology is increasingly viewed as one of the most promising research fields worldwide due to its vast potential and practical applications. Over the past decade, interest in nanocomposites, a novel class of materials reinforced with submicron particles, has surged. Nanocomposites are employed across a wide range of industries, including electronics, automotive, aerospace, packaging, energy and serveas catalysts, antimicrobial agents, optical probes, and sensors. In this study, we synthesized copper-doped bentonite nanocomposite as acost-effective solution for treatement hazardous dyes, specifically methylene blue (MB) and rhodamine b (RB).Using the ion exchange method, copper ions were incorporated to bentonite frameworks forming copper–bentonite nanocomposite. They were characterized via FTIR, while EDX and TEM provided detailed morphological analysis. Overall, the synthesized nanocomposite was excellent solution for the discoloration of hazardous dyes.

Keywords: Nanocomposites, dyes treatement, methylene blue (MB), rhodamine b (RB).



Graphical abstract

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Study and implementation of a compression molding device in the production of thermoplastic test specimens

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Abstract: The increasing development of composite materials and the increasing number of new applications testify to the growing interest in this type of material. The design of composite material structures must take several factors into account. Given the significant number of parameters, the constituents of this material, and the types of stresses that can be applied to this material. The present invention relates to the search for a new solution for the design and manufacturing of a device for the compression molding of thermoplastic specimens. The obtained test tube will be considered acceptable if the conditions mentioned below are met: Uniform thickness while staying within the tolerance range, Absence of porosities, burrs, and discoloration; and No deformation, especially in the useful part of the specimen. Several essays have been developed: Temperature regulation tests aimed at maintaining a constant temperature over time. Molding tests have been carried out with very specific conditions.

Keywords: composite materials, , compression ,molding ,thermoplastic, specimens.

Graphical abstract

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Simulation of multiple crack growth by XFEM

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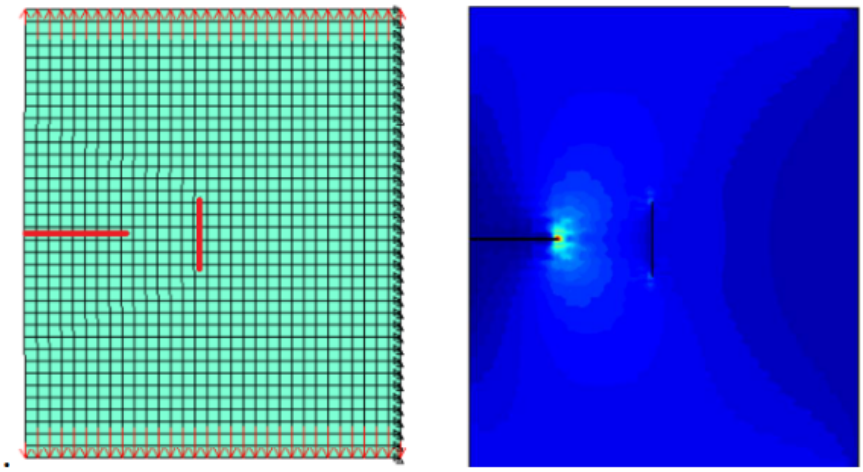
Abstract: The insufficiencies of the classical finite elements in cracked domain which requires the refining of the mesh around the bottom of crack, and also remeshing after propagation of the crack this influences the rate of convergence. In order to overcome these drawbacks, we have developed a numerical simulation code based on the extended finite element method combined with the Level Sets technique to deal with the problems of the multi-cracks growth whose numerical solutions are obtained at the using the Newton-Raphson formulation

Keywords: finite elements method; extended finite element method; Level Sets technique; multiple crack growth



Graphical abstract

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Studies on the structure and properties of unsaturated Epoxy/Luffa ?ber composites

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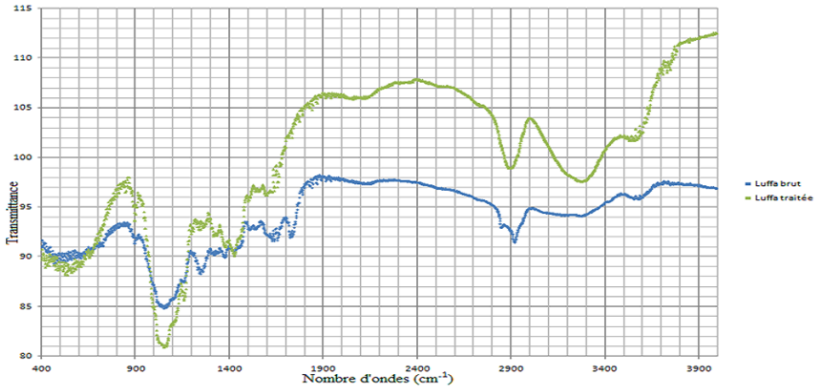
Abstract: Composite materials with plant fibers are gaining in popularity due to the increasing use of these fibers in industry. Our work focuses on the development of an epoxy composite reinforced with natural fibers, with good compatibility between the resin and the fiber, obtained by alkaline treatment (05% NaOH) of Luffa fiber. The surface modification of Luffa fiber after alkaline treatment is confirmed by Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Composites with different volume fractions (3%, 5%, 8% and 10%) of Luffa fibers (treated/untreated with NaOH) and epoxy resin were developed. Luffa epoxy composites are subjected to various tests such as tensile, flexural and impact tests to see the effect of fiber treatment on fiber/epoxy composites. Dynamic mechanical and fatigue analysis are carried out to study the effect of amine functionalization. Variations in the thermal stability of composites are studied using TGA analysis. The maximum tensile strength of 18.3 MPa is achieved for the 6% fiber of luffa, compared with 9.4 MPa for ordinary epoxy.

Keywords: luffa fiber,composite materials ,epoxy resin



Graphical abstract

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Point Interpolation Meshless Method Analysis of Stress Concentration

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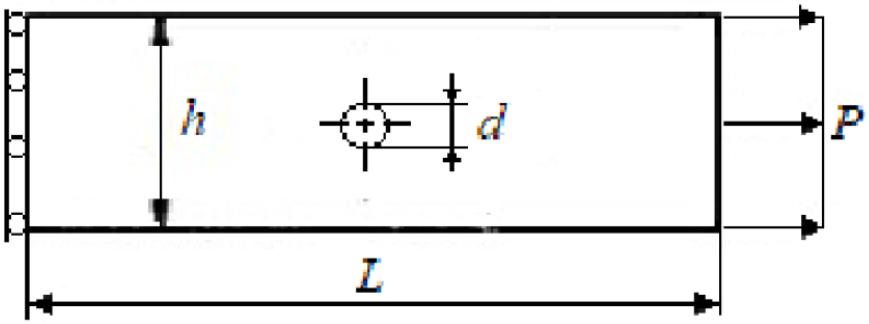
Abstract: Stress concentration is a problem often encountered in the mechanical design of a component or mechanical element. It occurs because of abrupt changes in the geometry of the part due to holes, grooves, shoulders, throats, cracks tip, ... Due to these irregularities, the intensity of stresses in the part increases locally which often represents the risk of local initiation of fatigue cracks but can also be the cause of a brittle fracture in the case of a fragile material. For this purpose, we have studied the point interpolation meshless (PIM) method analysis of stress concentration.

Keywords: : Stress concentration, abrupt changes geometric, fatigue cracks, point interpolation method



Graphical abstract

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Optimization of Dissimilar Welding of CopperStainless Steel using CCD-RSM Methodology

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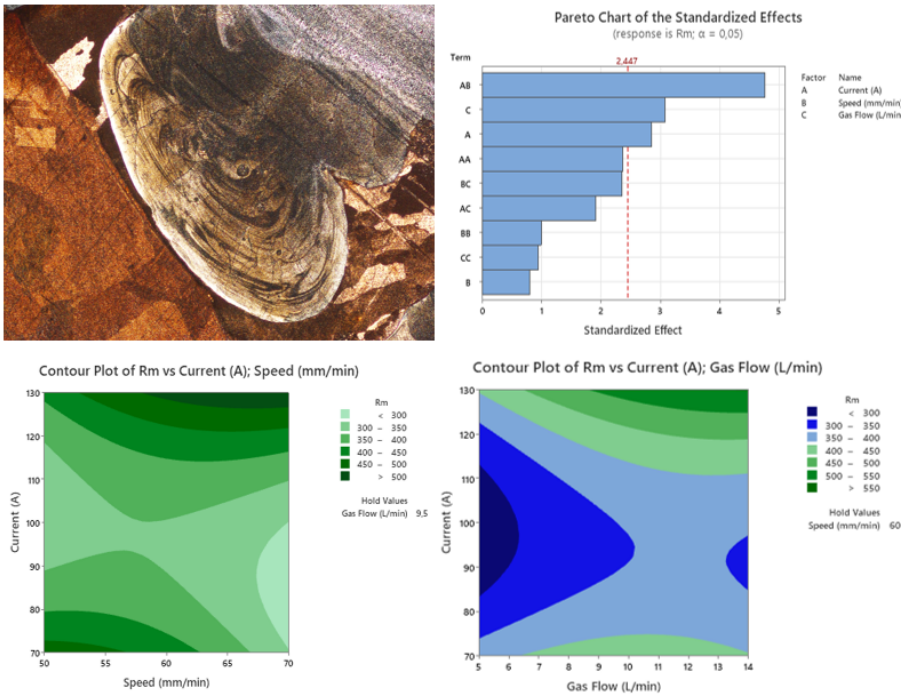
Abstract: To adjust the automatic welding parameters and ensure high mechanical properties of welded joints, we utilized a practical and numerical approach in this study. This approach combined response surface designs with laboratory experiments. Specifically, the Central Composite Design (CCD) within the Response Surface Methodology (RSM) was applied to optimize three crucial operating variables: current intensity, welding speed, and gas flow rate in an automatic welding process to achieve high mechanical resistance of dissimilar welds. The results indicated that the effect of current intensity was highly sig-nificant, welding speed had a limited effect, and gas flow rate showed a weak effect. Quadratic models for mechanical resistance as a function of these variables were developed based on the values obtained from the analysis of variance (ANOVA). The optimal conditions identified for automatic welding yielded a mechanical resistance of 503.2 MPa. ANOVA analysis indicates substantial positive impacts from both current and gas flow on Rm, contrib-uting approximately 13.36% and 15.64% respectively, whereas the influence of welding speed is about 1.08%.

Keywords: Dissimilar welding, Tensile strength, RSM-CCD design, ANOVA, Copper, Stainless steel.



Graphical abstract

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Effect of surface roughness of steel on structural and mechanical properties of galvanization coatings

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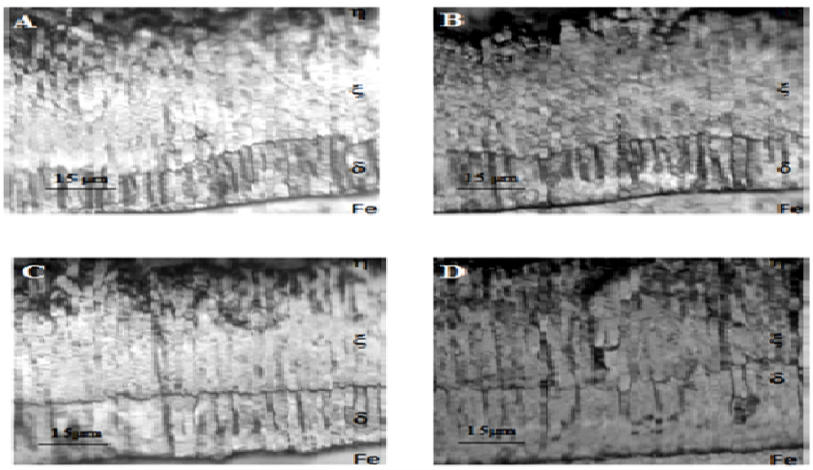
Abstract: Zinc and some of its alloys have a number of characteristics that make it well suited for use as a protective coating against the corrosion of steel substrates under severe atmospheric conditions. The metal zinc, which represents the main galvanization element offers then a cathodic protection to the ferrous materials. Because of these excellent characteristics, galvanization coatings are expected to be used for different protective applications fields. The aim of this research work is to study the effect of surface roughness of steel substrate on structural and mechanical properties of intermetallic compounds of galvanization coatings obtained at different immersion time. After a best preparation of here surfaces by different roughness process, various steel of substrates were galvanized by immersion in a molten zinc bath maintained at 450°C During the galvanization process, the chemical reactions that take place between the steel and the liquid zinc give rise to the formation of different intermetallic. Thus, three phases of Gamma, Delta and Zeta are produced on the steel substrate. Theses metallic compounds have been coated then by a solid solution of iron in zinc Eta. These intermetallic compounds are hard and fragile and the product that is obtained is not suitable for working, since this would inevitably lead to cracking and detachment of the coating. The morphology and thickness of phases formed the coatings at different parameters took place with scanning optical microscope. Finally the hardness of coatings was measured with a Vickers hardness tester.

Keywords: Steel, zinc, galvanization, iron



Graphical abstract

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Hard Chromium Films Produced by Electrolytic Process on Low Steel Substrates

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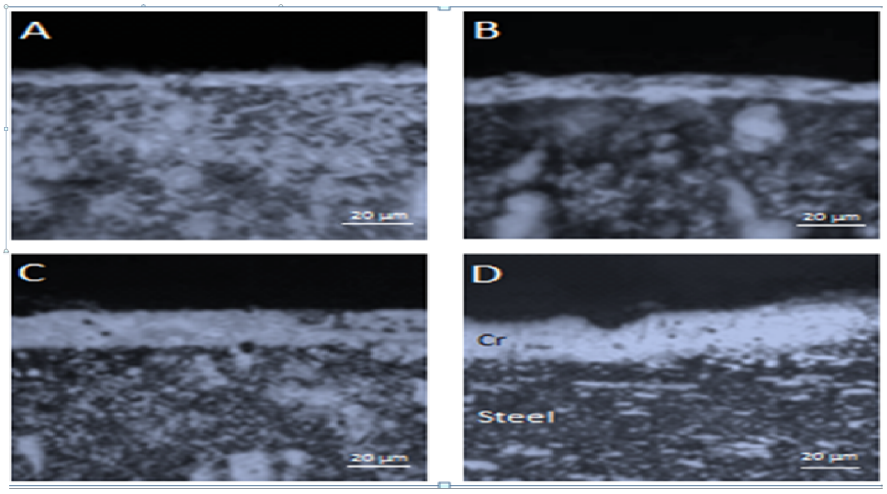
Abstract: Generally, problems of wear and corrosion begin on the surface of metallic materials and results in the degradation and reduction of lifetime of these materials. Therefore, surface treatment which can provide suitable properties for substrates without compromising their characteristics is the best effective process than changing the whole bulk material. Hard chromium coatings have proven to be one of the most effective materials to increase the service life of mechanical work parts and the most used in several industrial applications such as in petro-chemistry, oil and gas industries, especially to improve wear and corrosion re-sistance. In this work, a deposit of chromium was prepared by using an electro-plating technic on low steel substrates. For this purpose, chromium coatings were carried out in bath of chromium electrolyte solution at temperatures of 50 °C for immersion time varied from 10 to 50 min with step of 10 min. This study is to in-vestigate the effect of immersion time and temperature bath on the thickness, morphology, structure and hardness of produced chromium coating by using vari-ous analysis technics as X-Ray diffraction, microstructural observation, and hard-ness test. The results show that the increase of the time of electrolytic treatment increases the thickness and the hardness of the chromium layer. The microhard-ness profiles of samples confirm the results obtained by structural and microstruc-tural analysis.

Keywords: Chromium, steel, electrolytic, immersion time, coating



Graphical abstract

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Inhibitory effect of a new Schiff base As an effective inhibitor for aluminum corrosion in 0.5 m H2SO4

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Abstract: This study explains the performance of organic inhibitors in preventing corrosion at the interface between aluminum and H2SO4 solution, as well as their adsorption behavior. A Schiff base is the organic inhibitor that is being used. Using electrochemical analysis, the corrosion behavior of this inhibitor is examined. The primary cathodic character of the inhibitor's mechanism of inhibiting aluminum corrosion is revealed by the results of the open circuit potential. Potentiodynamic polarization studies show an increase in inhibition efficiency starting at 86.95% at 400 ppm concentration. Measurements using scanning electron microscopy (SEM) demonstrate that the inhibitor protects the metal surface from acid attack, and XPS measurements indicate that this is most likely due to the inhibitor's ability to prevent SO42-based corrosion attacks on the metal surface.

Keywords: characterisation, Aluminum, Corrosion.

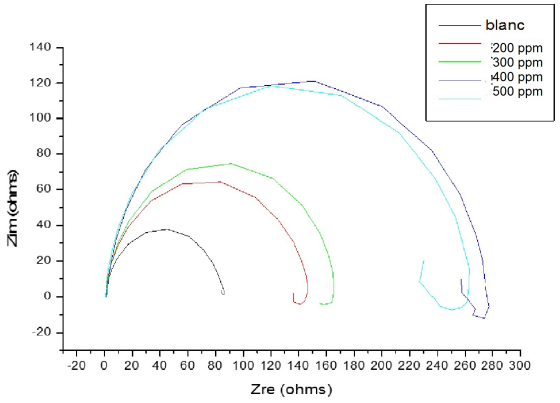

Fig. I : Nyquist plots of Aluminium in 0.5 M de H_2SO_4 in absence and in presence of different concentrations of inhibitor.

Graphical abstract

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Archive CAD models of complex products through MBSE for improved traceability

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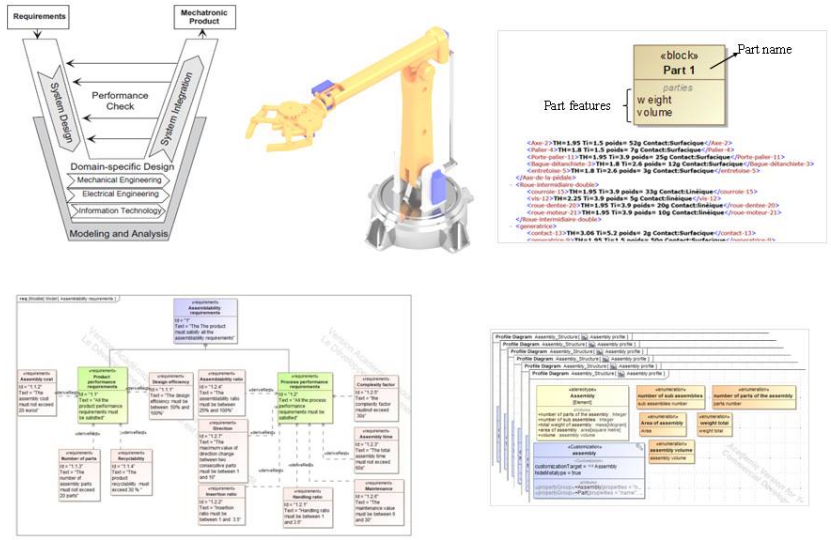
Abstract: Archiving CAD models for reuse is a highly promising line of research. The traceability of existing projects is a difficult task, given the complexity of today's products. Model Based System Engineering (MBSE) is a promising way. This paper is set in a context of detailed design of complex systems, in which the model-based system engineering approach is used. System Modeling Language (SysML) is the modeling language we'll be focusing on. This language provides concepts and models for modeling the behavior of complex systems. An industrial case study of mechatronic product will be used to demonstrate the feasibility of the proposed approach.

Keywords: Complex product, Traceability, CAD model, MBSE, SysML, Reuse



Graphical abstract

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Flow Topology Utilizing Suction and Blowing from Two Symmetrical Slots Downstream of the Square Cylinder

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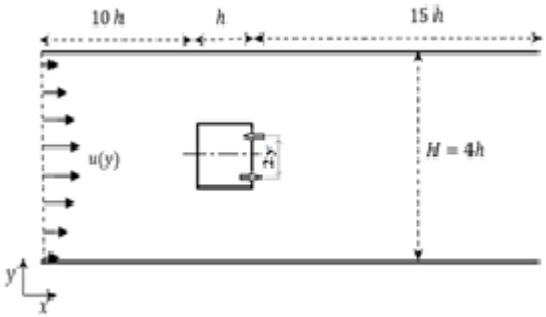
Abstract: Strict secondary flow (suction and blowing) issued from two slots symmetri-cally placed at a distance y from the cylinder's axis and embedded on the rear face of the cylinder has been used to numerically study the active control of flow past a square cylinder in a horizontal channel. We investigate the effects of the slots position y, blowing and suction intensity ui on the drag and lift coefficient variations on the instantaneous wake structure. The findings indi-cate that blowing and suction both have the ability to lessen the frequency of vortex shedding and the varying lift and drag forces. The splitting of the cir-culation bubble into multiple vortices causes a drop in St values at low jet ve-locities. A bistable pattern is observed at y = 0.35, 0.40 and 0.45 for ui = 1.5 and 2. We show that the periodic flow regime is characterized by the alternat-ing shedding of a single vortex from the rear face of the square cylinder at high velocities (from ui = 3.15)

Keywords: Square cylinder, active flow control, suction and blowing, vortex shedding, flow topology



Graphical abstract

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Computational Study of Reactive Hypersonic Flow Around Blunt Bodies for Aerospace Engines Including Radiative Heat Transfer

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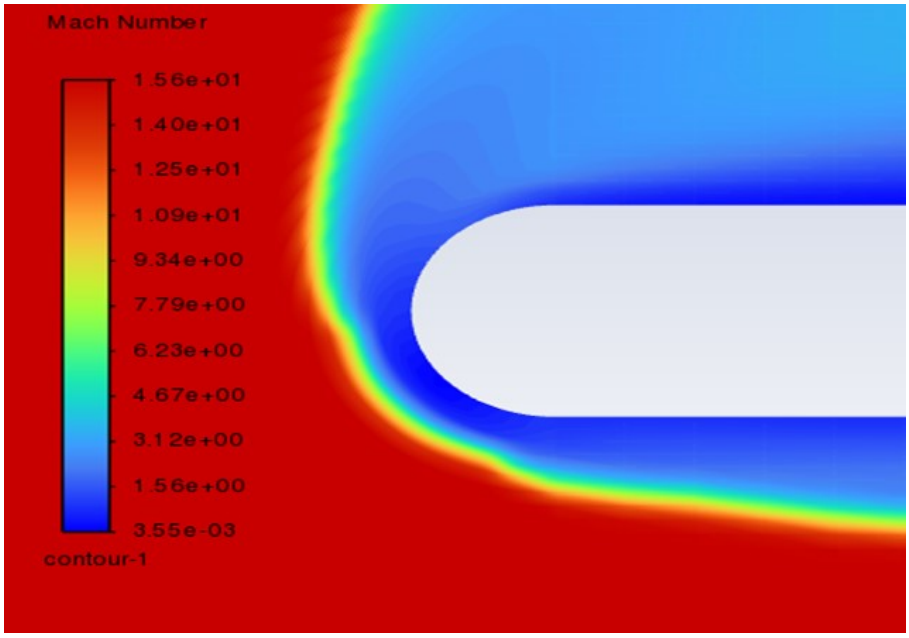
Abstract: In this study, we investigate the vibrational relaxation and dissociation processes of an air mixture at high temperatures, focusing specifically on the flow within the shock layer where intense thermochemical non-equilibrium phenomena occur. We employ the Park and Zeldovich chemical-kinetic models, which include eleven species—N?, O?, NO, N, O, NO?, N??, O??, N?, O?, and e?—and a kinetic mechanism featuring between five and seventeen reactions. The study also incorporates the impact of radiation, a critical factor in high-temperature flows that significantly affects energy distribution and temperature profiles. Using ANSYS Fluent 22, we simulate both two-dimensional and three-dimensional viscous air flows in a chemically non-equilibrium state, integrating turbulence models for greater accuracy. The configurations analyzed include Lobb's sphere and cone flare geometries, as well as the re-entry trajectory of a space shuttle. The inclusion of radiation modeling provides a more realistic representation of real-world conditions, enhancing the fidelity of the simulations. The results are validated against established scientific literature, demonstrating strong consistency and confirming the reliability of our computational approach. These insights contribute to a deeper understanding of high-temperature aerodynamics, with implications for aerospace engineering and vehicle design.

Keywords: Hypersonic, shuttle reentry, dissociation, chemical model, Radiation effect



Graphical abstract

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Effect of martensite morphologies of X70 Dual Phase Steel on Corrosion resistance in 5% H2SO4 solution

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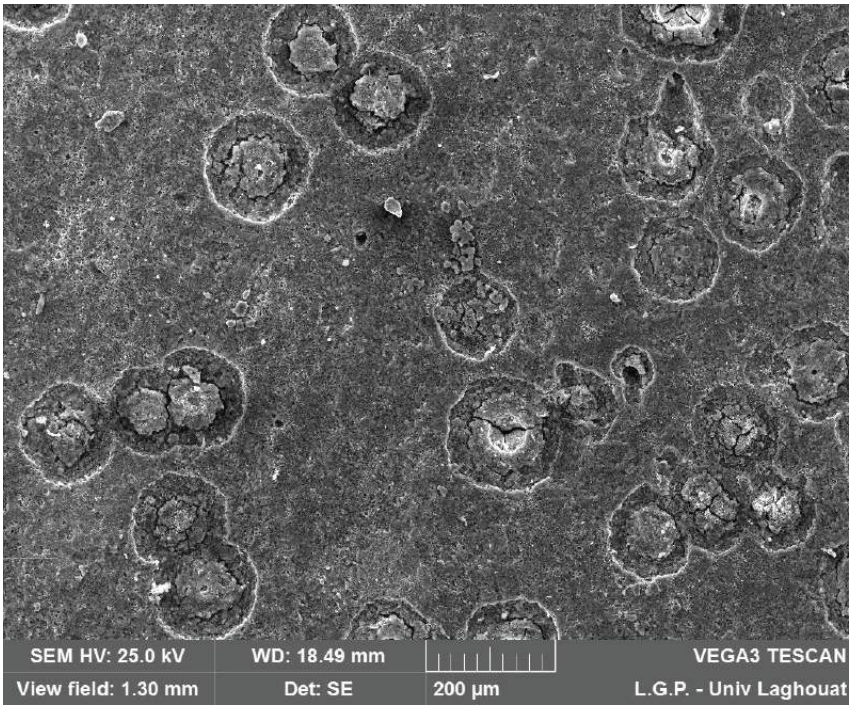
Abstract: The This paper presents a study on corrosion behaviour of API X70 dual phase steel with three different microstructures. The (IQ) treatment resulted in the formation of fine and fibrous martensite morphology uniformly distributed in the ferrite matrix. The (DQ) treatment showed a spherical network of martensite along the ferrite/ferrite grain boundaries. However, the (SQ) treatment yielded blockly and banded martensite and ferrite morphology. The corrosion behaviours of Dual-phase steel were investigated with Tafel extrapolation method in a 5 wt. % H2SO4 solution. The corrosion rate for (DQ) treatment is found to be lower than that for (SQ) and (IQ) treatments.

Keywords: Intercritical annealing treatment, Dual-phase steel, corrosion resistance.



Graphical abstract

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Path Planning in 3D Static Environments Using ACO, GA, Potential Fields and RRT-Connect Integrated in FreeCAD

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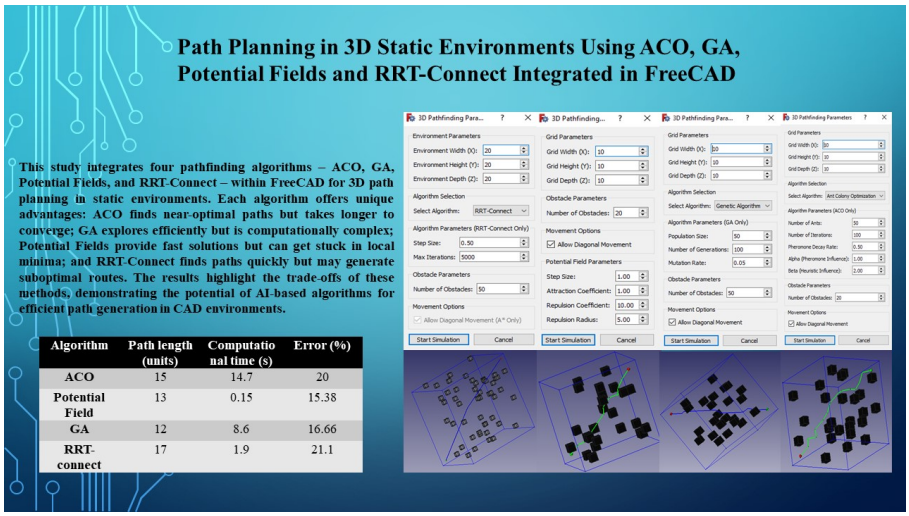
[2] *Department of Engineering and Mathematics, College of Business and Technology, Sheffield Hallam University, Sheffield, United Kingdom*

Abstract: This paper presents an exploration of the integration of four prominent pathfinding algorithms: Ant Colony Optimization (ACO), Potential Fields, Genetic Algorithm (GA), and Rapidly-Exploring Random Trees Connect (RRT-Connect) within the FreeCAD environment. Each algorithm is implemented independently to evaluate its effectiveness in path planning for robotic arms and assembly applications. The study aims to provide insights into the performance of these algorithms in terms of trajectory optimization, computational efficiency, and obstacle avoidance. The paper also presents a comparative analysis of the four algorithms to evaluate their performance in terms of computational time, path length, and effectiveness in a 3D static environment. The framework, implemented in FreeCAD, serves as a tool for simulating and comparing different path planning strategies in industrial scenarios.

Keywords: Ant Colony Optimization, Potential Fields, Genetic Algorithm, RRT-Connect, Pathfinding, FreeCAD, 3D Static Environment.



Graphical abstract

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Numerical modeling of water distillation process

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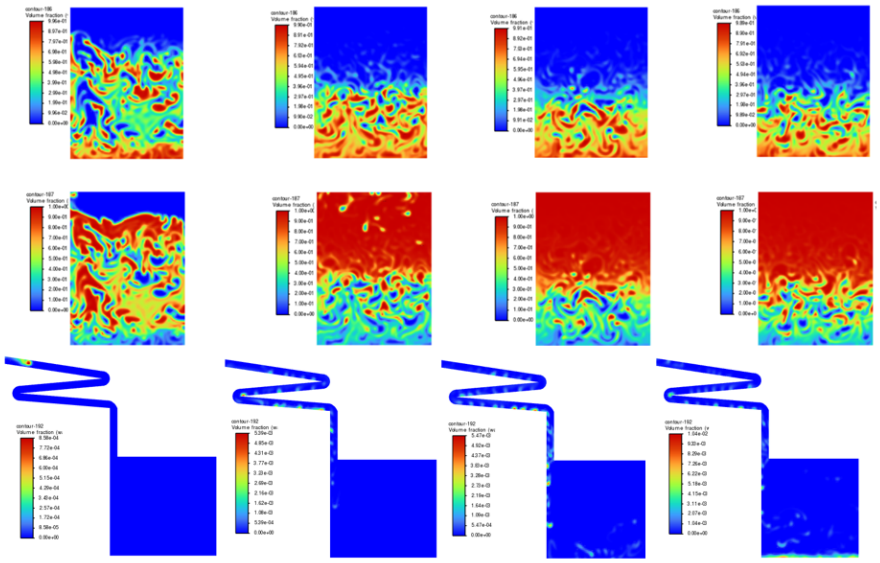
Abstract: In this paper, numerical modeling of the distillation process using the CFD code FLUENT was proposed. The proposed model is based on the resolution of the Navier-Stokes equation. It takes into account the evaporation of the liquid in the boiling chamber and the condensation, of the vapor at the condenser. According to this study, the CFD provides a powerful tool for modelling and predicting the dynamics of the flow within the water distiller. The effect of varying the empirical coefficient in the Lee model was also examined. It has been shown that the flowrate of the pure water in the storage bottle in-creases with the increase of the value of this coefficient. We noted that the value of the coefficient equal to 1.4 gives a flow rate closest to the value an-nounced by the manufacturer which is equal to 1L/h.

