5th INTERNATIONAL CONFERENCE

on

RECENT ADVANCES IN MECHANICAL ENGINEERING AND NANOMATERIALS

Organized By

DEPARTMENT OF MECHANICAL ENGINEERING

St. John College of Engineering and Management, (Palghar)

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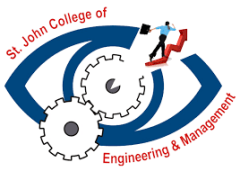

Department of Mechanical Engineering

ST. JOHN COLLEGE OF ENGINEERING AND MANAGEMENT, PALGHAR, INDIA

In Association with

RESEARCH ASSOCIATION OF MASTERS IN ENGINEERING, INDIA

St. John College of Engineering and Management (SJCEM)
Vevoor, Manor Road, Palghar (East), Maharashtra, India

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PREFACE

ICRAMEN 2025 is committed to provide a peer reviewed platform to outstanding researchers to exhibit their findings for the furtherance of technology. We are devoted to continuous innovation to better support the wishes of our communities, making sure the integrity of the research we publish and championing the importance of open research.

ICRAMEN 2025: 5th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials is focused on the development and integration of mechanical and nanomaterial technologies, inviting well-known experts and scholars at home and abroad, as well as scientific researchers and industry practitioners in the field of mechanical and material, to jointly discuss the cutting-edge technologies of mechanical and nanomaterial and their new applications in different industries and build a innovation ecosystem. ICRAMEN 2025 aimed to showcase state-of-the-art methodologies and technologies in Engineering and Technology. It focused on new ideas and paves the way to disseminate the latest innovations and practices. It facilitates opportunities to network, collaborates and exchange ideas with renowned leaders, scientists, and researchers in Mechanical Engineering and Nanomaterials. It acts as a crucial platform for industry and academia to foster innovative ideas, theories, frameworks and applications. ICRAMEN 2025 was encouraged recent and futuristic advancements, challenges, and new strategies in the frontiers of Mechanical Engineering and Nanomaterials.

About the Editor

Dr. Kishor Rambhad is a distinguished academician in the field of Mechanical Engineering, with a B.E. in Mechanical Engineering, M.Tech. in Heat Power Engineering from Visvesvaraya National Institute of Technology and a Ph.D. in Mechanical Engineering from Rashtrasant Tukadoji Maharaj Nagpur University. He currently holds the position of Associate Professor & HOD in the Mechanical Engineering Department at St. John College of Engineering and Management, Palghar, with an extensive academic career spanning over 18 years. He has made significant contributions to research and innovation, with over 45 research papers published in international journals and conferences, 2 granted patents, and 2 copyrights to his credit. He has contributed as an author of book chapters published by international publishers. His expertise is sought after in editorial roles, having served as reviewer and editorial board member for reputed journals. Dr. Rambhad has successfully guided numerous undergraduate and postgraduate projects, and is recognized for his involvement in NBA and NAAC accreditation processes, curriculum development and academic leadership. His research interests include alternative fuels, renewable energy, IC engines, heat transfer and computational fluid dynamics (CFD).

Dr. Kamal Shah is a distinguished academician in the field of Engineering, renowned for her expertise and leadership. She holds a B.E. in Electrical Engineering, an M.E. in Electronics and Telecommunication Engineering, a Ph.D. in Information Technology, and a Post-Doctorate in Quantum Computing. Currently serving as the Principal of St. John College of Engineering and Management, Palghar, she brings over 27 years of rich academic and administrative experience. Throughout her illustrious career, Dr. Shah has made substantial contributions to research and innovation. Her scholarly influence extends to prestigious academic journals, where she has served as both a reviewer and a member of editorial boards. She has successfully mentored numerous undergraduate, postgraduate and doctoral research projects, demonstrating a deep commitment to academic excellence and student development. Recognized for her visionary approach to education, Dr. Shah has played a pivotal role in the curriculum development of Information Technology at the University level. Her leadership, academic rigor and dedication to the advancement of engineering education continue to inspire students and peers alike.

About St. John College of Engineering and Management

St. John College of Engineering and Management (SJCEM), established in the year 2008, is located in Palghar, Maharashtra. The college is part of the St. John Technical and Educational Campus and is affiliated to the University of Mumbai. SJCEM offers a range of undergraduate and postgraduate programs in engineering and management disciplines, including Civil Engineering, Computer Engineering, Information Technology, Electronics and Telecommunication, Mechanical Engineering, Artificial Intelligence and Machine Learning, Data Science, Electronics and Computer Science.

The campus is situated in a serene environment in Vevoor, Palghar (East), providing a conducive atmosphere for learning and research. SJCEM has achieved significant milestones, becoming the youngest engineering college under the University of Mumbai to receive "Autonomous Status" from the UGC and the 1st engineering college in Palghar District to do so. The college has also consistently secured first prizes in the "Smart India Hackathon" in the years 2017, 2020 and 2022.

SJCEM is committed to imparting quality education and fostering holistic development, aiming to nurture socially responsible engineers, entrepreneurs, and leaders.

Vision and Mission of SJCEM

Vision

“Excellence in Engineering Education & Creating Next-Gen Leaders / Managers in the Service of Society”

Mission

- To impart quality engineering education for holistic development
- To provide conducive environment for joyful learning, innovation and research
- To promote innovative technology enabled teaching and learning process
- To nurture socially responsible engineers, entrepreneurs and leaders
- To enhance employability skills to meet the changing industrial trends

About Research Association of Masters in Engineering

Research Association of Masters in Engineering is committed to providing a peer reviewed platform to outstanding researchers to exhibit their findings for the furtherance of technology. They are devoted to continual innovation to better support the wishes of their communities, making sure the integrity of the research they publish and championing the importance of open research.

They invite young students, scientist, researchers and academicians to contribute their research and convert their research work in technical papers. The publication also helps in enhancing awareness about the need to become innovative and research minded. They provide a forum to publish complementary aspects in science and engineering using computational methods and experimental measurements, and to stress the importance of their harmonious development and integration. Their aim is to become an effective medium for inspiring the innovators and researchers to bring out their contributions in the form of research papers, articles, case studies, review articles and innovations in the fields of Engineering, Science and Technology.

About ICRAMEN 2025

ICRAMEN 2025 is a two day conference that aims to showcase state-of-the-art methodologies and technologies in Mechanical Engineering and Nanomaterials. It focuses on new ideas and paves the way to disseminate the latest innovations and practices. It facilitates opportunities to connect collaborates, and exchange ideas with renowned leaders, scientists, and researchers in Mechanical Engineering and Nanomaterials. It acts as a crucial platform for industry and academia to foster innovative ideas, theories, frameworks and applications. ICRAMEN 2025 will encourage recent and futuristic advancements, challenges and new strategies in the frontiers of Mechanical Engineering and Nanomaterials.

Conference website: **https://icramen.rame.org.in/2025/**

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Message from the Chairman

Research, innovation and invention play a pivotal role in gaining a competitive edge for learners in this era of rapid technological and scientific advancement.

St. John College of Engineering and Management (SJCEM) is a premier autonomous technical institute committed to delivering quality education in all major disciplines of Engineering and Management. With strong associations with national organizations and the integration of the National Education Policy (NEP) into its curriculum, the institute provides a holistic and multidisciplinary learning experience. SJCEM places significant emphasis on extracurricular activities to foster the all-round development of its students.

Our world-class infrastructure, state-of-the-art equipment and a team of competent, talented, and dedicated faculty members contribute to an impactful learning environment that meets global standards. The institute is dedicated to nurturing a culture where new ideas, research, and scholarship thrive paving the way for the emergence of creators, innovators, leaders, and entrepreneurs.

SJCEM has a long-standing tradition of organizing seminars, conferences, workshops, and symposiums that stimulate intellectual growth. One such flagship event is ICRAMEN 2025, an International Conference that serves as a distinguished platform to deliberate on the latest trends in science and technology, analyze challenges and explore innovative solutions. It facilitates the exchange of ideas, cutting-edge research and fosters collaboration among academicians, researchers and industry professionals.

With the conferment of autonomous status from the Academic Year 2024–25, SJCEM is better poised to design and deliver an enriched academic ecosystem tailored to evolving global standards.

I believe that young researchers deserve such opportunities to excel in their respective domains. I wish all participants a successful, safe and enriching experience at ICRAMEN 2025.

Mr. Albert W. D'Souza

Chairman - Aldel Education Trust

Message from the Principal

At the outset, I extend my heartfelt congratulations to the organizing committee of ICRAMEN 2025 for successfully bringing together scholars, researchers, and professionals from across the globe to share their knowledge, innovations, and research outcomes.

The wide spectrum of topics covered under the conference tracks spanning Engineering, Management and Technical Education has fostered a truly interdisciplinary platform. This comprehensive approach has evoked an overwhelming response and provided a 360-degree perspective on emerging research areas and industry trends.

Such events are not only vital for knowledge dissemination but also act as catalysts in nurturing a culture of research, innovation and critical inquiry. The rich deliberations and insightful sessions held during ICRAMEN 2025 will undoubtedly leave a lasting impact, inspiring participants to explore, ideate, and contribute meaningfully to their respective fields.

I wish all the delegates, presenters and organizers continued success and fruitful engagement. May ICRAMEN 2025 mark yet another milestone in the journey of academic excellence at SJCEM.

Dr. Kamal Shah
Principal,
SJCEM, Palghar

Message from the Convener

It gives me immense pleasure to welcome you all to the 5th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025), organized by the Department of Mechanical Engineering, St. John College of Engineering and Management (SJCEM), Palghar.

In an era driven by innovation and interdisciplinary research, this conference serves as a dynamic platform for researchers, academicians, industry professionals and students to come together and deliberate on the recent trends, challenges, and advancements in the fields of Mechanical Engineering and Nanomaterials. Research, as we know, is a journey of continuous exploration and rediscovery that fuels the growth of knowledge, technology and sustainable solutions for society.

At SJCEM, we are committed to fostering a culture of research and innovation. ICRAMEN 2025 reflects this vision by encouraging the exchange of ideas, collaborative learning and knowledge sharing on both national and international fronts. The conference also aims to bridge the gap between academia and industry by inviting experts to share insights from real-world practices and emerging technologies.

I take this opportunity to congratulate all participants and thank our keynote speakers, reviewers, organizing team, and sponsors for their valuable contributions. I am confident that the discussions and research presented during this event will inspire further exploration and collaborative initiatives.

Wishing you all an enriching and insightful experience at ICRAMEN 2025!

Dr. Kishor Rambhad
Convener – ICRAMEN 2025
Head, Department of Mechanical Engineering
St. John College of Engineering and Management, Palghar

Message from Co-Convener

It is with great enthusiasm that I extend a warm welcome to all participants of the 5th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025), hosted by the Department of Mechanical Engineering, St. John College of Engineering and Management (SJCEM), Palghar.

This conference stands as a testimony to the spirit of collaborative innovation and the pursuit of scientific excellence. ICRAMEN 2025 brings together a distinguished assembly of researchers, academicians, industry experts, and students from across the globe to engage in meaningful discourse, present pioneering work, and explore the evolving landscape of Mechanical Engineering and Nanomaterials.

At SJCEM, we firmly believe that progress emerges from synergy—between disciplines, institutions, and individuals. This event is an embodiment of that belief, aiming to foster impactful dialogue, promote knowledge dissemination and build bridges between theoretical research and industrial applications.

I would like to express my heartfelt appreciation to our keynote speakers, paper reviewers, organizing committee and sponsors for their invaluable support. Your contributions are the pillars that uphold the success of this scholarly gathering.

May this conference serve as a catalyst for new ideas, enduring collaborations and transformative research journeys.

Wishing you a rewarding and intellectually enriching experience at ICRAMEN 2025!

Mr. Kiran Beldar
Co-Convener – ICRAMEN 2025
Assistant Professor, Department of Mechanical Engineering
St. John College of Engineering and Management, Palghar

Message from the President, Research Association of Masters in Engineering,

I am very happy to share that St. John College of Engineering and Management in association with Research Association of Masters in Engineering is organized an International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025) during May 16-17, 2025.

The fast advancements in technology make the promotion of technical competence in the workforce highly essential nowadays. One of the main problems for scientists is the implementation of their highly specialized research in many domains of human knowledge and interdisciplinary study. This problem must be seen as an opportunity for human resources development in a variety of areas. The other significant problem is to discover how these material advancements may be utilized to better the everyday job and the common person's surroundings. In these recent years there has been a lot of focus to promoting cross-disciplinary research with issues in Science and Engineering.

I'm confident there will be many intellectually engaging contacts and the presentation of constructive ideas which would benefit a broad spectrum of participants in the conference on current achievements in Science and Engineering.

I congratulate the entire team and extend my best wishes for its success.

Dr. Manoj Kumbhalkar

President, Research Association of Masters in Engineering,

Message from the Chief Guest

It gives me immense pleasure to be associated with the 5th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025*)*, organized by St. John College of Engineering and Management, Palghar, in collaboration with the Research Association of Masters in Engineering. This academic congregation serves as a vital platform to bring together researchers, academicians, and industry professionals from across the globe to deliberate on cutting-edge innovations and practical applications in the interdisciplinary areas of mechanical engineering and nanomaterials.

As a firm believer in the power of research and innovation, I commend the efforts of the organizing committee in promoting a research-oriented culture and fostering intellectual synergy. Such conferences play a pivotal role in bridging the gap between academia and industry while simultaneously motivating budding engineers and scholars to contribute towards sustainable technological development.

I extend my best wishes to all participants, organizers, and contributors for the successful execution of ICRAMEN 2025 and hope that the knowledge shared here leads to fruitful collaborations and transformative innovations.

Dr. Santosh Rane
Chief Guest
Professor, Sardar Patel College of Engineering, Mumbai

Message from National Advisory Committee Member

It is a privilege to extend my greetings as a National Advisory Board Member for the International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025). This conference stands as a dynamic forum where innovative minds converge to discuss transformative developments in two of the most rapidly evolving domains—mechanical engineering and nanomaterials.

The integration of nanotechnology into mechanical systems has redefined the scope of design, efficiency, and functionality. As we transition into a future driven by smart manufacturing, energy optimization, and miniaturized solutions, platforms like ICRAMEN 2025 become critical for knowledge dissemination and collaborative growth.

I applaud the organizers for their initiative in assembling a diverse and esteemed group of contributors from academia and industry. I am optimistic that the ideas exchanged and the research presented during this event will inspire forward-thinking strategies and pave the way for groundbreaking innovations.