Keywords: CFD, FLUENT, evaporation, condensation, water distiller



Graphical abstract

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Modeling of Magnetic, Magnetocaloric and electrical properties of La0.67-xPrxBa0.33Mn03(x=0.1and x=0.2) Manganite Oxide prepared by sol-gel process

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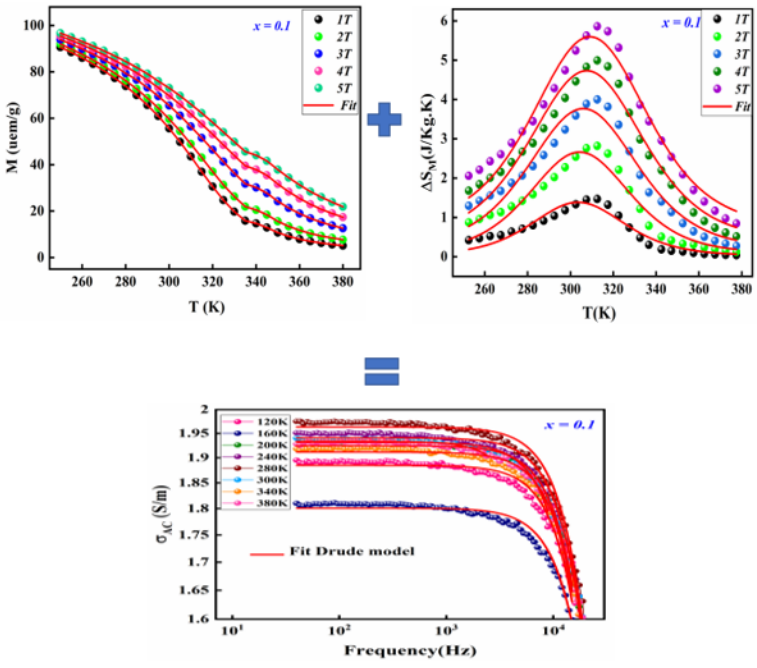
[2] *Higher Institute of Applied Sciences and Technology of Gabes (ISSATG) ISSAT Gabes,Uinversity of Gabes, Tunisia*

Abstract: – In this study, we examined the magnetic and electrical characteristics of sol-gel-prepared polycrystalline manganites La0.67-xPrxBa0.33MnO3 (x = 0.1 and 0.2). The temperature dependence of magnetization shows that, as the temperature decreases, all of our samples exhibit a second-order paramagnetic to ferromagnetic transition. A correlation between experimental results and theoretical analysis based on a phenomenological model is investigated. The magnetic and magnetocaloric measurements are well simulated by this model. The maximum magnetic entropy change (?SMax) under a 5 T magnetic applied field has theoretical absolute values of 5.8 J kg-1 K-1 and 3.33 J kg-1 K-1 for x = 0.1 and 0.2, respectively. The relative cooling power and the specific heat capacity values are also estimated. We can extrapolate from the expected results that our compounds could be good candidates for low-temperature magnetic refrigeration. On the other hand, the electrical characteristics of La0.67-xPrxBa0.33Mn03(x=0.1 and x=0.2) have been examined over a broed temperature range [120K to 380K]and frequancy range [40 to 107Hz] employing independence spectoscopy. for a samples transition from semiconductor to metal behavior is noted at 300K

Keywords: : perovskite, model Hamad, electrical.



Graphical abstract

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Deep learning algorithms for predicting deformation and stress values developed in the micro wind turbine blade manufactured by the 3D printed process

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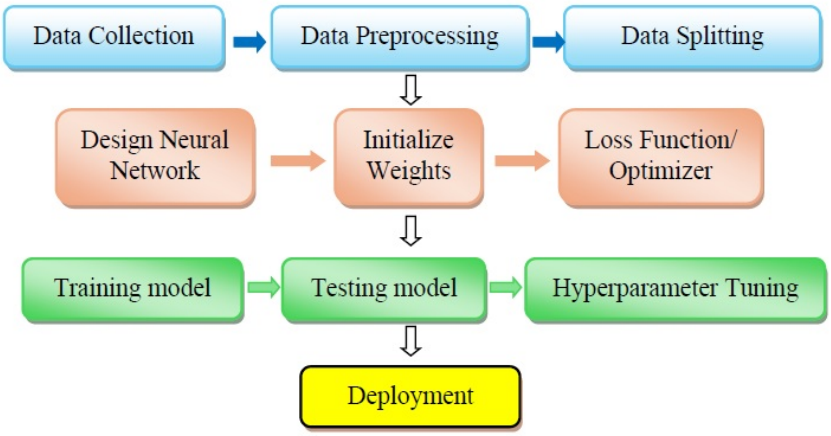
Abstract: The main purpose of this work is to evaluate different deep learning al-gorithms in prediction deformation and equivalent stress in the micro wind blade initially manufactured with 3D printed process for low wind speed values. Based on numerical data available in literature, Recurrent Neural Network (RNN), Deep Feedforward Network (DFF) and Deep Neural Network (DNN) are developed and evaluated to determinate the optimal model that achieving optimal performance in prediction the two-target feature previously mentioned. The wind speed (WS) and the infill percentage (IF) for PLA material with different levels are considered as the two input variables for predicted models. The R2 metric is adopted as the valu-able tool in evaluating the performance of the deep learning model. Prediction re-sults affirmed that DFF algorithm present the highest value of R-squared and it is considered that the most appropriate model in this specific prediction task com-pared to the DNN and RNN models.

Keywords: Wind turbine blade, 3D printing, deep learning algorithms, defor-mation, equivalent stress



Graphical abstract

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Photocatalytic activity under sunlight by Copper Oxide Thin Films

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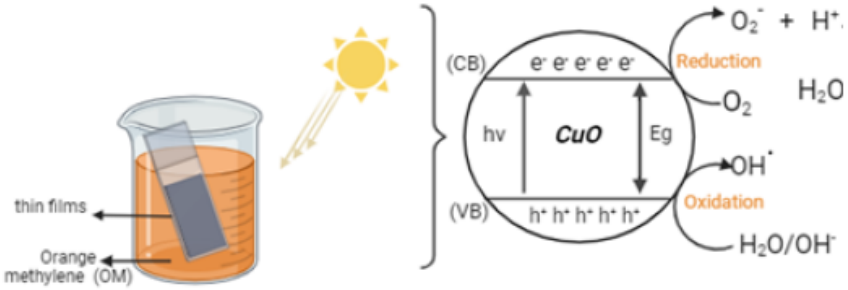
[2] *Laboratory of molecular chemistry and environment, Mohamed Khider University Biskra, BP145 Biskra 07000, Algeria*

Abstract: Copper oxide is a P-type semiconductor material that is black in color with a slight transparency. It is an interesting material for various applications due to the abundance of its components in nature, its good thermal stability and its structural and optical properties. This property allows it to be almost excellent in many applications such as catalysts, solar cells and batteries ... In this work-in-progress, the solution was prepared by the Sol-Gel method and thin films of CuO were deposited on glass substrates by Dip Coating technique, this study focused on different film thicknesses by varying the frequent number of layers deposited. The structural analysis by X- ray diffraction (XRD) shows that all the samples are polycrystalline with monoclinic crystal structure. The optical properties of the films were characterized by UV–Visible spectrophotometry, which shows that the films show high absorbance in the visible region. Their optical band gap decreases from 2.10 to 1.80 eV when varying the frequent number of layers deposited increases from 2 to 5 layers. The photocatalytic performance of nanocomposites synthesized under sunlight was studied in the degradation of methylene orange (OM) dye as a target pollutant for 210 min

Keywords: Sol–Gel, Dip-Coating, Copper Oxide, Thin Films, photocatalytic



Graphical abstract

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Analysis of the Bolt Inclination Angle during Tensile Testing Using Digital Image Correlation (new optical Method)

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Abstract: Abstract –The inclination of the bolt during a tensile test in a fastened joint of composite material can be influenced by several parameters, including bolt dimensions, preload, type of composite material and its properties, design, configuration of the joint, and testing conditions. This work focuses on the effects of stacking sequence and specimen geometry on the inclination angle of the bolt under load. Three types of specimens were used in the experimental tests, which were carried out to measure the inclination of the bolt during tensile testing of the composite material using digital image correlation. This optical method allows the evaluation of the bolt's inclination throughout the test. The relationships between bolt inclination under load and damage mechanisms were obtained experimentally. The results demonstrate the influence of stacking sequence and specimen geometry on the evolution of bolt inclination under stress. Keywords: tensile test, bolt inclination angle, optical method, composite materials.

Keywords: tensile test, bolt inclination angle, optical method, composite materials.

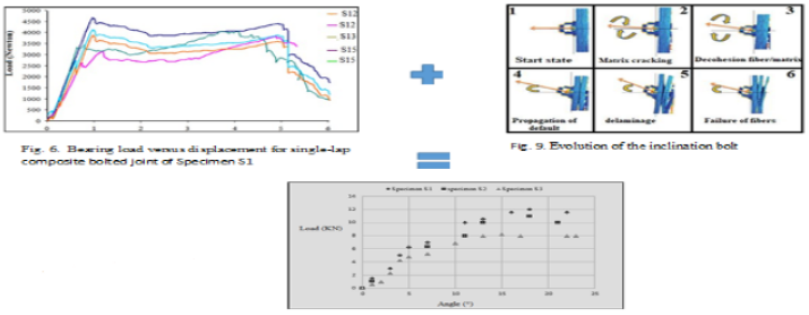

Fig. 6. Bearing load versus displacement for single-lap composite bolted joint of Specimen S1

Fig. 9. Evolution of the inclination bolt

Fig. 10. Load versus angle bolt inclination for a typical specimen S1, S2, and S3 during tensile test.

Graphical abstract

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Effect of precursor concentration on the photocatalytic activities of hydrophilic bi2O3 thin films prepared by dip-coating technique

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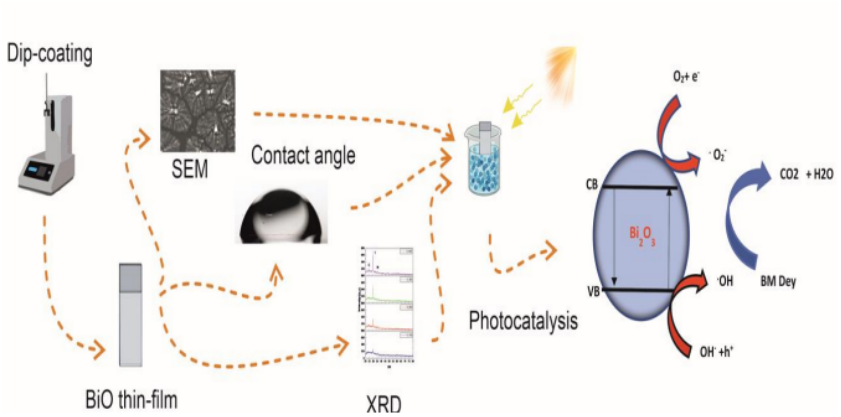
Abstract: In our study, we employed the sol-gel method to fabricate Bi2O3 thin films, utilizing bismuth nitrate as the precursor. We explored the impact of different precursor concentrations on the films' structural, morphological, optical, and photocatalytic characteristics. XRD analysis revealed that all films predominantly exhibited a tetragonal phase. SEM images illustrated that the thin films offered effective coverage. The presence of bismuth and oxygen elements was verified through EDAX spectra. In terms of optical properties, the transmission spectrum demonstrated that the highest average transmission in the visible spectrum was approximately 78% for the 0.1M Bi2O3 film. For our photocatalytic assessments using methylene blue, we observed exceptional degradation, with a degradation percentage of ? 99% achieved within just 2 hours at ambient conditions using no more reactive oxidant species.

Keywords: Bismuth oxide; Sol-gel method; dip coating; photocatalysis, methylene Blue



Graphical abstract

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The impact of lithium incorporation on the properties of the In2O3 thin films prepared by ultrasonic spray deposition

Ranida Bourhefir [1] *, Hanane Saidi [1], Nadjette Hamani [1], Abdellah Attaf [1], Okba Benkhetta [1], Amina Youcef [1], Nour Elhouda Redjouh [1]

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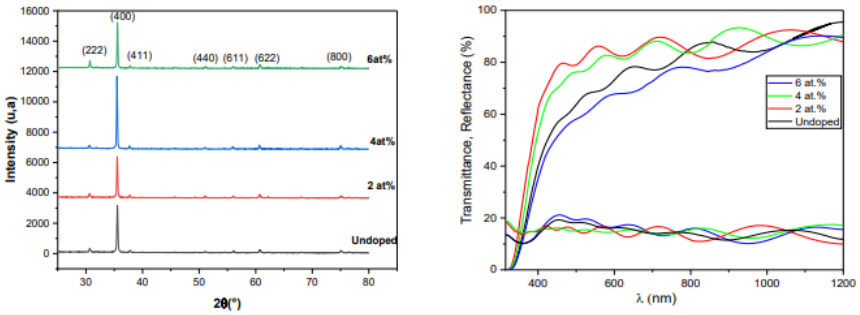
Abstract: Indium oxide (In2O3) is a material belonging to the group of transparent conductive oxides, which are widely used in many fields of technology including optoelectronics and photovoltaics. However, the properties of In2O3 thin films depend on many factors. Therefore, the aim of the study was a thorough investigation of the properties of In2O3 thin films of different doping concentrations. Indium oxide thin films were deposited by ultrasonic spray at different deposition times to investigate the influence of different doping concentrations on the structural and optical properties of thin films. The structural and optical properties characteristics of these layers were investigated by X-ray diffraction and UV-Vis-NIR spectrophotometer.it is observed that all the films are polycrystalline and crystallize in a cubic structure with a preferential orientation along the (400) plane. While the optical transmittance spectra with high transmittance of more than 80 % for all samples at the visible and near-infrared ranges. optical band gap varying in the range of 3.64-3.67 eV. In turn, Li-doped In2O3 thin films are strongly affected by their structural and optical properties.

Keywords: Indium oxide, thin films, Lithium, Doping.



Graphical abstract

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Ovalization behavior the shell of a cement rotary kiln - numerical analysis

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Abstract: The rotary kiln is a critical component in the cement manufacturing process, providing the conditions necessary for the formation of high quality clinker in an efficient, economical and controlled manner. Its proper operation and proper maintenance are essential to ensure the profitability and sustainability of a cement plant's operations. This work aims to study the mechanical behavior of a rotary kiln by calculating the deformability of the shells. The numerical simulation of the shell and the layers of the refractory and the crusting by the finite volume method was developed using the WORKBENCH software (ANSYS). The idea is to check the behavior of the oven under three different conditions chosen, which are the own load of the kiln, consideration of thermal conditions and with different thickness of refractory brick. Ovalization of the rotary kiln shell is a serious problem which can have significant repercussions on the operation and safety of a cement plant. It is essential to carefully monitor the condition of the shell, take appropriate preventive measures and perform regular inspections for any signs of ovality to minimize the risks and costs associated with this problem.

Keywords: Rotary kiln, shell, deformation, simulation, ovalization

Graphical abstract

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Hydrodynamic Modelling of a pendulor wave energy converter

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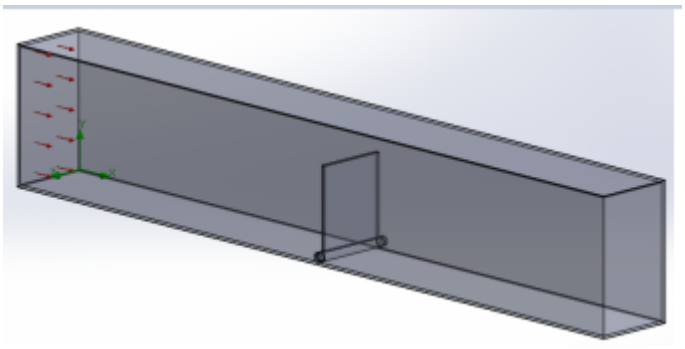
[1] *Laboratory of Electro-Mechanic Systems (LASEM), National Engineering School of Sfax (ENIS),University of Sfax, Sfax, Tunisia*

Abstract: This study discusses the hydrodynamics of the modular concept of a well-known wave energy device, the oscillating wave surge converter. The flat Pendulor Wave Energy Converter (PWEC) shows a classic design integrates a pendulor, two sidewalls and a hing to concentrate the wave power. Like some previous pendulums, one end is hinged to the bottom and the other end swings left and right near the water free surface. The mechanical energy of the flapping motion is converted into hydraulic energy by the hydraulic pump connected to it, and then it is converted into electrical energy. Three proposed designs, three pendulum inclination angles, are verified numerically using Solidworks FLOW SIMULATION. The simulations show the interaction of the waves with different flap angles and the effect on the total power output.

Keywords: Wave Energy Converter, Pendulor, Computational Fluid Dynamics, Oscillating wave Surge Converters



Graphical abstract

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Comparative study of the water uptake of two bio-composites PLA-DPFs and PLA-PO

Ines Ghanmi [1], Faouzi Slimani [2], Samir Ghanmi [1] *, Mohamed Guedri [3]

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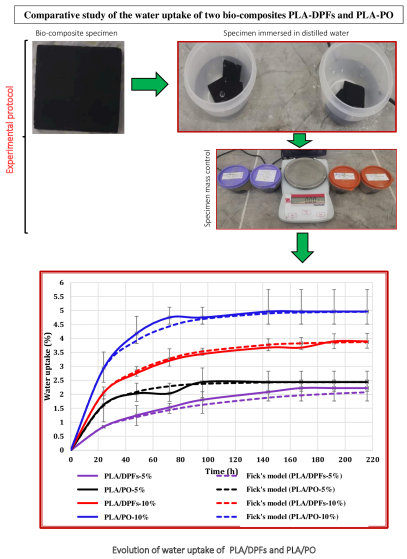
Abstract: This work presents the experimental results of a study of the water uptake of two biodegradable bio-composites developed in the laboratory based on polylactic acid (PLA) as a matrix and date palm fibers (DPFs) and posidonia oceanica (PO) as reinforcement. The choice of the two types of fiber is justified mainly by their biodegradability and their abundance in nature in many countries, particularly Tunisia. So, for a better development of these bio-composites, it is necessary to have additional information on their durability. Therefore, for a better development of these bio-composites, it is necessary to have additional information on their durability. Indeed, a low water uptake property, allows these bio-composites to be used in applications where moisture could be involved or they could get wet sometimes. Low water absorption also ensures bio-composite durability. The procedure consists of monitoring the absorbed mass of each bio-composite over time, until water saturation is reached. This involves regularly weighing of standardized samples of these bio-composites after they have been immersed in distilled water at room temperature. The results show that the higher the fiber content of the bio-composite, the more sensitive it becomes to moisture. Furthermore, PLA/DPFs bio-composites are more resistant to moisture than PLA/PO bio-composites for the same fiber content.

Keywords: bio-composite, date palm fibers, posidonia oceanica, water absorption



Graphical abstract

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Utilization of date waste as biomass for the production of bioethanol and polyhydroxyalkanoates

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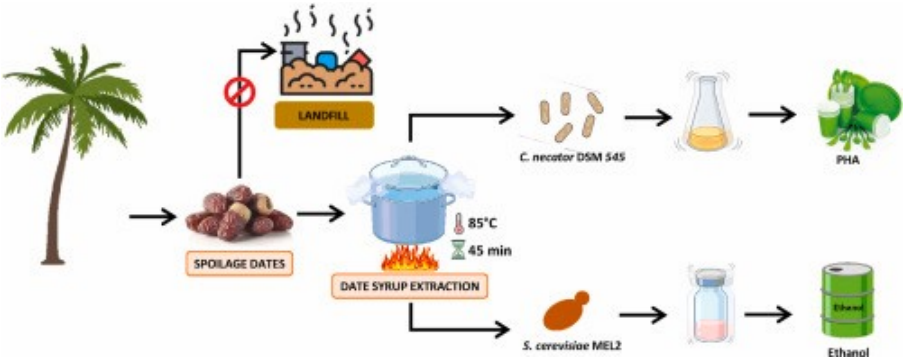
Abstract: In Tunisia, where approximately 550,000 date palms are recorded, their maintenance generates biomass that can lead to diseases harmful to the environment and date production. The valorization of this biomass is of great importance for environmental and economic reasons. Date waste is an attractive biomass that can be used as a carbon source for the growth of microorganisms to produce value-added products. In this research area on the valorisation of oasis waste, low-market-value date syrup, also known as date byproducts, has been tested as a carbon source for the production of polyhydroxyalkanoates (bioplastics: PHA) and bioethanol by Saccharomyces cerevisiae MEL2 and Cupriavidus necator DSM 545, respectively. Initial laboratory-scale results show a relative ethanol yield of 93.52%, equivalent to 47.95 g/L, and 79.20% (PHA weight per dry biomass mass), demonstrating that date waste can be utilized to obtain new biomolecules such as bioethanol and PHA, thus contributing to the development of a profitable exploitation of this waste with both economic and environmental benefits.

Keywords: Biomass, Bioethanol, Polyhydroxyalkanoates



Graphical abstract

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Fractional-order PID Controller based on Immune Feedback Law in a Smith Predictor Structure

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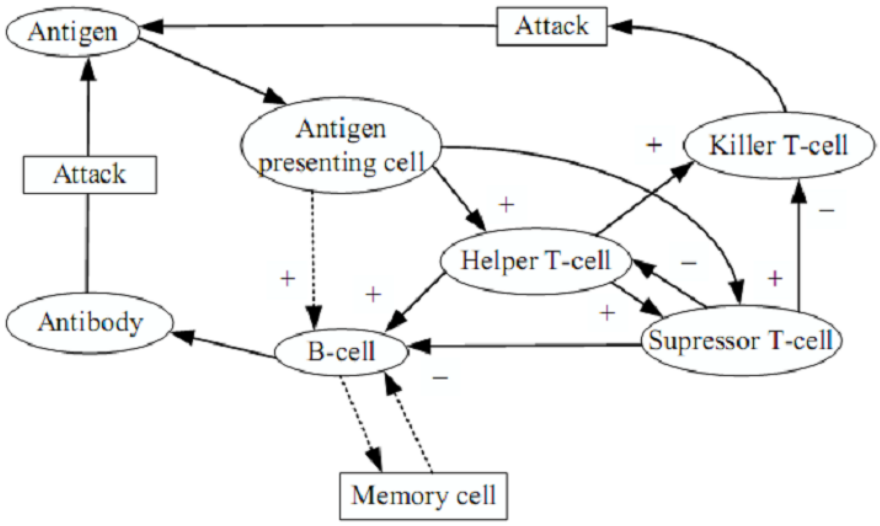
Abstract: Control of processes with time delays is crucial in process industries such as petrochemical, hydraulic, and manufacturing. This article presents a design control law based on the combination of fractional-order control (FOC) and computational intelligence (CI). We proposed a fractional-order PID (FOPID) controller based on bio-inspired immune feedback mechanism (IFM) are developed for controlling processes described as first order plus time-delay systems (FOPTD) in a Smith predictor (SP) structure. The advantages of using the fractional-order control is to take in consideration the non-integer parameters of the integration and derivative operators, and the use of immune feedback mechanism permit to add additional degree of freedom to the FOPID controller. Genetic algorithms (GAs) are used to determine controller parameters. The proposed technique has been validated by simulation in terms of dynamic tracking and disturbance rejection. A comparison with the most famous techniques based on FOC is presented to confirm the superiority and the validity of the proposed strategy.

Keywords: : fractional-order control, computational intelligence, optimization algorithms, control system design, time delay systems.



Immune system mechanism

Graphical abstract

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Effect of Doping with Various Elements on the Physical Properties of Gallium Oxide Thin Films

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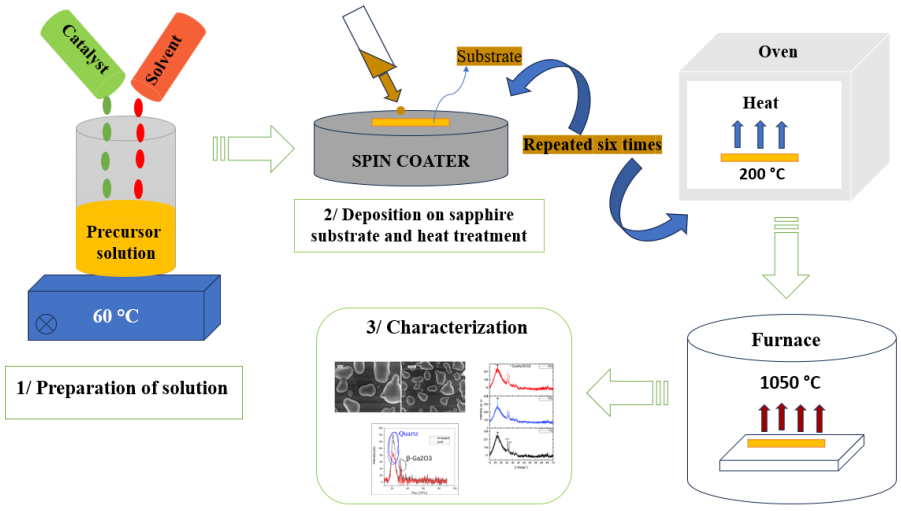
Abstract: This study investigates the effect of doping gallium oxide (?-Ga?O?) thin films with Sn, Zn, and Al on their physical properties. The thin films were successfully deposited using the sol-gel spin coating method, aiming to enhance the quality of pure ?-Ga?O? through elemental doping. Each element was incorporated separately at a 3% concentration. The structural, optical, and morphological properties of the films were analyzed. X-ray diffraction (XRD) results indicated no changes in the phase structure, though variations in crystallinity were observed. Energy Dispersive X-ray Spectroscopy (EDS) confirmed the elemental compositions of the doped films. UV-Vis spectroscopy revealed high transmittance values above 90%, along with bandgap modifications. Surface morphology, studied using scanning electron microscopy (SEM), displayed distinct surface features for each dopant. These findings demonstrate how elemental doping influences the physical properties of Ga?O? thin films, enhancing their potential for optoelectronic applications.

Keywords: Thin films, Gallium oxide, Doping, Characterization.



Graphical abstract

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Electrochemical behavior of AISI1080 steel in marine environment applications

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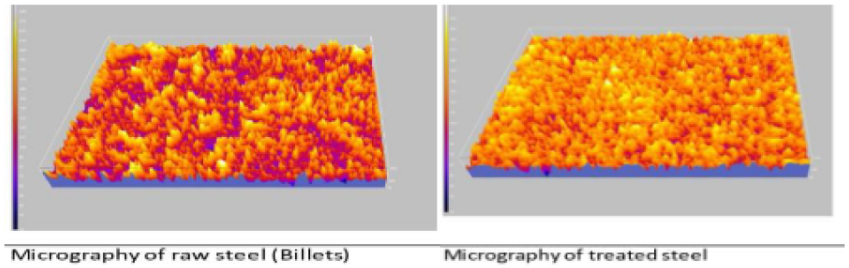
Abstract: Threaded rods are used in mechanical and metal structures for industrial applications. They are generally designed in steel to be subsequently heat treated to improve their performance when commissioning in the agro-exploitation structures. These rolled rods, have problems related to their low resistance to the various loads to which they are subjected during their commissioning corrosion (L. Jean-Paul 2009, A. Manfred 2006, A. Reynaud 2004). Thus, the goal of this work is to study the effect of the surrounding environment on intrinsic and electrochemical properties by seeking to optimize various treatments in order to improve the performance of these rods made of steel (G. Murry 2006). The results of the mechanical, microstructural and electrochemical investigations performed on the treated steel gave lower corrosion rates than those of the standard steel, thus indicating a higher resistance to corrosion since their use is in a corrosive environment that would facilitate the fall of their mechanical characteristics and to protect the natural resources (G. Murry 2000, H. Yanuar 2018, B. Buj?áková 2019).

Keywords: Rods Steel, agriculture structures, Corrosion, Microstructure.



Graphical abstract

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Influence of the prepration conditions on the copper oxide thin films via sol-gel (sping coating)

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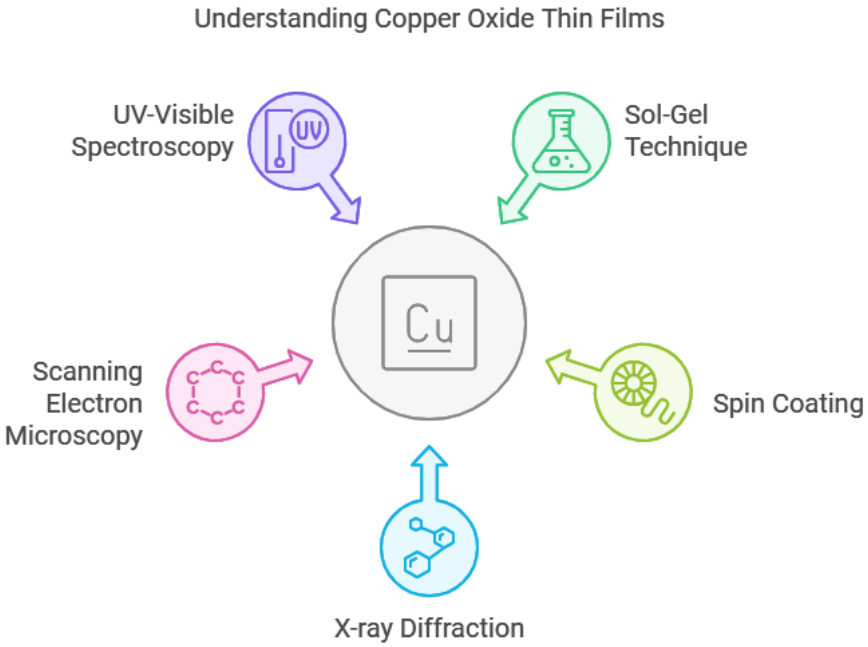
Abstract: The aim of this study is elaboration and characterization of cupric oxide thin films have been prepared on microscope glass substrate using sol-gel spin coating technique with different layers. To determine the physical properties of these films have been studied using different technique: the XRD showed that all samples it is polycrystalline and has monoclinic crystal structure, the SEM device results showed a homogeneous layer with less void space and pores for the 6 layer films compared to the other films also the UV-VIS device showed that the 6 layer films has high absorption in the visible region with decrease in the band gap from 4.1to 3.8 ev

Keywords: thin films, spin coating, copper oxide, physical properties.



Graphical abstract

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Artificial intelligence approach to extract I-V-T parameters of NiO/Ga2O3 heterojunction diode

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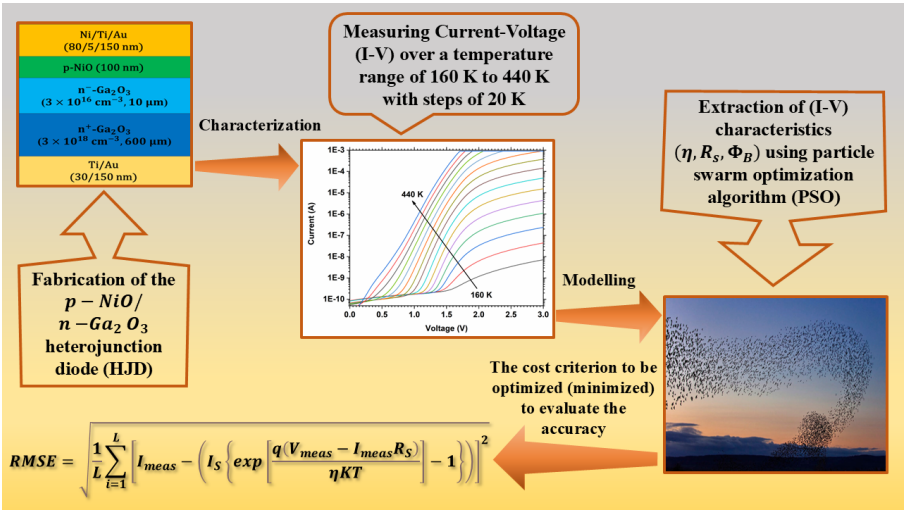
[2] *Micro-manufacturing Technology Platform, center for development of advanced technologies of Algiers, Algeria*

Abstract: NiO/Ga?O? heterojunctions exhibit unique electronic properties, making them promising candidates for next-generation optoelectronic and power electronic devices. This study presents an innovative approach to extracting the current-voltage (I-V) characteristics of NiO/Ga?O? heterojunctions across a temperature range of 160 to 440 K by employing the Particle Swarm Optimization (PSO) algorithm. The key parameters of the heterojunction diode, including the ideality factor (?), barrier height (?B) and series resistance (RS) were extracted. The ideality factor values exceed unity and exhibit a decreasing trend as temperature increases, and the barrier height increases with increasing temperature indicating inhomogeneity in the barrier. In this modelling, the HJD parameters extraction is considered as an optimization problem, in which the cost criterion to be optimized (minimized) is the root mean square error (RMSE), and it achieved a minimal value estimated to be on the order 10-11. The algorithm shows good robustness along a large number of running cycles, and also it shows rapid convergence.