Wishing all attendees a successful and stimulating conference experience.

Dr. Pramod Walke
Dean Academics and Deputy Director
Professor in Mechanical Engineering
G H Raisoni College of Engineering, Nagpur

Message from the International Advisory Committee Members

It is a privilege to be associated with the 5th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025), organized by St. John College of Engineering and Management, India. I am delighted to offer my best wishes to the entire team behind this commendable initiative.

Conferences like ICRAMEN 2025 play a pivotal role in advancing global research by providing a collaborative platform for scholars, innovators, and industry experts. The fusion of mechanical engineering principles with the transformative potential of nanomaterials opens up exciting avenues for research and application.

As an International Advisory Committee member, I am truly impressed by the vision and academic rigor reflected in the themes of this conference. I am confident that the insights shared and connections built during these two days will lead to significant contributions to science and technology.

Wishing all participants a thought-provoking and fruitful experience. May ICRAMEN 2025 continue to grow in reach, impact, and academic distinction.

Dr. Wadhah Hussein Al Doori
Member, International Advisory Committee
Professor, Tikrit University, Tikrit, Iraq

Message from the Keynote Speaker

It gives me immense pleasure to extend my heartfelt best wishes to the organizing committee, participants, and esteemed delegates of the 5th International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (ICRAMEN 2025), being held at St. John College of Engineering and Management, Palghar, on 16th and 17th May 2025.

Conferences like ICRAMEN serve as a vibrant platform for academicians, researchers, and industry professionals to come together, share innovative ideas, and explore the frontiers of knowledge in Mechanical Engineering and the rapidly evolving domain of Nanomaterials. I am truly honoured to be a part of this intellectual gathering as a Keynote Speaker and to witness the dedication and enthusiasm of emerging scholars and professionals.

I commend the efforts of the organizing team for their commitment to fostering research and collaboration. May this conference inspire new thoughts, ignite meaningful discussions, and contribute significantly to the global body of knowledge.

Wishing ICRAMEN 2025 great success and a lasting impact in the academic and industrial community.

Dr. S. A. Khan
Keynote Speaker
Professor, Department of Mechanical Engineering,
International Islamic University Malaysia, Kuala Lumpur. Malaysia

List of Papers

ABSTRACTS

ICRAMEN-2025

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Track
General Engineering

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ICRAMEN_2025_002

Review of the design concept & manufacturing of dip tube cutting machine

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Abstract

The Aerosol Valve Dip Tube Cutting Machine is a specialized equipment designed for precise and efficient cutting of dip tubes in aerosol valves. This machine plays a crucial role in the manufacturing process of aerosol products, ensuring accurate dip tube lengths to facilitate proper dispensing and functionality. In today's highly competitive market, it is crucial to develop new methods or processes for more efficient dip tube cutting.

Keywords: Aerosol valve, Pneumatic switch, Stem-actuated valve

ICRAMEN_2025_010

Development and Optimization of Flexible Ultrasonic Phased-Array Probes for Enhanced Inspection of Complex-Shaped Components

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Abstract

This review paper provides a thorough analysis of recent developments in ultrasonic testing techniques in domain of testing of complex-shaped industrial components. It has been challenging for conventional ultrasonic testing (UT) methods due to inconsistent coupling and beam distortion on such irregular surfaces. We try to analyze the root causes and come up with possible solutions via theory on development and optimization of flexible ultrasonic phased-array probes, advanced imaging algorithms to support these probes, and few alternatives such as cryo-ultrasonic testing. We also dive into modeling and simulation techniques for ultrasonic wave propagation in this context. We examine the design aspects of flexible transducers, Total Focusing Method (TFM) and Time-Reversal MUSIC algorithms and the potential use of cryo-ultrasonic testing using ice as a solid couplant. Model approaches like the Fast Marching Method (FMM) and Finite Difference Time Domain (FDTD) can be used to forecast wave propagation in complex and intricate geometries. At the end we note few research.

ICRAMEN_2025_012

Review on Steel Beam Structures with Web Openings

Shadab Qureshi, Prafull J. Wadhai
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Abstract

Many types of structures include steel beams, which improve the strength and flexural behaviour of the structures. Different kinds of apertures are necessary in these beams to accommodate different building services. Using both experimental and numerical methods, the current study examines previous work in the subject of beam design and analysis. These methods calculate the flexural strength and safety factor using FEA simulation programmes. Scholars who have studied the impact of web opening on beam stiffness have put forth a number of analytical ideas.

Key Words: Web Entrance, Beam

ICRAMEN_2025_020

A Comparative Analysis of Suspension Systems in Electric Vehicles

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Abstract

When it comes to climate change and emissions, electric vehicles are the key to unlocking changes in transportation systems throughout the world. Still, specific characteristics that are peculiar to wheel drive vehicles, especially motors installed directly into the wheels and varying weight distribution, are quite problematic for the suspension system. To overcome these issues, this research compares passive and semi-active suspension systems to examine their use in EVs.

Analytical models were created for both types of suspension describing the variety of factors, to include sprung mass, un-sprung mass, tire stiffness, suspension stiffness, damping coefficients, and road irregularities. Several driving simulations in MATLAB were carried out to analyze the dynamic responses considering primarily, comfort, road contact, and efficiency. It is observed from the results that at least for the case of SA suspension systems, particularly the MR damper the performance is better than the passive systems. Semi-active shows better adjustability to roads: resistance & substrate accomplishments the best ratios of performance & effectiveness.

This paper shows the benefits of implementing only certain portions of the semi-active system for EVs; these include comfort, handling and energy benefits over the passive systems. The recent studies elicited valuable information that will inform future research and development of suspension systems for EVs that meet the demands of the former for better form, function, and performance. first, second, and third level headings.

Keywords: Electric vehicles (EVS), Suspension Systems, Passive Suspension, Semi-active Suspension, Active Suspension Magneto-rheological (MR) dampers ride comfort etc.

ICRAMEN_2025_024

Methylene Blue (Mb) Removal from Aqueous Solution by Electro-Coagulation (Batch and Continuous Modes)

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Abstract

Dye contamination of wastewater has recently emerged as a critical concern on a global scale. Various physical and chemical methods for color removal from effluents have been developed and implemented with success recently. Unfortunately, owing to high operating expenses or other operational challenges, the majority of these techniques are not very useful. Because of its low operating cost and excellent results, Electro Coagulation (EC) has been a very promising technology among these others. This research investigated the feasibility of removing effective MB dye from treated wastewater by means of the EC approach. The first step in conducting electrocoagulation tests was to construct a rectangular cell out of 40 x 20 x 20 cm 3 of 6 mm thick Perspex glass. Two phases of EC experiments were carried out: It takes very little time and money to use the batch electrocoagulation reactor to test how different factors affect the treatment of dye-contaminated water. Using the following parameters: gab = 2 cm, voltage = 18 V, initial dye concentration = 12 ppm, pH = 7, and time = 40 min, the results demonstrated the maximum dye removal efficiency (90%). The process employs an electrocoagulation reactor with a continuous flow. The best conditions for removing EC were studied, along with how flow rate affects the removal of dye, turbidity, and COD, as well as the EC process itself. It was found that V = 18 V, Q = 0.071 L/min, gab = 2 cm, KCl = 350 ppm, initial dye concentration = 12 ppm, effective anode area of the aluminum electrode = 1120 cm^2, and hydraulic detention duration = 30 minutes were the best settings for MB to remove dye, turbidity, and COD. Utilizing aluminum electrodes resulted in the maximum efficiencies of 92% for dye removal, 93% for turbidity removal, and 92.5% for COD removal.

Keywords: batch mode, continuous mode, electrocoagulation, electrodes, dye, and effectiveness.

ICRAMEN_2025_027

Comparative analysis on Black Spot Identification and Prediction Using Machine Learning Techniques

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Abstract

Traffic accidents have serious social and economic effects, thus transportation authorities and city planners worldwide emphasize road safety. Road safety is considerably improved by identifying and avoiding "black spots," or high-risk traffic accident zones. Machine learning (ML) systems can now analyze complex traffic data patterns and locate black spots. This comprehensive analysis examines all machine learning-based black spot prediction and detection experiments. This analysis relies on peer-reviewed journals, conference papers, and technical reports from the last decade. Several supervised, unsupervised, and hybrid machine learning methods are utilized to discover accident-causing patterns and risk factors. Decision trees, random forests, SVMs, neural networks, and clustering are examined. The research's pretreatment for missing or inconsistent data, input data quality and type (traffic volume, road layout, weather, and historical accident data), and results must be evaluated. We compare methods and assess machine learning models using accuracy, precision, recall, and F1-score. The study also discusses ML black spot prediction concerns. Improving model interpretability, sophisticated calculations, and large, high-quality datasets are difficult. It also investigates emerging trends like using deep learning and IoT data to improve forecast accuracy and implementation timelines. Finally, the paper suggests research and highlights data gaps. We emphasize consistent data gathering and model evaluation. This project aims to help academics, policymakers, and practitioners utilize machine learning to improve road safety and traffic management.

Keywords: Construction waste, Machine learning, Prediction model, Quantification of waste.

ICRAMEN_2025_034

Effect of building construct in up stream of AL Kut Barrage on Flood hazard by using 1D HEC-RAS

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Abstract

It has been frequently observed at the present time that buildings and recreational facilities are being built in river basins located in urban cities, causing peak rainfall and floods, which are some of nature's most destructive threats, resulting in significant losses in infrastructure and human life.. Floods is somewhat preventable, however the risk of flooding cannot be ruled out. And with Therefore, It is necessary for future flood protection efforts to place a greater emphasis on integrated approaches that take into account flood predictions and risk uncertainty. For this reason, it is necessary to establish an effective flood modeling and mapping strategy in order to evaluate the possible damages. This research is a hydrological models and geographic information systems were combined in order to arrive at a projection of the floods zone. at the front and back of the dam located within the borders on the river known as the Tigris in the city of Kut, central Iraq. To do this, the hydrological models HEC-RAS and HEC-GeoRAS were utilized. identify flood-prone zone with different discharge values. A fine resolution topographic scan of the target area (front and back of the embankment) was used to create a DEM of the area. Cross sections of 6 km in front and 12 km in back were used for the dam. GIS technology was used to determine terrain variation and find depths Floods in different locations in the location designated for study. There was a calibration of the model and verified through different drainages and the appropriate Mannick coefficient was found for the region using statistical estimate (RMSE). The maximum flood depth can reach 17.5 meters that correspond to this output quantity. The results employing HEC-RAS, the results of the investigation demonstrate that buildings located in river basins have a large and important impact.

Keywords: HEC-RAS1, Flood prediction , Fluid Control

ICRAMEN_2025_035

Comparative analysis on Accidental Spot Identification and Prediction for Urban roads Using Machine Learning Techniques

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Abstract

Urban road accidents pose significant risks to public safety and urban mobility. Identifying and predicting accident-prone locations can help mitigate accidents and enhance traffic management. This study presents a comparative analysis of machine learning techniques for accident spot identification and prediction in urban areas. Various supervised learning models, including Decision Trees, Random Forest, Support Vector Machines, and Neural Networks, were evaluated based on real-world accident datasets. Key influencing factors such as road geometry, traffic volume, weather conditions, and historical accident data were considered in model development. Performance metrics such as accuracy, precision, recall, and F1-score were used to assess the effectiveness of each model. The results indicate that ensemble-based approaches outperform traditional models in terms of predictive accuracy and robustness. The study highlights the potential of machine learning in proactive accident prevention and provides recommendations for urban planners and traffic management authorities.

Keywords: Accident Prediction, Machine Learning, Urban Roads, Traffic Safety, Risk Analysis

ICRAMEN_2025_036

Analysis and Prediction Model for Black Spot Identification Using Machine Learning Techniques

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Abstract

Road safety is a critical concern in transportation planning and traffic management. Identifying accident-prone locations, commonly referred to as "black spots," is essential for implementing effective countermeasures to reduce road accidents. Traditional methods for black spot identification rely on statistical analysis and historical crash data, which may lack predictive capabilities. In this study, we propose a machine learning-based approach to analyze and predict black spots using various classification and regression techniques. The research utilizes accident datasets, incorporating key influencing factors such as traffic volume, road geometry, and environmental conditions. Multiple machine learning algorithms, including Decision Trees, Random Forest, Support Vector Machines, and Artificial Neural Networks, are applied to develop a predictive model for black spot identification. The performance of these models is evaluated using accuracy metrics, such as precision, recall, and F1-score, to determine the most effective technique. The results demonstrate the potential of machine learning in enhancing road safety by accurately predicting hazardous locations and enabling proactive intervention strategies. The proposed approach can assist transportation authorities in making data-driven decisions to improve road infrastructure and minimize accident risks.

Keywords: Black spot identification, road safety, machine learning, accident prediction, traffic management.

ICRAMEN_2025_037

Mitigation of Road Accidents in Expressways using a Novel Approach

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Abstract

The "Mitigation of Road Accidents in Expressways using a Novel Approach" system is designed to enhance road safety on the Mumbai-Nagpur Expressway by integrating advanced technologies and essential amenities. The system employs a Digital Tachometer with an Infrared (IR) Sensor for real-time speed monitoring, ultrasonic sensors for proximity detection, and an alert system to notify drivers of potential hazards. Additionally, strategically placed rest stops equipped with essential facilities, including food hubs, petrol pumps, hospitals, and emergency services, ensure driver well-being and reduce fatigue-related accidents. The system also incorporates real-time monitoring, data analysis, and continuous improvement mechanisms to enhance its effectiveness. By combining sensor-based automation, speed regulation, hazard alerts, and traveler support, this approach aims to significantly reduce accident rates and improve overall expressway safety.

Keywords: Road safety, accident prevention, expressway monitoring, digital tachometer, infrared sensor, ultrasonic sensor, speed detection, alert system, real-time monitoring, rest stops, driver assistance.

ICRAMEN_2025_038

Prediction Model for Crash Zone Identification for Urban Road Using Machine Learning Techniques

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Abstract

Urban road safety has emerged as a significant concern due to the rising number of traffic accidents in rapidly developing cities. Timely identification of crash-prone zones is crucial for implementing effective preventive strategies and enhancing transportation safety. This study presents a predictive model for crash zone identification specifically focused on the urban road network of Nagpur, Maharashtra, India, using machine learning techniques. A comprehensive dataset comprising historical road accident records, traffic volume, road geometry, environmental conditions, and spatial features was collected from relevant local authorities and preprocessed for analysis. Several supervised machine learning algorithms—including Random Forest, Support Vector Machine, and Gradient Boosting—were developed and evaluated to classify and predict high-risk crash zones. Model performance was assessed using standard metrics such as accuracy, precision, recall, F1-score, and area under the ROC curve (AUC). Among the models tested, the Gradient Boosting algorithm demonstrated the highest predictive performance. The findings emphasize the effectiveness of machine learning-based approaches in crash zone identification and offer valuable insights for urban planners and traffic management authorities in Nagpur. The proposed model serves as a data-driven decision-support tool to prioritize safety interventions and optimize resource allocation. Future work will aim to integrate real-time traffic data for dynamic crash risk monitoring and support the development of intelligent transportation systems.

Keywords: Crash Zone identification, road safety, machine learning, accident prediction, traffic management.

ICRAMEN_2025_040

Estimation of Scour at a Bridge Planned to Be Built North of Al-Kut Barrage By Using HEC-RAS Model

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Abstract

Scour is the removal or erosion of bed or bank materials at bridge piers and abutments as a result of water flow disturbance caused by these structures obstructing the flow path. The study aims to estimate scour around the planned bridge north of Al-Kut Barrage in Al Kut city,Wasit, Iraq, by using the HEC-RAS model. The researchers highlighted the critical impact of scour on bridge stability, as previous studies indicate that 60% of bridge failures are due to scour. The scour was simulated under three different flow scenarios (500, 1050, and 2800 m^3/s) using field and hydrological data collected from the site. Results showed that scour depth increases with higher discharge, with the highest recorded scour depth reaching 7.87 m at some piers under the 2800 m^3/s scenario. The study recommends future calculations of long-term scour using mathematical models, as this feature is not available in the HEC-RAS version used.

Keywords: Bridge Scour, HEC-RAS, North Al-Kut Barrage Bridge

ICRAMEN_2025_044

Finite Element Analysis of Beam-Column Joint Under Torsional Effect by Wind Load

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Abstract

For high-rise buildings, the complexity of wind-induced forces increases with height, requiring scrutiny of beam-column joints of the structural part of the building. Hence, the finite element method has been analyzed in ANSYS to assess torsional behavior, warping stresses, and displacement of a G+20 framed structure under varying wind intensities. The primary focus was to find the structural effects at various floors and to identify the failure mechanisms with various wind loads of 44, 47, 50, and 55 m/s. Significant results include a really big increase in displacement with an increase in height, with a maximum displacement value of 18.7 mm occurring at the 20th floor, and at its extreme, concentrated stress in the beam-column joints reaches a maximum value of 35.8 MPa. Increasing the wind load intensity increases the maximum torsional moments experienced by the structure, which was recorded at 19.7 kN.m at the topmost floor. This finding could indicate low joint stiffness at higher elevations. Another important factor that contributes to the instability of the joints was warping stress. The levels increased from 8.2 MPa at the ground floor to 30.7 MPa at the 20th floor. Typical modes of failure were shear failure for lower floors, joint distortion occurred at mid-levels, and material yielding occurred at upper levels. These observations put emphasis on the necessity of improved structural design strategies to offset the torsional effects in high-rise buildings, thus improving the safety and resilience against extreme wind conditions.

Keywords—Beam-Column Joint, Finite Element Analysis, Ansys Software, Structural Stability, Torsional Effect, Wind Load.

ICRAMEN_2025_047

Study of Response of Horizontal and Vertical Irregular RC Structures Using Non-Linear Time History Analysis

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Abstract

The performance of RC buildings in terms of seismicity with horizontal and vertical irregularities is an issue of prime importance in structural engineering. The usual linear static and dynamic methods do not always replicate the true non-linear behavior of irregular structures under strong ground motions. The present study deals with the Non-Linear Time History Analysis (NLTHA) method with ETABS to assess the seismic response of irregular RC buildings subjected to real earthquake excitations including El Centro, Kobe, various Bhuj earthquakes, etc. The goal of this research is to evaluate inter-story drift, base shear, roof displacement, story shear, overturning moments, and plastic hinge formations in irregular buildings with respect to regular buildings. The results demonstrate that irregular buildings tend toward increased ISDR, peak floor acceleration (PFA), and more lateral displacements, which heightens their chance of sustaining damages during earthquakes. Soft-story irregularities and mass irregularities, in particular, produce localized failures and stress concentrations. The results indicate the need for non-linear analysis in the seismic design, along with recommendations for mitigation such as stiffness modification and retrofitting techniques. Further investigations should consider incorporating soil-structure interaction, AI-driven predictive modeling, and experimental validation to help predict the seismic capacity of these irregular RC structures more accurately and elevate their chances of survival

Keywords: Base shear, Inter-story drift, Irregular structures, Non-linear time history analysis, Plastic hinge formation, Seismic response.

ICRAMEN_2025_050

Analytical Investigation of Shear Lag Effect on Unsymmetrical High Rise Building

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Abstract

Shear lag phenomenon is one of the most important structural phenomena that impacts axial force distribution in high-rise buildings; especially in high-rise buildings with geometry asymmetry. There is extensive research done on shear lag in symmetric structures in the past. Little has been found about the effects of shear lag in asymmetric high-rise buildings, especially those that are significantly affected by the central eccentricity and irregular configuration. This study thus considers an investigation into shear lag in unsymmetrical high-rise buildings. The analysis is done through empirical studies using finite element analysis in ETAB. It has been found that shear lag manifests itself as a phenomenon more much pronounced in asymmetric structures and has a sharp ratio maximum of 0.32 compared to 0.18 for symmetrical buildings. The axial force concentration in edge columns was found to increase by 37.5% while the bending moments are 44% greater in unsymmetrical buildings because of redistribution of stresses. Shear lag is amplified by seismic loads about 42% higher than compared to standing conditions. Increased stiffness modifications reduced shear lag by 20%, while adjustments to the outrigger systems and core placements resulted in reductions of 35% and up to 35%, respectively. Thus, the need for strategic distribution of stiffer cores with respect to lateral load optimization in high-rise design can be emphasized. Thus, future research should move toward experimental verification and AI-optimized improvements for an efficient and resilient structure in asymmetrical buildings.

Keywords— Axial Force Distribution, Finite Element Analysis, High-Rise Buildings, Shear Lag Effect, Structural Asymmetry, Stress Redistribution.

ICRAMEN_2025_053

Improving Integrated Water Resources Management in Wasit Governate

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Abstract

Planning for future water usage in light of changing climate conditions is mainly dependent on WEAP. Using WEAP, climate change forecasts and future water resource multi-model simulations were conducted. Using optimization processes alongside WEAP helps enhance decision-making. This strategy demonstrated the model's ability to aid in the complex decision-making processes associated with water resource management. Enclosing WEAP in a RESTful framework makes it more versatile and facilitates integration with other models, such as those for energy and food systems. Weak and adaptable, WEAP is an excellent tool for managing and modeling water resources. It can help with decision-making, scenario analysis, and integrating various components of the water cycle, which makes it useful for water management concerns. When the model is calibrated correctly and its optimization capabilities are utilized, water management approaches can be implemented that are both effective and long-lasting. The intricacy of managing regional projects and drought calls for a combined strategy that makes use of both internal and external resources. Political cooperation and robust policy execution are essential for resolving regional concerns. In order to promote sustainable development and lessen the effects of drought, adaptive techniques and good management practices are essential. Scholars, NGOs, communities, and governments must work together to strengthen resilience and provide sustainable solutions. The location of the case study was the Wasit governorate. Detailed in the document are the water import details for Wasit Governorate, as well as the water consumption, irrigation, and operational projects in that region. A whopping 75% of the water that the governorate imports goes toward farming and related crops. 16 m^3/s of the imported water that the governorate receives is used for irrigation and desalination plants; details and methods for calculating this amount are accessible.

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ICRAMEN_2025_054

Comparative Analysis of Seismic Responses in Reinforced Concrete Buildings with Conventional Vs. Alternative Infill Materials

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Abstract

The role of infill walls in reinforced concrete buildings is crucial for enhancing their seismic performance, especially in earthquake-prone regions. Infill walls, which have traditionally been viewed as non-load bearing components, contribute significantly to improving a structure's stability, durability, and load management during seismic events. This paper presents a comparative analysis of the seismic responses of buildings with different infill materials—Red Clay Brick, Fly Ash Brick, and AAC Blocks—under earthquake loads. The study adheres to Indian seismic design codes, including IS 1893 (Part 1): 2016, IS 2250:1981, and IS 1077:1992, to evaluate the material properties and their influence on the overall structural behavior. A simplified diagonal strut model is used to simulate the effect of infill walls on the building's response during seismic loading. Essential factors like shear force, bending moments, and stiffness are assessed for structures using various infill materials. The findings demonstrate that the choice of infill material greatly influences the lateral load resistance and deformation capabilities of the building. Red Clay Brick and Fly Ash Brick infill walls provide higher resistance compared to AAC blocks, which have a lower overall stiffness. The study concludes that the selection of appropriate infill materials can substantially improve a building's seismic resilience, thereby contributing to safer structures in seismic zones. This research provides valuable insights into the optimization of infill materials for earthquake-resistant design, promoting more effective and cost-efficient construction practices in seismic regions.

Keywords: Infill Walls, Seismic Response, Diagonal Strut Model, Building Stiffness, Seismic Resilience.

ICRAMEN_2025_055

Evaluating of the Seismic Vulnerability of Infill Masonry wall as Diagonal Strut component of R/C Structures

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Abstract

This study investigates the impact of masonry infill walls on the seismic performance of reinforced concrete (R/C) structures, particularly in the comparison of asymmetrical structure that commonly face structural vulnerabilities during earthquakes. The research highlights the effects of structural irregularities caused by dynamic loads and emphasizes the need for thorough seismic assessments. Through macro modeling techniques, the study analyzes the behavior of R/C frames with various infill configurations, revealing that infill walls significantly enhance structural stiffness, energy dissipation, and overall seismic resilience. The findings indicate that the presence of infill not only improves base shear and reduces axial forces but also leads to lower story displacements compared to bare frames. The study underscores the critical role of infill walls in mitigating earthquake-induced damage and contributes to the development of safer building practices.

Keywords: Seismic analysis, infill walls, asymmetrical buildings, symmetrical buildings, time history

ICRAMEN_2025_056

Effect Of Bracing on Seismic Fragility of Reinforced Structure

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Abstract

The assessment of seismic fragility is significant for the evaluation of structural performance of RC buildings loaded in earthquakes. Braces act mainly in increasing lateral stiffness, minimizing displacement, and enhancing energy dissipation. In the present study we examine the seismic fragility for different bracing positions of a seven-story (G+6) RC structure modelled in ETAB. The main objective would be to compare the performance of X-, V-, K-, diagonal, chevron-, and eccentric bracing systems in the mitigation of seismic response. Numerical analysis involving nonlinear time-history and pushover assessment was performed to assess the displacement, inter-story drift, base shear, and energy dissipation capacity. It was observed that X-bracing is the most effective among other systems as it reduced the maximum lateral displacements to 62% (from 112.4 mm to 42.7 mm) and the inter-story drift ratio by 61% as compared to the unbraced frame. The fragility curve analysis strengthens the statement that X-bracing reduces the chances of structural failure in all seismic intensities. Energy dissipation capacity proved highest for X-bracing (1250 kN-m) which is 84% more than that of the unbraced frame. The findings thus emphasize mainly the importance of bracing systems in improving seismic resilience. The future works include experimental validation and advanced modeling techniques for optimizing bracing design so as to enhance earthquake performance.

Keywords—Bracing systems, Fragility analysis, Nonlinear time-history analysis, Pushover analysis, Seismic performance, ETAB modeling.

ICRAMEN_2025_057

Comparative Analysis of Seismic Response Reduction of Building with and Without Base Isolation (Lead rubber bearing, Elastomeric Bearing, Friction Pendulum System)

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Abstract

Earthquakes pose a major danger to the structural integrity of buildings, particularly in seismically active locations. One effective strategy to lessen seismic damage is to install base isolation devices, which isolate the superstructure from ground motion. This research analyzes the reduction of seismic response in structures with and without base isolation, focusing on three commonly used base isolation techniques: Friction Pendulum Systems (FPS), Elastomeric Bearings (EB), and Lead Rubber Bearings (LRB). Time-history analysis and finite element modeling are used to evaluate the seismic performance of a multi-story building under different isolation situations. Parameters including base shear, interstory drift, and floor acceleration are analyzed. The results demonstrate that buildings with base isolation exhibit much lower seismic activity as compared to fixed-base structures. When it came to lateral displacement control and energy dissipation, FPS performed better than LRB and EB among the isolation systems. This comparison study shows how base isolation may effectively increase seismic resistance and aids in selecting the most appropriate isolation systems based on project requirements and performance benchmarks.

Keywords: Seismic Response, Base Isolation, Lead Rubber Bearing (Lrb), Elastomeric Bearing (Eb), Friction Pendulum System (Fps), Earthquake Resistance, Structural Dynamics

ICRAMEN_2025_059

The Impact of Recent Upstream Dams Constructed on the Iraqi Darbandikhan Dam in Drought Conditions

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Abstract

This study examines the impact of recent upstream constructions, particularly the Daryan Dam, on Iraq's Darbandikan Dam during drought. These constructions have blocked inflows, reducing water levels in the Darbandikhan reservoir and worsening water scarcity. Use a water budget approach with the HEC-ResSim simulation model to assess water availability changes, and evaluate existing reservoir operation policies. The findings show that the reduced inflows have significantly affected the capacity of the reservoir to service irrigation, and hydroelectric power generation, and environmental requirements. This emphasizes the need for such international cooperation in establishing transboundary water resources regimes to deal with the challenges posed by climate change, and dam constructions upstream. Furthermore, the study points to the requirement for adaptive water management strategies to ease diminished inflow impacts, and sustainable water use for agricultural, domestic, and environmental needs. Supporting international cooperation helps policymakers create fair water-sharing agreements that consider all stakeholders. Studies highlight severe environmental impacts, including biodiversity loss and increased soil salinization. Notable fica socio-economic evaluation derive significant declines in agricultural productivity, and increased water scarcity, affecting local livelihoods. International organizations such as UNECOSOC, and the World Bank have put across messages on the necessity for cooperative water management programs for ecological preservation and the well-being of communities. As such, the report would detail different aspects regarding the multifaceted impacts of upstream dam constructions and advocacy for regional cooperation to guarantee water security in drought-prone areas concerning Darbandikhan Dam, and provide recommendations for sustainable water management strategies.