Keywords: I-V characteristics, NiO/Ga2O3 heterojunction, Modelling, PSO.



Graphical abstract

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Effects of gravity on transient evolution of gas-liquid interface in capillary tube

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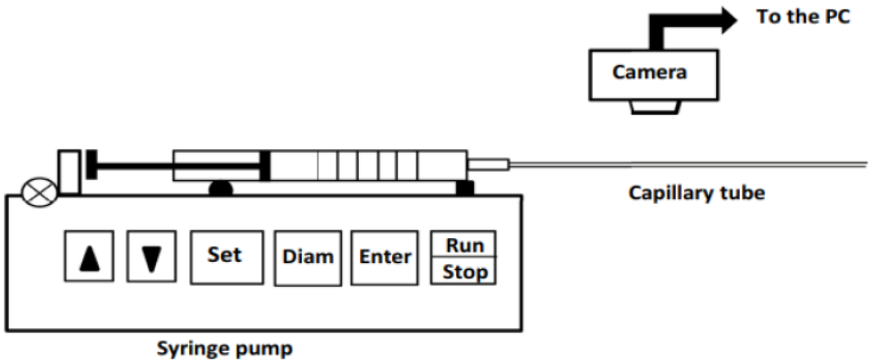
[2] *University of Gabes, National Engineering School of Gabes, LR18ES34, 6072 Zirig, Gabes, Tunisia*

Abstract: In this paper, we investigate the dynamics of the drainage of a transparent capillary tube (radius 0.4 mm). A non-wetting fluid (gas) displaces a wetting fluid (oil). The gas phase is continuously injected at an extremity of the capillary tube (inlet tube) at a constant injection-rate Qinj , ranging from 0.1 to 10 ml/h. Oil phase, initially filling the tube, leaves the system at the second opened extremity (outlet section). We consider in this work the compressibility of non-wetting fluid (gas), viscous forces in the liquid column, capillary forces and gravity. The effect of gravity, on the progress of the gas-liquid interface has been investigated. It is found that gravity forces cannot be neglected when studying the drainage in capillary tube.

Keywords: Two-phase flow, capillary pressure, capillarity, drainage, meniscus, gravity



Graphical abstract

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Prediction of Water Quality Index Using Machine Learning Models

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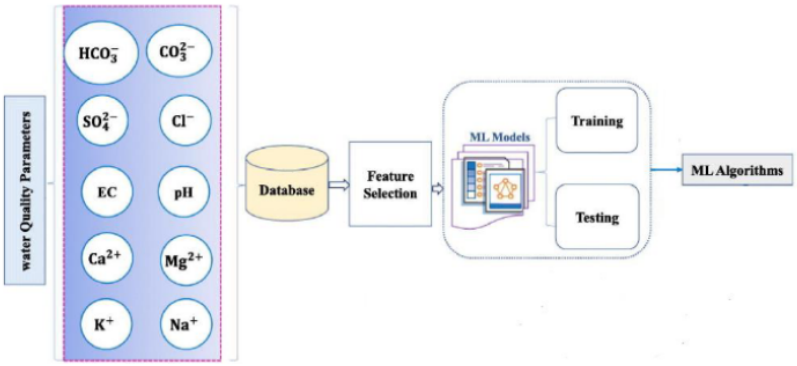
Abstract: Water quality is identically important as quantity in terms of meeting basic human needs. Therefore, evaluating the surface-water quality and the associated hydro-chemical characteristics is essential for managing water resources. Therefore, the present research was conducted to evaluate and predict water quality for agricultural purposes in Kebili, Tunisia. For that, the irrigation water quality index (IWQI) is predicted by using artificial neural network (ANN) model. The physicochemical parameters, such as turbidity, pH, EC, TDS, DO, K+, Na+, Mg2+, Ca2+, Cl?, SO42?, HCO3? and CO32?, were determined at 2 surface-water locations. The irrigation water quality index (IWQI) have mean value of 98.50. The findings revealed that ANN model is effective method for predicting irrigation water quality to assist decision plans.

Keywords: Irrigation, Water quality, ANN, IWQI.



Graphical abstract

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Intelligent control of a hybrid production system for electrical energy

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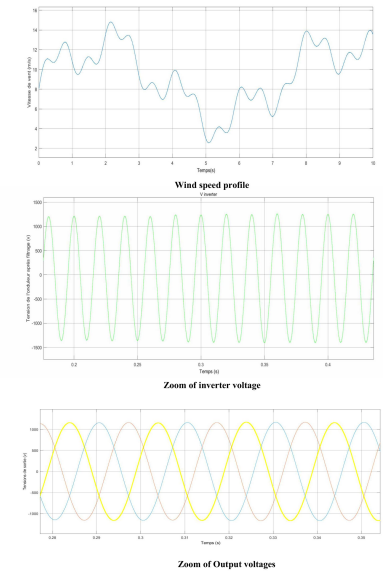
Abstract: Renewable energy resources, particularly solar and wind power are called upon to replace other fossil resources and nuclear power in order to meet environmental requirements such as greenhouse gases. Their great advantage lies in the fact that they are inexhaustible, non-polluting and well suited to decentralized production. However, solar and wind energy have a common drawback defined by their random nature and their dependence on weather and climate conditions. To remedy these difficulties, researchers approve the use of hybrid systems with the aim of combining several renewable energy sources. In this paper, a detailed modelling and simulation with MATLAB of a hybrid energy system (HES) is presented, which includes PV and Wind subsystems. The PV system consists of photovoltaic generator; DC/DC boost converter with MPPT command, the wind system contains a wind turbine with variable speed, a PMSG generator, an AC/DC rectifier and DC/DC boost converter. In order to optimize the energy efficiency of PV/Wind system, an intelligent MPPT control based on fuzzy logic control (FLC) is developed to reach and track the maximum power point MPPT, and smoothing the output fluctuation of the wind and PV power. Simulation for different scenarios under variable weather conditions, In case of absence of sun and wind; storage batteries are provided for emergency power.

Keywords: Hybrid energy system(HEC); Wind system; Photovoltaic system ;MPPT; Fuzzy Logic Control (FLC); PMSG; Wind-PV-battery system.



Graphical abstract

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Application of Stacked Autoencoder approach in SPIF process for springback prediction

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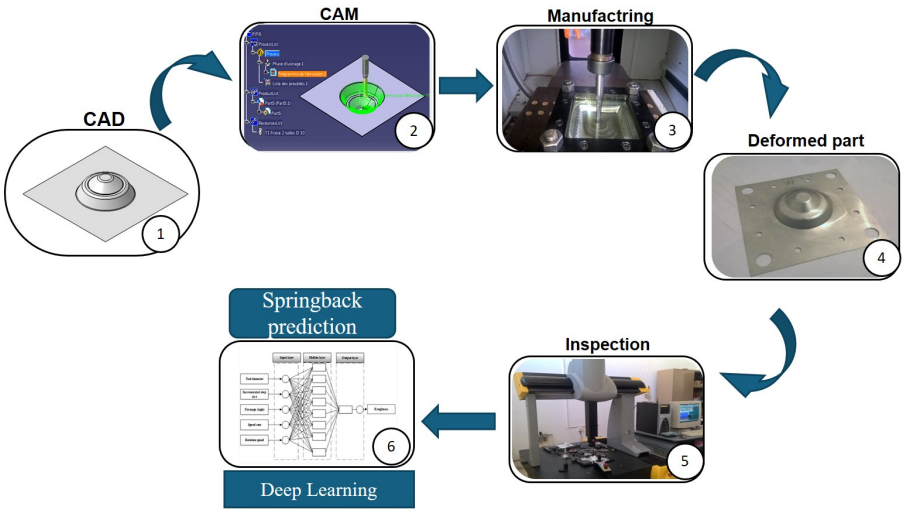
Abstract: In this work, a nonlinear neural network model based on deep learning was used for the geometric and dimensional accuracy prediction of the Single Point Incre-mental Forming (SPIF) process. A stacked autoencoder (SAE) network coupled with a backpropagation algorithm was chosen to predict the geometric precision of the parts. Geometric accuracy was presented by springback phenomenon. However, six parameters were selected as input factors: initial sheet thickness, tool trajectory, vertical increment, spindle speed, feed rate, and wall angle. A nov-el deep learning-based approach was proposed that includes both the feature ex-traction phase and the regression phase in a single model to predict geometric ac-curacy. The proposed approach combines the SAE with a back-propagation algo-rithm. Finally, the experimental findings demonstrate that the suggested approach achieves better prediction accuracy for springback, according to the correlation coefficient values R2 of 0.963.

Keywords: SPIF, Springback, SAE, Deep learning



Graphical abstract

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Prediction of Solar insolation and optimization of Photovoltaic systems using machine learning

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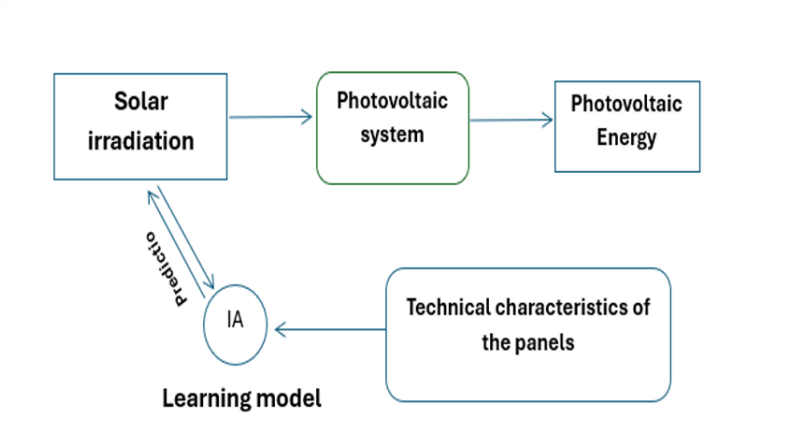
[3] *OASIS Laboratory, ENIT, Tunisia*

Abstract: In a context marked by the increasing global energy demand and the urgency to adopt sustainable solutions, this research focuses on predicting solar isolation and optimizing photovoltaic (PV) systems using advanced machine learning tech niques. We present here the results of an artificial intelligence (AI) model capable of predicting solar insolation over a given period while improving the efficiency of photovoltaic systems based on energy consumption. This model uses historical solar insolation data, as well as meteorological and environmental variables, to generate accurate forecasts of solar irradiation. The main objective of this research is to develop a robust predictive model for solar insolation while optimizing pho tovoltaic systems through machine learning techniques. We specifically aim to improve the accuracy of insolation forecasts over different time scales, whether hourly or daily, and to optimize the operational parameters of photovoltaic sys tems. This integrated approach will enhance the efficiency of photovoltaic systems and promote better integration of renewable energies into the electrical grid. To achieve these objectives, we will adopt a structured methodology in several steps, including data collection, modeling using machine learning algorithms, model validation through cross-validation techniques, and optimization of PV sys tems based on insolation forecasts. This innovative approach will not only allow for better planning of solar energy production but also make photovoltaic systems more efficient and suited to real needs, thus contributing to optimized management of energy resources.

Keywords: Solar insolation prediction, photovoltaic optimization, machine learn ing, solar energy, energy efficiency



Graphical abstract

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Numerical study of cooling process of gas turbine blade for several turbulent models

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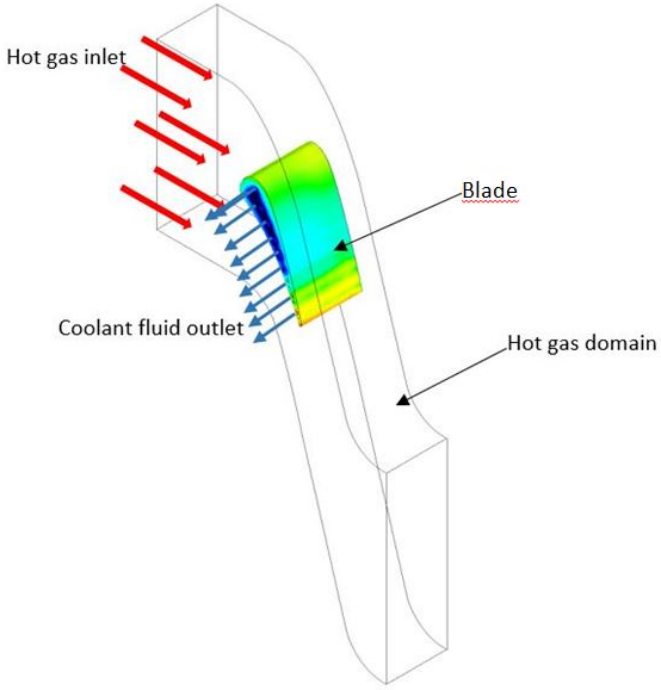
Abstract: In order to understand and master the cooling process of the blades of the high-pressure wheel of a gas turbine, we studied in this numerical work a blade model with ten holes distributed over the section of the dilution air passage. The three-dimensional model is placed in the path of the gases coming from the combustion chamber under very high temperature. Under the effect of the geometry and the operating conditions, the flow is turbulent. By means of Ansys-Fluent 16.0 we analyzed the dynamic, pressure and especially thermal fields for several turbulence models. Comparisons with recent works showed the accuracy and precision of our results. Finally, the Realized k-epsilon (RKE) model is recommended for this type of problem.

Keywords: turbine blade, cooling, turbulent flow, turbulence model



Graphical abstract

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Prediction of thickness variation in SPIF using Deep learning approach

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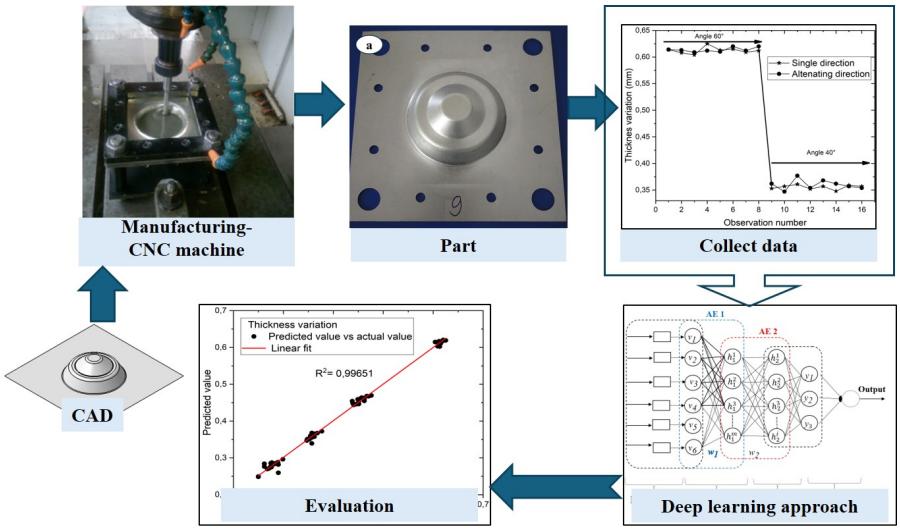
Abstract: Single point incremental forming (SPIF) is a promising sheet metal forming technology with high potential to shape complex three-dimensional parts. In the incremental forming of thin sheet metal, the thickness variation is a measurable value to control and validate the finished part. In this framework, a stacked auto-encoder (SEA) approach has been developed that predicts the value of thickness after the deformation of a double-truncated cone part. The determination of the thickness is mainly based on various input parameters: the tool path, initial thickness, the spindle speed, the feed rate, incremental step size, and the wall angle. The major goal of this research project is to develop a deep learning model to predict thickness variation. To estimate finished part quality, the data was collected and trained using supervised machine learning with a stacked autoencoder approach. With a Mean Absolute Percentage Error (MAPE) of 13.11, a Root Mean Square Error (RMSE) of 0.11, and a correlation coefficient R2 of 0.99, the SAE approach presents the best prediction

Keywords: Single Point Incremental Forming, Thickness variation, Deep learning, Stacked auto-encoder.



Graphical abstract

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Mechanical Properties of Compressed Earth Blocks with Wood Chip Additions

Tej El Moulouk Zayed [1] *, Aya Zoghlami [2], Brahim Mazian [2], Nihel Grich [1], Walid foudhil [1], Belgacem Dhifaoui [1], Sadok Ben jabrallah [1], Salah Mezlini [3], Pedro Augusto [2], Patrick Perre [2]

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[2] *CentraleSupélec, Laboratory of Process and Materials Engineering, European Center for Biotechnology and Bioeconomy (CEBB), 3 rue des Rouges, Terres 51110, Pomacle, France.*

[3] *d University of Monastir, National Engineering School of Monastir, Mechanical Engineering Laboratory, LR99ES32, 5019, Monastir, Tunisia*

Abstract: This paper presents an experimental study on the mechanical properties of locally sourced materials used in buildings. Construction, specially focusing on compressed earth blocks with incorporated wood chip. The study aim to valorize wood chips in the production of compressed earth blocks for their potential use in durable construction. To achieve this, bricks were manufactured by incorporating varying percentages of wood chips. Compressive strength tests revealed significant variations in the material's properties, with wood chips additions at levels of 0%, 1.23%, 2.47%, and 3.7%. Results showed that the addition of 1.23% wood chips improved compressive strength, while higher percentages (2.47% and 3.7%) gradual redused it. Further study on wood incorporation is essential, particularly to inderstand its influence on the internal cohesion. A better understanding of this mechanism is crucial for optimizing the mechanical performance of the blocks and ensuring effective interaction between the wood and the earth matrix.

Keywords: Mechanical Properties, Compressed earth blocks, Wood Chip fillers, Earth matrix.

Graphical abstract

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Structural and optical characterization of beta-gallium oxide for solar-blind ultraviolet photodetectors.

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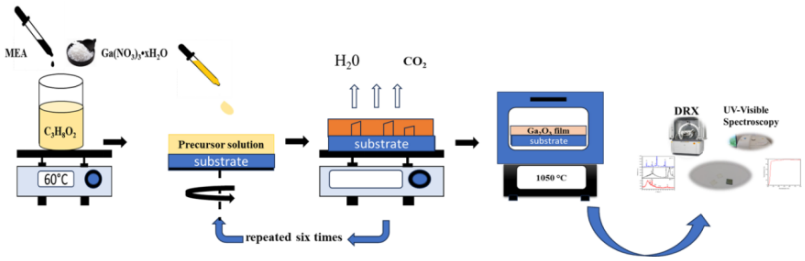
[1] *Laboratory of metallic and semiconducting materials LMSM, Mohamed Khider University, Biskra , Algeria*

Abstract: ?-Ga?O? thin films were successfully deposited on sapphire, quartz, and silicon substrates using a sol-gel spin coating method. This study aims to investigate the influence of different substrates on the properties of ?-Ga?O? thin films. The properties of the films were analyzed using various techniques, including X-ray diffraction (XRD). The highest transmission, nearly 100% in the visible spectrum, was observed for the ?-Ga?O? film grown on the sapphire substrate, which also had a band gap of approximately 5.4 eV as evaluated from UV-Vis spectrophotometry.

Keywords: ?-Ga2O3, spin-coating, sapphire substrate.



Graphical abstract

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Turbine blades cooling improvement by protuberances implementation along air circulating passages

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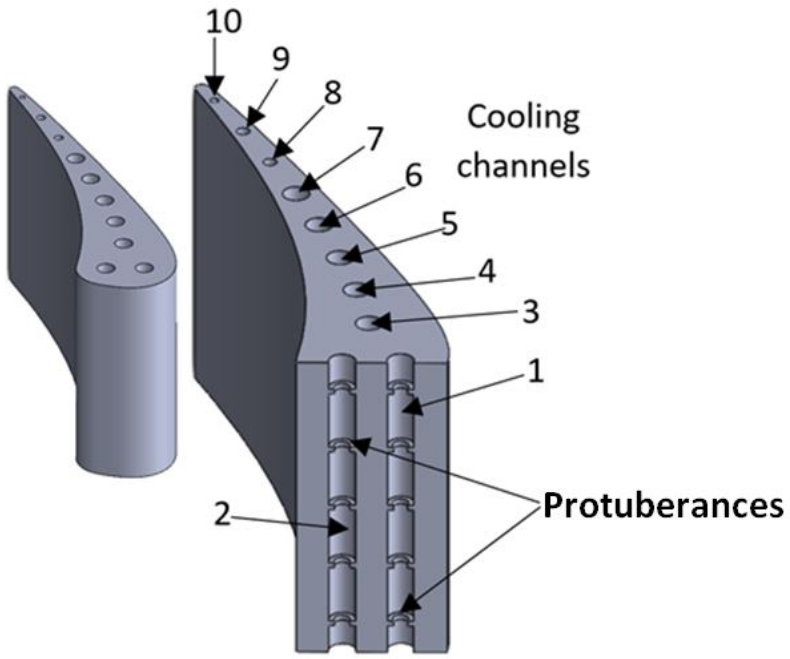
Abstract: Proper cooling of the blades of the high-pressure wheel of a gas turbine is essential and directly serves to resist the melting of their metal and thus to their longevity. In this simulation work under Ansys-Fluent 16.0, we tested the effect of placing protuberances in the dilution air passage ducts. Rectangular protuberances are considered. Different sizes (length/depth) are proposed, in addition to the assumption of different numbers of protuberances (ranging from one to five uniformly spaced grooves). Comparisons with the classical case currently used show the remarkable effect of protuberances on the cooling of the blade locally and globally. An optimal size is possible. The multiplicity of protuberances leads to excellent cooling of the entire blade. A compromise between size and number of protuberances is possible.

Keywords: turbine blades, cooling, protuberances



Graphical abstract

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Multi-objective optimization of surface quality and productivity in turning Stellite 6 cobalt al-loy using a hybrid SVR-GRA approach

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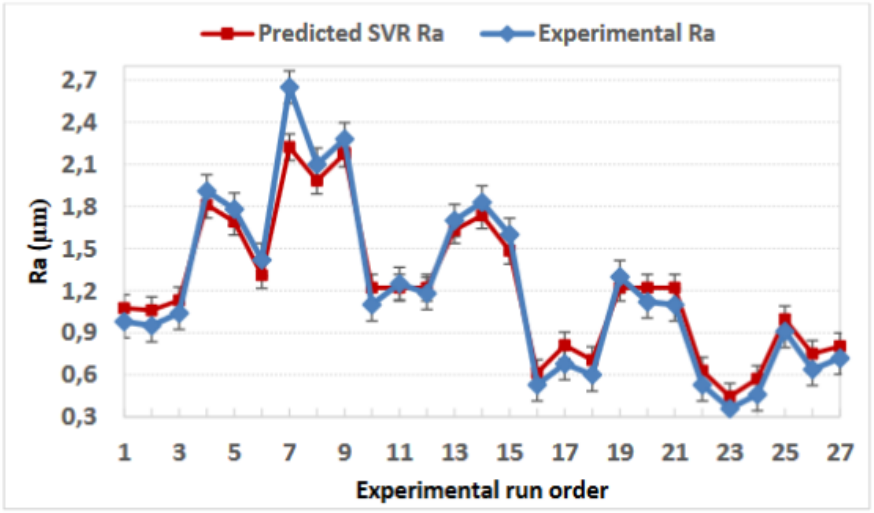
[2] *Mechanics and Structures Research Laboratory (LMS), May 8th 1945 University, P.O. Box 401, 24000 Guelma, Algeria*

Abstract: This paper proposes a hybrid model of the Support Vector Regression (SVR) and Grey Relational Analysis (GRA) to find significant parameters leads of the optimal surface roughness and material removal rate values of the Stellite 6 co-balt based-superalloy turning process. The parameters significant of the process parameters four in the turning, i.e. tool nose radius, cutting speed, feed rate and cutting depth, are to be evaluated using the GRA approach. Support vector re-gression (SVR) and Grey Relational Analysis (GRA) were exploited to highlight the performance of regression models and to find significant parameters affecting the process response factors. Optimization technique, based on a hybrid SVR-GRA approach, was then applied to find optimal combinations of cutting conditions to minimize surface roughness (surface quality) and maximize the material removal rate (productivity). The experimental results reveal that the most important ma-chining parameter affecting surface roughness is the feed rate followed by the tool nose radius. The Grey Relational Analysis (GRA) was used to optimize cut-ting parameters leading to a minimum surface roughness (Ra) and maximum re-moval rate (MRR).

Keywords: Stellite 6, Optimization, SVR, GRA, Surface roughness, MRR



Graphical abstract

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Prediction of surface roughness and tool flank wear during the turning process of Stellite 6 based on artificial neural networks

Riadh Saidi [1] *, Tarek Mabrouki [2], Salim Belhadi [2], Mohamed Athmane Yallese [2]

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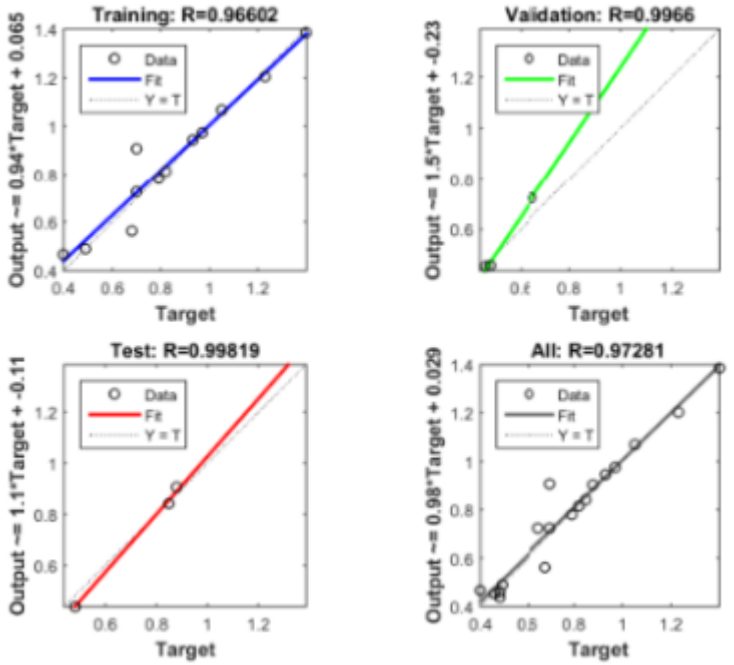
Abstract: This paper presents the development of a predictive artificial intelligence tech-niques (artificial neural networks (ANN)) as a robust alternative to traditional methods for predicting optimal machining parameters that minimize surface roughness (Ra) and tool flank wear (VBmax) during the turning of the Stellite 6 cobal-based superalloy. A real machining experiment is employed to evaluate the effectiveness of the proposed model in accurately predicting and optimizing sur-face roughness and tool flank wear. The results demonstrate a strong correlation between the predicted and experimental values, confirming the model's predictive accuracy.

Keywords: Stellite 6, Prediction, ANN, Surface roughness, tool flank wear, machining



Graphical abstract

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Evaluation of Machinability in Hard Turning of AISI 52100 Steel Using Statistical Techniques

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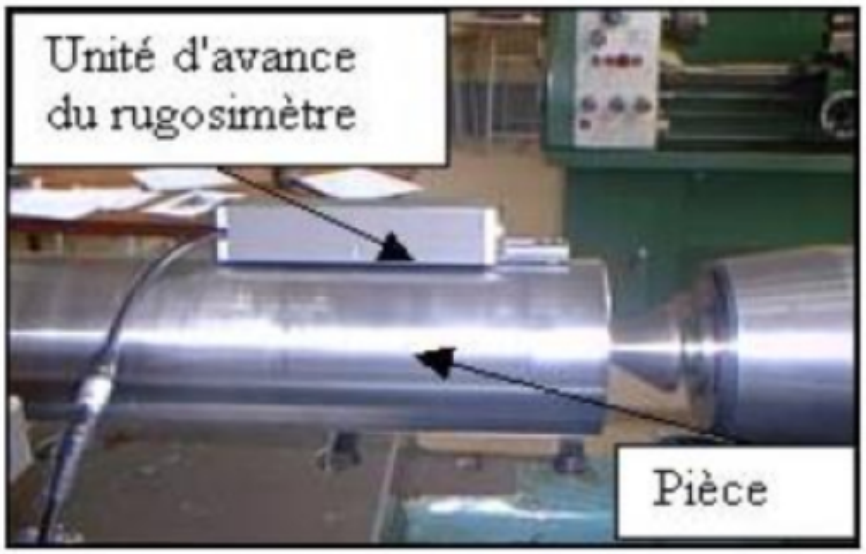
Abstract: The aim of this work is to study the effects of cutting conditions during the hard turning of AISI 52100 bearing steel using a coated carbide tool (GC2025). A Taguchi L16 experimental design was employed to investigate the impact of cutting conditions (cutting speed, feed rate, and depth of cut) on the output parameter through a statistical analysis based on ANOVA. The analysis of the results allowed for the development of a mathematical model to predict the output parameter, specifically surface roughness (Ra). Two optimization methods, the Taguchi approach (signal-to-noise ratio analysis) and the desirability function (DF), were used to determine the optimal combination that ensures the minimization of surface roughness (Ra) and the maximization of Material Removal Rate (MRR).

Keywords: Machining, Turning, AISI 52100 Steel, ANOVA, Roughness, RSM, Optimization.



Graphical abstract

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Optimization of welding process parameters for pulsed GTA welding of stainless steel sheets

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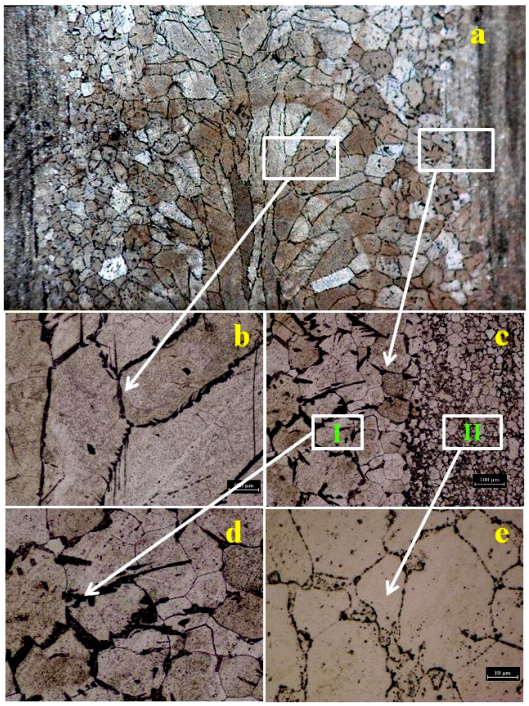
Abstract: In this work, the effect of pulse frequency on microstructure and mechanical behavior of AISI 430 ferritic stainless steel has been investigated. Microstructural examination shows sensitivity of the fusion zone (FZ) microstructure to the pulse frequency. Significant transition from coarse columnar grain to fine grain microstructure has been recorded when the pulse frequency is decreased from 6 to 1 HZ. The HAZ exhibited less sensitivity to the pulse frequency variation due to the slight grain refinement registered in this region. The mechanical behavior investigated through microhardness measurements and tensile test showed that optimal properties were obtained for pulse frequencies that are between 1 and 2 HZ.