Keywords: Darbandikhan dam, Daryan dam, Diyala weir, Water budge.

ICRAMEN_2025_064

Integrated Water and Agricultural Management: Kharaj Principles of Imam Ali ibn Abi Talib (PBUH).

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Abstract

Kharaj is a significant source of public revenue, particularly in countries that rely heavily on agriculture. Integrated management of water resources and agricultural lands necessitates dialogue between Kharaj collectors and investors in both plant and animal sectors. This dialogue aims to determine the value of Kharaj, mechanisms for land and water utilization, and to optimize water investment, thereby increasing yields. It serves as an operation and maintenance guide for the land. Imam Ali's (peace be upon him) policy on Kharaj emphasizes procedural flexibility and its role in reforming agricultural and water sector investors, which in turn reforms other societal groups, promoting housing and construction. Imam Ali advocates for a focus on land development through a system that maintains and invests in land fertility, akin to an operation and maintenance manual for irrigation and agricultural projects. This approach should be adopted in managing reclaimed lands and practices used by water resources departments to maintain irrigation systems, soil fertility, and prevent salinization in non-reclaimed lands. Addressing housing problems and other human necessities should be prioritized over merely collecting Kharaj. Revenue and its sustainability are achievable only through development, housing, and human stability and happiness. Pursuing Kharaj as revenue without considering these factors results in the country's destruction and instability. Case study is considered in order to improve the water resources management in Islamic country.

Keywords*:* Kharaj, Integrated Management, Water Resources, Agricultural Lands, Imam Ali's Policy.

ICRAMEN_2025_066

An Innovative Gadget for Safety of Senior Citizen & Women

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Abstract

In this technological world everyone have smart phone but in severe condition we don't have much time to contact anyone. Students face incidents like child trafficking and kidnapping. Aged people faces problems like heart attack, paralysis, Hypertension shoot, respiratory problems in public places. Girls get sexually abused. All such problems can be traced and controlled by our innovative gadget. It senses the danger using pulse rate of victim and send alert message with real-time location to the respective care takers. Safety of girls is the utmost need of the society. Our Innovative technology provides full proof safety to child girl, women, senior citizens.

Keywords: Hypertension, pulse rate, message with real-time location, child trafficking, 3D printing

ICRAMEN_2025_069

Efficiency Evaluation of General Insurance Companies: A Data Envelopment Analysis based Study

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Abstract

This study investigates the operational efficiency of general insurance companies in India from 2020 to 2024 using Data Envelopment Analysis (DEA). In light of the sector's post-liberalization expansion and the rising complexities driven by COVID-19, regulatory changes, and digital transformation, evaluating efficiency has become increasingly critical. The study employs Constant Returns to Scale (CRS) along with Variable Returns to Scale (VRS).DEA models to analyze technical and scale efficiency across several insurers. Input and output variables were considered through correlation and regression analyses to ensure model robustness, with key financial indicators such as commission, operating expenses, equity, net premiums earned, and investment income driving the analysis. Results reveal a significant gap in average technical efficiency under CRS (0.586) versus VRS (0.744), indicating prevalent scale inefficiencies.

Keywords: Data Envelopment Analysis, Regression, Correlation, Technical Efficiencies, Indian General Insurance.

ICRAMEN_2025_075

Study Of Intelligent System to Detect Faulty Joint-Reducer in Multi-Joint Industrial Robots

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Abstract

Use of Robots in industries and our society is increasing rapidly due to their flexibility, user friendly and cost effectiveness. Accuracy and repeatability of robots depends on clearances in joint reducers, links stiffness, feedback device like encoders, control system etc. Among all these factors, major factor is clearances in joint-reducers. Early detection of faulty joint is very important for the precision movement of robot arm. Intelligent fault diagnosis methods from different researchers are reviewed in this paper and on observing research gap, intelligent fault-finding method to detect faulty joint-reducer among all multi joints is proposed based on kinematic theory and AI.

Keywords. Robotics, Robot, RV Reducers, Robot Joint Reducers, Robot faulty joint detection, Harmonic Drives, Industrial Robots, Extreme Learning Machine, Sparse Auto Encoder, Joint clearances, Manipulators.

ICRAMEN_2025_078

Design Of Industrial Steel Building with Different Types Of Bracing for Seismic Conditions

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Abstract

Structures like industrial steel buildings are mainly susceptible to lateral displacements and structural instability during seismic events due to their large spans and flexibility in frame systems. Adequate seismic resistance thus becomes imperative to shield structural integrity and operational continuity. The purpose of this study is to investigate the behaviour of an industrial steel shed structure subjected to earthquakes with different bracing patterns in terms of analysis and modelling using STAAD Pro. The study primarily compares various bracing arrangements, such as X-bracing, K-bracing, V-bracing, Inverted V-bracing, and Diagonal bracing, with respect to the bare frame without bracing under seismic loading conditions as per IS 1893:2016. The response spectrum analysis was carried out for a zone III site with a zone factor of 0.16, importance factor of 1.0, and medium soil type. The study finds that X-bracing resulted in a maximum reduction in lateral displacement of 68.25%, followed by Diagonal bracing with 61.73%, concerning the bare frame. In the case of base shear capacity, X-bracing was recorded at maximum value 228.54 kN, significantly enhancing the lateral stiffness. The same time period value was found 1.92 seconds for a bare frame versus 0.88 seconds for an X-braced frame. This study evidently states that X-bracing has best seismic performance and recommends its use in industrial sheds located in moderate seismic zones.

Keywords: Bracing systems, Industrial steel sheds, Lateral displacement, Response spectrum analysis, Seismic performance, STAAD Pro.

ICRAMEN_2025_103

Optimized Ship Routing Algorithm

Dr. Sandeep Kumar, Vishvash
MEdicaps

Abstract

Current developments in naval navigation focus on the optimization of ship routing using predicted weather conditions and safety parameters, a notable step through higher-order algorithms and real-time integration to improve naval safety, efficiency, and decision-making. The fundamental aim is to create and deploy algorithms and systems minimizing fuel expenditure and travel time while optimizing safety, responding to various kinds of ships and changing geographical and meteorological information for effective route planning. Techniques utilized are a MATLAB tool utilizing genetic algorithms to compute optimal routes through physics-based models, a general-purpose algorithm minimizing cost, safety, and journey time, a multi-objective weather routing algorithm trading fuel efficiency and safety, and a decision support system for the North Indian Ocean utilizing Dijkstra's algorithm and dynamic programming for minimum-time routes with realistic constraints. These approaches collectively illustrate notable advancements, promoting maritime safety, operational efficiency, and informed decision-making by offering pragmatic solutions that respond to environmental conditions, thus contributing to more sustainable and efficient maritime operations. As a result we have achieved a point where we can use this algorithm at the real time as it is able to provide us fast solutions and get a 200ms faster response than other algorithms developed.

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ICRAMEN_2025_107
Performance Assessment of Indian Reinsurers Using SBM-DEA and Malmquist Approach

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Abstract

This research assesses the operational efficiency and productivity dynamics of Indian reinsurers from 2019 to 2024 using the Slacks-Based Measure Data Envelopment Analysis (SBM-DEA) and Malmquist Productivity Index. This research assesses 11 reinsurers including domestic and foreign entities to identify performance drivers and inefficiencies. Employing SBM-DEA under Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS), the study measures technical efficiency, pure technical efficiency, and scale efficiency, while the Malmquist Index breaks down productivity changes into efficiency catch-up and technological progress. Key findings reveal that GIC Re, India's sole public-sector reinsurer, consistently achieved full technical efficiency (1.0), underscoring its scale advantages and operational dominance. Foreign reinsurers such as AXA France Vie (average TE = 0.929) and RGA (0.996) demonstrated near-optimal efficiency, leveraging global expertise, while others like Lloyd's India (average TE = 0.382) lagged due to chronic scale mismatches. Scale efficiency analysis highlighted that 70% of inefficiencies under CRS stemmed from suboptimal firm size rather than managerial shortcomings. The Malmquist results indicated a 10.7% total productivity growth (TFPch = 1.107), driven predominantly by technological advancements (Techch = 1.151), though managerial efficiency slightly declined (Effch = 0.962). The study underscores the dual imperative of technological adoption and operational scale optimization for sustained competitiveness. This research gives knowledge about growing markets by using advanced methods to measure efficiency and analyse productivity changes over a time period. It helps with ideas to strengthen and improve India's changing reinsurance industry.

Keywords: Slacks-Based Measure Data Envelopment Analysis (SBM-DEA), Malmquist Productivity Index, Indian Reinsurers, Technical Efficiency, Scale Efficiency.

ICRAMEN_2025_112

Actuation Mechanisms in Robotic and Prosthetic Hands: A Comprehensive Review of Technologies and Trends

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Abstract

The requirement for dexterity, flexibility, and effective human-object interaction has given rise to a major shift in robotic hand technology. In this review, robotic hand designs are carefully examined with a focus on the classification of actuation methods: fluid-based, motor-driven, tendon-driven, and Shape Memory Alloy (SMA)-based systems. The functioning, grasping capabilities, fabrication approaches, and operation characteristics of each actuation type are discussed. According to comparisons, there is no one actuation system that is universal to all, instead, the right choice depends on the needs of the particular application, including force output, compliance, weight, and control complexity. SMA-based systems improve lightweight design at the cost of speed, tendon-driven and fluid-based actuators enhance adaptability and safe human interaction, and motor-based systems offer strength and precision. Grasping performance is examined through interaction methods such as precision, spherical, and cylindrical grips. The study as well observes the development of hybrid actuation systems and the crucial roles of the additive manufacturing and sensing integration for further advancement in the field.

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ICRAMEN_2025_117

Assessing the Impact of a Digital Treatment Workflow in Implant-Based Dental Restorations

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Abstract

This study evaluates the impact of a fully digital treatment workflow on clinical outcomes and patient satisfaction in implant-based dental restorations. The workflow integrates cone-beam computed tomography (CBCT), intraoral scanning, virtual planning, guided surgery, and CAD/CAM-fabricated prostheses. A total of 25 patients requiring single or multiple implants were treated using this approach. Surgical guides were 3D printed to ensure precise implant placement based on virtual plans. Key outcome measures included implant placement accuracy, implant stability (ISQ values), prosthetic fit, and patient satisfaction assessed through a visual analog scale (VAS). Statistical analysis using one-way ANOVA showed significant improvements in implant placement precision, higher ISQ values, and reduced marginal discrepancies in CAD/CAM prostheses compared to conventional workflows ($p < 0.05$). Patients reported enhanced comfort, function, and esthetic satisfaction with the digital approach. The results demonstrate that a fully digital workflow improves clinical predictability, reduces treatment time, and enhances patient experience. While initial costs and training are required, the long-term benefits support broader adoption in modern dental practices. Further studies are recommended to assess cost-effectiveness and applicability in more complex restorative cases.

Keywords- Digital Dentistry, Prosthetic Rehabilitation, Guided Surgery, Intraoral Scanning;

ICRAMEN_2025_118

Comprehensive Study on Torsional and Fatigue Failures in Transmission Components of Stacker Reclaimers

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Abstract

Stacker reclaimers are critical assets in bulk material handling systems, especially in Direct Reduced Iron (DRI) plants and other heavy industrial operations. Their continuous duty cycle and exposure to dynamic loads make the reliability of transmission components—such as shafts, couplings, and gear assemblies—vital for ensuring uninterrupted operation. This study presents a comprehensive investigation into torsional and fatigue failures commonly observed in the transmission systems of stacker reclaimers. Emphasis is placed on identifying stress concentrations, cyclic loading effects, material limitations, and operational misalignments as root causes of failure. The paper reviews historical case studies, failure inspection reports, and relevant experimental data to highlight the interplay between material selection, shaft geometry, and load variability. Furthermore, advanced diagnostic techniques such as Finite Element Analysis (FEA), vibration analysis, and non-destructive testing (NDT) methods are evaluated for their effectiveness in early fault detection. The study proposes mitigation strategies including improved design practices, use of high-fatigue-resistant materials, and predictive maintenance approaches. The insights aim to enhance operational safety, minimize downtime, and extend the service life of critical drive components in stacker reclaimer systems. This work serves as a valuable resource for plant engineers, maintenance planners, and mechanical designers working in high-demand industrial environments.

Keywords- Torsional failure, Fatigue analysis, Transmission components, Stacker reclaimers, Power transmission shafts, Finite Element Analysis (FEA), Vibration monitoring, Material fatigue, Predictive maintenance;

ICRAMEN_2025_121

An Ergonomic Approach of a Dual-Purpose Stick and Chair for Urban and Rural Applications

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Abstract

Mobility aids that serve multiple functions are increasingly important for enhancing the quality of life, particularly among elderly individuals, travelers, and individuals with limited mobility. This study presents an ergonomic design approach to a dual-purpose stick and chair tailored for both urban and rural applications. The device is engineered to function as a stable walking stick during mobility and quickly transform into a compact, foldable chair when rest is needed. Key design considerations include lightweight construction, load-bearing capability, ease of transformation, stability on uneven terrain, and user comfort. The materials selected ensure strength while maintaining portability, with aluminum alloys and composite polymers offering an ideal balance between durability and weight. Ergonomic principles are applied to handle design, seating posture, and deployment mechanisms to reduce user strain and enhance functionality. Field testing in diverse environments, including crowded cityscapes and unpaved rural paths, demonstrates the versatility and user-friendliness of the design. This innovation not only reduces the need to carry separate mobility and resting aids but also supports independent movement and convenience. The device has promising implications for daily commuters, senior citizens, and healthcare-focused mobility solutions across varied geographies.

Keywords- Dual-Purpose Stick, Portable Chair, Ergonomic Design, Urban and Rural Mobility, Assistive Device, Elderly Support, Foldable Seat;

Track
Material Science and Nanomaterials

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ICRAMEN_2025_001

Enhancing Diesel Engine Performance through Nanoparticle-Infused Fuel Blends: A Comprehensive Review

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Abstract

This review article explores the potential of nanoparticle additives in enhancing the performance of diesel engines through fuel blends. It provides a comprehensive analysis of the mechanisms by which nanoparticles, such as cerium oxide and carbon nanotubes, improve combustion efficiency, reduce fuel consumption, and lower harmful emissions. Despite promising experimental findings, challenges related to nanoparticle dispersion, economic viability, and long-term effects on engine components are discussed. The review concludes that while nanoparticle-enhanced fuels offer a sustainable approach to cleaner diesel combustion, further research is needed to optimize their practical applications.