Keywords: Ferritic stainless steels, GTA welding, pulse frequency, microstructure, mechanical behavior.



Graphical abstract

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Hydrodynamic characteristics of a new design for fixed OWC wave energy conversion device using spherical shapes

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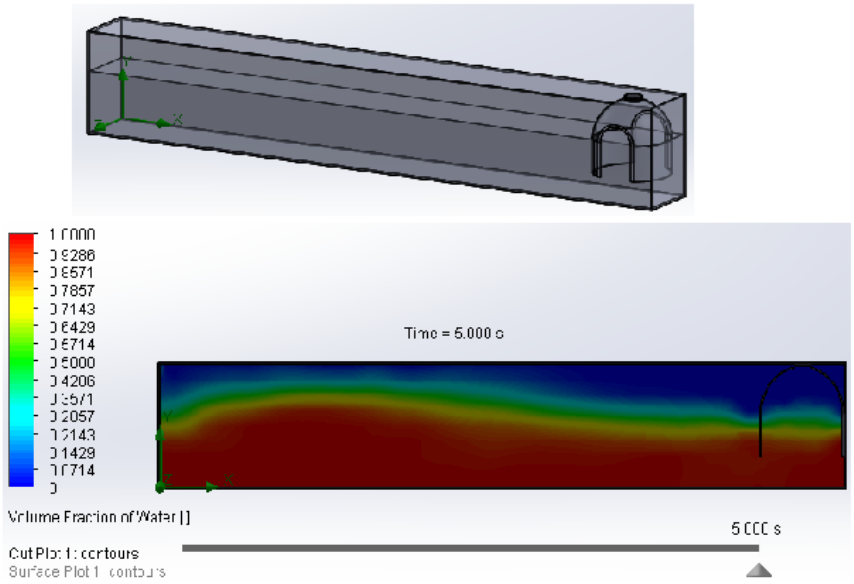
Abstract: Wave energies, and in particular oscillating water column (OWC) systems, repre-sent a promising source of renewable energy, offering many advantages in to-day's energy transition. They play a key role in diversifying green energy sources and securing power grids by complementing other renewable sources. In this con-text, a numerical study is developed in this work to predict the interaction of waves with a semi-submerged oscillating chamber. The effect of chamber shape on water and air flow performance has been performed. the simulation focuses on the effect of classical and spherical shapes on the structure's hydraulic and aerodynamic characteristics.

Keywords: Oscillating water column, numerical simulation, hydrodynamic performance, wave energies



Graphical abstract

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Shape Optimization and Control of Fluid Flow in Porous Media: A Brinkman Approach with Topological Sensitivity

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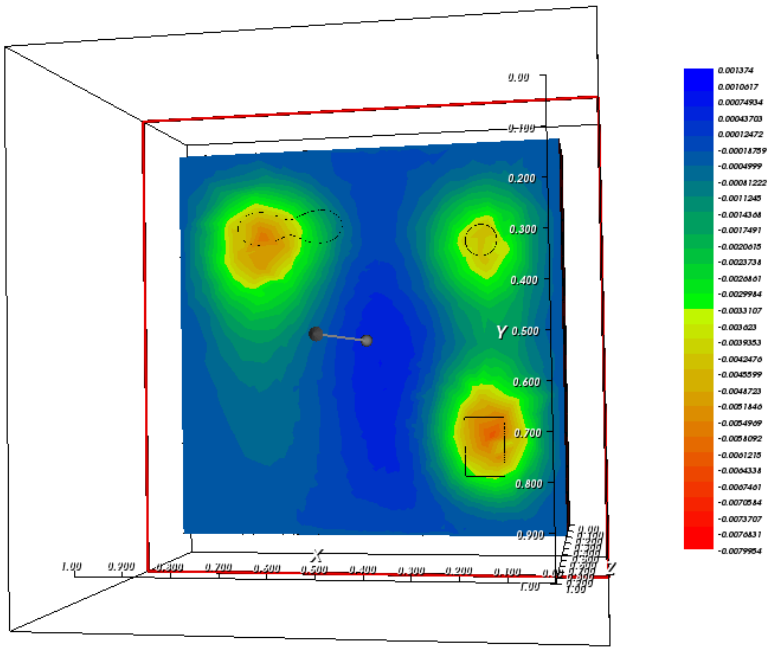
Abstract: We address a geometric inverse problem focused on detecting an elusive obstacle, denoted by ?, submerged within a bounded fluid flow domain ?, governed by the time-dependent Brinkman model. Our approach transforms the problem into an optimization task using a least-squares functional. We establish the well-posedness of an optimal solution to this optimization problem. To reconstruct the obstacle, we propose an efficient single-iteration algorithm based on the concept of the topological derivative.

Keywords: Porous media, Brinkman flow, Topological sensitivity.



Graphical abstract

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Thermal study of a car brake disc

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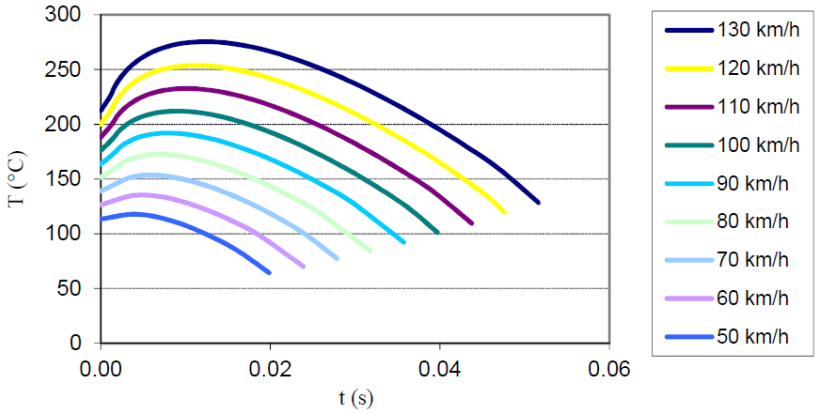
Abstract: This study aims to develop a calculation code necessary for the determination of the temperature field in the entire volume of a car brake disc. The three-dimensional calculations carried out in unsteady mode are based on the finite volume discretization method. In this paper, the emphasis is more specifically placed on the new resolution technique called sliding boundary condition technique, which allowed us to take into account the temporal variation of the pad-disc contact area by assuming that this contact gives rise to a sliding heat flux varying as a function of time and angular pitch. The results obtained by this technique are related to the study of the influence of the braking parameters variation such as initial speed, acceleration, vehicle mass, and air in the contact surface.

Keywords: Disc brake, thermal study, sliding boundary condition, braking parameters



Temporal evolution of the temperature in the zone of contact (influence of the initial speed)

Graphical abstract

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CFD simulation of Solar Air Heater equipped with a curved restriction zone in turbulent flow

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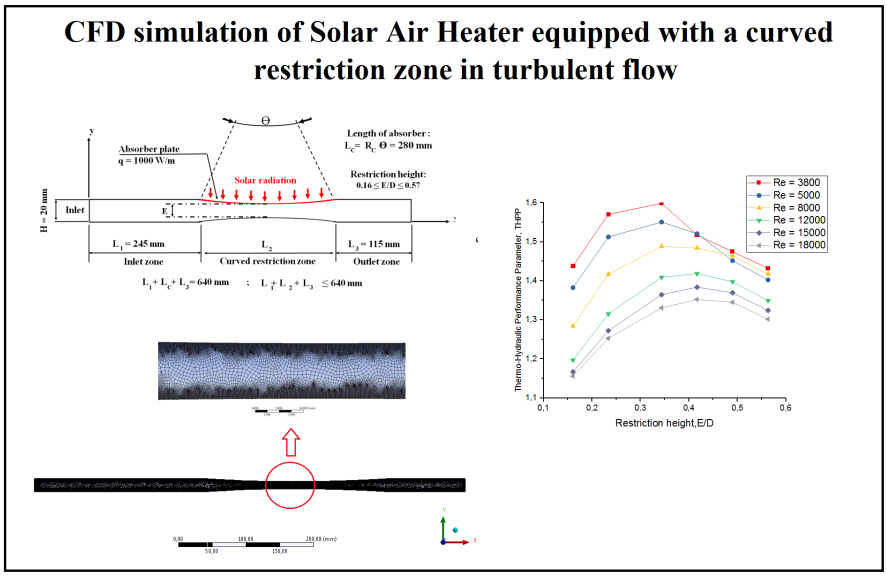
Abstract: The current study conducts a CFD study of the thermal and flow char-acteristics within a solar air heater designed with a curved flow passage that in-corporates a restriction zone. Typically, solar air heater collectors exhibit low thermal efficiency and limited heat transfer in turbulent conditions. The restriction zone here is created by incorporating double curved walls in the test section. This innovative configuration aims to enhance heat transfer by accelerating airflow near the restricted area, especially along the heated curved surface. Secondary flows generated after the constriction improve thermal performance by enhancing air mixing. ANSYS Fluent 15.0 and the turbulence model of RNG k–? were em-ployed to resolve the transport equations for dissipation rate and turbulent kinetic energy. Various geometric and operational parameters were examined, such as the restriction depth (E/D) within the variety of 0.16 to 0.57, along with Reynolds number (Re) fluctuating starting from 3,800 to 18,000. The impacts of these spe-cific parameters on number of Nusselt (Nu), friction factor (fr), and the Thermo-hydraulic performance parameter (THPP) were analyzed. The maximum comput-ed THPP was achieved at 1.6 with a restriction height of E/D = 0.34 at Re = 3,800.

Keywords: Curved restriction zone, SAH, Friction factor, Nusselt, THPP.



Graphical abstract

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Predictive model for evaluating and optimizing the performance of a Solar Panel using machine learning

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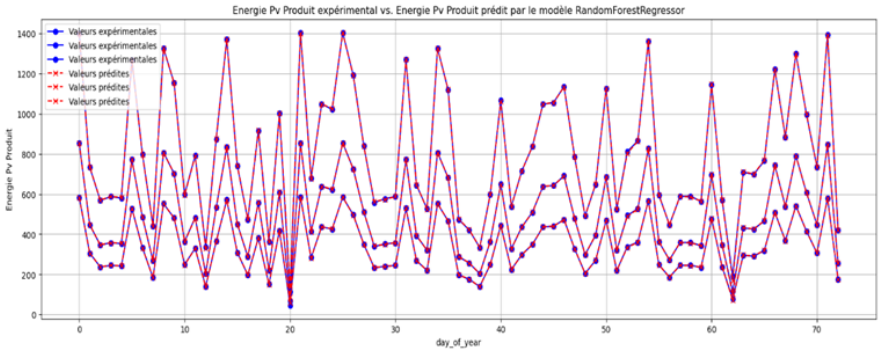
[2] *Laboratory of Electromechanical Systems (LASEM), National Engineering School of Sfax, University of Sfax, Tunisia*
[3] *Research Laboratory of Mechanics, Modeling and Manufacturing, National Engineering School of Sfax, University of Sfax, Tunisia*

Abstract: Among the various sources of renewable energy, solar energy stands out for its unlimited potential and its low environmental impact. However, optimizing the performance of solar panels remains a major challenge, influenced by a multitude of environmental and technological factors. This study focuses on the development of a predictive model to evaluate and optimize the performance of solar panels, using advanced machine learning techniques. The main objective is to develop accurate and efficient methods to predict the energy production of solar panels and thus improve their performance according to specific environmental conditions. Different models and machine learning algorithms (linear regression, polynomial regression, Random Forest, and Gradient Boosting Regressor) were exploited to achieve temperature classification and solar radiation prediction and solar energy produced prediction. The results show that both Gradient Boosting and Random Forest Regressor models provide exceptional performance for PV power generation prediction. Gradient Boosting, in particular, displays slightly better metrics, with very low MSE, near-perfect R^2, and extremely low MAPE, making it the best model among those tested.

Keywords: performance of solar panels, predictive model, machine learning techniques, solar radiation prediction



Graphical abstract

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A new hybrid model for assessing the reliability of periodic structures

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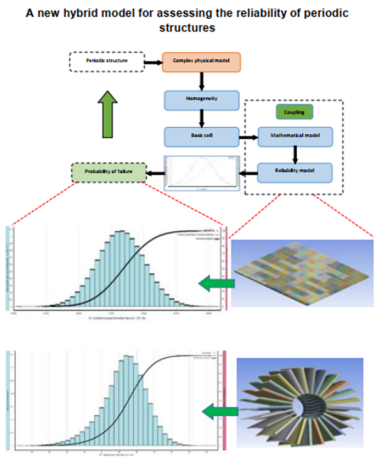
[2] *National Higher Engineering School of Tunis, University of Tunis – Tunisia*

Abstract: This study aims to improve safety and decision support for complex periodic structures by developing an efficient and robust numerical modelling method. Fi-nite element modelling of these structures raises challenges related to the size of the models. To remedy this, we exploit the periodicity assumption, which consid-erably reduces the complexity of the calculations. By focusing on a single basic cell, we can study the vibratory behaviour of the entire structure while keeping sufficient accuracy. Characterising vibration behaviour is essential for assessing the reliability of structures regarding different failure scenarios (e.g. fatigue, shock, etc.). Realistic numerical modelling coupled with probabilistic analysis can be used to quantify the probability of failure and identify critical zones. We compare the results obtained with Monte Carlo method to validate the robustness of our approach and to highlight the major gain in calculation time that it offers

Keywords: Periodic structures, reliable model, basic cell, Periodic structures, realistic modelling



Graphical abstract

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Comparative Analysis of the Impact of Cast Brass Quantity on the Thermal Fatigue of Shot Sleeves in High-Pressure Casting

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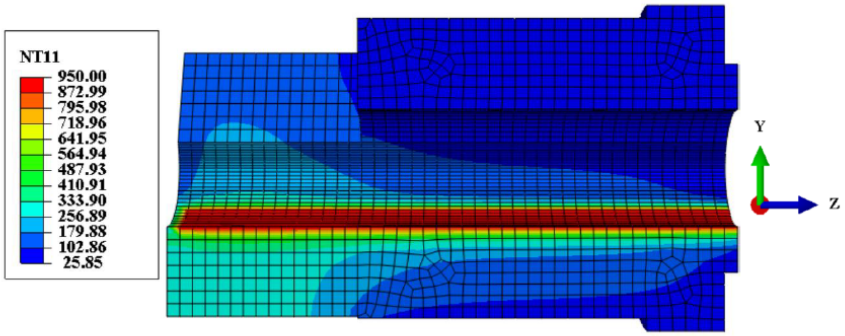
Abstract: A failure investigation analyzed the thermal fatigue processes of a shot sleeve made from AISI H10 tool steel used in brass die casting. During opera-tion, the shot sleeve endures heating and cooling cycles, reaching tempera-tures between 320°C and 950°C at its molten brass contact surface. Examina-tion of the damaged sleeves revealed a network of cracks on the internal sur-faces, suggesting thermal fatigue as the primary failure cause. To validate these findings, a numerical simulation was conducted using 3D thermal modeling with Abaqus® software. The thermal calculations were con-firmed through experimental measurements from an operational shot sleeve. The study compared the temperature distribution when melting 2 kg and 500 g of brass at 950°C, aiming to understand how the quantity of cast material af-fects temperature distribution, thereby supporting the investigation's conclu-sions.

Keywords: Shot sleeve/brass-die casting/ Finite element Analysis / Thermal calculation/ cracks network.



Graphical abstract

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Exploring the Kolmogorov-Arnold Network for Modeling Carbon Dioxide Emissions from In-ternal Combustion Engine Vehicles

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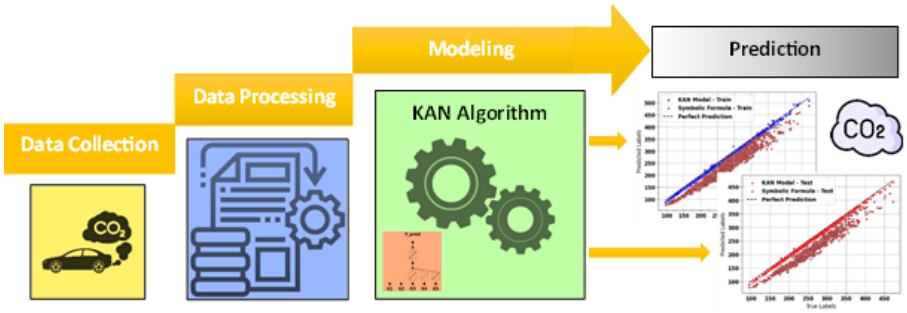
Abstract: The accurate prediction of CO2 emissions from internal combustion engine vehi-cles is essential for reducing environmental impact and meeting strict emission regulations. This study introduces the Kolmogorov-Arnold Network (KAN) as a recent alternative to the Multi-Layer Perceptron (MLP) for the predictive analysis of CO2 emissions from conventional vehicles. An exploratory data analysis was initially conducted, followed by a detailed description of the Kolmogorov-Arnold Network architecture and the selected model configuration. The study findings were then presented and analyzed in terms of performance and accuracy. This new approach provided improved performance in both prediction accuracy and computational efficiency, achieving a mean absolute error (MAE) of 7.4250 for the training phase and 7.3404 for the testing phase. The coefficient of determina-tion (R^2) was found to be 0.9823 for training and 0.9827 for testing. Furthermore, the performance metrics obtained by the suggested symbolic formula closely aligned with those obtained from the KAN model.

Keywords: Carbon Dioxide, Conventional Vehicles, Predictive Analysis, Kolmogorov-Arnold Network.



Graphical abstract

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Impact of heat treatments on the mechanical properties of 6061 T4 and T6 alloys

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Abstract: Heat treatment can have a significant impact on the mechanical properties of 6061 alloy, a versatile and widely used material known for its excellent mechanical properties and corrosion resistance. This study explores the ef-fects of various heat treatment processes, including solution heat treatment and aging, on the tensile strength, yield strength, and hardness of aluminium alloy 6061, focusing on the two most common conditions: T4 and T6. The findings demonstrate that heat treatment markedly enhances the mechanical properties of 6061 aluminium, with T6 treatment resulting in notable im-provements in yield strength and micro-hardness. However, T6 treatment also leads to a 50% reduction in ductility compared to T4, causing tears and cracks during folding operations on T6 samples. Additionally, the study identifies the optimal balance between economic efficiency and mechanical perfor-mance, pinpointing a treatment duration of 1 hour at 204°C as ideal.

Keywords: aluminum 6061, heat treatment, T4, T6, mechanical properties.

Graphical abstract

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Statistical Modeling of Combined Electrical Energy Consumption for Fully Electric Vehicles via the Kolmogorov-Arnold Network

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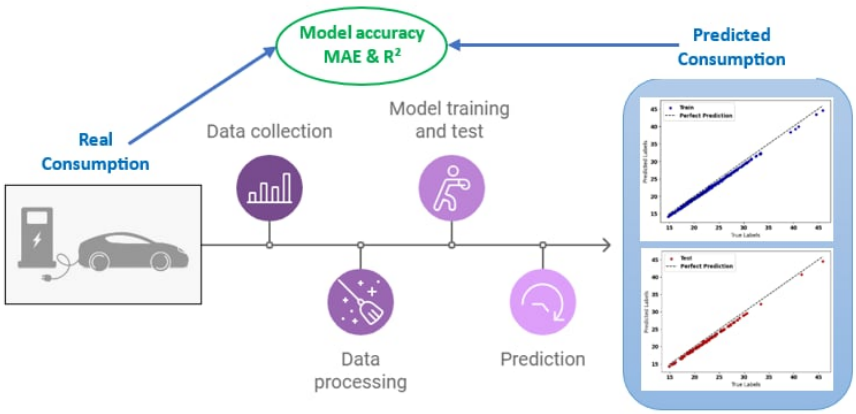
[2] *Energy and Thermal Systems Laboratory, National Engineering School of Monastir, University of Monastir. Ibn El Jazzar Street 5019 Monastir, Tunisia*

[3] *Micro-optoelectronics and nanostructure Laboratory, Faculty of Sciences of Monastir, University of Monastir. Environment Street 5019 Monastir, Tunisia*

Abstract: Electric vehicle technology is seen as a highly promising alternative to conven-tional vehicles. Understanding and managing the energy consumption of electric vehicles becomes a crucial advantage during the design phase, allowing for the optimization of both range and energy efficiency. The advent of artificial intelli-gence algorithms has enabled the prediction of energy consumption in electric ve-hicles by leveraging their technical specifications. This research focuses on model-ing and predicting the combined electrical energy consumption of electric vehicles through a novel methodology based on the Kolmogorov-Arnold network. This in-novative approach significantly enhanced both prediction accuracy and compu-tational efficiency, yielding a mean absolute error (MAE) of 0.7912 on the train-ing dataset and 0.7766 on the testing dataset. Likewise, the coefficient of deter-mination (R^2) reached 0.9712 for training and 0.9715 for testing. Furthermore, the performance metrics derived from the proposed symbolic formula closely matched those produced by the Kolmogorov-Arnold Network model.

Keywords: Electric Vehicles, Energy Consumption, Prediction, Kolmogorov-Arnold Network.



Graphical abstract

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Evaluating the Efficiency of Double Finned Trombe Wall Through Transient 3D CFD Simulations

Nessrine Essid [1] *, Zouhayar Al adel [1]

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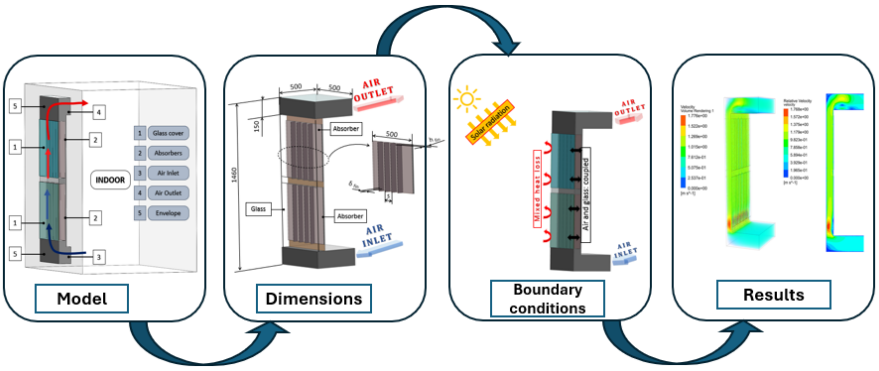
Abstract: Achieving thermal comfort in buildings is essential for human well-being, but often comes with high energy consumption. Utilizing solar energy for building heating is a sustainable approach, with Trombe wall (TW) systems offering an eco-friendly solution. This study aims to improve TW system efficiency by investigating the impact of adding fins to the solar radiation absorber. Addressing gaps in existing literature, a novel transient 3D computational fluid dynamics (CFD) model is proposed to analyse the daily thermal behaviour of a Trombe wall with double finned absorbers. Turbulence is simulated using the k-omega model, while experimentally measured solar radiation intensities are integrated using the Discrete Ordinates model. The transient analysis reveals that adding fins creates air vortices, resulting in a lower pressure zone and non-uniform air velocity in the exit air vent. The proposed configuration enhances heat transfer inside the TW channel, leading to outlet air temperatures up to 53°C at noon. This study confirms the effectiveness of utilizing prismatic vertical fins to enhance TW system performance, with minimal additional investment costs.

Keywords: Trombe wall, Energy, CFD, Transient.



Graphical abstract

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Modeling and Control of a Grid-Connected Photovoltaic System

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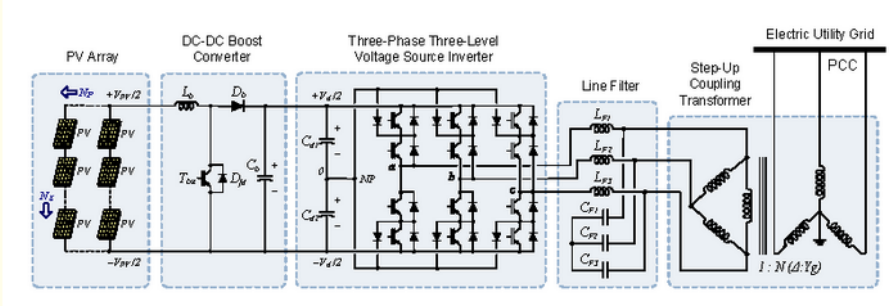
[2] *Department of Electrical Engineering, University of ghardaia 47000 ghardaia, Algeria*
[3] *Department of Electrical Engineering, University of M'sila 28000 M'sila, Algeria*

Abstract: In this article, we'll be looking at the modeling and control of a grid-connected photovoltaic system with the aim of extracting maximum power with the MPPT method from the PV field and injecting it effectively and efficiently into the grid. We'll start by detailing the operating principle of the boost chopper, its PWM control, and its average mathematical model. Next, we'll give a detailed presentation of the two most common methods for tracking the point of maximum power. This is followed by a detailed study of NPC-type three-level voltage inverters. The structure, operating principle, modeling, and control using the SVM (Space Vector Modulation) control of these topologies will be considered. Finally, the mathematical model of the complete system in the (abc) frame of reference as well as in the (d, q) frame will be developed. The control of the DC bus and AC-side currents using PI-type controllers will also be discussed. The performance of this system employing the proposed control approach is proven using MATLAB/SIMULINK simulation results. The simulation results show that the proposed system control is very satisfactory.

Keywords: photovoltaic, NPC, SVM, MPPT



Graphical abstract

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PI Controller Optimization Based on PSO and BBO for Quadruple Tank System

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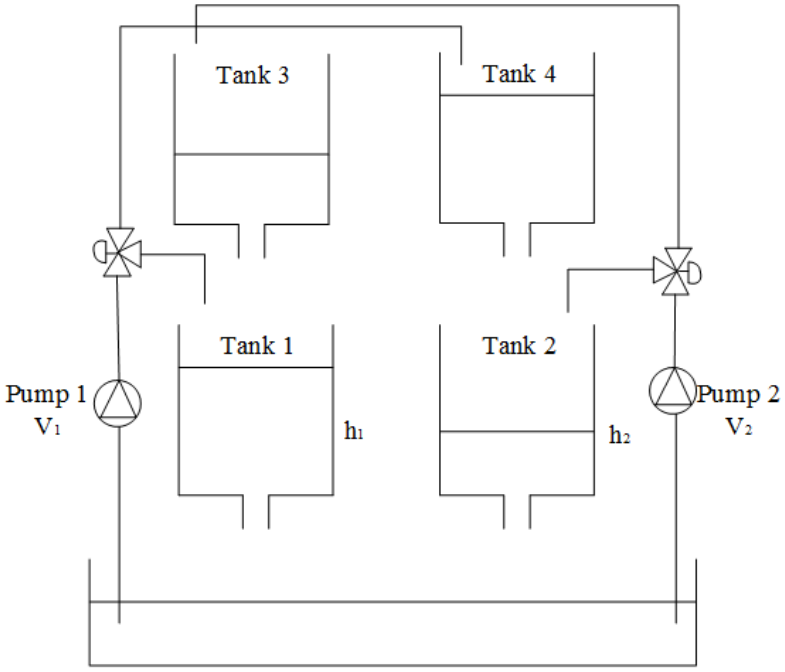
Abstract: We propose in this paper a PI controller for Quadruple Tank System (QTS) in which we employ two bio-inspired optimization methods: Particle Swarm Optimization (PSO) and Biogeography Based Optimization (BBO) in order to adjust the parameters of the PI controller (kp, ki) to enhance the capability of traditional PI. Simulation results have confirmed both the effectiveness of the proposed control methods and the advantages of the optimized PI controller.

Keywords: Quadruple Tank System, PI controller, Particle Swarm Optimization, Biogeography Based Optimization.



Graphical abstract

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Characterization and FEM-SPG Modeling of Bonded Composite Assemblies

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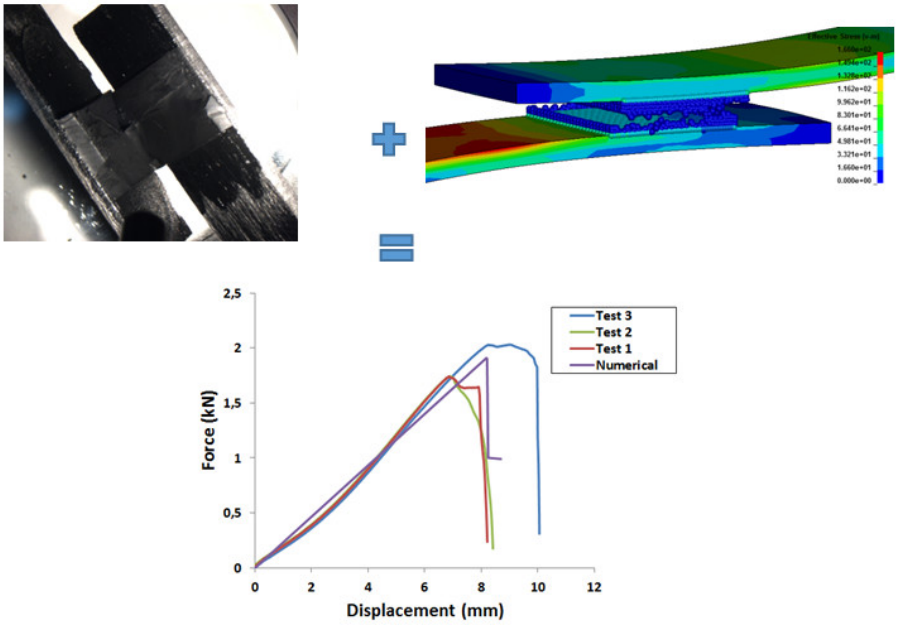
Abstract: The lightweighting of metallic structures has made significant advances with the integration of composite materials, recognized for their promising properties across various industrial sectors. However, this integration poses technical challenges related to assembly processes. Unlike traditional welding and riveting techniques suited for metals, composites require bonding solutions. In this study, single lap shear tests were conducted to evaluate the performance of adhesive joints between composite parts. The assembly consists of substrates made of glass fiber-reinforced thermoplastic polyamide 6-6, bonded with a flexible polyurethane adhesive. A numerical model was developed using LS-DYNA, incorporating a coupling between the Finite Element Method (FEM) for composite substrates and the Smoothed Particle Galerkin (SPG) method for the adhesive discretization. The results show a good correlation between the numerical model and experimental data, thus validating the effectiveness of the FEM-SPG coupling in simulating fracture in composite assemblies.

Keywords: Composite Materials, FEM-SPG Coupling, SLJ Shear Tests, Adhesive Bonding.



Graphical abstract

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Exploring Ovalbumin-PSSMA Complex Formation via IDLS

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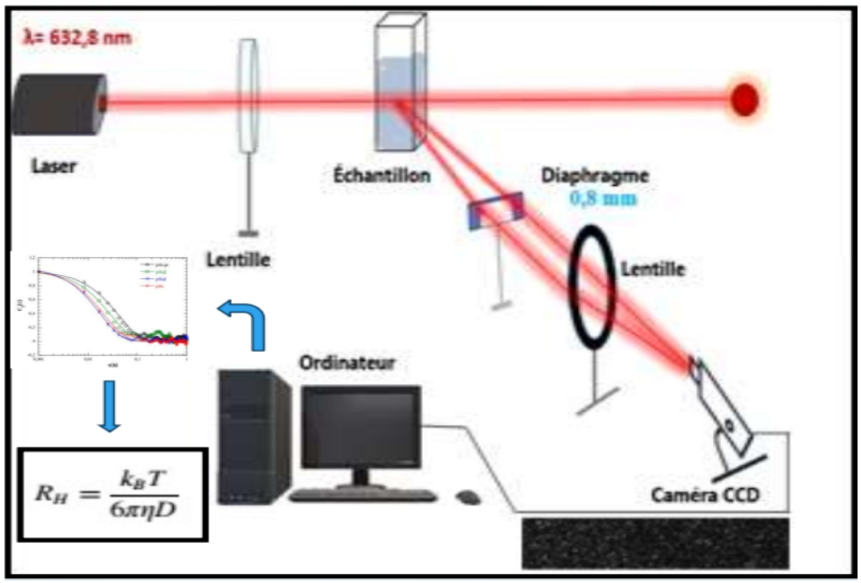
Abstract: In this work, we focus on the analysis of the Ovalbumin-PSSMA complex, which relies on the formation of coacervates using various methods, including UV-visible spectroscopy and Image-Based Dynamic Light Scattering (IDLS). Turbidity has been precisely from spectroscopy employed to identify the critical pH values for complex formation (pHC, pH?1, pHopt, and pH?2). Simultaneously, the IDLS technique has been used to thoroughly examine the g2(t) correlation and the size of the coacervate droplets, rich in proteins and poly electrolytes, within the liquid-liquid phase separation. These analyses reveal that the growth of coacervate droplets is attributed to attractive electrostatic interactions within the complex.

Keywords: polyelectrolyte, protein, complex, PSSMA (sodium salt of poly (4-styrene sulfonic acid-co-maleic acid)), Ovalbumin, turbidity, IDLS (Image Dynamic Light Scattering).



Graphical abstract

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An Assessment of Irrigation Water Quality, Southern Tunisia

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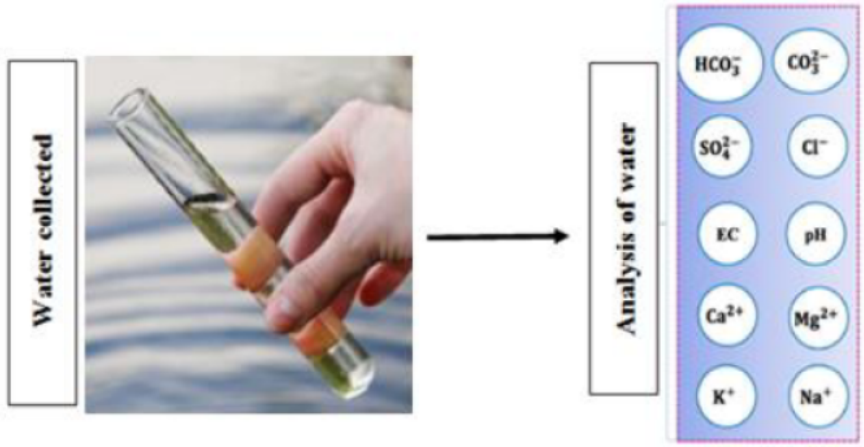
Abstract: Water derived from agricultural drainage systems may be repurposed when its quality meets acceptable standards or when it is mixed with water from irrigation canals to mitigate water scarcity. The principal objective of this investigation was to assess the quality of surface drainage water for potential reuse in irrigation practices. The evaluation of water quality was conducted within a laboratory setting. Two distinct water samples were procured and subjected to analysis for the predominant cations (Na+, Ca2+, K+, and Mg2+) and anions (HCO3?, CO32?, Cl?, and SO42?). Parameters such as turbidity, total dissolved solids (TDS), pH, electrical conductivity (EC), and dissolved oxygen (DO) were measured. The findings from the drainage water quality index assessment, in accordance with the established water quality index for irrigation applications, exhibited a range from 42.4 to 79.8. This range signifies that the adequacy of drainage water for irrigation applications is classified as ‘poor to very poor’. Consequently, to mitigate adverse effects on soil quality for agricultural production resulting from the risks associated with substandard agricultural drainage water in irrigation, it is imperative that such water undergoes treatment prior to its reuse for irrigation purposes.

Keywords: Drainage water, irrigation water quality, water quality index, irrigation reusse.



Graphical abstract

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Effect of LPG and hydrogen as alternative fuels on spark-ignition engine performance and emissions; thermodynamic analysis

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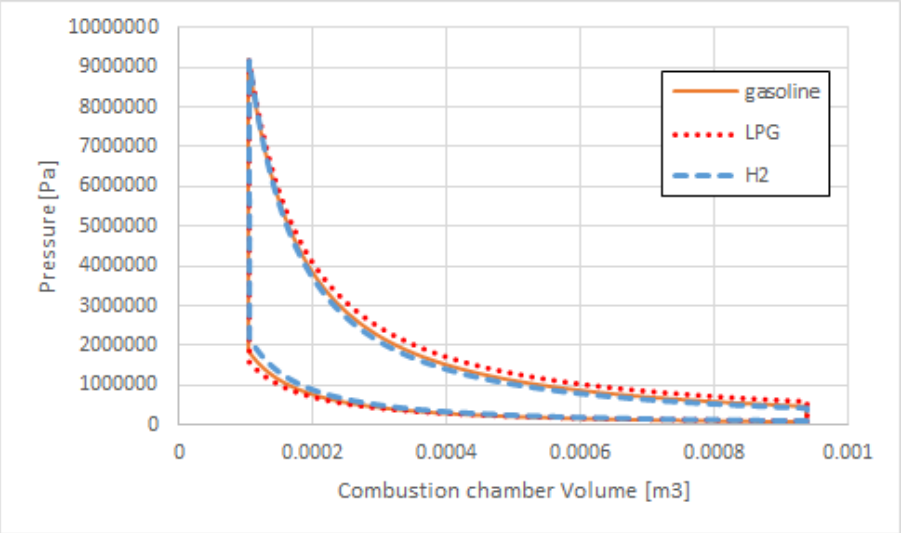
Abstract: Alternatives fuels used by internal combustion engines (ICEs) have po-tential for higher efficiency compared to conventional fuels, as gasoline, due to the higher possible compression ratios, the lean operation reducing exhaust losses and the lower overall entropy generation due to the lack of hydrocarbon products. Thermodynamic analyses of these gas-fueled engines, helping to identify the en-gine's mechanical and energy performance and its emissions. This paper reports on the thermodynamic features of a CLIO2 naturally aspirated spark-ignition, 9.7 compression ratio engine for automotive applications, fueled by gasoline, lique-fied petroleum gas (LPG) and hydrogen (H2). Three air-fuel mixtures were used: air-gasoline, air-LPG and air-H2. Cycle-by-cycle variations in cylinder pressure and emissions were analyzed as representative indicators of combustion quality. It was found that the use of hydrogen improved combustion and engine performance

Keywords: IC engine, hydrogen, LPG, thermodynamic analysis



Graphical abstract

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CFD study of roughened curved restriction zone used in a solar air heater under turbulent flow

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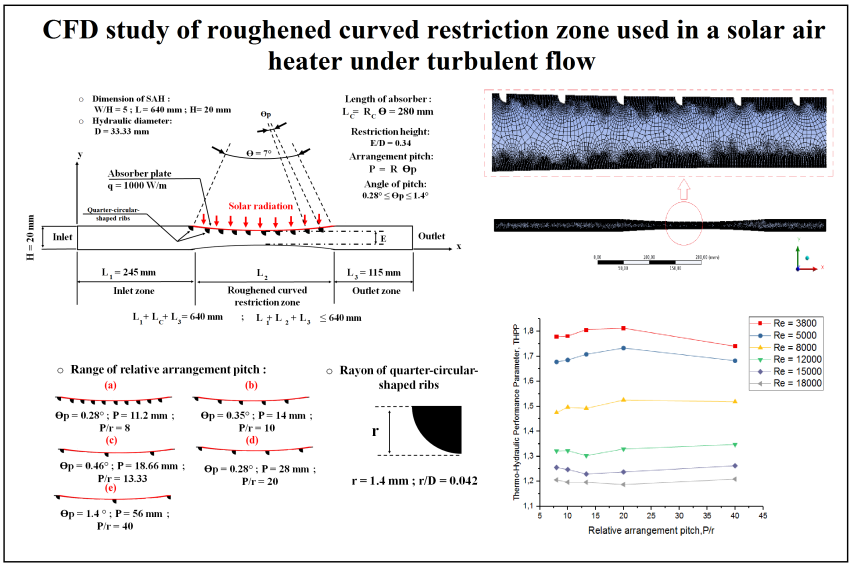
Abstract: The incorporation of a roughened, curved restriction zone in a solar air heater, achieved by arranging ribs along the curved absorber surface, can be regarded as an innovative design enhancement aimed at boosting the collector's perfor-mance. In our research, a numerical examination has been showed to evaluate the thermo-hydraulic efficiency of roughened curved restriction zone in SAH hav-ing different relative arrangement pitch (r/D) of quarter-circular-shaped roughness in which its values varied from 8 to 40. The CFD analysis has included different Reynolds numbers varied from 3800 to 18000, fixed relative height of roughness (r/D) of 0.042 and restriction height of tested zone (E/D) of 0.34. To find the solu-tions of turbulent flow transport and energy dissipation rate, simulations were car-ried out using the turbulence model of RNG k- ?. It has been discovered that the smaller arrangement pitch values of quarter-circular-shaped ribs used in curved restriction zone enhance both the Nussult number and the parameter of thermo-hydraulic performance (THPP) as well as the heat dissipation rate. In the other side, the insertion of these ribs gives more high pressure in the tested restriction zone. As results, the optimum THPP value is discovered to be 1.81 at relative ar-rangement pitch P/r = 20 with a Reynolds number of 3800 for fixed E/D = 0.34.

Keywords: Roughened curved restriction zone, SAH, Quarter-shaped-ribs, r/D, RNG k-? tur-bulence, THPP.



Graphical abstract

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Impact of Physical Parameters on Poiseuille Flow: A Comparative Study Using Finite Differences, Finite Volumes, and Lattice Boltzmann Methods

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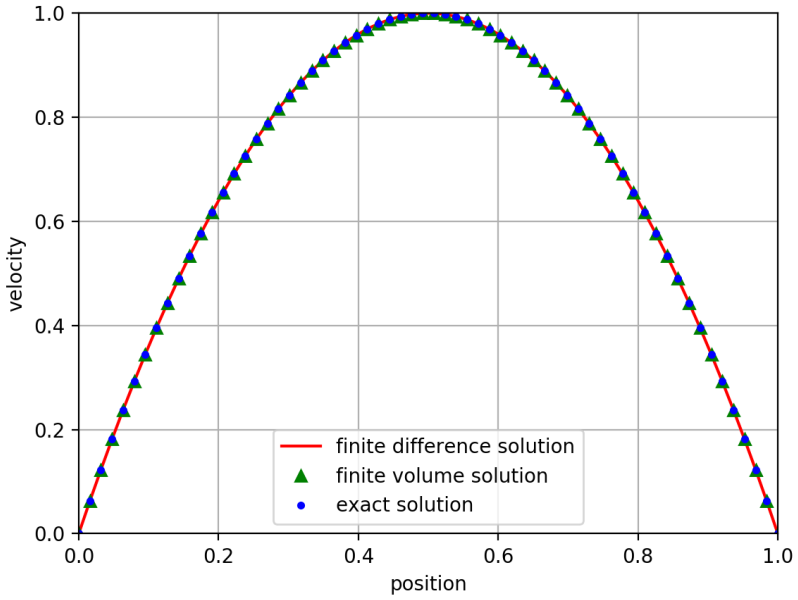
Abstract: This study presents a comparative analysis of the effects of physical parameters on Poiseuille flow using three distinct numerical methods: Finite Differences (FD), Finite Volumes (FV), and Lattice Boltzmann (LB) methods. Poiseuille flow, a fundamental fluid flow model in pipe-like geometries, serves as a benchmark for evaluating the performance and accuracy of these methods under varying flow conditions. The study focuses on key physical parameters, such as viscosity, pressure gradient, and flow rate, exploring how these factors influence the velocity profiles and pressure distributions. The results highlight the strengths and limitations of each numerical approach in terms of computational efficiency, accuracy, and ability to handle complex flow regimes. The comparison provides valuable insights into selecting the most appropriate method for simulating Poiseuille flow in different engineering and scientific applications.

Keywords: Poiseille flow , Finit difference method , Finit Volume method , Lattice Boltzmann method



Graphical abstract

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Models Correlation of Inconel 718 Dry Cutting Parameters Using RSM and ANN Approaches

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Abstract: Inconel 718, a nickel-based superalloy, is prized for its strength under extreme stress and high temperatures along with its resistance to corrosion and creep. These performances make it ideal for high-performance applications in various industries such as aerospace, submarines …etc. The present investigation examines the impact of the cutting conditions represented by the cutting speed (Vc), the feed rate (f), the depth of cut (ap), and the tool nose radius (r) on machining performance, specifically cutting power (Pc) and cutting temperature (T) on the machining performances illustrated by the cutting power (Pc) and the cutting temperature (T). Dry turning tests were performed on Inconel 718 using a ceramic composite tool, with an orthogonal Taguchi design (L18) for experimental setup. The prediction of both machining performances necessitates the application of two modelling approaches: the Response Surface Methodology (RSM) and the Artificial Neural Networks (ANN). The RSM model achieved a coefficient de determination (R^2) of 93.70% for (Pc) and 94.25% for (T), while the ANN model showed an (R^2) of 99.98% for (Pc) and 99.91% for (T). These results demonstrate the high accuracy and reliability of both modelling approaches.

Keywords: Machining, Inconel 718, Modelling, RSM, ANN.

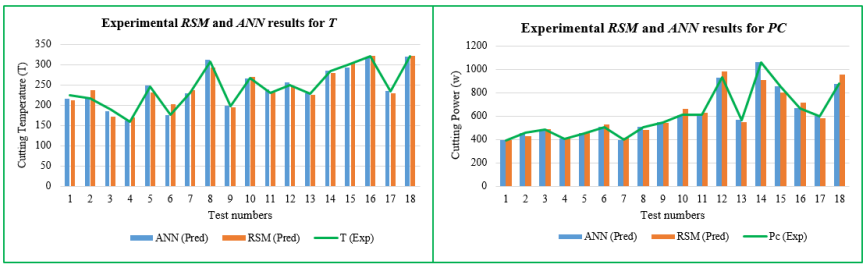

Figure 1: Experimental, RSM and ANN Predicted Results

Graphical abstract

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Computational analysis of a fluid–structure interaction for a flapping flexible plate (FFP)

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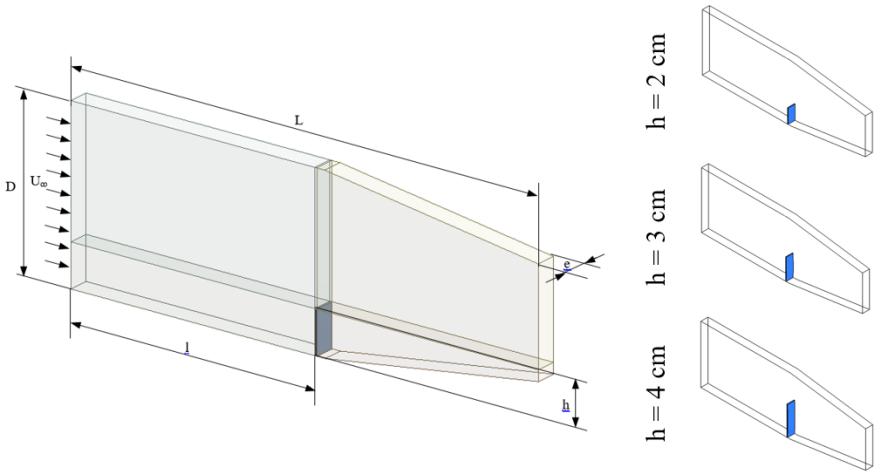
Abstract: This paper presents the computational analysis of a fluid–structure interaction for a flapping flexible plate (FFP) in quiescent fluid to investigate the effect of flexibility to create swirl on an intake manifold. The numerical simulation is performed using the commercial code “ANSYS” in particular system coupling module. This system coupling is based on a parti-tioned approach, which requires co-simulation between ANSYS Fluent and ANSYS Me-chanical. Three Flapping flexible plates (FFP) lengths are selected depending on the Reyn-olds numbers set to 104. In the flexible cases, flaps oscillations increase the veloci-ty gradients and generate an unsteady turbulent flow with complex coherent vor-tices detaching from the tip of the flaps. The numerical results, such as the dis-placement distribution, the stress Von Mises, the streamline and velocity swirling strength have been presented. Particularly, we are interested in the study of the dynamic behavior of flaps and the evolution of the displacement field of the plate.

Keywords: Swirl generation, Flapping Flexible plate (FFP), Computational Fluid Dynamics (CFD), Computational structure Dynamics (CSD), fluid-structure interaction (FSI), Ansys.



Graphical abstract

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Experimental investigation of flexural strength and stiffness of honeycomb-sandwich structures produced by FDM

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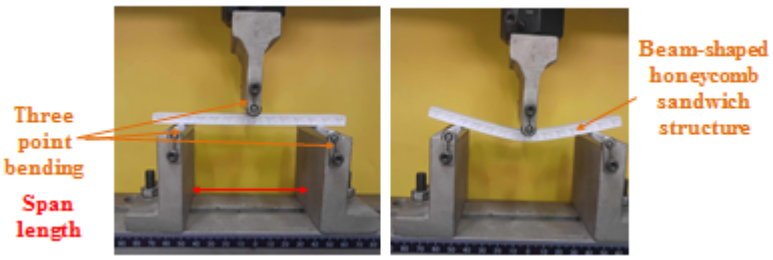
[1] *Laboratory LEE, National Engineering School of Sfax, ENIS, 3038 Sfax, University of Sfax, Tunisia*

Abstract: This study investigates the three-point bending behavior of honeycomb sandwich structures with different core topologies (rectilinear, auxetic, and hexagonal) using 3D-printed Polylactic Acid (PLA) and Polyethylene Terephthalate Glycol (PETG) materials. The fused deposition modeling (FDM) is implemented for 3D printing specimens. Tensile tests were conducted to compare the tensile strength, modulus of elasticity and yield strength between PLA and PETG polymers. Then, within 3points bending settings, experimental results highlight the influence of core geometry on the bending performance, with particular focus on stiffness and strength. Comparative analysis of PLA and PETG materials reveals differences in material properties that affect the overall performance of the sandwich structures. The findings provide insights about the impacts of core topology and material selection in optimizing the mechanical properties of honeycomb sandwich composites for various engineering applications.

Keywords: FDM, PLA, PETG, honeycomb sandwich, 3Points bending



Graphical abstract

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Comparison of impact responses of 3D printed polymeric sandwich structures: PLA and PETG

Hanen Mallek [1] *, Hana Mellouli [1], Marwa Allouch [1], Mondher Wali [1], Fakhreddine Dammak [1]

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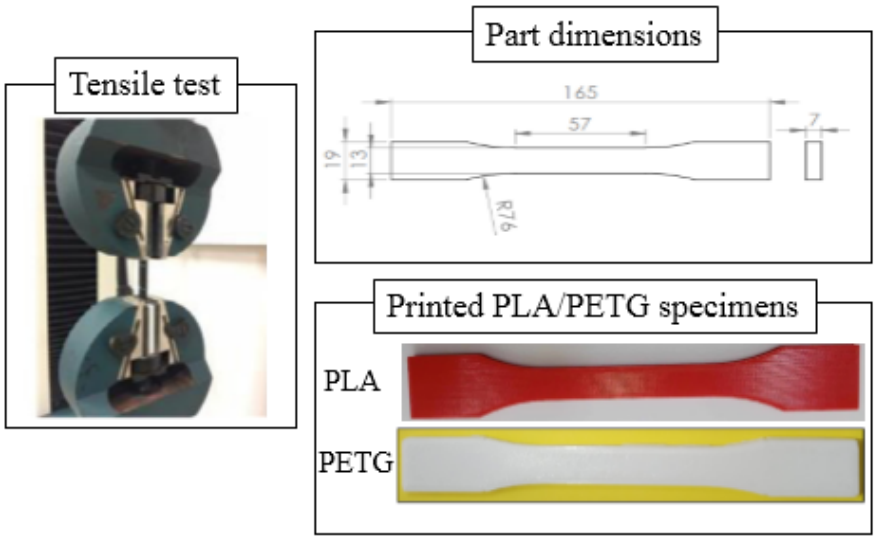
Abstract: This work investigates the low-velocity impact performance of cellular sandwich structures fabricated using Fused Deposition Modeling (FDM) with Polylactic Acid (PLA) and Polyethylene Terephthalate Glycol (PETG) materials. Initially, both materials were characterized through tensile testing to determine their mechanical properties. Following this, low-velocity impact tests were conducted using a drop weight impact testing machine to evaluate the dynamic response of the structures. The study focuses on hexagonal and auxetic cell embedded within the sandwich structure due to its high strength-to-weight ratio. During impact testing, impact forces were closely monitored, allowing for a comparative analysis of the behav-ior of PLA and PETG under two different initial velocities. This research aims to enhance the understanding of material and structural effects on impact resistance for lightweight applications.

Keywords: FDM, Auxetic, PLA, PETG, Impact, Sandwich



Graphical abstract

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Analysis of the Effects of Physical Parameters in Internal Flow using the Highly Stable Lattice Boltzmann Method and MRT Lattice Boltzmann Method

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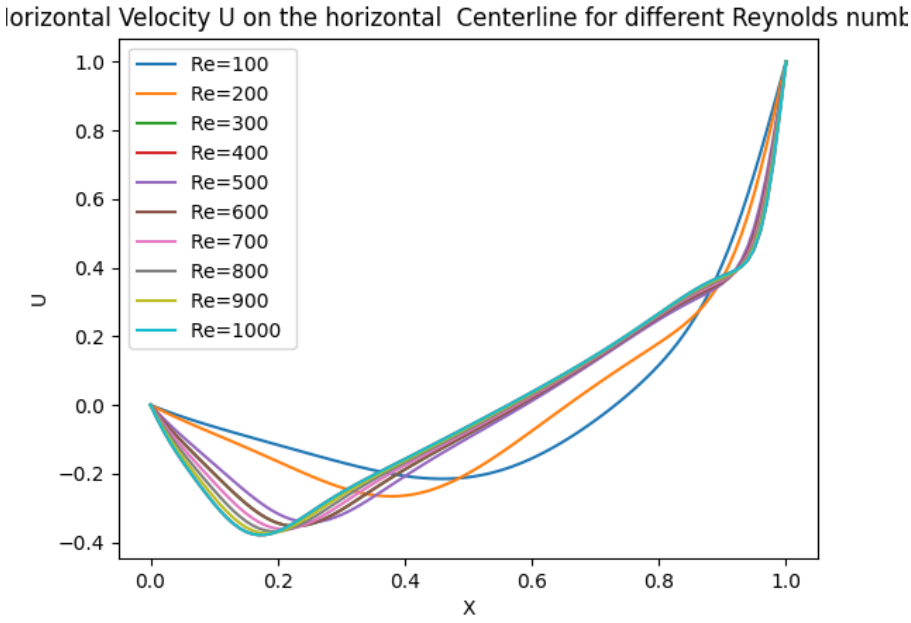
[2] *Laboratory of thermodynamics and energetic systems, Faculty of physics ,university of science and technology Houari Boumediene, Algeria*

Abstract: This study investigates the influence of various physical parameters on internal flow dynamics using two advanced computational methods: the Highly Stable Lattice Boltzmann Method (HSLBM) and the Multiple-Relaxation-Time Lattice Boltzmann Method (MRT-LBM). Internal flows, characterized by fluid motion confined within boundaries, are critical in numerous engineering applications such as heat exchangers, ventilation systems, and microfluidic devices. The research focuses on how variations in parameters such as viscosity, density, boundary conditions, and external forces affect flow behavior, including velocity profiles, pressure distributions, and stability. The HSLBM is utilized for its enhanced stability and accuracy in simulating complex flows, while the MRT-LBM offers flexibility in capturing a broader range of flow phenomena by modifying relaxation times. Through a series of numerical simulations, the study analyzes the sensitivity of internal flow patterns to these physical parameters, comparing results from both methods to assess their performance in terms of accuracy, computational efficiency, and stability. The findings highlight the strengths and limitations of each method in capturing the nuances of internal fluid flow, providing valuable insights for future computational fluid dynamics (CFD) applications.

Keywords: Lattice Boltzmann method , Internal flow ,Numerical methods , CFD



Graphical abstract

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An Integrated Approach to Mechatronic Sys-tem, Production System, and Manufacturing Process Design: Optimizing Solutions Using SBCE Principles and MBSE model

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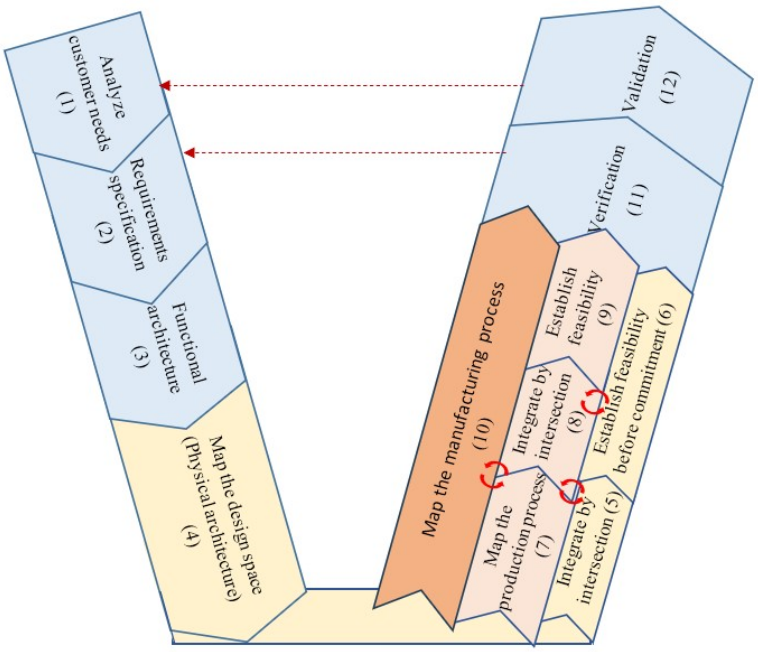
Abstract: In the context of Industry 4.0, engineering products are required to be more intelligent, efficient and compact. Manufacturing firms are now compelled to adjust their production systems with constant and unforeseen changes in customer needs in order to address different needs and usage modes. Consequently, manufacturing as well as production constraints must be integrated into the early design phases of complex systems. In this paper, we propose a new approach to integrate production constraints as well as manufacturing constraints within the product design process. To achieve this, the principles of the SBCE (Set-Based Concurrent Engineering) approach are incorporated using MBSE (Model-Based Systems Engineering) method, so as to reduce iterative exchange loops between engineering stakeholders.

Keywords: Mechatronic product, MBSE, SBCE, Production Process, Manufacturing pro-cess



Graphical abstract

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Experimental characterization of PETG material reinforced with carbon nanotubes

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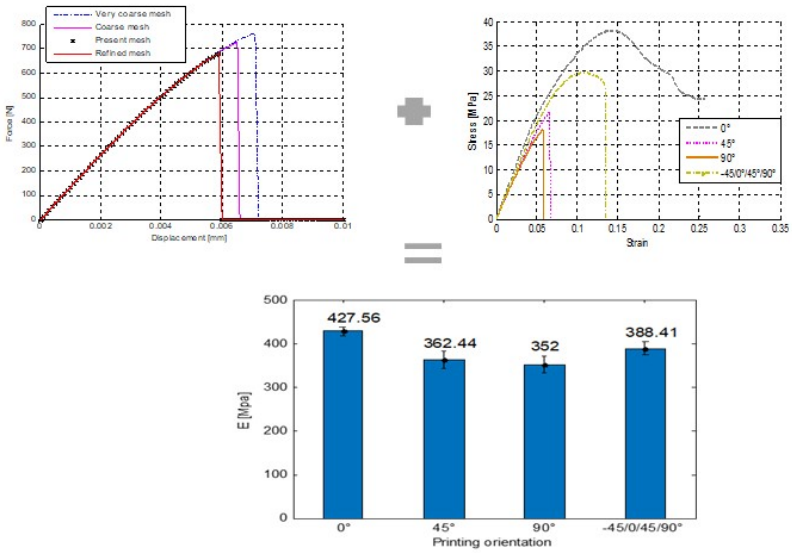
Abstract: This study investigates the properties of polyethylene terephthalate glycol-modified (PETG) reinforced with carbon nanotubes (CNTs). The incorporation of CNTs significantly enhances the mechanical and thermal performance of PETG, leading to improvements in tensile strength, rigidity, and toughness. Charpy impact and tensile tests were conducted to evaluate these enhancements, showing that the composite exhibits superior tensile strength and better impact resistance compared to unreinforced PETG. Additionally, the composite material demonstrates excellent electrical conductivity, making it suitable for applications in electronic devices and sensors. The thermal stability and chemical resistance of PETG are maintained, while its printability is preserved, allowing for versatile manufacturing options. Through these experimental characterizations, the research highlights the potential of CNT-reinforced PETG in various industries, including aerospace, automotive, and electronics. The findings suggest that further exploration of the interactions between CNTs and PETG could optimize formulations and processing techniques, thereby expanding the application range of this innovative composite material.

Keywords: PETG reinforced with carbon nanotubes (CNT-reinforced PETG), Staggered schema.



Graphical abstract

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Study of the Machinability of a Developed Composite

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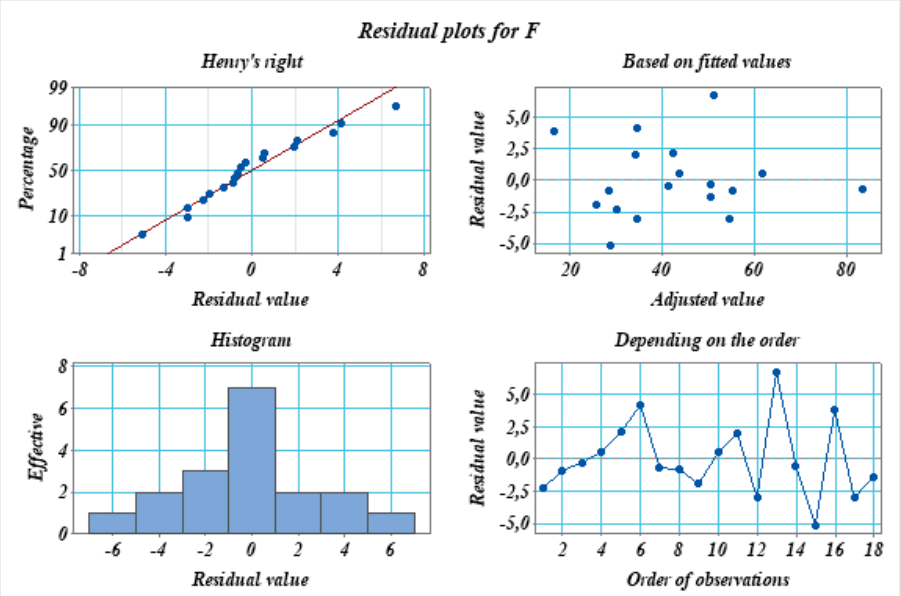
Abstract: The development of composite materials around the world has evolved dramatically over the last few decades, transforming many industries thanks to their unique properties. A composite material is made up of two or more separate components which, when combined, create a material with characteristics superior to those of individual materials. Composites often offer advantages in terms of lightness, mechanical strength, durability and corrosion resistance, making them suitable for applications in sectors as diverse as aeronautics, automotive, construction, energy and many others. This work involves developing a new composite based on glass fibres and a thermoplastic resin (GFRP) and studying its suitability for machining by turning. GFRP composite specimens were prepared in the laboratory with different percentages of chopped glass fibres of different lengths. The machining studies were carried out using a T9325 negative turning insert, coated with an MT-CVD WC-Carbide Co material, classified ISO P15-P35. The aim was to study the impact of machining parameters (cutting speeds, feeds and depths of cut) on surface finish, cutting forces and material removal rate (MRR). A design of experiment was developed using Minitab software to analyse these influences. An experimental design was developed using Minitab software to study the surface roughness of the machined GFRP composite material. Roughness was measured using a roughness meter, while cutting forces in all three directions were recorded using a Kistler platform. A Pareto chart was used to identify the relative impact of each cutting parameter. Plots of the residual Ra values were calculated, and a mathematical model of roughness was established, with a correlation coefficient greater than 0.98.