Keywords: Diesel engines, Nanoparticle additives, Fuel blends, Combustion efficiency, Emission reduction, Cerium oxide, Carbon nanotubes

ICRAMEN_2025_007

Effects of Hygrothermal Aging on the Flexural Properties of Steel Single-Lap Adhesive Joints in Marine Applications

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Abstract

Adhesive bonding technology in the marine industry is frequently exposed to demanding environmental conditions, which often include fluctuating temperatures and varying moisture levels. Both aspects have been extensively researched and recorded in prior studies; however, there is still a notable gap in comprehending how their interactive impacts affect the structural performance of steel-based adhesive joints frequently employed in the marine sector. As a result, this study aims to examine the impact of moisture and temperature exposure on the bending characteristics of steel single-lap bonded connections. The study seeks to explore how environmental factors change the mechanical response and long-term stability of the adhesive-bonded structures, providing valuable insights into their performance under extreme conditions commonly encountered in industrial and marine applications. It was determined that, regardless of the adhesive type, higher temperatures during hygrothermal exposure cause a more significant loss in both the failure load and the maximum displacement under failure conditions. Ultimately, a considerable deterioration in flexural characteristics was observed with a rising number of hygrothermal cycles. Notably, the water/air setting was significantly more harmful than the water/water setting.

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Mechanical Characterization and Optimization of Spot Welding Parameters on Advanced High Strength Steel (AHSS) Joints

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Abstract

The mechanical characterization and optimization of the parameters for spot-welded multi grade Advanced High Strength Steel (AHSS) joints to facilitate improvement in joint performance in structural applications is investigated in this research. Tensile strength, fatigue resistance and failure modes in the study depend on the values of the electrode force, welding current and weld time. Experimental analysis showed that when optimized, welding conditions gave tensile shear strength of 11.5 kN which was higher than that in recent studies with values closer to 9.8 to 10.5 kN. The fatigue life of the optimized joints was found to be 92,000 cycles, which is much higher than 75,000 cycles as in similar research. Microstructural analysis of the SPP showed that pull out failure modes and less interfacial failures point to better bonding quality. Optimized spot welds were able to withstand higher load bearing capacity and durability, thus they can be used for automotive and structural applications. These results convey relevant information regarding how to improve welds integrity, decrease material failures, or reduce cost effectiveness of manufacturing processes. With such an interest in improving weldability of AHSS, future studies could investigate hybrid welding methods and advanced material finish coatings.

Keywords: Spot welding, Advanced High-Strength Steel (AHSS), Tensile strength, Fatigue resistance, Weld optimization

ICRAMEN_2025_067

Device Parameters Optimization of Organic Solar Cell by Mean Of SCAPS-1D Simulation

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Abstract

This study investigates the influence of varying positive charge carrier layer - HTL materials regarding the efficiency of organic solar cells, utilizing the 1D-SCAPS programming tool. Through numerical simulations, we systematically compare the impact of different HTLs on device parameters such as efficiency, Jsc, Voc, and FF. Analysis focuses on optimizing the band alignment, charge carrier transport, and interface properties between the Organic absorber and the HTL. By evaluating a range of HTL materials with diverse electrical and optical characteristics, we aim to identify optimal configurations that enhance device performance and stability. The simulations provide valuable insights into the crucial role of the HTL in achieving high-efficiency Organic solar cells, guiding future experimental efforts in material selection and device design.

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ICRAMEN_2025_077

A Finite Element Approach to Investigate the Structural Behavior of Composite Laminates

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Abstract

In materials science, a composite laminate is made by stacking and bonding layers of fibrous composite materials and designed to meet specific engineering needs, such as high strength and in-plane and bending stiffness. This study focuses on analyzing the stress and deformation behavior of carbon fiber-reinforced composite laminates. Using ANSYS Composite PrePost (ACP), simulations were carried out under uniform pressure loading for laminates with different thicknesses and layer counts. Two common stacking sequences, angle-ply [45/-45/-45/45] and cross-ply [0/90/90/0], were considered. The effects of varying laminate thickness (ranging from 0.025 m to 0.1 m) and boundary conditions (with the left edge fixed and both edges fixed) were also considered to understand their influence on structural response. In addition, the stiffness matrix (ABD matrix) obtained from these numerical simulations was validated using Classical Laminate Theory (CLT) in MATLAB. The analysis results show that increasing thickness enhances stiffness and reduces deformation. Boundary conditions also impact stress and displacement, with both-edge-fixed laminates performing better. Additionally, stacking sequences play a crucial role, where ±45° layups are better for shear loads, while 0°/90° layups are more effective for axial loads. This study demonstrates that optimizing laminate thickness, stacking sequence, and boundary conditions is crucial for achieving the desired structural performance in composite laminates.

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ICRAMEN_2025_080

Numerical analysis of Nacre inspired orientation of glass fiber/epoxy and carbon fiber/epoxy composite material

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Abstract

Nacre inspired composites are gaining attention of researchers involved in advanced engineering applications owing to their exceptional toughness, lightweight characteristics, and enhanced energy absorption capabilities. This paper presents comparative analysis of two nacre like composite systems using E-glass fiber and carbon fiber as reinforcement, both incorporated in epoxy matrix. A five-layer laminate configuration is employed, wherein the odd-numbered layers are oriented at 0°, and the even-numbered layers follow a symmetric angular variation of ±15°, ±30°, ±45°, ±60°, and ±75°, designed to emulate the hierarchical microstructure of natural nacre. Finite Element Method (FEM) simulations involving standardized three-point bending load of 100 N is used to evaluate total deformation, stress distribution and strain behaviour. The results obtained are compared with conventional unidirectional laminates. Superior mechanical performance was observed in case of nacre inspired configurations, with carbon fiber-reinforced composites demonstrating higher stiffness and load-bearing capacity compared to glass fiber counterparts. This work demonstrates the importance of biomimetic design principles in enhancing structural performance and offers a framework for future studies focused on dynamic and multifunctional behaviour of such engineered composites.

Keywords: Bio-Inspired Composite Structures, Ply Angle Optimization, Strain Energy Analysis, Principal Stress Distribution

ICRAMEN_2025_081

Effect of Friction Material and Additives on Brake Application

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Abstract

This review examines the effects of friction materials and additives on brake performance, focusing on tribological behavior, heat resistance, environmental impact, and NVH (Noise, Vibration, and Harshness) performance. The study divides brake pads into four categories: NAO (Non-Asbestos Organic), semi-metallic, ceramic, and hybrid/composite, and assesses their friction stability, wear resistance, thermal behavior, and emission properties. Key additions, including graphite, MoS_2, alumina, barite, and bio-based fillers like cashew dust and CNSL (cashew nutshell liquid), improve friction stability, reduce wear, and improve thermal management. Advanced formulations using micaceous minerals, ceramic abrasives, and hybrid reinforcements have been found to outperform classic copper-based pads, in line with developing environmental laws. Furthermore, the review investigates the processes behind tribo-film generation, heat dissipation, and NVH management, offering experimental data from relevant investigations. The report also examines future developments, such as the use of nanoadditives, bio-based materials, and smart self-healing polymers to improve performance and sustainability. It underlines the critical need for standardized testing methodologies and circular material models to assure ecologically friendly, efficient, and long-lasting braking systems in current automotive applications, notably electric and self-driving cars.

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ICRAMEN_2025_083

A Comprehensive Review on Al6061-Based Composites Reinforced with TiB_2 & Cr_2O_3: Fabrication to Performance evaluation

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Abstract

Metal Matrix Composites (MMCs) have emerged as advanced materials in aerospace, automotive, defence, and marine applications due to their exceptional mechanical strength, corrosion resistance, and thermal stability. Among aluminium alloys, Al6061 is highly favoured for its balanced mechanical properties and weldability. This review investigates Al6061 reinforced separately with 10 wt.% titanium diboride (TiB_2) and chromium oxide (Cr_2O_3), synthesized via stir casting—a scalable, cost-effective liquid-state processing technique. Microstructural characterization through SEM and XRD revealed refined grain structures and uniform particle distribution in both composites, with TiB_2 showing slightly superior dispersion. Mechanical testing demonstrated that the TiB_2-reinforced composite achieved a tensile strength of 195 MPa**,** Vickers hardness of 190 HV**,** and a density of 2.83 g/cm³, indicating strong particle–matrix bonding and improved load-bearing capability. In comparison, the Cr_2O_3-reinforced composite exhibited a tensile strength of 183 MPa, hardness of 170 HV, and a density of 2.89 g/cm³, highlighting its excellent surface strength and thermal stability, albeit with slightly reduced ductility. The unreinforced Al6061 alloy, serving as the baseline, demonstrated lower values—tensile strength of 125 MPa**,** hardness of 115 HV, and density of 2.70 g/cm³**.** These findings confirm that ceramic reinforcements, especially TiB_2, significantly enhance the structural performance of Al6061 composites. The review concludes by identifying TiB_2-reinforced AMMCs as ideal for high-strength and wear-critical applications, while Cr_2O_3-reinforced variants offer added advantages in corrosion and oxidation resistance, particularly under marine and thermal exposure.

Keywords: Metal matrix composites, Al6061, Stir casting, Titanium diboride, chromium oxide,

ICRAMEN_2025_090

Innovative Teeth Implant Methods: Review of Conventional Approaches and Introduction to Zirconia Implants

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Abstract.

The restoration of dental structures through implants has seen significant advancements over the decades. Conventional dental implant methods, predominantly utilizing titanium, have been the gold standard due to their high success rates. However, challenges such as aesthetic limitations, metal hypersensitivity, and corrosion have necessitated the exploration of alternative materials and techniques. This review provides a comprehensive analysis of conventional implant methods, their drawbacks, and the emerging role of Zirconia implants. Zirconia, known for its superior biocompatibility, aesthetic appeal, and resistance to corrosion, presents a promising alternative to conventional titanium-based implants. This paper discusses the structural and functional aspects of various teeth, reviews existing implant methods and their limitations, and highlights the innovative applications and potential of Zirconia implants in addressing these shortcomings. Furthermore, this review identifies future research directions and clinical implications to enhance the effectiveness and adoption of Zirconia implants in modern dentistry.

Keywords- Dental Implants, Titanium Implants, Zirconia Implants, Osseointegration, Biocompatibility, Peri-Implantitis;

ICRAMEN_2025_100

A Comprehensive Review on Austenitic and Martensitic Stainless Steels: Properties, Processing and Performance

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Abstract

Stainless steels, particularly austenitic and martensitic grades, are integral to modern engineering due to their superior mechanical properties, corrosion resistance, and adaptability to various manufacturing processes. This review presents a comprehensive overview of the metallurgical behavior, processing techniques, mechanical performance, and application potential of austenitic and martensitic stainless steels. Austenitic stainless steels, known for their excellent ductility, formability, and corrosion resistance, are widely used in food processing, medical devices, and marine environments. In contrast, martensitic stainless steels offer high strength and hardness, making them ideal for applications requiring wear resistance and mechanical durability. The paper explores key aspects such as microstructure-property relationships, welding behavior, work hardening mechanisms, and corrosion phenomena including general and pitting corrosion. It also discusses recent technological advances in additive manufacturing, hybrid processing methods, and smart manufacturing systems that enhance the performance and sustainability of stainless-steel components. The sustainability of stainless steels is evaluated in terms of recyclability, lifecycle performance, and environmental impact. By comparing the structural, thermal, and chemical properties of these two classes of stainless steel, this review provides valuable insights into material selection, design considerations, and future research directions for industrial applications in energy, transportation, biomedical, and construction sectors.

Keywords- Corrosion Resistance, Work Hardening, Weldability, Additive Manufacturing, Formability, Sustainability, Microstructure;

ICRAMEN_2025_111

Productivity Enhancement and Water Quality Analysis of Triangular Solar Still using Recycled Material

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Abstract

Access to clean water for drinking is a major problem. Among the various solutions being used, solar desalination stands out as a promising, cheaper, and eco-friendly method also it is the one of the simplest ways to do it. That said, their limited freshwater output often holds them back from being widely used on a larger scale. In our study, we looked at a straightforward and sustainable way to improve the efficiency of TSS by adding heat storage materials made from recycled construction waste. These materials were shaped into frustum, tapered cone, and petaloid forms, and put in still maintaining higher water temperatures for longer thus boosting overall clean water yield. Our experiments were done in New Delhi during October 2024. TSS-F improved the fresh water yield by 34% compared to TSS. TSS-C and TSS-P showed 31% and 22% improvements, meeting the WHO safety standards for drinking. This method represents how affordable, materials available locally can be recycled to increase the efficiency, especially in areas with poor facilities and water supplies.

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Impact of Chromium Doping on Copper Nickel Spinel Nano Ferrites

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Abstract

Spinel nano feerrites are ceramic materials in a nanosized diameter with extraordinary properties and outstanding applications. Ferrite nanocrystals are fascinating materials owing to their unique physical and chemical properties. The transition metal-doped ferrites have well-defined structures and magnetic response, such as high permeability for a specific frequency range. In the present research module, Chromium doped copper nickel spinel nano ferrites with generic chemical formula $Cu_{(1-x)}Ni_xCr_yFe_{(2-y)}O_4$ were synthesized by microwave assisted sol-gel auto combustion route. The impact of concentration of chromium on crystal structure and magnetic properties of synthesized materials were also studied. The structural properties were characterized by XRD. The X-ray diffraction analysis confirmed the formation of Spinel, single phase cubic nano ferrite material. Magnetic properties such as coercivity and magnetic saturation of the synthesized materials were characterized by Vibrating Sample Magnetometer. Surface morphology with composition of prepared materials was confirmed by Scanning Electron Microscopy (SEM) and Energy dispersive X-ray analysis (EDAX).

Keywords -Nano ferrites, Sol Gel method, XRD, SEM, saturation magnetization, coercivity etc.

ICRAMEN_2025_123

Influence of concentration ratio on thermophysical properties of graphene oxide based nanofluid for solar thermal application

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Abstract

This article investigates the preparation and thermophysical characterization of graphene oxide (GO) nanofluids at varying concentrations for potential application in photovoltaic thermal (PVT) systems. The nanofluids were synthesized using a two-step method, where powdered GO nanoparticles were dispersed in water through mechanical stirring followed by ultrasonication. Samples (S1, S2, S3, etc.) were prepared with volumetric concentrations of 0.1%, 0.2%, 0.3%, 0.4% and 0.5%. The structural properties of the GO nanoparticles were analyzed using X-ray diffraction (XRD) and Raman spectroscopy. Stability tests indicated that the nanofluids remained highly stable up to 41 days, with moderate to good stability observed in some samples even after 90 days, indicating that GO-based nanofluids offer superior stability relative to other nanofluid types. Taghuchi method was used to design the experiment trials for thermal conductivity and viscosity test. Thermal conductivity tested using the transient hot-wire technique while dynamic viscosity tested using brookfield viscometer over a temperature range of 25°C to 65°C. The test results showed an enhancement in thermal conductivity from 5.67% to 39.11% with variation of nanoparticle concentration and temperature. Notably, concentration had a more significant impact on thermal conductivity, particularly at lower temperatures. Rheological analysis revealed that the dynamic viscosity of GO-based nanofluids increased by approximately 155.62% as the concentration rose from 0.1% to 0.5% at ambient temperature. The experimetal results validated using the regression equations. The test also shows a slight declination in specific heat capacity and minor increase in density compared to the base fluid. indicating that GO-based nanofluids offer superior stability relative to other nanofluid types.

Track
Production and Manufacturing Processes

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Evaluating the efficicency of micro end mill tools and performance metrics in micro milling

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Abstract

Recent improvements in micro-milling, tool treatments, and ultra-precision machining centers have made it easier to produce tiny, high-quality parts for various industries. This paper looks at the latest developments in these areas, focusing on how new tools, surface treatments, and advanced machining technologies have helped improve accuracy, surface finish, and the lifespan of tools. These advancements have made a big impact in industries like biomedical engineering, electronics, and aerospace. The paper also talks about future research, emphasizing the need for continued innovation to keep up with the growing demand for precise micro-manufacturing. The study deals with study of micro tools, coatings and cryogenic treatment and its effect on machining outcomes. The paper discusses the importance of coating and cryogenic treatment on micro end mill tool so as to reduce friction and enhance tool life for better productivity and surface quality of machined surface.

Keywords: Micro milling; Tool Treatments; Ultra-precision machining; Micro-manufacturing; Surface Finish

ICRAMEN_2025_008

Design and fabricate multipurpose agricultural machine

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Abstract

The foundation of the Indian economy is farming. Much fieldwork is involved in this agricultural industry, including ploughing, reaping, sowing, fertilizing, levelling, and other tasks formerly completed with conventional machinery. This field has several challenges, including how to reduce costs, boost productivity, and limit losses. India uses two kinds of agricultural methods: the traditional manual approach and the mechanized way. Working with those tools was tiresome and time-consuming compared to using the manual way. Traditional methods also take a lot of time. In order to mechanize, a hybrid device is used between the work and the power supply. This hybrid device typically offers a sample of mechanical advantages or transfers motion, such as from rotary to linear. Agriculture became faster and easier with mechanization. For practically any agricultural work, several machines are available. Land preparation, crop harvesting, and other processes can all be completed by machines. In addition to making the process easier, these machines are also incredibly effective. Nowadays, most farmers from rural backgrounds cannot afford the more expensive agricultural machinery. The majority of Indian farmers own very small plots of land; thus, it might not be possible for them to afford these more expensive tools. The majority of farmers continue to practice their traditional methods. Because the majority of farmers earn poor incomes, they are unable to make the investment necessary to buy significant machinery. In light of the aforementioned considerations, it is necessary to create a machine or piece of equipment that is both multipurpose and, most importantly, inexpensive.

Keywords: IoT, Multipurpose, Chili Farming ,Agricultural,

ICRAMEN_2025_009

Design & Fabrication of Steering System for Go-Kart

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Abstract

The steering mechanism is among the most essential parts of a go-kart, directly affecting its manoeuvrability, stability, and complete driving experience. A properly crafted steering system guarantees accurate control, but issues such as misalignment, too much steering force, and instability at high velocities can impair performance. This research aims to analyze and enhance the go-kart steering system by investigating essential parameters including caster, camber, toe angle, and steering geometry. To accomplish this, a blend of computer-aided design (CAD), motion simulation, and practical testing is utilized. By utilizing tools such as SolidWorks, ANSYS, and MSC ADAMS, various steering setups are designed and examined for stress distribution and motion efficiency. A prototype featuring the enhanced design is subsequently evaluated under different track conditions to assess advancements in responsiveness, turning radius, and driver effort. The results of this research are anticipated to offer practical guidance for creating a more effective and reliable steering system for go-karts. This study seeks to improve performance, safety, and control by tackling prevalent steering problems, aiding kart designers, racers, and motorsport fans. Beyond the fundamental adjustments of caster, camber, toe, and steering ratio, experienced go-kart engineers and drivers recognize that the intricacies of track conditions and driving styles exert a significant influence. A track with tight, technical corners necessitates a different steering configuration compared to a high-speed, flowing circuit. For instance, a more confined track may benefit from a quicker steering ratio, facilitating rapid directional changes, while a high-speed track may prioritize stability with a slightly reduced ratio and a more pronounced caster angle. Moreover, the driver's physical attributes and preferences warrant consideration. A younger driver, or one with reduced upper body strength, may find the increased steering effort resulting from a large caster angle detrimental to their performance. Conversely, a more experienced driver may appreciate the enhanced feedback and stability provided by a higher caster angle.

Keywords: Go-kart, Steering system, Ackermann geometry, Steering optimization, Vehicle handling, CAD simulation.

ICRAMEN_2025_016

Design and fabrication of Power Transmission system (Go-kart)

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Abstract

The design and fabrication of power transmission systems play a crucial role in ensuring efficient energy transfer across mechanical components. This paper presents a comprehensive study on the conceptualization, design, and manufacturing of a robust power transmission system tailored for industrial and automotive applications. The methodology includes material selection, system modelling, stress analysis, and performance evaluation to optimize efficiency and durability. Various transmission mechanisms, such as belt drives, chain drives, and gear systems, are analysed based on load-bearing capacity, frictional losses, and maintenance requirements. The fabricated system is tested for operational efficiency and reliability under different working conditions. Experimental results validate the design's effectiveness in reducing power losses while ensuring smooth mechanical transmission. This research contributes to advancing power transmission technology by integrating innovative materials and manufacturing techniques, leading to improved mechanical efficiency and sustainability.

Keywords: Power transmission, mechanical design, gear system, belt drive, chain drive, fabrication, stress analysis, efficiency, industrial applications, automotive engineering, material selection.

ICRAMEN_2025_018

Design & Analysis of Go-Kart Chassis

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Abstract

The design and analysis of a go-kart chassis are critical in determining the vehicle's overall performance, safety, and durability. A well-engineered chassis must provide sufficient structural integrity while remaining lightweight to maximize speed and handling efficiency. This study focuses on the systematic approach to designing an optimized go-kart chassis, considering essential factors such as material selection, weight distribution, torsional rigidity, impact resistance, and aerodynamics. The design phase begins with an in-depth analysis of various chassis geometries, comparing their advantages and limitations in terms of stability, manoeuvrability, and load-bearing capacity. The choice of material is a crucial aspect, with options such as AISI 4130 steel alloys being evaluated for their mechanical properties, including yield strength, tensile strength, and fatigue resistance. The geometric configuration is designed to achieve an optimal balance between stiffness and flexibility, ensuring efficient power transmission and improved cornering capabilities. To validate the structural integrity of the chassis, Finite Element Analysis (FEA) is employed to assess stress distribution, deformation characteristics, and overall durability under different loading conditions such as acceleration, braking, and cornering forces. The FEA simulations help identify high-stress concentration areas, allowing for necessary design modifications and reinforcements. Additionally, modal analysis is conducted to evaluate vibration characteristics, as excessive vibrations can negatively impact driver comfort and control precision. The study further explores different reinforcement strategies, such as additional bracing and optimized tubing profiles, to enhance the chassis' torsional stiffness without adding unnecessary weight. The integration of safety considerations, including crashworthiness and impact absorption, is also analysed to improve driver protection during collisions. By combining advanced design methodologies with computational analysis, this research aims to develop an efficient and high-performance go-kart chassis suitable for both recreational and competitive applications. The findings provide valuable insights into optimizing chassis design to enhance structural reliability while maintaining lightweight characteristics, ultimately contributing to improved handling, speed, and safety. The study's results can be instrumental for manufacturers and racing enthusiasts in refining go-kart chassis designs for superior performance on the track.

Keywords: Go-kart chassis, Structural analysis, Finite Element Analysis (FEA), Material selection, Impact resistance, Stress distribution, CAD simulation.

ICRAMEN_2025_019

Design & Fabrication of path tracking automated waste management system

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Abstract

Efficient waste management is a crucial challenge in urban areas, requiring innovative solutions to optimize collection and disposal processes. This project focuses on the design and fabrication of a path-tracking automated waste management system to enhance efficiency, reduce human intervention, and minimize operational costs. The system integrates IoT-based sensors, GPS navigation, and autonomous robotics to track and collect waste along predefined routes. Using ultrasonic sensors for obstacle detection and RFID technology for waste bin identification, the system ensures seamless waste collection and disposal. The robotic unit is equipped with a microcontroller-based control system to automate movement, avoiding obstacles and ensuring precise navigation. This approach significantly improves waste collection efficiency while contributing to a cleaner and more sustainable urban environment. With the rapid urbanization and increasing waste generation, efficient waste management has become a pressing challenge. Traditional waste collection methods often suffer from inefficiencies, including missed pickups, fuel wastage, and high operational costs. To address these issues, this project presents the design and fabrication of a path-tracking automated waste management system that utilizes autonomous navigation, IoT-based monitoring, and smart sensors to optimize waste collection. The system employs GPS and GIS-based path tracking to follow predefined routes while integrating ultrasonic sensors for obstacle detection and RFID technology for waste bin identification. A microcontroller-based control unit governs the robotic waste collector, enabling it to autonomously navigate urban environments, detect waste bins, and optimize collection routes. Additionally, IoT-enabled real-time monitoring allows for remote tracking of waste levels in bins, ensuring timely collection and reducing unnecessary trips.

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Advancements in Cotton Feeder Technology for Improved Performance and Sustainability

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Abstract

Efficient cotton feeding is essential for enhancing the performance of ginning machines, ensuring uniform fiber processing, and reducing operational costs. Traditional cotton feeders often suffer from inefficiencies such as inconsistent feeding rates, high maintenance, and increased energy consumption. This review analyzes advancements in cotton feeder design, development, validation, and optimization, focusing on simplicity, cost-effectiveness, and reliability. Various feeder mechanisms, material selections, and process optimization techniques are discussed, highlighting their impact on feeding uniformity, fiber quality, and energy efficiency. Studies show that optimized feeders incorporating advanced materials, automation, and adaptive control systems significantly improve ginning performance. Statistical optimization techniques like Design of Experiments (DOE) and the Taguchi method have been effective in determining optimal process parameters. Future research should focus on automation, IoT integration, and sustainable materials to enhance feeder performance further. This review provides insights into developing an optimized cotton feeder that improves efficiency while maintaining low cost and reliability.

Keywords: Cotton feeder, ginning machine, feeder optimization, process parameters, automation, energy efficiency, fiber quality

ICRAMEN_2025_061

Critical Success Factors for Implementation of Lean Six Sigma in Small and Medium Enterprises – A Literature Review

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Abstract

Implementing Lean Six Sigma (LSS) in Small and Medium Enterprises (SMEs) has garnered significant attention due to its potential to improve efficiency, reduce waste, and enhance productivity. However, SMEs face distinct challenges in deploying LSS successfully. This literature review identifies and synthesizes the critical success factors (CSFs) that influence the effective implementation of LSS within SMEs. Key factors highlighted in the literature include strong leadership commitment, employee engagement, organizational culture, training and skill development, resource availability, and effective change management. Additionally, barriers such as resistance to change, lack of expertise, limited financial resources, and inadequate infrastructure are examined. The review also explores frameworks, methodologies, and case studies that offer insights into overcoming these challenges, focusing on integrating Six Sigma principles and Lean Manufacturing techniques tailored for SMEs. This study provides a comprehensive understanding of the determinants for successful LSS implementation in SMEs, offering practical recommendations for organizations seeking to adopt these methodologies for continuous improvement and sustainable growth.

Keywords: Lean six sigma (LSS); Small & Medium enterprises (SME); DMAIC; Critical success factors (CSF)

ICRAMEN_2025_065

The Investigation of Multiple sampling Techniques to minimize consumer and Producer Risk Probability assessment

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Abstract

Sampling is a sample taking method, which is basically used for inspection purpose. Inspection of unprocessed materials complete outcome or un-complete outcome is an essential part of quality sureness. When the inspection aims to determine whether to reject or accept the type of inspection method used is typically based on compliance with a standard product is known as acceptance sampling. A supplier delivers a shipment of product to a company. This item often acts as a raw material or components in the companies manufacturing procedure. A sample is taken from the shipment and the quality characteristic of the units are assessed. A decision regarding the fate of the shipment is then made based on the information from this sample usually this involves rejecting or accepting the shipment. The selection was sometimes known as “Lot Sentencing.” Non accepted lots may be returned to the supplier or may be subject to another lot disposition action accepted lots are used in manufacturing. Although acceptance sampling is typically thought of as a receiving inspection activity, sampling techniques have additional applications.

Lot Formation is a basic concept in sampling method. Lot formation and lot quality assurance sampling is a hypothesis of numerical quality control (SQC). In sampling procedure operating characteristic curve (OC Curve) shows graphically percentage defective of fraction defective of the lot and probable condition that lot is going to be accepted.

Keyword: Sampling, Lot Sentencing, Lot Formation, Numerical Quality Control (SQC), Acceptance Sampling and Operating Characteristic Curve (OC Curve), AOQ, AOQL LTPD.

ICRAMEN_2025_074

Impact Of Water Absorption On Tensile Properties On Waste Tire Rubber Particle Filled Epoxy Composites

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Abstract

This study investigates the impact of water absorption on the mechanical properties of waste tire rubber particle-reinforced epoxy composites with varying rubber content. Composites were fabricated using the open mold solution casting method, and their tensile properties were evaluated before and after water absorption in distilled water at room temperature. The results showed a progressive increase in water uptake from 0.69% to 1.11% and thickness swelling from 1.46% to 2.01% with higher rubber content, attributed to void formation and microstructural imperfections at the epoxy-rubber interface. The incorporation of 3 wt.% rubber particles led to the highest improvement in tensile strength (3.78%) and modulus (14.82%), demonstrating an optimal reinforcement effect. However, post-absorption testing revealed a reduction in tensile strength, modulus, and strain values, indicating moisture-induced degradation. Notably, composites with higher rubber content exhibited less strain reduction due to the inherent flexibility of rubber particles, which helped mitigate the impact of water absorption. These findings provide insights into optimizing rubber particle content to enhance the mechanical performance and durability of epoxy-based composites in moisture-prone environments.