Keywords: composite; machining; cutting parameters; roughness; mathematical model; MRR.



Graphical abstract

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Lattice Boltzmann approach for magnetohydrodynamic Thermosolutal mixed convection in presence of Soret and Dufour effects

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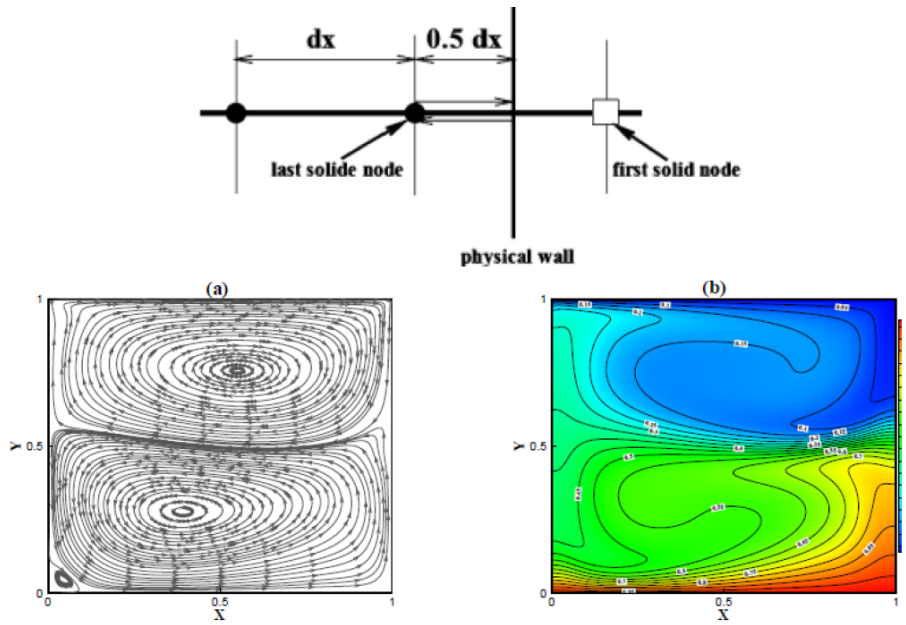
[2] *Renewable Energies and Advanced Materials Laboratory, International University of Rabat (UIR), Rocade Rabat-Salé Rabat (UIR), Rocade Rabat-Salé, 11100, Rabat-Sala El Jadida, Morocco*

Abstract: This research explores the problem of magnetohydrodynamic double-diffusive mixed convection in a driven cavity considering thermal diffusion (Soret) and diffusion thermo (Dufour) effects. A novel hybrid MHD lattice Boltzmann scheme is developed for this study, combining multiple relaxation time (MRT-LBM) parameters for the velocity field and a single relaxation time (SRT-LBM) parameter for the magnetic field. On the other hand, the temperature and concentration fields are further investigated using a finite difference method (FDM) to solve the governing energy and species balance equations. Firstly, the proposed model is validated against results from the literature and shows good agreement with the different comparisons. Numerical simulations unveil the significant influence of the Soret and Dufour parameters, along with the magnetic field, on temperature and concentration distributions. Furthermore, the analysis of average Nusselt and Sherwood numbers provides valuable insights into the overall heat and mass transfer characteristics.

Keywords: Heat and mass transfer, Soret and Dufour effects, Magnetic Field, Lattice Boltzmann Method (LBM), Finite Difference Method (FDM).



Graphical abstract

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Comparative study of the hydric ageing of the two bio-composites PLA-DPFs and PLA-PO

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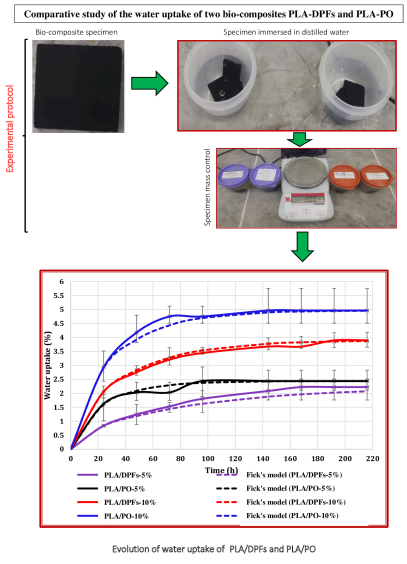
Abstract: This work presents the experimental results of a study of the water uptake of two biodegradable bio-composites developed in the laboratory based on polylactic acid (PLA) as a matrix and date palm fibers (DPFs) and posidonia oceanica (PO) as reinforcement. The choice of the two types of fiber is justified mainly by their biodegradability and their abundance in nature in many countries, particularly Tunisia. So, for a better development of these bio-composites, it is necessary to have additional information on their durability. Therefore, for a better develop-ment of these bio-composites, it is necessary to have additional information on their durability. Indeed, a low water uptake property, allows these bio-composites to be used in applications where moisture could be involved or they could get wet sometimes. Low water absorption also ensures bio-composite du-rability. The procedure consists of monitoring the absorbed mass of each bio-composite over time, until water saturation is reached. This involves regularly weighing of standardized samples of these bio-composites after they have been immersed in distilled water at room temperature. The results show that the high-er the fiber content of the bio-composite, the more sensitive it becomes to mois-ture. Furthermore, PLA/DPFs bio-composites are more resistant to moisture than PLA/PO bio-composites for the same fiber content.

Keywords: : bio-composite, date palm fibers, posidonia oceanica, water absorption



Graphical abstract

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Innovative thermal regulating materials and systems for energy-efficient and comfortable buildings: A comparative analysis

Nessrine Essid [1] *

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Abstract: This study explores the use of innovative thermal regulating materials and systems to enhance the energy efficiency and comfort of buildings. With rising energy demands and increasing environmental concerns, the need for sustainable building solutions has never been more critical. The research identifies and evaluates various thermal regulation technologies, considering factors such as energy efficiency, cost, durability, environmental impact, and ease of installation. A multi-criteria decision-making approach, using tools like ELECTRE III, was employed to systematically assess and rank the materials and systems based on their performance. The study emphasizes that there is no universal solution, and selection should be context-specific, taking into account factors like climate, building type, and user requirements. Additionally, the importance of involving all stakeholders in the decision-making process is highlighted, ensuring that the final solutions align with both technical and user needs. As part of the research, different material solutions were tested in a residential building using Revit Architecture Building Information Modelling (BIM) software to evaluate their performance under various thermal conditions. The findings provide valuable insights for optimizing building design and operation to achieve long-term sustainability and occupant comfort.

Keywords: Energy efficiency, Buildings, Thermal comfort, BIM, REVIT.

Graphical abstract

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First-principles study of the structural, electronic and magnetic properties of diluted magnetic semiconductors (Ba1-yKy)F (Zn1-xMnx)As

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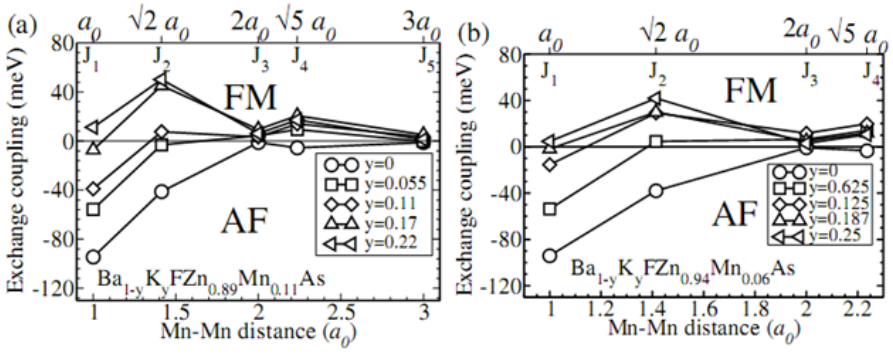
Abstract: The structural, electronic and magnetics properties of the (Ba1-yKy)F (Zn1-xMnx)As were investigated using density functional theory within the Perdew-Burke-Ernzerhof generalized gradient approximation (PBE-GGA) of the exchange-correlation energy implemented, in the Vienna ab-initio simulation package (VASP). The optimized lattice parameters and bulk modulus of the parent compound are determined by fitting a set of data points to the Birsh-Murnaghan equation of state. The vdW-SCAN+rVV10 density can predict perfectly the lattice parameters which are in excellent agreement with experimental value. The coexistence of two types of magnetic exchange coupling interactions was detected via the calculation of the distance-resolved and the individual exchange parameters. The ferromagnetic coupling is dominates only with both spin and charge dopings

Keywords: Diluted magnetic semiconductors (DMSs). iron-based superconductors, magnetic exchange , DFT



Magnetic exchange as function of the distance between Mn-pair atoms in host $Ba_{1-y}K_yZn_{1-x}Mn_xAs$ with varying charge y and spin x co-dopant

Graphical abstract

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Raman characterization of amorphous silicon thin films induced by aluminum deposited on glass

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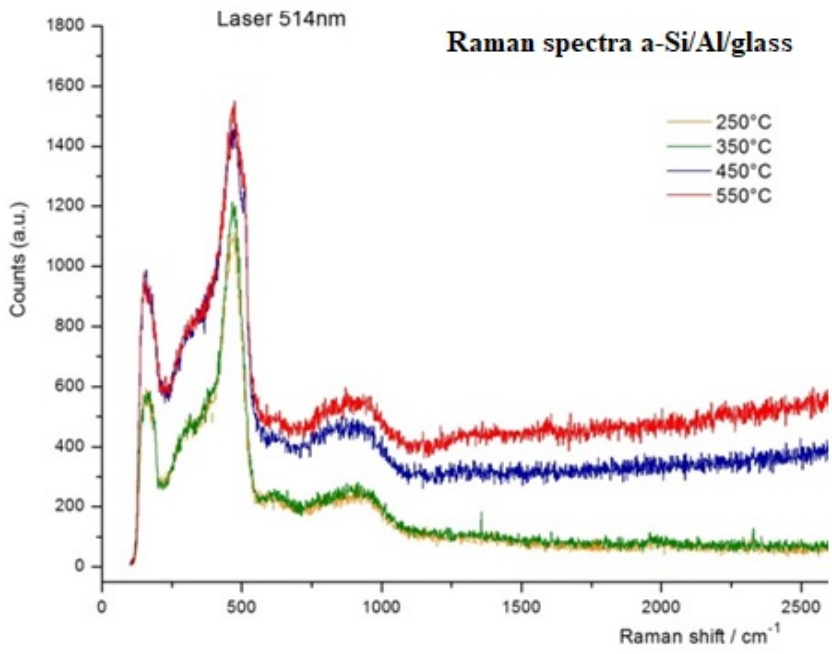
Abstract: Polycrystalline silicon (poly-Si) is highly solicited for various applications in the field of electronics and photovoltaic. This material is used in transistors, solar cells and display panels. The contribution of Raman spectroscopy is important in the study of the crystallization of amorphous silicon thin films, In this work, we propose to follow the state of crystallization of amorphous silicon layers induced by the aluminum layer deposited on glass by Raman spectroscopy. The results obtained show the importance of the technique in monitoring the crystallization of the layers.

Keywords: Raman spectroscopy, amorphous Silicon, polycrystalline silicon, thin films



Graphical abstract

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Enhancing PA66-GF30% Machining Efficiency Using OFAT and WASPAS Optimization

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Abstract: Today's manufacturers strive to reduce machining costs by lowering energy con-sumption, enhancing productivity, and maintaining high product quality. This study aims to identify optimal cutting conditions to achieve these goals and en-hance performance characteristics. In this work, a metal carbide tool was em-ployed to manufacture polyamide (PA66-GF30%) specimen in a dry environ-ment. Experimental trials were conducted following Taguchi's L9 orthogonal ar-ray methodology. The influence of variations in cutting process parameters on the studied responses was analyzed using the One-Factor-At-A-Time (OFAT) experi-mental technique. Additionally, a multi-objective optimization of the operating conditions was performed using the classification method based on the Weighted Aggregated Sum Product Assessment (WASPAS) approach. The objective of this study concerns the minimization of (Ra, Pc, and Ecs) at the same time as maxim-izing MRR. OFAT results reveal that feed rate (f) exerts the most significant influ-ence on surface roughness (Ra), while depth of cut (ap) is the primary factor im-pacting tangential cutting force (Fz). The morphology of the machined chip is sensitive to variations in cutting speed (Vc), feed rate (f), and depth of cut (ap).

Keywords: PA66-GF30%, OFAT, optimization and WASPAS method.

Graphical abstract

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Parameter identification of a visco-hyperelastic constitutive model for 3D printed PETG components

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[2] *Gafsa Preparatory Engineering Institute, IPEI Gafsa, University of Gafsa, Tunisia*
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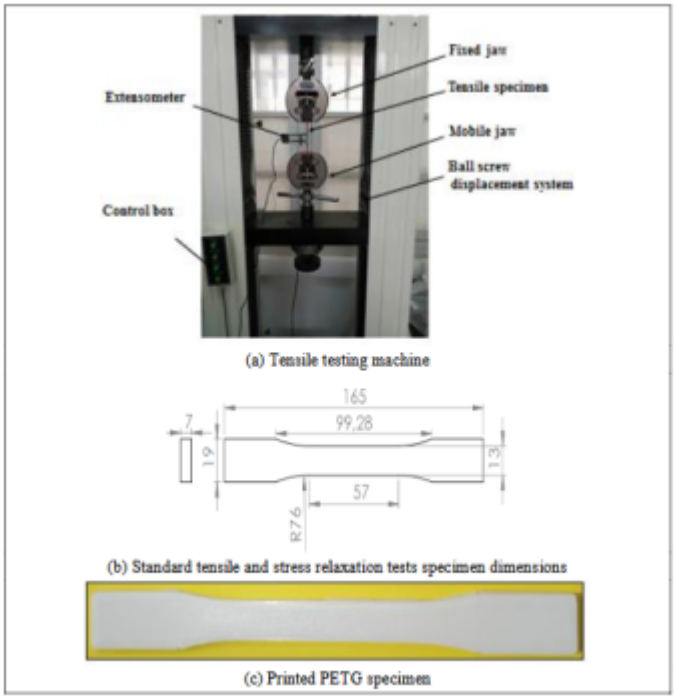
Abstract: Fused Deposition Modeling (FDM) offers significant design flexibility for creating 3D-printed parts. However, the mechanical performance of these components remains a critical challenge. This study aims to explore the behavior of 3D-printed thermoplastic materials under static and quasi-static loading conditions through both experimental and numerical methods. For this purpose, uniaxial tensile tests are performed to generate force-displacement curves for 3D-printed PETG materials. Additionally, stress relaxation tests are conducted to characterize the time-dependent viscoelastic behavior resulting from deviations from purely static deformation. A visco-hyperelastic constitutive model is then proposed to characterize the behavior of these materials. The experimental data are utilized to calibrate the model's parameters through curve-fitting within commercial finite element software, ABAQUS. The results reveal a high degree of correlation between between experimental observations and numerical predictions, confirming the model's effectiveness in representing the nonlinear behavior of the 3D-printed polymeric materials.

Keywords: FDM process, PETG, Mechanical testing, Visco-hyperelastic model, FE simulation



Graphical abstract

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Study and expertise of the properties of industrial metals using advanced and modern analysis and characterization techniques

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[2] *Université Paris-Saclay, CNRS, Orsay Institute of Molecular Chemistry and Materials, 91405 Orsay, France*

Abstract: EBSD (Electron Back Scattered Diffraction) is a technique based on the exploitation of the diffraction patterns of electrons backscattered by a crystalline material placed under the electron beam of a scanning electron microscope (SEM). It makes it possible to acquire a multitude of data and quantitative microstructural information about the crystallographic nature: grain morphology, grain boundary distribution, intragranular orientation gradients, crystallographic texture, etc. Unlike other diffraction techniques (X-rays or Neutrons), EBSD makes it possible to correlate morphological and crystallographic texture, that is to say the size and shape of grains, and the distribution of associated crystallographic orientations [Badji 2008,Karch 2014].

Keywords: EBSB technique, Crystallographic texture, mechanical properties, deformed grains, recrystallization, metal alloy, industrial metals, dislocations

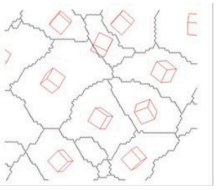

Fig. 1 Schematic description of the orientation of grains from cubes in a material with a cubic crystal structure

Graphical abstract

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Numerical analysis of the improvement of the performance of the heat sink

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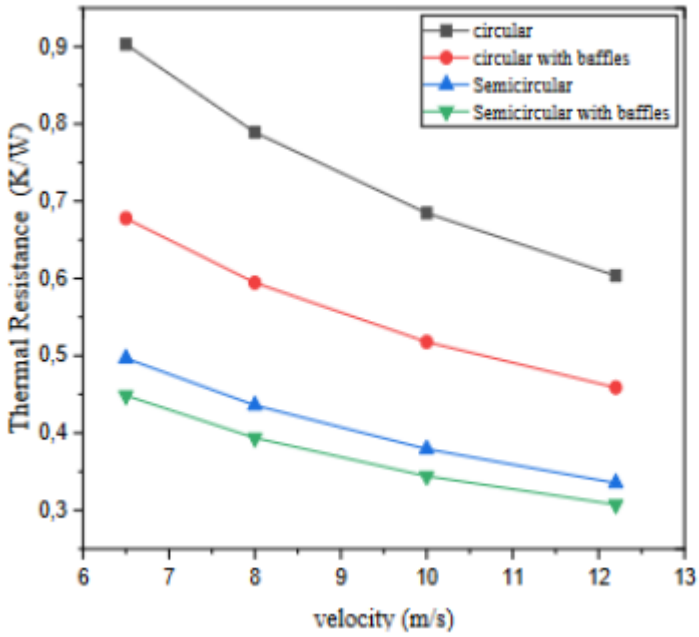
Abstract: Comparative numerical analysis of the thermal and hydraulic performance of a turbulent flow of incompressible air through a heat sink plat pin-fin (PPFHS) of circular and semi-circular, with and without baffles. The K-? model was used for numerical calculations of the geometric configuration of this 2D heat sink to see the influence of geometry on heat dissipation with a change in velocity from 6.5 m/s to 12.2 m/s. The results show a 51% improvement in thermal resistance of the semi-circular PPFHS with baffles compared with the circular PPFHS.

Keywords: Heat sink, thermal resistance, turbulent flow,PPFHS.



Graphical abstract

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Tailoring the Mechanical and Thermal Properties of PEEK with Hydroxyapatite Addition for Enhanced Orthopedic Performance

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[2] *Mechanics, Materials and Processes Laboratory, University of Tunis, ENSIT, Tunisia*
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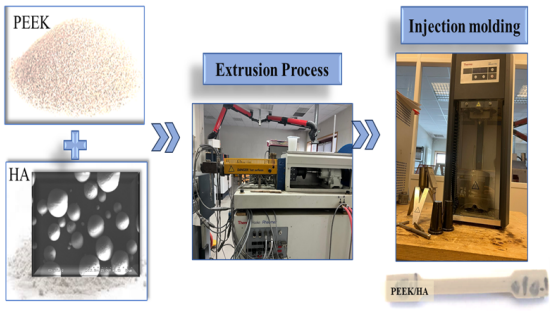
Abstract: This study focuses on developing bioactive PEEK composites for orthopedic and dental applications. While PEEK offers excellent strength, biocompatibility, and radiolucency, its biological inertness limits bone integration. Incorporating hydroxyapatite (HA) enhances PEEK's bioactivity, improving osseointegration and bone cell adhesion for medical implants. The PEEK and PEEK/HA (20% HA) composites were fabricated using twin-screw extrusion and injection molding, ensuring uniform HA dispersion within the matrix. Scanning electron microscopy (SEM) revealed increased surface roughness in PEEK/HA composites due to HA particles, improving cell adhesion and tissue integration. Differential scanning calorimetry (DSC) indicated that HA acts as a nucleating agent, raising crystallinity from 31.89% to 42.86%, enhancing rigidity and thermal stability without altering the melting temperature. Mechanical testing showed that HA addition increased maximum stress by 10.94% and Young's modulus by 30.07%. In fact, pure PEEK offers a maximum stress of 96.83 MPa, a modulus of 2.96 GPa and a strain of 54.9%, combining strength and elasticity. With 20% HA, the stress reaches 107.43 MPa and the modulus 3.85 GPa, increasing stiffness and strength, but reducing the strain to 35.04%. This balance between enhanced stiffness and reduced flexibility makes PEEK/HA composites suitable for load-bearing applications like orthopedic implants.

Keywords: PEEK, hydroxyapatite, extrusion composite, thermal, mechanical



Graphical abstract

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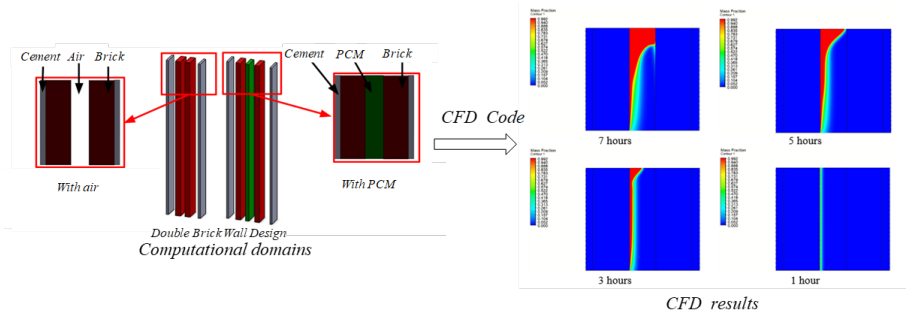
CFD Investigation of Heat Transfer Enhancement Using Phase Material Change PCM Filled Between Double Walls

Fatma Kria [1] *, Sirine Chtourou [1], Jaweher Hamden [1], Moez Hammami [1], Mounir Baccar [1]

[1] *Laboratory Ad- vanced fluid dynamics energetic and environment, National School of Engineers of Sfax(ENIS), University of Sfax Road Soukra km 3.5, 3038 Sfax, Tunisia*

Abstract: This paper discusses numerically the thermal behavior of phase change mate-rial PCM filled between two walls using CFD code. The novel building wall's role was to receive and store the solar energy during the day. Then, it release it indoors at night. These CFD simulations aim to compare the liquid fraction and the temperature contours of the proposed double partition walls, which were filled with and without PCM layer in the building under the same tem-perature and external solar radiation conditions of Tatouine, Tunisia. The findings show the ability of the PCM RT28 to delay the thermal propagation from the outside to the indoors during all the day.

Keywords: thermal behavior, PCM layer, CFD code building wall.



Graphical abstract

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CFD Analysis of Heat Transfer Improvement in Double Brick Wall Design Filled with PCM

Jaweher Hamden [1] *, Fatma Kria [1], Sirine Chtourou [1], Moez Hammami [1], Mounir Baccar [1]

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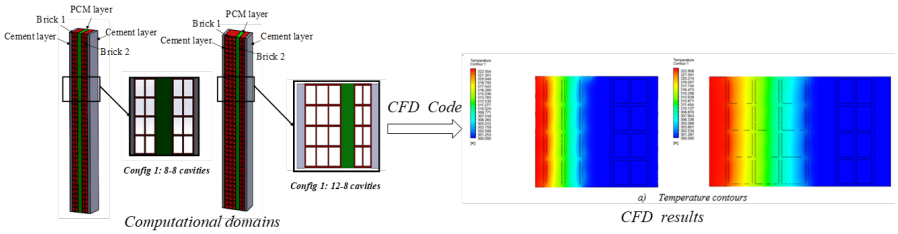
Abstract: In this work, the melting behavior and the thermal efficiency of phase change materials PCM RT28 filled between two walls with distinct brick cavity con-figurations 8-8 and 12-8 cavities are analyzed numerically using CFD (com-putational fluid dynamics) code. The paper aims to predict the effect of the brick geometry on the PCM melting rate using Ansys Fluent software, in terms of temperature contours and liquid fraction under identical external solar ra-diation and temperature conditions in Tatouine, Tunisia. The results show that the results demonstrate that the PCM RT28 can delay the transfer of heat from the exterior to the interior throughout the day in august month. In comparison to the 12-8 cavity design, the 8-8 cavity layout provides better heat transport, resulting in faster melting and a more even temperature distribution.

Keywords: thermal efficiency, PCM RT28, CFD code, Ansys Fluent, brick cavity.



Graphical abstract

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Rehabilitation of RC Structures

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[2] *University Abbes LAGHROUR, Kkenchela, Algeria*

Abstract: Old buildings have several vulnerabilities due to their age, the construction tech-niques used at the time and the lack of modern safety and resistance standards. The rehabilitation of existing buildings is one of the main challenges in reducing seismic risk in Algeria. However, the constraints relating to earthquake-resistant reinforcement are sometimes strong: taking into account the socio-economic di-mension of the project, poor knowledge of the building, difficulty in choosing a reinforcement strategy. The strategy consists of finding, among a range of possi-ble solutions, the optimal repair or reinforcement which takes into account the cost, the duration of the work, and the inconvenience caused to the occupants (dislodged or not). The aim of this article is the choice of the rehabilitation strate-gy: repair or reinforcement according to the desired level of resistance or defor-mation capacity or both simultaneously. The results obtained showed the possi-bility of compliance with current seismic codes and also of improving the perfor-mance level of old structures.

Keywords: Rehabilitation, repair, strengthening, building, pushover analysis.

Photo 1 Effect of the earthquake in Boumerdes (Algéria 2003)

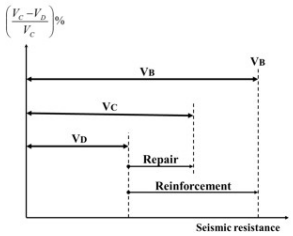

Fig. 1 Seismic resistance

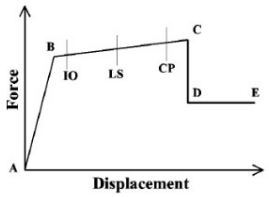

Figure 1. force-displacement relationship used in SAP2000 for plastic hinges

3

Graphical abstract

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Surface Hole Defect Detection of rolled Sheets Based on Pixel Classification Approach

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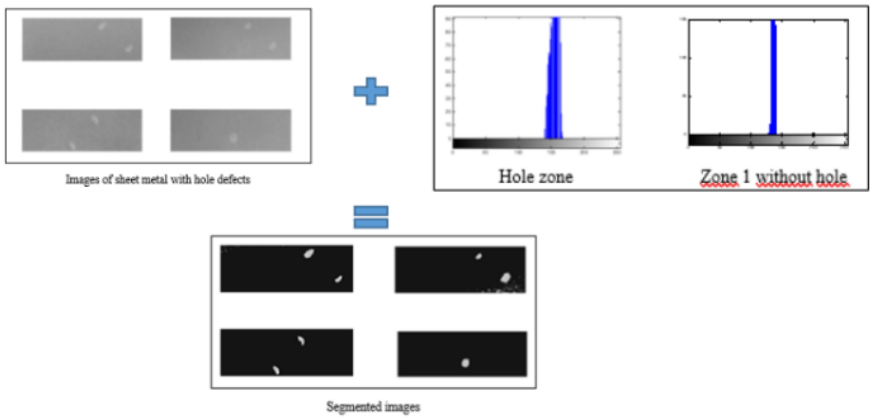
[2] *Laboratoire de Génie Electrique (LABGET) Dpt Génie électrique, University of Larbi tebessi- Tebessa, Algeria*

Abstract: Rolling is a pressure treatment technique that modifies the shape of steel ingots or billets between rotating rollers. During this process, defects may form on the surface of the rolled sheets and are likely to affect the performance and quality of the finished product. In our study, we developed a method for detecting surface hole defects using a pixel classification approach [1]. This work includes several steps. First, we performed image preprocessing to delimit areas with and without hole defects on the sheet image. Then, we developed the histograms of each area to generate the gray level membership intervals of the pixels that characterize each area. As we noticed an intersection between the character istics of the gray level intervals of the images of the two areas, we finally performed a learning step based on a series of detection tests to refine the membership intervals of each area, and to choose the defect detection criterion in order to optimize the recognition of the surface hole.

Keywords: Classification, defect, surface, detection, hole.



Graphical abstract

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Copper- oxide coating to combat viral infection surfaces: Antiviral and mechanical efficacy

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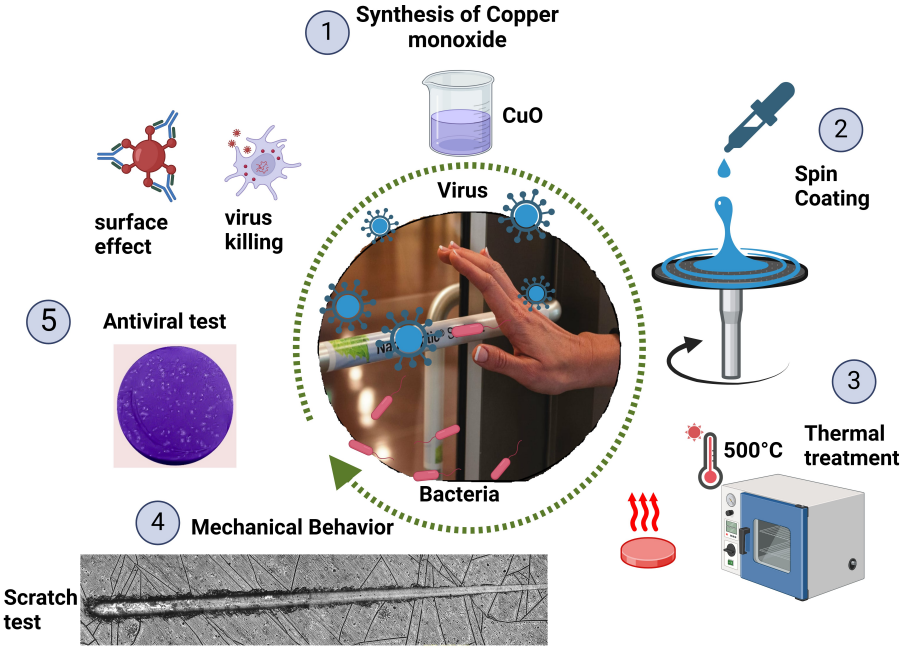
Abstract: Copper-Oxide (CuO) film has attracted attention for its potential antiviral and antibacterial properties, including its ability to combat COVID-19. This investigation focuses on the development, deposition and characterization of a copper oxide film microstructural examination was caried out using SEM/EDS (Scanning Electron Microscopy/Energy Dispersive X-ray Spectroscopy). Mechanical investigation was conducted through Vickers hardness and scratching test. Our study was extended to include the evaluation of antiviral efficacy, assessing the surface's ability to inactivate viruses. Results demonstrated a dense and homogeneous microstructure. Additionally, it was found a hardness of about 11.14 ± 0.04 GPa. scratching tests revealed a high scratch resistance with a critical load LC of about 1.89 ± 0.02 accompanied by a friction coefficient of 0.093. This study revealed that the CuO film. Antiviral tests confirmed the efficacy of the CuO film in combating the HSV-2 virus, demonstrating its potential as an effective antiviral coating.

Keywords: Copper-Oxide film, Mechanical Behaviour, Antiviral Activity.