Keywords: Epoxy, rubber particles, water absorption, thickness swelling, tensile properties,

ICRAMEN_2025_082

Investigation of the Effects of Submerged Arc Welding Parameters on Bead Geometry of E250 Mild Steel

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Abstract

Submerged arc welding (SAW) is an automated arc welding process in which a continuously fed electrode creates a deep-penetration weld beneath a protective blanket of granular flux. It is widely adopted for joining thick, high-strength steels due to its high deposition rate, deep penetration, and stable arc characteristics. The E250-grade mild steel is used extensively in construction, shipbuilding, and pressure-vessel manufacturing. The objective of this investigation is to understand the effects of various SAW parameters on the weld bead geometry of E250-grade mild steel. Weld bead geometry has a significant impact on joint strength, stress concentration, and fatigue resistance. In this study, a three-factor, three-level central composite design (CCD) matrix consisting of 20 experimental runs was applied to 12 mm-thick E250 plates to understand the influence of voltage, wire-feed rate, and weld speed on bead width, penetration depth, and reinforcement. The developed models and Analysis of Variance (ANOVA) revealed that bead width was largely influenced by voltage and wire-feed rate, penetration by wire-feed rate and weld speed, while reinforcement was influenced by all three parameters. Response Surface Methodology (RSM) was used to study the interaction effects of the parameters graphically. The optimized values for the desirable bead geometry of voltage, wire-feed rate, and weld speed were found to be 40V, 67.82 m/min, and 34.58 cm/min, respectively.

Keywords: Submerged Arc Welding, Welding Process Parameters, ANOVA, Mild Steel, Central Composite Design (CCD), Response Surface Methodology (RSM)

ICRAMEN_2025_085

CNN Integrated System For Real Time Gear Defect Assessment

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Abstract

Ensuring gear quality and reliability remains a central challenge in modern industrial systems. The costs associated with gear inspection significantly limits accessibility, primarily due to the dependence on complex automated systems implemented by large industries. In this study, an experimental setup was fabricated and tested, to achieve a competitive, and accurate solution. The dataset comprising spur gear images were sorted, labeled, data augmented and pre-processed. Two distinct models were evaluated: a Support Vector Machine (SVM) incorporating feature extraction techniques such as Gray-Level Co-occurrence Matrix (GLCM) and Edge detection, and a Convolutional Neural Network (CNN). The CNN outperformed the SVM, achieving an accuracy of 99.58%.The results presents a framework for advanced gear defect detection, with future directions in Remaining Useful Life (RUL) estimation and the prognosis of potential failure areas. With applications in predictive maintenance and quality control, the system, initially focused on spur gears, extends to various gear types, increasing maintenance efficiency and reducing industrial downtime.

Key Words: Machine Learning, Model-based quality inspection, Computer Vision, Predictive maintenance

ICRAMEN_2025_093

Fatigue Analysis of 3D-Printed PETG using a Hybrid Experimental and Finite Element Approach

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Abstract

The present work investigates the fatigue performance of FDM-printed PETG components through a combined experimental and simulation-based approach. Using an L16 Taguchi orthogonal array, specimens were fabricated under varying process parameters like infill pattern, infill density, layer thickness, and nozzle temperature, each at four levels. The specimens were subjected to tensile testing and the UTS values were between 20.58 MPa (Run 1) and 45.04 MPa (Run 4). These values were input into ANSYS Workbench to perform fatigue life simulations under uniaxial cyclic loading. The results identified the gauge section as the critical fatigue zone, with life decreasing from the infinite domain to low-cycle fatigue as stress increased. Among all configurations, Run 4 with grid infill, 90% density, 0.25 mm layer thickness, and a nozzle temperature of 260 °C, exhibited the most promising fatigue performance, while Run 1 with grid infill, 60% density, 0.1 mm layer thickness and a nozzle temperature of 230 ºC proved least resilient under cyclic loading. Although base material outperformed all printed variants, parameter optimization significantly improved durability. The study demonstrates the predictive capability of FEM in identifying failure-prone regions and optimizing print parameters for enhanced fatigue resistance in PETG components.

Keywords: Fused Deposition Modelling (FDM), PETG (Polyethylene Terephthalate Glycol), Fatigue Life Prediction, Finite Element Analysis (FEA), Taguchi Method.

ICRAMEN_2025_106

A Comprehensive Review on the Influence of Fused Deposition Modelling Process Parameters on the Structural and Functional Attributes of Fabricated Components

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Abstract

Fused deposition modelling, or FDM, is a popular additive manufacturing technology for 3D printing. This process is typically used to produce prototypes with complex geometries. The reason for the rise in popularity of this printing technique is the reduction in time required to manufacture a product without the requirement of expensive tools. FDM is an intricate process and the traits of the end product obtained from FDM rely profusely on the process parameters. A few shortcomings including less dimensional accuracy, inadequate mechanical attributes, and poor surface finish have limited the capitalization of this printing technique. Many process parameters influence the part qualities of FDM products, including build orientation, air gap, layer thickness, infill density, and raster angle. These parameters are responsible for changes in part properties like tensile, flexural, impact, and compressive strength of the model. The variation in settings and range of parameters is dependent on the category of FDM machine used. To optimize the printed model's attributes and reduce post-processing effort, the parameters must be adjusted optimally. As a result, it is critical to study the process parameters in the FDM process in order to give superior component qualities and use FDM created parts in a variety of fields.

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Design and fabrication of Manual Roller Bending Machine

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Abstract

This paper aims to develop a roller bending helpful machine to bend pipes and metal strips in the workshop. This project is to vogue and constructs a negotiable roller bending machine. This machine is utilized to bend steel pipes and meta strips into a curve and so the choice curvature shapes. The scale of the machine is very convenient for movable work. It is entirely created by steel. Moreover, it is easy to carry and use at anytime and anywhere. It reduces human effort and, in addition, required low less talent to figure this machine. We incline to face live arising with operated by hand roller bending machine using block, motors, gears, and support (frame). Power is that the machine for pipe bending, and everything works manually. Therefore, our objective is to extend preciseness at low costs while not moving the pipe bending's productivity. This machine works on the simple kinematic system instead of subtle vogue. Because of its mobility, it are usually utilized by workshop or fabrication search. A bending machine is also a standard tool in the workshop that is accustomed bend a metal.

Keywords: Manual, bending machine, pipe bending, metal strips

ICRAMEN_2025_110

Optimization Of Friction Stir Welding Parameters for Joining Aluminum Alloys 6061 & 6082

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Abstract

Friction Stir Welding (FSW) is a solid-state joining technique that has been applied in the energy sector, automotive, railway, aerospace, and marine industries. It uses a rotating tool to generate enough frictional heat to join metals. Solid-state welding techniques address a number of issues that arise during the fusion welding of Al alloys, including segregation, porosity, and HAZ liquation cracking. Aluminum alloys of two different series AA6061 and AA6082 thickness of 5 mm are FS welded using process parameters like tool rotational speed (800, 1000, 1200) rpm, transverse speed (30, 40, 50) mm/min, and pin profile (conical). The input parameters: tool rotational speed, traverse speed and axial load, the output parameters: Hardness and Tensile Strength. The experimental approach that was selected to construct the number of welding trials was the use of Taguchi method. At room temperature, the plates' tensile strength and hardness are evaluated after they have been satisfactorily welded. The results offer important information for improving FSW procedures in industrial settings for connecting aluminum alloys.

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ICRAMEN_2025_116

Design, Fabrication, and Analysis of a Compound Die for Blanking and Piercing Operations

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Abstract

This paper presents the design, fabrication, and analysis of a compound die capable of performing simultaneous blanking and piercing operations on mild steel sheet metal. The compound die was designed using an open-source 3D design software and manufactured to improve efficiency, reduce material waste, and enhance product accuracy. Key parameters such as sheet thickness, cutting forces, and material selection were considered to optimize the die design. Cutting load calculations were performed to determine operational feasibility. A roller mechanism was incorporated to facilitate the smooth removal of washers and scrap material. The resulting die system demonstrates improved production efficiency and dimensional precision, making it suitable for high-volume manufacturing applications.

ICRAMEN_2025_119

Design and Fabrication of a Six Degree of Freedom Robotic Manipulator

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Abstract

Design and fabricate a 6 DOF Robotic Manipulator capable of lifting loads up to 10 kg and performing several tasks. The robotic arm incorporates various approaches by integrating advanced mechanical, and electrical systems to achieve high precision, adaptability, and operational efficiency. The mechanical subsystem has carbon fiber composites for arm links, uses worm gear pairs and linear actuators. The electrical subsystem includes a fail-safe power distribution network with custom-designed PCBs, efficient DC motor drivers, and feedback mechanisms using rotary encoders and Hall-effect sensors to optimize control and precision. The arm's functionality is validated through rigorous testing protocols, including pre-and post-manufacturing phases. These tests cover subsystem performance, real-world load handling, and task precision to ensure adherence to theoretical design parameters.

This project incorporates iterative optimization, ensuring minimal difference between simulated and practical performance. Its robust integration of cutting-edge technology in robotics marks its potential for applications in industrial automation, research, and other advanced fields. By addressing the challenges of precision, adaptability, and efficiency, this work aims to set new benchmarks in the design and development of robotic arms and manipulators.

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Track
Solid Mechanics and Modeling

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ICRAMEN_2025_022

Finite Element Analysis of trans-tibial prosthetic socket

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Abstract

The aim of this paper is to conduct the finite element analysis (FEA) of the trans-tibial prosthetic socket by making use of the commercial analysis software ANSYS. The trans-tibial prosthetic socket serves as the primary connection between the residual limb of an amputee and the prosthesis. Initially the socket mold made from a patient was 3D scanned, and the scan was later post processed to attain a smooth 3D geometry with the help of Autodesk Fusion 360. The body weight was the force which was considered for loading. The material used for this analysis was a hybrid bio-composite material of abaca and glass fiber reinforced by epoxy. The material tests were conducted, and orthotropic properties were calculated for accurate analysis results. The results such as the total deformation, equivalent von-mises stress and equivalent elastic strain showed the weak parts of the design leaving room for topology optimization and helped understand how the socket behaves under these boundary conditions.

Keywords: FEA; trans-tibial; 3D scanning; bio-composite; Von-Mises Stress

ICRAMEN_2025_033

Development Of Wirenet Fencing Machine

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Abstract

The paper presents the review, analysis, study of concepts, innovation of machine producing chain-link. The length of the fence produced is adjustable. The machine also has a manually operated mechanism for situations like power cuts. The motto is to occupy less space at workplace and produce the fence as required on the spot.

Fences can be defined as an arrangement that provides an obstruction, enclosure, or a boundary, made up of posts or stakes linked together by boards, wire, or rails. The chains run vertically and are bent into a zigzag pattern so that each "zig" hooks with the wire immediately on one side and each "zag" with the wire immediately on the other. The manufacturing of chain-link fencing is called weaving. Preparing zigzag shape wire is a quite challenging task and cannot be done using basic mechanisms. So here we design a smart mechanism to automatically bend wires in order to get zigzag shaped wire for mesh. These wires can then be linked together to create chain links or meshes. For this system we make use of a wire bobbin to supply raw wire to the system, a motor with shaft connected to a unique mechanism that achieves our bending requirements. The system is a small yet complex system that achieves the task with ease.

A metal wire, frequently galvanized to reduce corrosion, is pulled along a rotating long and flat blade, thus making a somewhat flattened spiral. The spiral continuously rotates passing the blade and winds its way through the previous spiral that is part of the produced fence. When the spiral reaches the distant end of the fence, the spiralis cut near the blade. Then the spiral is pressed flat and the whole fence is moved up, ready for the next cycle. The end of each second spiral joins the end of each first spiral. The machine clamps both ends and gives them a few twists. This makes the links permanent. In this attempt of Experimental analysis of automatically manufacture chain link fencing wire is done.

Keywords: Chain link fencing, fencing machine, Wire net, Fencing Technology Evolution, Mechanical Properties, Wire quality, material selection, chain link mesh, motor

ICRAMEN_2025_072

Analysis of variable cross section composite pressure vessel

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Abstract

The design and finite element analysis (FEA) of a composite pressure vessel with variable cross section meant for better efficiency is described in this paper. The vessel has a length of 700 mm, inner diameters of 125 and 150 mm, and polar opening radii of 100 mm and 125 mm. The hoop and helical layer thicknesses were determined with a helical angle of 23.57° using netting theory. The composite structure consists of 20 layers 10 hoop (90°) and 10 helical (±23.57°) made from Epoxy Carbon UD and Woven materials. The first and twentieth layers are each 1 mm thick, while the remaining intermediate layers (2 to 19) are 0.5 mm thick, resulting in a total composite thickness of 11 mm. Mesh convergence was ensured with a 6-mm quadratic layered brick element. The problem was analysed with appropriate boundary conditions used in ground test under 10 MPa internal pressure. A maximum radial deformation of 0.313 mm and maximum axial deformation of 1.340 mm were observed. The fiber-directional stresses which play major role in the design were found to be well within the limits in all the layers.

Keywords: Composite Pressure Vessel with variable cross section, Finite Element Analysis, Structural Efficiency.

ICRAMEN_2025_076

Structural and Modal Analysis of Unwind Turret in RotoGravure Printing Machine

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Abstract

This study investigates the structural and modal analysis characteristics of an industry-used component by comparing its original design with a modified version featuring a reduced thickness of the frame. Finite Element Analysis (FEA) was conducted using ANSYS 2023 to assess the impact of this modification on structural integrity, vibrational characteristics, and overall performance. The primary objective is to determine whether a reduction in diameter can lead to material savings while maintaining or improving the mechanical properties of the component. The structural analysis evaluates stress distribution, deformation, and safety factors for both designs, providing insights into the effects of dimensional modifications. Modal analysis examines natural frequencies and mode shapes, ensuring that the modified design does not introduce resonance-related failures. Additionally, topology optimization techniques identify potential material reductions while maintaining necessary structural strength. The results indicate that a reduction in diameter leads to slight variations in stress and frequency values but remains within acceptable industrial limits. This study concludes that design optimization can be achieved with minimal trade-offs, offering potential weight savings without compromising performance.