Graphical abstract

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Comparison between the turbulent models for instantaneous study

Bilel Ben amira [1] *, Mariem Ammar [1], Makram Maaloul [1], Zied Driss [1], Mohammed Salah abid [1]

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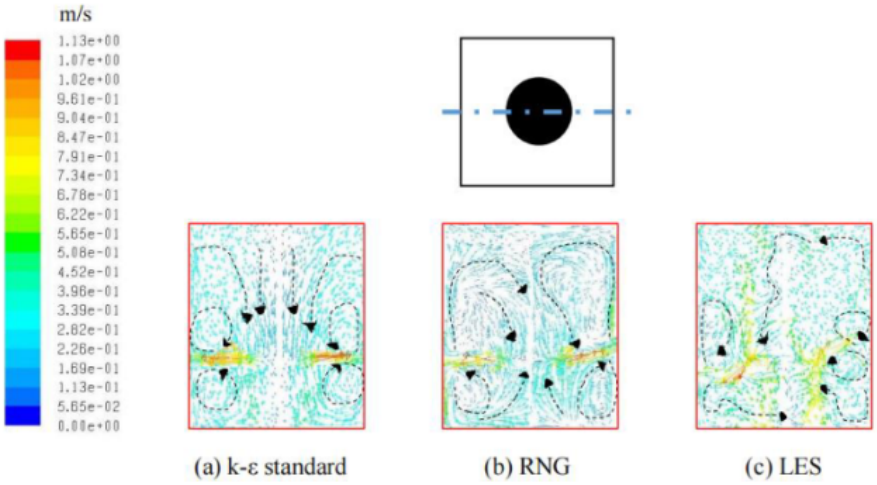
Abstract: This study aims to investigate the hydrodynamic behavior of a square vessel equipped with a Rushton turbine under unsteady flow conditions. Three turbulence models, namely the standard k-? model, the RNG k-? model, and the Large Eddy Simulation (LES) model, are compared. The results indicate that the LES model provides the most detailed representation of the unsteady flow, accurately capturing the formation and dissipation of turbulent eddies. However, LES is computationally expensive, particularly for long-time simulations. The RNG k-? model offers a reasonable compromise between accuracy and computational efficiency, capturing the main flow features and some of the unsteady behavior. The standard k-? model, while computationally efficient, tends to underpredict the intensity of turbulence, leading to less accurate results for unsteady flows.

Keywords: Rushton, turbulence models, unsteady flow, square vessel



Graphical abstract

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Predictive Design and Analysis of Concrete Slabs Doubly Reinforced with Carbon Composite Plates Using Artificial Intelligence

Sofiene Helaili [1] *, Taysir Rezgui [1], Moez Chafra [2]

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[2] *LaMOED, Tunis EL Manar University, Campus Universitaire, BP 244, Tunis 2092, Tunisia*

Abstract: Abstract – Concrete walls are critical structural elements subjected to tension, compression, shear, and bending moments. When employed as compression walls, the primary stresses are tension and compression. Over time, the materials comprising these walls can undergo aging, leading to reduced performance. A commonly used technique to extend the lifespan of concrete walls is reinforcing them with carbon fiber composites. These composites are bonded to one or both faces of the wall to enhance its resistance. This paper focuses on assessing the resistance of single-face and double-face reinforced concrete walls using artificial intelligence (AI). A model was developed to generate a comprehensive database of wall configurations and corresponding structural responses. This database was used to train an AI algorithm, which was then validated by comparing its predictions to real-case scenarios. The trained AI model demonstrated the ability to predict the resistance of wall configurations not included in the training dataset. The results highlight the predictive accuracy and potential of AI in optimizing the design and reinforcement of concrete walls.

Keywords: Artificial Intelligence (AI), Concrete Walls, Carbon Fiber Composites, Structural Reinforcement, Predictive Modeling

Graphical abstract

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Enhancing the Aging Resistance of Reinforced Concrete with Hybrid Fiber Composites: Numerical Analysis

Sofiene Helaili [1] *, Roua Knani [1]

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Abstract: Abstract – The use of metallic, synthetic, or natural fibers as reinforcement in concrete is a well-established technique to enhance its compressive and tensile strength, prolong its resistance to cracking, and provide ductility even after the appearance of cracks. Over time, the components of concrete deteriorate, leading to reduced mechanical properties. One technique to mitigate this is the application of fiber-reinforced shotcrete or the injection of fiber-reinforced concrete into existing cracks and structures faces. This paper investigates the effect of a sprayed layer of fiber-reinforced concrete, incorporating metallic fibers, synthetic fibers, and natural fibers, on extending the effective service life of structural elements. A numerical model was developed to simulate the reinforcement process, varying the properties of the fibers. The global structural resistance of the reinforced concrete elements was evaluated. Results show that the additional fiber-reinforced layer significantly enhances the lifespan of certain structures, provided their aging is carefully monitored and controlled.

Keywords: Fiber reinforcement, concrete aging, structural durability, numerical modeling, service life extension

Fibre de béton projeté [©ACPresse]

Graphical abstract

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Simulation of electronic, elastic and structural properties of semiconductor materials I-Cu2WSe4 and I-Cu2MoSe4

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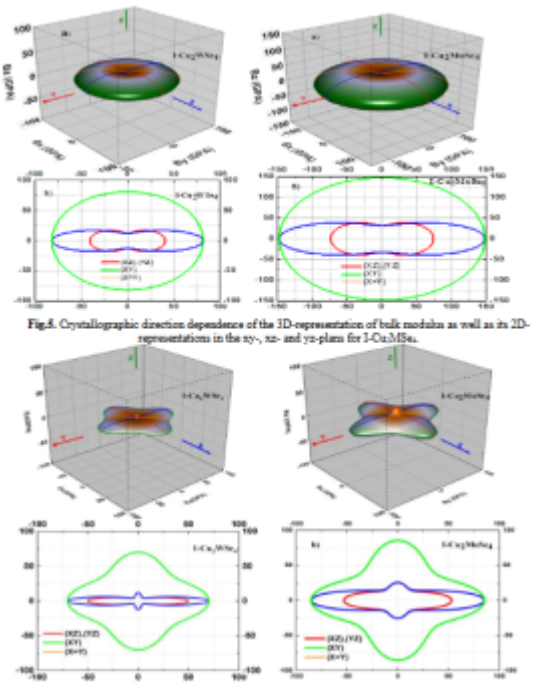
Abstract: Density functional calculations have been carried out to determine various physical properties of the ternary chalcogenide tetragonal compounds I-Cu2MSe4 (M=W, Mo) ng different exchange–correlation approximations including the generalized gradient approximation (GGA) within the density functional theory (DFT). The calculated equilibrium lattice constants (a, b and c), are in good agreement with the available experimental data. We have calculated and analyzed the energy gap, band structure and density of states. The electronic structure calculation demonstrates that crystals are indirect-gap semiconductors. Based on their elastic constants, these compounds are expected to be mechanically stable, The elastic moduli of the polycrystalline aggregates and their related properties are obtained in the framework of Voigt-Reuss-Hill approximations. Our results indicate that I-Cu2MSe4 (M = W, Mo) can be classified as brittle materials.

Keywords: Density functional theory; Cu2WSe4, Cu2MoSe4, mechanical properties; electronic structure



Graphical abstract

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Evaluating the Long-Term Effects of Maintenance Mortars on Concrete Aging and Structural Integrity

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Abstract: Abstract – The reinforcement of aging structures is a critical approach in modern civil engineering to enhance durability, restore mechanical performance, and extend service life. Techniques like surface application or injection of advanced materials are widely employed for structural rehabilitation and preservation. Maintenance mortars are mixtures composed of sand, cement, lime, additives, and water. They are applied to surfaces or injected into cracks. These mortars must possess mechanical properties compatible with the concrete they are intended to reinforce, ensuring deformation compatibility while providing superior strength properties. The injection or application of these mortars on structures in need of rehabilitation can potentially extend their service life. This paper examines the effect of using a repair mortar in structural elements undergoing aging. The mechanical properties of the mortar are varied, while the properties of the reinforced structure are degraded to evaluate long-term behavior, if deterioration leads to structural weakening. A numerical model was developed to simulate various scenarios and estimate the resulting structural resistance.

Keywords: Key words: Maintenance mortars, repair, structural aging, numerical modeling, durability.

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A Comprehensive investigation of structural, dielectric, and optical properties of Pr0.5Ce0.5FeO3 perovskite for high frequency and optoelectronic applications

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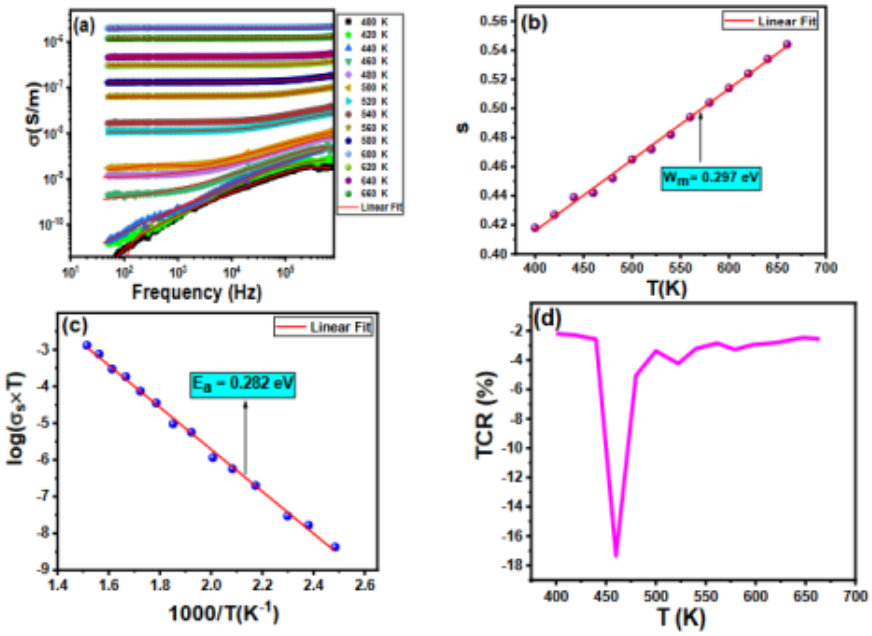
Abstract: This work aims to study in detail the structural, impedance-spectroscopy, thermodynamic and optical properties of the Pr0.5Ce0.5FeO3 compound. X-ray diffraction data reveals that our compound crystallize in the orthorhombic structure with the Pnma space group. Conductivity analyses reveals that the produced Pr0.5Ce0.5FeO3 sample have significant electrical resistivity. These significant results, implies that our sample have the potential to be employed in microwave devices. The NSPT model was used to explain the sample conduction process. The Pr0.5Ce0.5FeO3 material have an important negative TCR value. This result suggests that our perovskite is a good candidate for infrared radiation detection. The frequency-dependent behavior of dielectric constants in our sample can be interpreted based to Maxwell-Wagner's interfacial polarization theory. The as -elaborated sample display direct optical transition based on the Tauc method. The estimated Eu value for our sample is 0.698 eV. This lower value, implies that our material exhibits minimal disorder and demonstrates a lower localized states within its structure.

Keywords: The Pr0.5Ce0.5FeO3 material, NSPT model, Microwave devices, TCR value, Optoelectronic properties, Tauc method.



Graphical abstract

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Mass mixing performance for microfluidic system using chaotic vortex advection inside micromixer

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[2] *Department of Mechanical Engineering, College of Engineering, King Faisal University, Al-Ahsa 36362, Saudi Arabia*
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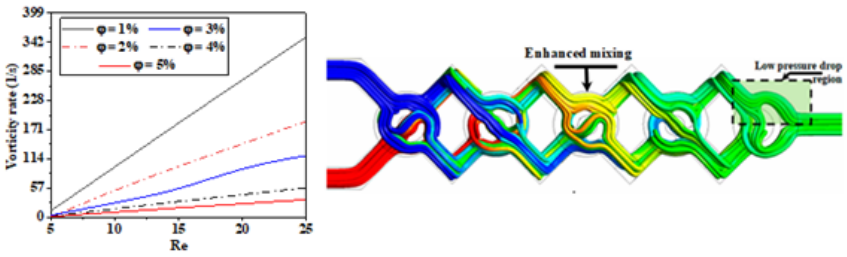
Abstract: In this study, we perform an extensive comparative analysis of chaotic flow behaviors in multi-layer crossing channels. The objective is to determine the optimal nanofluid concentration that enhances mixing efficiency at low Reynolds numbers. We introduce a micromixer design to examine how different nanofluid concentrations influence vortex characteristics and kinematics. Our computational assessment aimed at boosting mixing efficiency involved detailed kinematic measurements, including vorticity, deformation, stretching, and folding rates across various low Reynolds number conditions. Using Fluent ANSYS CFD software, we solved the 3D continuity, momentum, and species transport equations, yielding precise and dependable simulations. For different fluid regimes with Reynolds numbers ranging from 0.1 to 25, the new configurations showed a notable improvement in mixing performance, achieving enhancements of 40% to 60% compared to the basic Newtonian fluid, particularly in kinematic metrics. The results indicated that all proposed micromixers generated strong secondary flows that significantly enhanced fluid kinematics at low Reynolds numbers. Visualization of mass fraction and pathlines further demonstrated that the new designs facilitated rapid mixing while minimizing pressure losses. These outcomes indicate that the new designs are well-suited for enhancing homogenization in various microfluidic systems, which could lead to increased efficiency and performance in numerous industrial applications.

Keywords: chaotic advection, micromixer, mixing rate, deformation, rotation, vorticity, microfluidics



Graphical abstract

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Flexural properties prediction of plant biomass waste biochar reinforced mortar

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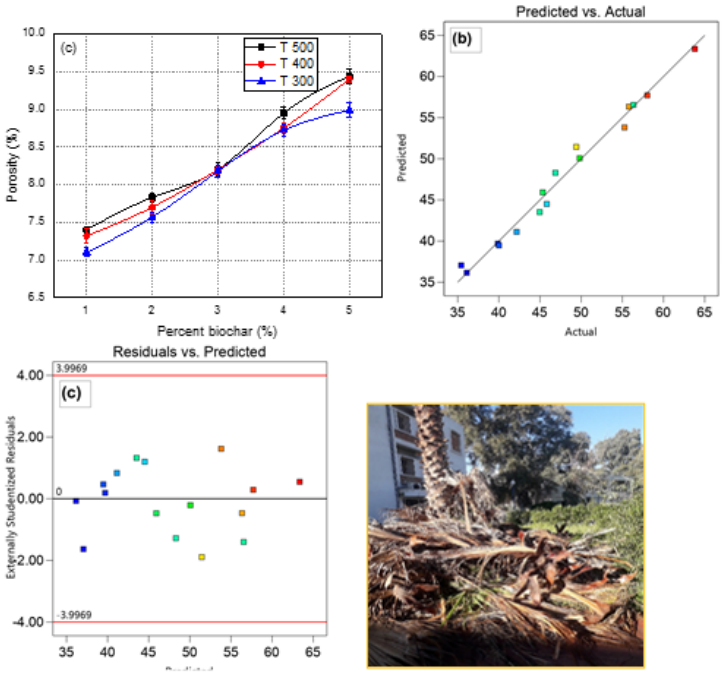
Abstract: The design and production of more sustainably and ecologically friendly building materials is a contemporary trend in the construction industry to lessen and minimize environmental effect. Because of its unique properties and advantages for the environment, biochar has the potential to be included into building materials. In certain environmental circumstances, plasters can break and crumble. The goal of this study is to create a novel plaster product that is reinforced with biochar made from the pyrolysis of Washingtonia plants (WPB). Three temperatures (300, 400, and 500°C) and three biochar contents (1, 2, and 3%) were investigated. There was a 28% decrease in displacement and 71% increase in flexural strength for plaster reinforced with 1 wt% of Washingtonia plant biochar (WPB) pyrolyzed at 500°C. Based on reference data for plaster biocompo-sites, this led to a decrease in the brittle material's ductility when compared to gypsum composites. Gypsum eco-mortars incorporating WPB are suitable for creating lightweight mortars offering excellent properties, such as low density.

Keywords: Reinforced plaster; Washingtonia waste biochar; Flexural properties; Prediction model.



Graphical abstract

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Early Diagnosis of High Fall-Risk Elderly Populations based on Machine Learning approaches

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Abstract: The integration of technology and artificial intelligence (AI) has revolutionized motion analysis in diverse fields such as sports, industry, and medicine. With the rise of smart devices and advanced computational techniques, AI-driven approaches provide innovative solutions for aided-making decisions through precise and reduced time movements analysis, whether healthy, pathological, or athletic. Despite its promise, challenges remain in leveraging data from affordable and accessible tools, such as smartphones, wearables, and phone cameras, while ensuring high precision and real-time capabilities. Worldwide, the global aging phenomenon poses significant public health and societal challenges, with an increased elderly population over 20% of the global population by 2050 (WHO, 2022). Tunisia is, also, experiencing similar demographic shifts (INS, 2024). As aging leads to a natural decline in motor and neurological function and contributes to postural instability and an increased risk of falls, fall prevention among the elderly is a growing global concern. Traditional methods for assessing balance, such as questionnaires, functional tests and evaluations of stabilography are often limited by their complexity, reliance on subjective reporting, and the need for sophisticated equipment. Also, they face limitations due to task difficulty and the severity of age-related constraints. Advances in ML have facilitated the development of fall detection and rely on statistical descriptors from the center of pressure (COP) (Quijoux et al 2021; Chen et al, 2021, Giovanini et al, 2018, Liao et al, 2021, Savadkoohi et al. 2022).). The potential of ground reaction force (GRF) measurements remains underexplored (Cetin et al. 2019). This study explores Machine Learning (ML)'s role in motion analysis to facilitate early diagnosis of elderly individuals at high risk of falling by using safer and more effective tools for fall-risk assessment and improved elderly care. The main objective is to evaluate the contribution of Vertical Ground Reaction Forces (vGRF) in fall detection among elderly groups based on ML approaches compared to COP and GRF ML and AP components.

Keywords: Artificial Intelligence (AI), Motion Analysis, Elderly Fall Prevention, Smart Devices, Global Aging Phenomenon

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Pressure-dependent constitutive model for sed-iment-organic matrix composites

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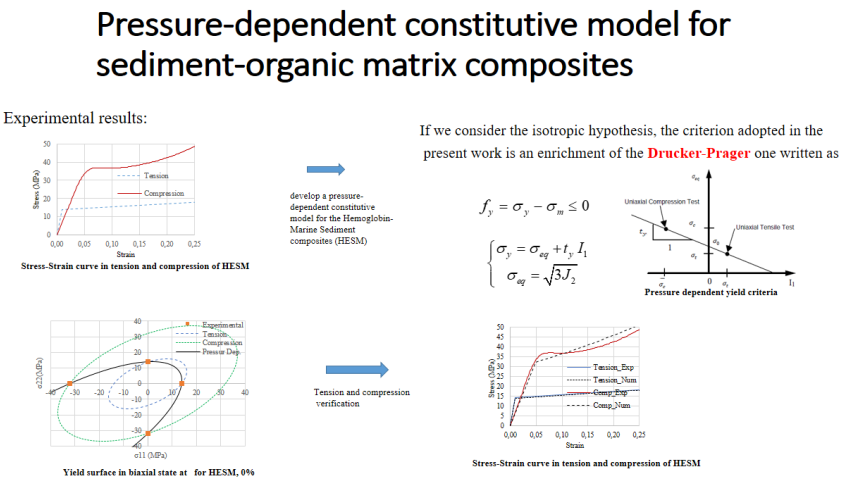
Abstract: Sediment-organic matrix composites are materials that exhibit complex mechan-ical behavior, particularly when subjected to different loading conditions. In many cases, the response to compression and tension is not symmetric, which poses challenges for accurate modeling using conventional criteria such as Von Mises and Tresca. These traditional approaches do not account for the influence of hydrostatic pressure on material behavior, which is a critical factor for pres-sure-sensitive materials. The aim of this work is to develop a pressure-dependent constitutive model for the Hemoglobin-Marine Sediment composites (HESM). This model is designed to predict the mechanical behavior of the composite un-der various loading conditions, with a specific focus on capturing the asymmetry between compression and tension responses. By incorporating hydrostatic pres-sure effects, the model seeks to provide a more realistic representation of the material's mechanical properties, improving the accuracy of simulations and structural predictions. The proposed approach involves characterizing the mate-rial's response through experimental data and implementing a constitutive framework that integrates pressure sensitivity into the prediction of mechanical behavior.

Keywords: composites, hydrostatic pressure, asymmetry, mechanical behavior



Graphical abstract

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Numerical simulation of a lubrication system using non Newtonian fluid

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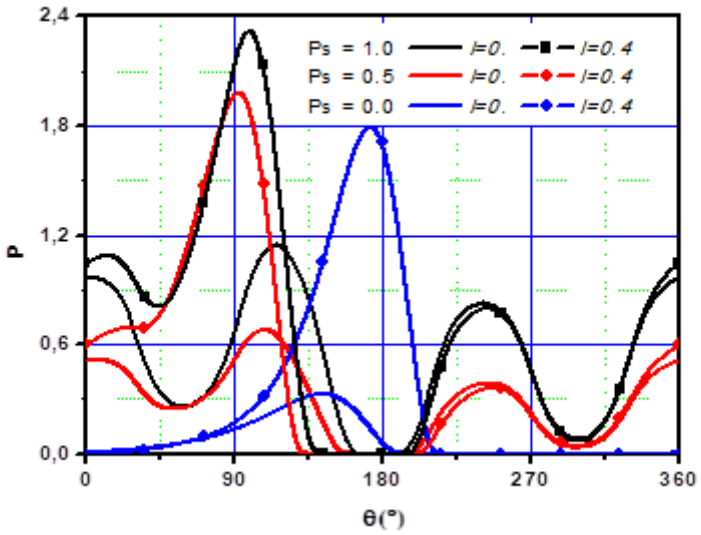
[2] *LGMD, Polytechnic National School of Algiers, Algeria*

Abstract: The present work is dedicated to a theoretical investigation of hybrid bearings lubrication (combined of hydrodynamic and hydrostatic effect) of finite length taking into account the non-Newtonian behavior of fluid. Notice that the addition of nanoparticles in lubricant fluids may enhance the lubricant viscosity and in turn changes the bearing performance characteristics which affects seriously the rheological behavior of these fluids. The problem becomes non-linear and then it is necessary to use a non-Newtonian model for predicting the performance of the system.The micro-continuum fluid theory of couple stress was used in the mathematical modeling of the problem. The governing equations were solved numerically using the finite difference approach. The hybrid bearing analyzed in this study is a set made up of six identical cells regularly distributed around the periphery of the bearing. The main control parameters which govern the equations used are the inlet pressure and the couple stress, their effects on the pressure generated in the bearing are studied. Obtained results showed an improvement in the pressure film operating with couple stress fluids compared to Newtonian fluids case. The parametric study highlights that the presence of additives in the lubricant can change the lubrication regime, particularly in the case of heavily loaded bearings rotating at high speeds. However for hydrostatic bearings case, the effect of couple stress fluid is negligible.

Keywords: Hybrid Lubrication, Non-Newtonian fluid, Couple stress fluid.



Graphical abstract

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Thermal Performance Analysis of a Parabolic Lens Solar Cooker Based on Key Parameters

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Abstract: This study investigates the effects of key parameters (solar irradiance, lens area, absorber plate area, and lens efficiency) on the performance of a solar cooker, specifically focusing on temperature increase over time. A mathematical model was developed to simulate the temperature change of the cooker plate, considering energy absorption from solar irradiance and heat loss through convection. The simulation was performed for varying values of solar irradiance (600, 800 and 1000 W/m²), lens area (1, 2 and 3 m²), absorber plate area (0.5, 1.0 and 1.5 m²), and lens efficiency (0.8, 0.9 and 1.0). The results demonstrate that solar irradiance, lens area, and lens efficiency have a direct impact on temperature rise, while the absorber plate area also influences heat absorption but to a lesser degree. The findings suggest that optimizing these parameters can significantly enhance the efficiency of solar cookers, contributing to more effective utilization of solar energy for cooking applications.

Keywords: key parameters, performance, solar cooker

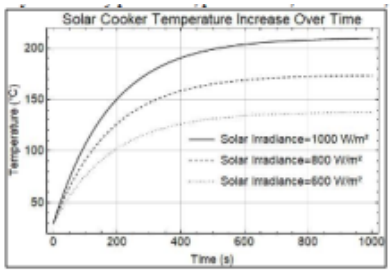

Figure 1: **Effect of solar irradiance on the temperature increase in the solar cooker.**

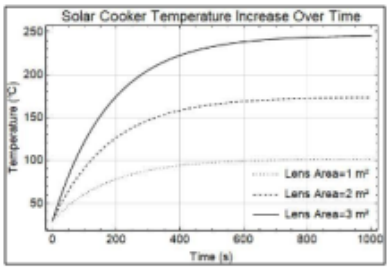

Figure 2: Effect of lens area on the temperature increase in the solar cooker.

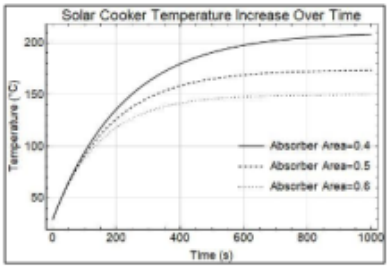

Figure 3: Effect of Absorber area on the temperature increase in the solar cooker.

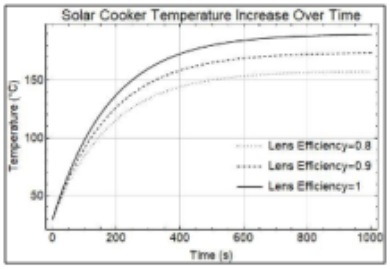

Figure 4: Effect of lens Efficiency on the temperature increase in the solar cooker.

Graphical abstract

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Optical properties of liquid phase CVD deposit-ed oxides thin films doped lanthanide ions

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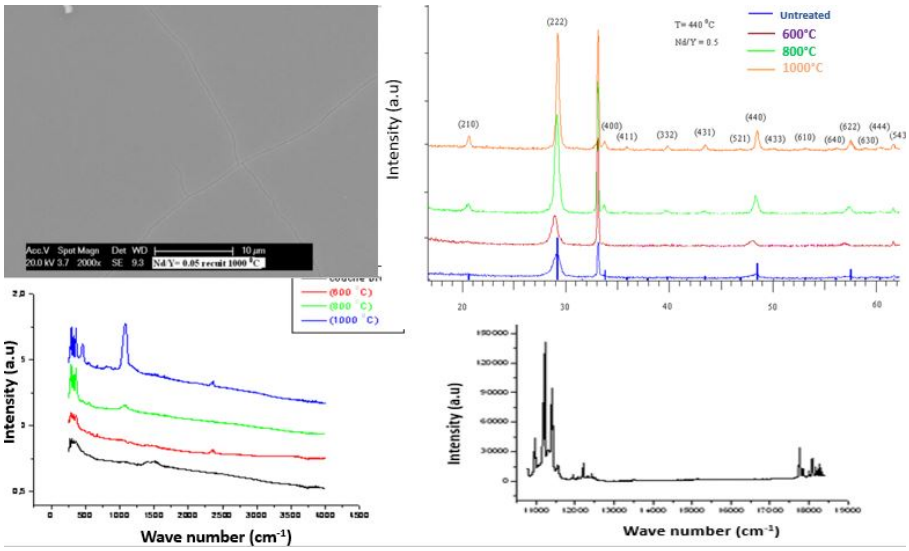
Abstract: Yttrium oxide nanomaterials are highly suitable as host materials for ra-re-earth elements. The high surface-to-volume ratio of rare-earth ions, such as Nd³?-doped yttrium oxide nanoparticles, makes them ideal for several applica-tions. In study, Nd³?:Y?O? nanograin-like structured films with varying Nd concen-trations were deposited on Si (100) substrates using the aerosol-assisted chemical vapor deposition process. Obtained thin films underwent post-heat treatment at 600 °C, 800 °C, and 1000 °C during one hour. Post-heat treatment was performed to enhance the crystallinity and the optical performances of as-prepared thin films. Characterization of the produced thin films was performed through ESD, SEM, XRD, FT-IR and photoluminescence analysis. X-ray diffraction analysis of the "as-deposited" thin films showed a transition from amorphous to highly crys-talline structure. SEM observations revealed that the surface morphology of the thin films became progressively smoother as the annealing temperature increased. In particular, the yttria film doped with 2.5 at.% neodymium and subjected to heat treatment at 1000 °C for one hour demonstrated the highest performance.

Keywords: Thin oxide films, Rare-earth ions, Aerosol-assisted CVD, Optical properties, Heat treatment.



Graphical abstract

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Design and Construction of a Savonius-type Wind Turbine

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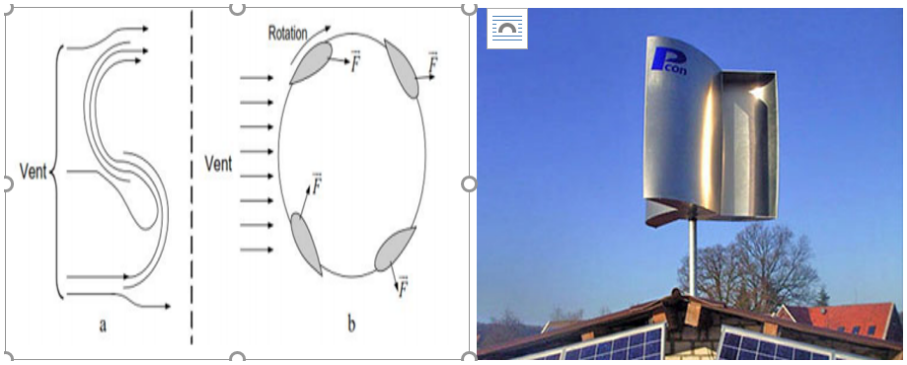
Abstract: Wind energy is a renewable energy source that uses the power of the wind to generate electricity, a natural and infinite resource. This study focuses on the vertical Savonius wind turbine. The goal is to optimize the Savonius model through a parametric study of several wind turbine prototypes. The efficiency of a prototype is defined by its electrical power output. The parameters studied include: geometrical configuration (the variation in the number of blades) and the influence of wind speed. The designed model was locally manufactured using materials sourced from the market. The model was tested within a wind speed range of 3 to 20 m/s, available during the testing period. The results obtained showed that increasing the number of blades and wind speed improved the turbine's properties.

Keywords: Key words: Energy, Savonius wind turbine, Wind speed, Pale.



Graphical abstract

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Kitagawa diagram of defective A357-T6 cast aluminium under torsion-tension loading based on affected depth

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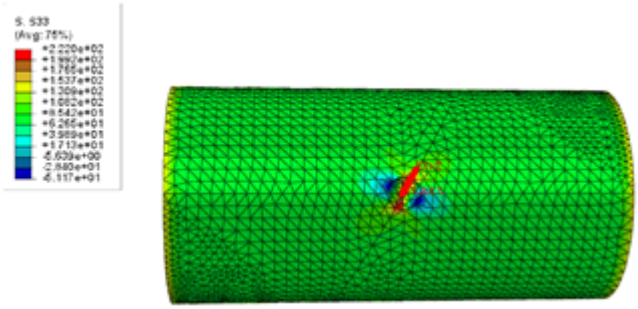
Abstract: The design of engineering components, especially under multiaxial loadings, requires careful consideration of fatigue behavior. This study aims to determine the fatigue limit for a defective cast aluminium alloy A357-T6. The analysis focuses on the Crossland equivalent stress near the casting defect using the finite element (FE) method. The defect forms a spherical void on the surface of a sample subjected to combined tension-torsion fatigue loading. The affected depth is calculated and referred to as the distance from the defect's tip to the specimen's interior. Based on the affected depth approach, the Kitagawa-Takahashi diagram is simulated for various defect dimensions and a load ratio of R_?= 0.1.

Keywords: cast A357/ high cycle fatigue/defect /affected depth/ Kitagawa diagram



Graphical abstract

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Fatigue strength analysis of EN3B material with hole defects under tensile loading using the affected depth approach

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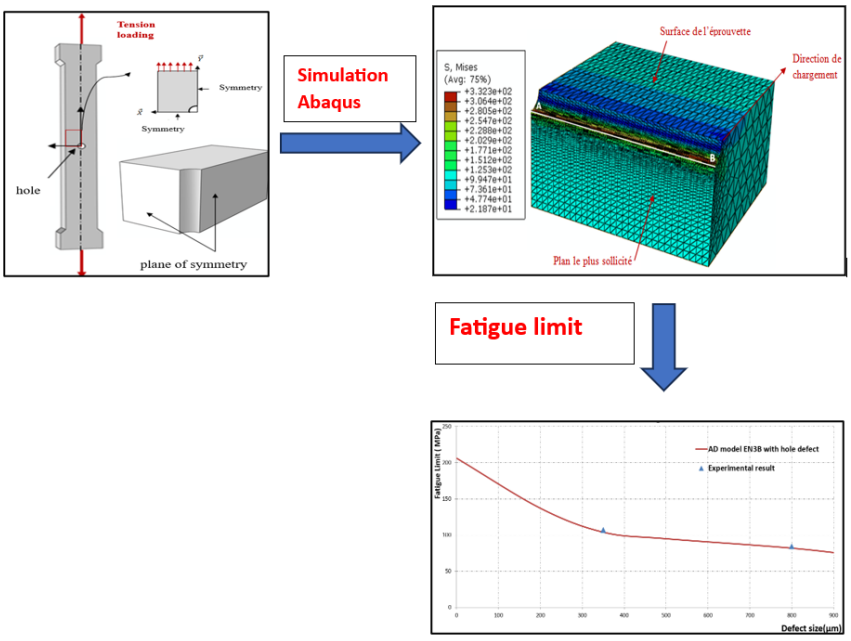
Abstract: In this paper, we employ the affected depth approach to evaluate the fatigue life of notched components under high-cycle fatigue conditions. The study assumes the presence of a hole situated at the specimen surface exposed to fatigue loading. Applying the Finite Element method, stress distribution around the defect is computed. The proposed model is assessed using the Crossland criterion. It is used to calculate the equivalent stress distribution in proximity to the defect by considering the concept of the affected depth approach. This approach characterizes the affected depth as the distance from the defect's tip to the specimen's interior where the Crossland criterion is violated. Experimental data from defective EN3B steel specimens are implemented for model validation and comparison, demonstrating a good correlation with the experimental results.

Keywords: Fatigue, affected depth, HCF criterion; defect; Hole, KITAGAWA



Graphical abstract

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Hygrothermal Performance of Composites for Biobased Applications

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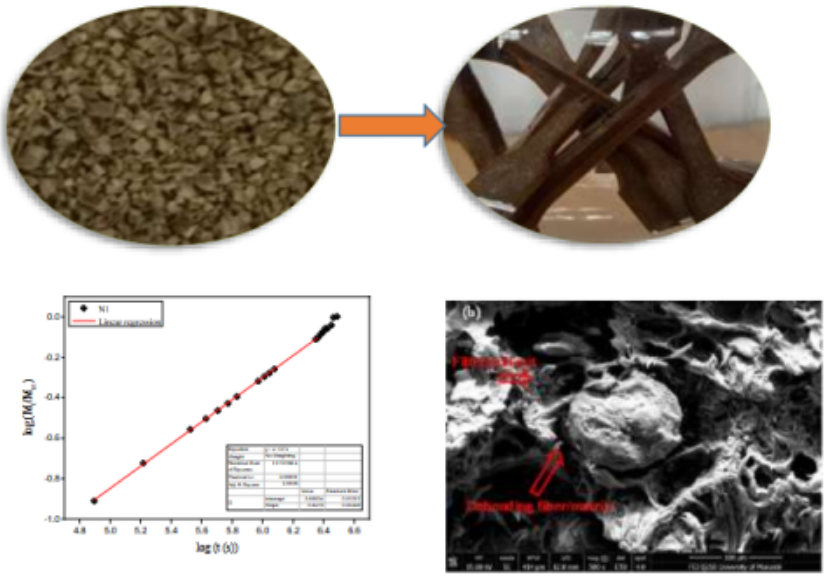
Abstract: The application of biobased composites in outdoor settings is a rapidly growing area, driven by the increasing demand for sustainable materials that can withstand environmental conditions. One of the key challenges is ensuring that biobased composites perform well under varying temperature and moisture conditions (hygrothermal environments). These materials must be able to withstand outdoor weather changes, including humidity, rain, and temperature fluctuations. The aim of the present study is to examine the hygrothermal performance of reprocessed composite materials based on a polypropylene (PP) matrix reinforced with 50 wt% Olive Stone Flour (OSF) and coupled with 5 wt% of PP-g-MA (MAPP). Comparative tests of the mechanical and morphological properties of both virgin and recycled composites are performed. Results indicate that the reprocessed PP/OSF/MAPP material maintains impact strength as compared to the virgin PP/OSF/MAPP material. In addition it is shown that water absorption is acting as a plasticizing agent in recycling process which generates the elongation at break and impact strength. Results are well correlated with experimental microstructural observation.

Keywords: biobased composite, Hygrothermal aging, Impact strength, SEM.



Graphical abstract

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Double half-Heusler Compounds: Novel High Efficiency Optoelectronic Materials for Energy Applications

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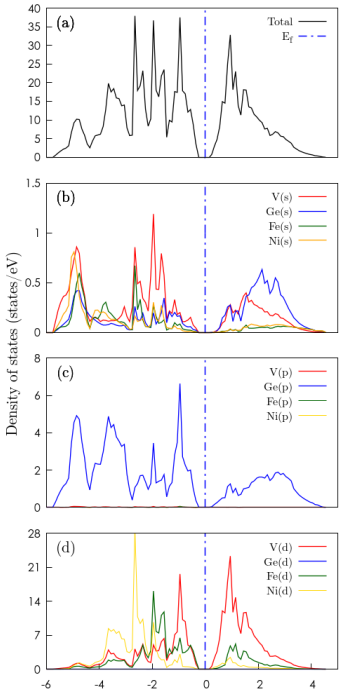
Abstract: Double half-Heusler compounds have emerged as promising candidates for opto-electronic and thermo-electric applications due to their unique structural and electronic properties. This review focuses on the comprehensive investigation of V?FeNiGe? and Hf?FeNiSb? compounds, highlighting their structural, mechanical, electronic, thermodynamic, and optical characteristics. These compounds exhibit intriguing optical properties, such as bandgap engineering and light absorption features, which are crucial for their application in photovoltaics and light-emitting devices. Additionally, their excellent mechanical stability and favorable thermoelectric performance make them suitable for energy conversion applications. The crystal structure of double half-Heusler compounds enables tailored band alignments, facilitating efficient heat-to-electricity conversion in thermo-electric devices. Understanding the interplay between these properties is essential for optimizing the design and performance of future opto-electronic and thermo-electric technologies based on double half-Heusler semiconductors.

Keywords: Double half-Heuslers, Optical and thermoelectric properties, opto-electronic and thermoelectric devices.



Graphical abstract

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The impact of different process parameters on the tensile properties of PLA produced by Fused Filament Fabrication (FFF)

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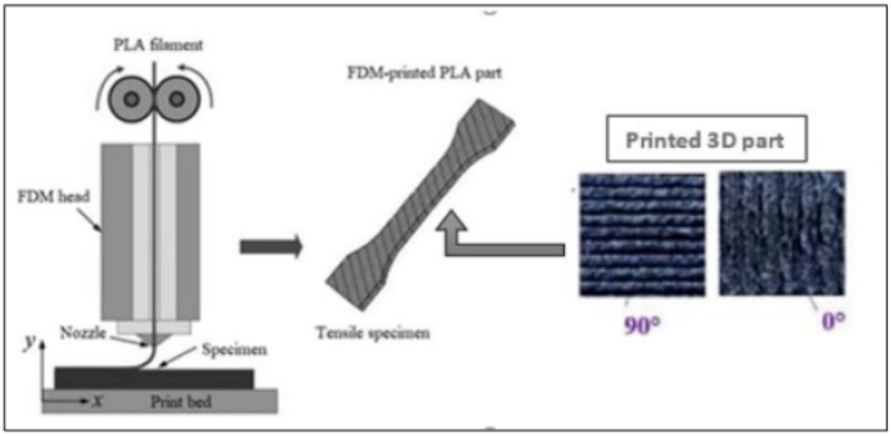
[2] *Laboratory of Electro-Mechanic Systems (LASEM), National School of Engineers of Sfax (ENIS), Tunisia*

Abstract: Fused Filament Fabrication (FFF) is one of the additive manufacturing (AM) techniques that currently plays a crucial role in the industrial sector, thanks to its simplicity and low operating costs. In particular, techniques such as FFF involve several parameters, including the choice of material, which have a decisive impact on print quality. Therefore, it is essential to carefully control process parameters, as they directly influence this quality, as highlighted by the extensive literature review on their effects. This study investigates the effect of various process parameters on the flexural properties of PLA processed via FFF, specifically the printing angle (°), carbon content (%), and layer thickness (mm), on the tensile strength of printed parts. To achieve this, 12 standard specimens were printed and subjected to tensile testing in accordance with ASTM D638 standards. The results were analyzed in terms of mechanical properties, particularly the ultimate tensile strength (UTS), and revealed that these parameters significantly affect the tensile strength of the printed samples.

Keywords: PLA polymers, mechanical properties, ultimate tensile strength (UTS), Flexural properties



Graphical abstract

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Multi-axis machining process of a gas turbine blade

Khadidja Bouhadja [1] *, Fethi Remli [1], Ilyes Hassaid [2]

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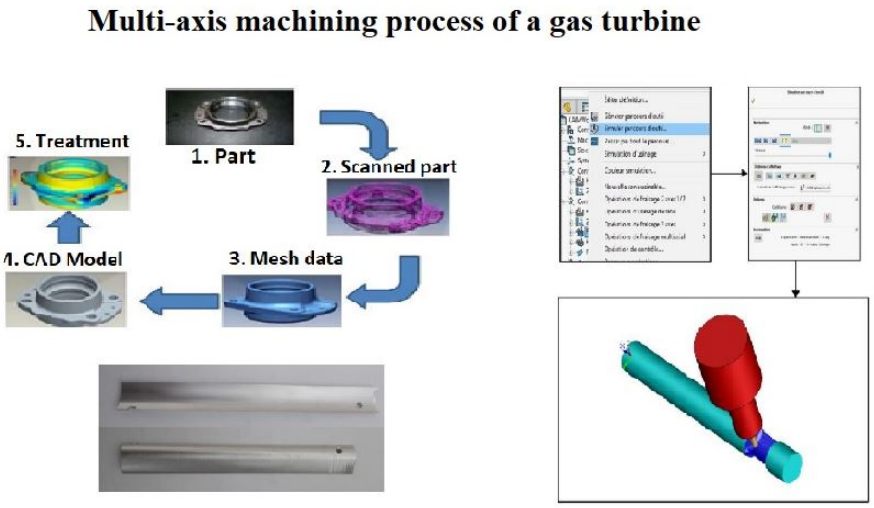
[2] *AlcadWorks, Algiers, Algeria*

Abstract: Increasing competition in the mechanical engineering industry is driving the de-velopment of more complex, higher quality part designs in the shortest possible time, combining aesthetics and functionality. Free surface geometry problems arise at three levels: design, manufacture and measurement. Despite the existence of several manufacturing processes, machining remains the most commonly used process to produce these parts. Moreover, due to their complex geometric shapes, these parts are machined on multi-axis digital milling machines (MOCN) with three or more axes. The aim of this work is to study the steps in the process of manufacturing free-form parts using multi-axis milling, focusing on the technical aspects. This study is founded on an experimental reverse engineering approach for the manufacture of a gas turbine blade.

Keywords: Free surface, multi-axis machining, CAD, CAM, reverse engineering



Graphical abstract

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Machining evaluation of Complex surfaces

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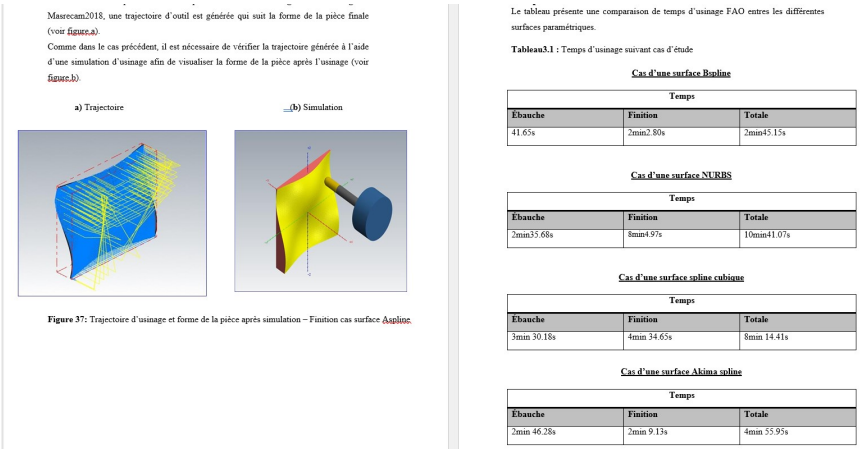
[2] *Laboratory of Applied Fluid Mechanics, Process Engineering and Environment, ENIS, University of Sfax, Tunisia*

Abstract: This study concerns modelling and optimizing the machining of certain polynomial surfaces such as NURBS, Bspline, Cspline, Aspline, using CAD/CAM software. A modeling method of parametric curves and complex surfaces is detailed. The work is achieved by a case of study of the roughing and the finishing machining simulations of certain surfaces with the CAM cycle time measurements. As results, the interpolation type influences the machining time of spline surfaces and free forms.

Keywords: Complex surfaces, Machining, NURBS, Bspline, Cspline, Aspline, CNC machine-tools, Cycle time


Masrecam2018, une trajectoire d'outil est générée qui suit la forme de la pièce finale (voir figure.a).
Comme dans le cas précédent, il est nécessaire de vérifier la trajectoire générée à l'aide d'une simulation d'usinage afin de visualiser la forme de la pièce après l'usinage (voir figure.b).

a) Trajectoire (b) Simulation

Figure 37: Trajectoire d'usinage et forme de la pièce après simulation – Finition cas surface Aspline

Le tableau présente une comparaison de temps d'usinage FAO entres les différentes surfaces paramétriques.

Tableau3.1 : Temps d'usinage suivant cas d'étude

Cas d'une surface Bspline

Temps		
Ebauche	**Finition**	**Totale**
41.65s	2min2.80s	2min45.15s

Cas d'une surface NURBS

Temps		
Ebauche	**Finition**	**Totale**
2min35.68s	8mn4.97s	10min41.07s

Cas d'une surface spline cubique

Temps		
Ebauche	**Finition**	**Totale**
3min 30.18s	4min 34.65s	8min 14.41s

Cas d'une surface Akima spline

Temps		
Ebauche	**Finition**	**Totale**
2min 46.28s	2min 9.13s	4min 55.95s

Graphical abstract

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MIs investigation in the stirred vessel by means of URANS model

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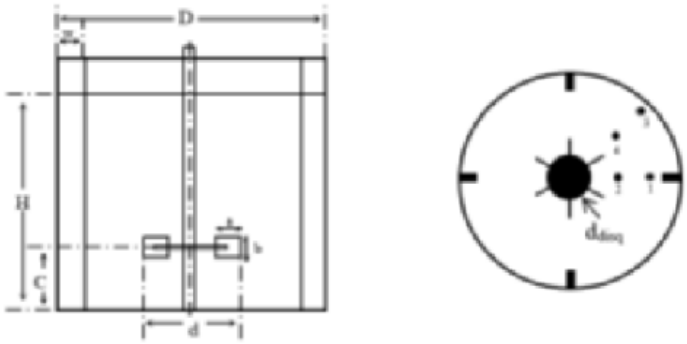
Abstract: In this investigation, we have tested the usual assumption identified for the resolution of Unsteady Reynolds Averaged Navies-Stokes Equations (URANS) inside the stirred vessel. In fact, CFD simulations of the hydrodynamic behavior induced by a Rushton turbine (RT) in a fully baffled vessel operating in a turbulent regime have been presented. Numerical results obtained with symmetrical and asymmetrical zones of the stirred tank and different turbulence models (standard k?? model, RNG k?? model, and Large Eddy Simulation) have been compared with the in-house PIV experimental data. Results shows that the k?? turbulence model applied in the entire tank is able to predict the macro-instabilities inside the vessel.

Keywords: CFD, URANS, LES, stirred vessel, Rushton Turbine, Macro-instability



H/D	C/D	w/D	d/D	d_{disq}/D	a/D	b/D
1	1/3	1/10	1/3	3/4	1/4	1/5

Graphical abstract

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Assessment of Global Solar radiation estimates from Satellite data in Algeria: A Case Study of the Adrar Region

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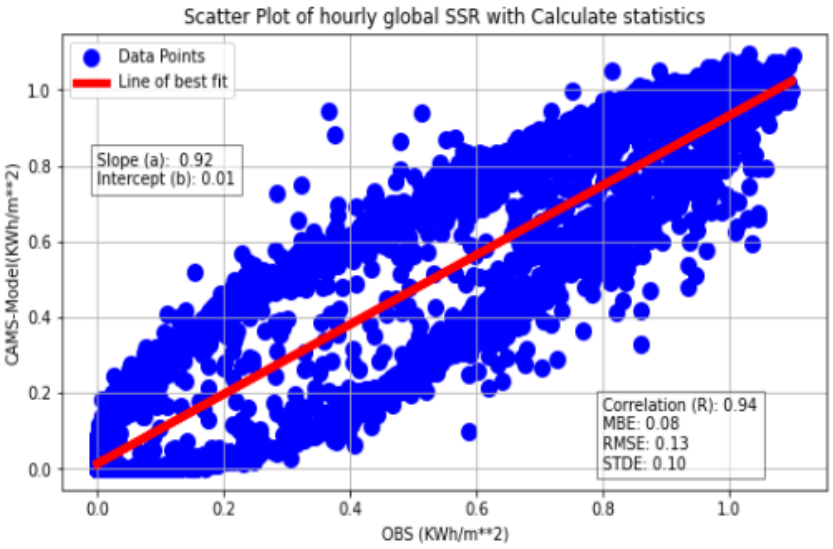
Abstract: To assess the solar potential of any region, accurate measurements of Global surface solar radiation (GSSR) are crucial. Here, we compare 1 year (2014) of global SSR measurements from Adrar region, Algeria, with satellite-derived estimates from the European CAMS Radiation Service data across hourly to daily timescales. Statistical metrics (Bias, RMSE, STDE, Correlation coefficient) are used to evaluate CAMS ability to reproduce the key features of the measured data. Our results demonstrate that CAMS global solar data satisfactorily captures the temporal dynamics of GSSR over Adrar with a correlation reaching (R=0.98).

Keywords: : Solar radiation, CAMS Radiation Service data, reanalysis, ECMWF



Graphical abstract

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Study of parameters influencing macro-instabilities

Mariem Ammar [1] *, Bilel Ben amira [1], Zied Driss [1], Mohamed Salah Abid [1]

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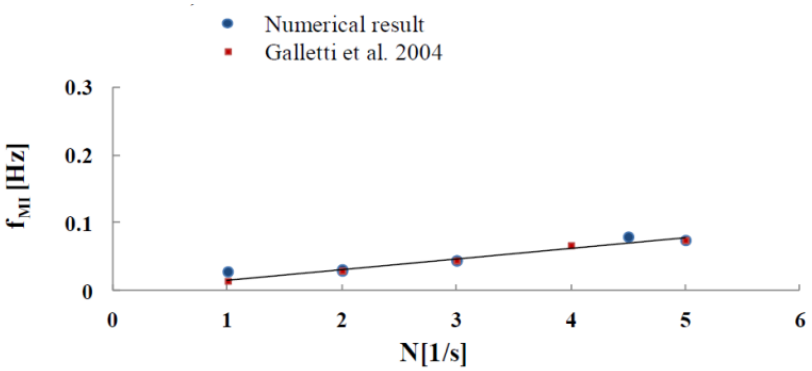
Abstract: This investigation includes a study of the influence of geometric and hydrodynamic parameters on the macro-instabilities (MI) appearing around a six-bladed Rushton turbine. We begin by studying the effect of baffles by comparing the flows in a baffled tank and an unbaffled closed tank. Then, the effect of the axial position of the Rushton turbine in a baffled cylindrical tank is studied, for two different axial positions C/T=1/2 and C/T=1/4. Finally, the effect of the turbine diameter on the frequency of macro-instabilities is analysed for two diameters d/D=1/2 and d/D=1/4. In a second part, the relationship between the rotational speed of the turbine and the frequencies of macro-instabilities is investigated for different flow regimes.

Keywords: baffles, geometric parameters, stirred vessel, Rushton Turbine, Macro-instability



Graphical abstract

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Energetic analysis of bio refinery processes for biofuels obtaining

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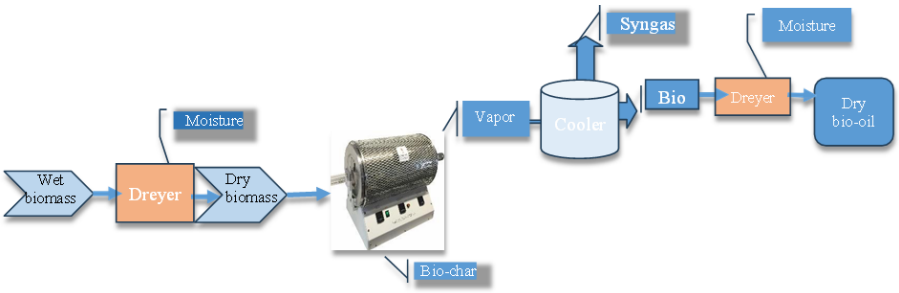
Abstract: In this research study, the aim was to explore and develop the potential of two types of biomass as viable sources for generating biofuel and biochar. The research methodology involved a comprehensive experimental analysis of the selected biomass types of Date pits and walnut shells. This analysis included characterizing the composition, moisture content, and energy content of the biomass samples. The goal was to understand the chemical and physical properties of the biomass and identify their suitability for biofuel and biochar production. The next phase of the study involved conducting a pyrolysis process on the biomass samples, the pyrolysis experiments conducted in this research study involved subjecting the biomass samples to high temperatures in the absence of oxygen. This thermal decomposition process resulted in the production of bio-oil, biochar, and syngas. The carefully designed and optimized pyrolysis experiments successfully demonstrated the efficient conversion of biomass into valuable biofuel and biochar products, highlighting the potential of pyrolysis as a promising technology for sustainable energy production. The simulation using Aspen Plus enabled a deeper understanding of the pyrolysis process and helped in optimizing the operating conditions for maximum biofuel and biochar yields. Additionally, the simulation provided insights into the energy efficiency and economic viability of the process.

Keywords: Biofuel, Biochar, Pyrolysis, simulation, Aspen Plus



Graphical abstract

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2D numerical modeling of Mass and Heat Transfer in Solid Oxide Fuel Cells Fueled by Biohydrogen

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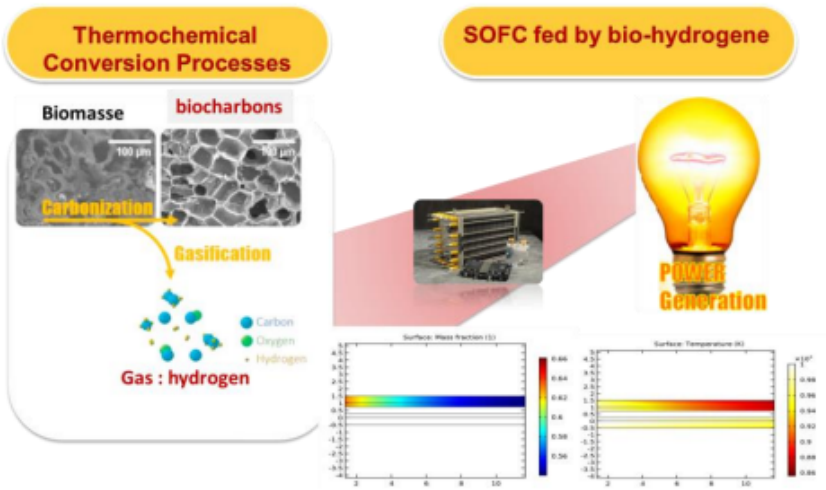
Abstract: This study investigates the integration of biohydrogen derived from biomass into Solid Oxide Fuel Cells (SOFC), focusing on intermediate temperature operations (650–800°C) that enhance ionic conductivity and simplify system architecture by enabling internal fuel reforming. A detailed numerical model was developed using COMSOL Multiphysics to analyze thermal and mass transfer dynamics within the SOFC system. Biohydrogen was produced through advanced gasification and reforming of biomass residues and microalgae, providing a sustainable and renewable fuel source. The SOFC design features an SDC/Ni composite anode (samarium-doped cerium and nickel) to achieve high mixed conductivity and resistance to carbon deposition. The electrolyte is composed of an SDC/molten carbonate composite for improved ionic conductivity and chemical stability at high temperatures. The cathode utilizes lithium nickel oxide (LiNiO?), recognized for its superior catalytic activity in oxygen reduction and robust thermal stability. Simulation results demonstrate efficient hydrogen diffusion and significant oxygen depletion, with critical thermal zones identified at the anode/electrolyte interface and the cathode due to exothermic reactions and ohmic losses. These findings highlight the compatibility of SOFCs with biohydrogen, showcasing their potential for high efficiency and long-term durability. This work underscores the role of optimized materials and operational strategies in advancing SOFC technology as a cornerstone for low-emission energy systems.

Keywords: solid oxide fuel, Biohydrogen, Heat transfer modeling, Mass transfer modeling, Intermediate temperature, COMSOL Multiphysics



Graphical abstract

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Investigating Surface Roughness in EDM: Experimental Observations from C45 Steel

Ikram Messaoudi [1] *, Amal Anizi [1], Boutheina Ben fraj [2], Taoufik Kamoun [3], Walid Meslameni [3], Hamdi Hentati [1], Mohamed Haddar [1]

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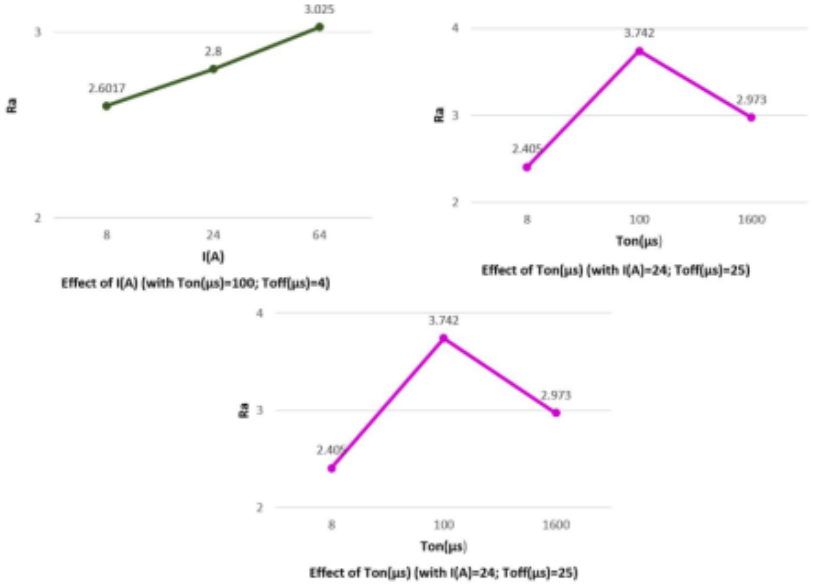
[2] *CRTEn, Technoparc Borj Cedria, Hammam Lif, Tunisia*
[3] *Higher Institute of Technological Studies of Sfax, Tunisia*

Abstract: The paper investigates the electrical discharge machining process (EDM), which is widely used in manufacturing dies. It focuses on key machining parameters principally pulse duration (Ton), pause time (Toff), and discharge current (I), which significantly affect both the workpiece and the tool during material removal. Experimental tests were conducted to analyze the effect of these parameters on the roughness (Ra) of C45 steel workpieces. We developed an experimental model to predict Ra using the design of experiments (DOE) method. The statistic method was applied to model and analyze the outcomes, demonstrating a strong correlation between experimental results and calculated predictions

Keywords: EDM process, Experimental analysis, DOE model



Graphical abstract

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From Sensors to Insights: Revolutionizing Medical Instrumentation with Artificial Intelligence

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[2] *LA2MP Laboratory, University of Sfax, Tunisia*

Abstract: AI-powered patient monitoring systems are revolutionizing healthcare by enabling real-time detection and response to critical health conditions. By analysing physiological data, these systems can predict emergencies and trigger timely interventions, significantly improving patient outcomes. The integration of advanced medical instrumentation, sensor selection, and cutting-edge medical equipment plays a pivotal role in enhancing accuracy and reliability. Through optimized sensor design, precise instrumentation, and AI-driven insights, these technologies reduce response times and personalize care, positioning AI as a transformative tool in modern medicine. This work examines the current impact, challenges, and potential of AI-driven monitoring technologies, with a focus on sensor choices, medical instrumentation, and their role in reshaping patient care.

Keywords: Monitoring system, Artificial Intelligence, instrumentation

Graphical abstract

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Exploring the Strength of Flexible-Bladed Rotors Using the Fluid-Structure Interaction Approach

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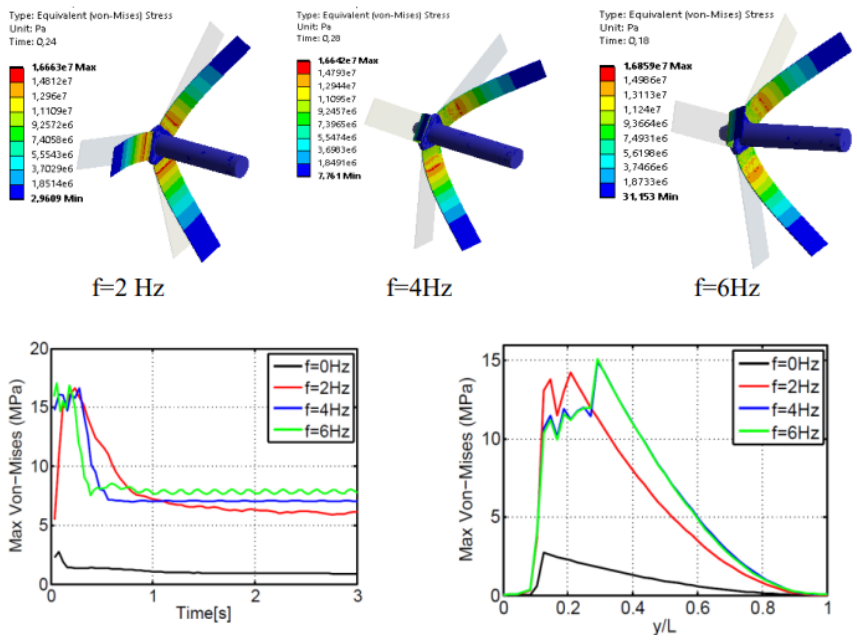
[2] *Aix-Marseille Université, Institut de Recherche sur les Phénomènes Hors Equilibre, UMR 7342, CNRS, Centrale Méditerranée, BP 146 Technopôle de Château Gombert, Marseille, 13384, France*

Abstract: Today, the study and research on flexible rotor blades dominate modern aerodynamic systems, especially in the fields of wind energy and aviation. The performance of flexible blade rotors is one of the key research objectives, as it is influenced by various factors such as aerodynamic design, flexibility, number of blades, etc. In this context, this study investigates a numerical exploration of fluidstructure interaction aimed at studying the elastic behavior of flexible-bladed rotors. This study uses a robust bidirectional fluid-structure interaction (FSI) approach developed under ANSYS Workbench software. This approach couples the transient structure solver to the fluid dynamics solver while respecting the coupling conditions at the interfaces. The rotors studied consist of moderately flexible blades with a simplified rectangular geometry. The main objective of this work is to analyze the effect of flow and blade number on the stress distribution in the blades. To this end, three rotor configurations are used. These rotors are submerged in water in order to apply more load. The results show that the behavior of the different rotors is similar, and the stress is highly dependent on the generated deformations.

Keywords: flexible rotor blades, number of blades, Von Mises stresses, ANSYS software



Graphical abstract

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Publication

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All the accepted papers will be published in the Conference Proceeding.

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- The consolidation of solidarity, mutual assistance and friendship among researchers in different countries,
- The online library rich documents,
- The organization of scientific events.

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