Keywords: Structural Analysis, Modal Analysis, Topology Optimization, ANSYS 2023, Finite Element Analysis, Design Optimization, Component Performance, Weight Reduction.

Track
Thermal Engineering and Fluid Mechanics

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ICRAMEN_2025_017

Experiment analysis of conical shape receiver tube parabolic trough collector

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Abstract

The growing demand for sustainable energy solutions has accelerated the development of advanced solar thermal technologies, with parabolic trough collectors (PTCs) emerging as a highly efficient method for harnessing solar energy. The receiver tube, a crucial component of the PTC system, directly influences its thermal performance by absorbing and transferring heat. Traditional cylindrical receiver tubes often suffer from non-uniform heat distribution and higher thermal losses, limiting overall efficiency. This study presents an experimental analysis of a conical shape receiver tube designed to enhance heat absorption, reduce heat losses, and improve thermal performance. The conical geometry facilitates better heat concentration, resulting in higher thermal efficiency and optimized heat transfer characteristics. Experimental investigations assess temperature distribution, heat retention, and system efficiency compared to conventional designs. The findings contribute to the ongoing advancements in solar thermal systems, offering insights into improving energy conversion efficiency for industrial and power generation applications.

Keywords: Parabolic Trough Collector, Conical Shape Receiver Tube, Solar Thermal Energy, Heat Absorption, Thermal Efficiency, Renewable Energy.

ICRAMEN_2025_023

Recent Advancements and Sustainable Approaches in Vapor Adsorption Colling Technologies

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Abstract

The rising global demand for energy-efficient and eco-friendly cooling solutions has spurred significant progress in vapor adsorption cooling technologies. Vapor adsorption refrigeration systems present a promising alternative to traditional compression-based cooling systems by using adsorbent materials to capture and release refrigerants, offering sustainable and clean cooling options. This review paper provides a thorough overview of the latest advancements, challenges, and future potential in vapor adsorption cold storage technologies. It begins by explaining the core principles of vapor adsorption refrigeration, such as the adsorption-desorption cycle, working fluids, and thermodynamic processes. The paper then covers key components of adsorption systems, including adsorbent materials, heat exchangers, and adsorption cycles. Recent innovations in adsorbent materials, such as metal-organic frameworks (MOFs), zeolites, and activated carbon, are highlighted for their excellent adsorption capacities, selectivity, and thermal stability. Additionally, the paper examines various heat sources for driving the adsorption process, including waste heat, solar energy, and low-temperature heat sources. The integration of vapor adsorption refrigeration with renewable energy sources is explored as a sustainable strategy to reduce greenhouse gas emissions and improve energy efficiency.

Keywords: Vapor adsorption refrigeration, Energy efficiency, Environmental sustainability, Adsorbent materials, Heat sources.

ICRAMEN_2025_025

Dimensional Optimization of the Receiver Pipe in a Parabolic Trough Collector with Integrated Thermal Storage Using CFD and the Taguchi Method

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Abstract.

This research focuses on enhancing the thermal performance of a parabolic trough collector with thermal storage by optimizing three key parameters: HTF pipe diameter, concentration ratio, and thermal storage quantity. Computational Fluid Dynamics simulations and statistical analysis using the Taguchi method were employed to determine the most effective configuration for achieving higher outlet heat transfer fluid temperatures. The study found that the heat transfer fluid pipe diameter substantially influences parabolic trough collector performance. Increasing the pipe diameter from 12.7 mm to 25.4 mm led to a significant increase in outlet heat transfer fluid temperature from 425 K to 550 K, representing an improvement of nearly 29.4%. The optimal concentration ratio of 8.35 was identified as the most effective in maximizing heat absorption, while an increase beyond this level had minimal effect.

Additionally, a thermal storage quantity of 2.25 kg was optimal for thermal storage, with larger quantities showing diminishing returns. Analysis of the signal-to-noise ratio and mean response values confirmed that heat transfer fluid pipe diameter had the most dominant effect on performance, followed by the concentration ratio and thermal storage mass. The study suggests that further improvements can be achieved by introducing nanoparticles into the heat transfer fluid to enhance heat absorption and retention. This optimized setup provides a practical approach for medium-temperature solar thermal applications, ensuring efficient heat storage and utilization even in low radiation conditions.

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Experimental study of solar parabolic trough collector by varying heat Transfer fluid

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Abstract.

This study evaluates the thermal performance of a parabolic trough collector (PTC) using water and Therminol VP-1 as heat transfer fluids (HTFs) under identical conditions. The experimental results demonstrate that Therminol VP-1 exhibits superior thermal efficiency, achieving a maximum outlet temperature of 323 K on December 26, 2024, compared to 316 K recorded with water on December 25, 2024. The higher temperature difference between inlet and outlet in the case of Therminol VP-1 indicates its enhanced heat absorption and retention capabilities. The findings suggest that Therminol VP-1 minimizes heat losses and improves the overall efficiency of the PTC system, making it a more suitable choice for solar thermal power generation and industrial heating applications. Its higher thermal stability allows for efficient energy transfer, ensuring better system performance. This study highlights the advantages of using Therminol VP-1 over water, emphasizing its role in enhancing solar energy conversion and utilization. These insights contribute to the development of more effective and reliable solar thermal systems, supporting the advancement of renewable energy technologies.

Keywords: Parabolic Trough Collector, Heat Transfer Fluid, Solar Thermal Energy, Therminol VP-1, Water, Thermal Efficiency

ICRAMEN_2025_039

Determination of heat transfer coefficient of sCO_2 flowing in an inclined cavity using CFD approach

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Abstract

The present work focuses on highlighting the significance of natural convection of supercritical fluids within an inclined cavity. A model was constructed to replicate the natural convection process of supercritical fluids in an inclined setting. The study examines the effects of various incline angles (ranging from 0 to about 90°) and pressures (8 and 9 MPa). To investigate the flow and heat transfer related to natural convection of supercritical fluids, this work employs a numerical analysis using Ansys Fluent. The findings indicate that the optimal heat transfer performance occurs at an incline angle of 30°. Moreover, as the incline reaches 90°, the Nusselt number begins to decrease. Additionally, correlations for the average Nusselt number are also established. The outcomes of this study can serve as a theoretical framework for exploring heat transfer of supercritical fluid natural convection in engineering applications.

Keywords: Natural convection, Ansys fluent, Heat transfer, Function correlation, Supercritical fluid

ICRAMEN_2025_060

Parametric Performance Analysis of Nozzle Jet Spray Condensers for Sugar Vapor Condensation Using Matlab Simulation

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Abstract

The production of sugar crystal size uniformly with purety is the main object of the sugarcane Juice processing industries. To fulfill the proper vacuum area requirement in sugar and pharmaceutical industrial barometric condenser role is important. The condensation after evaporation of sugarcane juice has highly energetic cost and is usually performed in multiple effect evaporation. The loss of performance during operation due to fouling makes the process complex. In this study analysis were performed for a sugarcane juice industrial condensation system with evaporation composed of falling to provide constant temperature of water inside condensation processing to achieve continuously Vaccum area inside barometric condenser to better evaporation to affect on uniform crystal size pure sugar for where pharmaceutical kids syrup require.

Barometric Jet Condenser is one of the most Energy Intensive sections of sugar and pharmaceutical food process industries. Single Jet Barometric Condenser can be wasteful of energy if vapours heat removal for the better vaccum creation. In Sugar Industrial from Cane to Sugar crystal Creation formation better vaccum creation inside the barometric jet condenser play more effective and economical roll. In the sugar juice extraction process for uniform sugar crystal size formation depends role of better vaccum creation and effect on sugar purification and crystal size. Single Jet Spray condenser gives efficiency 59% and Multi nozzle jet condenser efficiencies 79% has been seen usng different condensers.

Keywords- Barometric Condenser, Sugarcane Juice, Vacuum, Evaporation, Sugar Crystal, Juice Extraction

ICRAMEN_2025_062

Comparative study of CFD simulation of flow boiling in heated pipe and subchannel of Nuclear reactor

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Abstract

Subcooled flow Boiling has major application in thermal engineering and nuclear industry. It is important to model the effect of void fraction of vapour under subcooled flow boiling at high pressure condition, as it is limiting the heat flux values. Over years, CFD has proven to be effective in determining and analysing the multiphase flow system. Eulerian–Eulerian two fluid model coupled with RPI boiling mode is used to predict the subcooled boiling in vertical tubes. It is important to understand the interaction between the two phases and the forces acting on each other which is required for modelling the subcooled flow boiling. In this study, a comprehensive analysis is done to understand the impact of boiling and momentum closures on subcooled flow boiling prediction. Validated model is used to perform 3D subchannel analysis. The results from the subchannel analysis are compared with that of the tube to understand the impact of the shape of 3D subchannel on the overall flow characteristics.

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ICRAMEN_2025_063

Optimization Techniques for Multi Nozzle Jet Spray Condensers a Comprehensive Performance Study

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Abstract

Multi-nozzle jet spray condensers are gaining attention as an green answer for improving heat switch in industrial applications. These structures use more than one nozzles to distribute the operating fluid, improving the condensation procedure and substantially boosting warmness dissipation fees. This paper explores the experimental performance of multi-nozzle jet spray condensers, that specialize in their potential to optimize heat switch performance. The warmness transfer mechanisms of multi-nozzle systems are in comparison to single-nozzle systems, revealing their advanced warmth dissipation talents and operational balance. Experimental consequences examining the outcomes of spray stress, nozzle configuration, fluid homes, and environmental elements on condenser overall performance are presented. The findings display that these parameters substantially have an impact on warmness transfer performance, providing practical benefits for industries like power generation, refrigeration, and chemical processing. The paper additionally discusses layout issues for integrating multi-nozzle jet spray condensers into present structures and the challenges confronted in their implementation. Lastly, the take a look at identifies technical limitations in optimizing these structures for big-scale packages and shows future research instructions to enhance their overall performance, ultimately broadening their commercial use.

Keywords: Multi-nozzle, jet spray condensers, warmth transfer, condensation, overall performance, commercial packages, optimization.

ICRAMEN_2025_070

A Critical Review of Heat Transfer through Curved Tubes of Non-Circular Cross Section

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Abstract

Heat exchangers of various types have been widely used to transfer heat between fluids at different temperatures. The tubes used in heat exchangers are of various cross sections, such as circular, square, rectangular, triangular, and elliptical, and are in straight or curved forms. In the case of curved tubes, the centrifugal force is induced in the flow due to the tube's curvature. This creates a secondary flow perpendicular to the primary flow direction and results in turbulent flow, leading to a pressure drop and a higher heat transfer rate. Further, in helically coiled tubes, the fluid flow inside the tube is subjected to torsional motion due to its helix angle, enhancing the turbulence through chaotic mixing and improving the heat transfer phenomenon. However, a significant pressure drop demands higher pumping power due to enhanced turbulence in the flow. Researchers have conducted numerous studies on the constructional features of heat exchangers. Most of the studies focused on straight tubes and curved tubes with circular cross-sections. In contrast, limited studies were conducted on curved tubes in the form of in-plane spirals, conical spirals, and helical coils with their sections non-circular ones, such as square, rectangular, triangular, and elliptical. A more complex geometry of the coils with a non-circular cross-section may result in still higher heat transfer rates, but at the penalty of higher pressure drops in the flow and higher manufacturing cost. The present paper is intended to review and summarise such limited studies through the review of primary published documents during the last five decades to provide an overview of the benefits and drawbacks/limitations of heat exchanger coils in the form of curved tubes with non-circular cross sections for realising their thermal engineering applications at optimal cost.

Keywords: Curved tubes, Spiral coils, Helical coils, Non-circular sections, Laminar flow, Turbulent flow.

ICRAMEN_2025_071

A Comparative Study of Experimental and CFD Investigations on Heat Transfer to Newtonian Fluid Flow through Helical Coils of Circular and Square Cross Sections

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Abstract

Numerous experimental studies have reported fluid-to-fluid heat transfer through helical coils with Newtonian and non-Newtonian fluid flow under steady-state or unsteady-state conditions. Most of the studies were on helical coils with circular cross-sections. The present work reports a comparative analysis of experimental and numerical investigations of heat transfer to Newtonian fluid flow through two mild steel helical coils, one with a circular cross-section and the other with a square cross-section. Both coils had the same helix diameter, pitch and flow areas. Water was used as a Newtonian fluid. The coils were tested with various flow rates in laminar to turbulent flow regimes, with the Reynolds numbers 3311 to 34095 for circular and 2935 to 30226 for square-section coils, under isothermal steady-state conditions. Heat transfer parameters, viz., the overall, inside and outside convective heat transfer coefficients and Nusselt number, were estimated based on experimental data. These parameters were then compared numerically for their validation using the FLUENT 19.2 solver of the ANSYS CFD package for three typical flow rates in laminar to turbulent regimes. The outlet temperature of the flow, as per the CFD-generated temperature profile, was adopted as the performance parameter for validation of the experimentally observed outlet flow temperature. The experimentally observed outlet flow temperatures were slightly on the higher side but well within the acceptable variation of about 10% of their corresponding value evaluated using CFD, thus validating the experimentally evaluated heat transfer parameters. The comparative analysis showed that the helical coil with a square cross-section yielded higher heat transfer parameters than a circular cross-section.

Keywords: CFD - computational fluid dynamics, Helical coils, Heat transfer, Laminar flow, Turbulent flow, Newtonian fluid.

ICRAMEN_2025_087

CFD-based performance evaluation of ship propeller for different blade angles

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Abstract

Marine vessels' hydrodynamic performance and propulsion efficiency are greatly influenced by the design of their propeller blades. In order to determine how these variations affect important performance metrics like thrust and flow characteristics, this study focuses on the numerical analysis of a marine propeller at three different blade pitch angles. The study intends to visualize and compare the pressure and velocity distributions surrounding the propeller blades for each configuration using computational fluid dynamics (CFD). With ANSYS Fluent, a three-dimensional model of the propeller was constructed and examined in steady-state flow conditions. To simulate real-world rotation, the simulation setup featured a rotating reference frame. The Reynolds-Averaged Navier-Stokes (RANS) equations in conjunction with the conventional k-ε turbulence model were used to capture the turbulence behaviour. The study involved analyzing pressure contours, velocity contours, and calculating the resulting thrust produced at each blade angle.

Keywords: CFD (Computational Fluid Dynamics), Ship Propeller, Blade Angle, Thrust, Pressure Contour, Velocity Contour, Hydrodynamic Performance, Propeller Efficiency

ICRAMEN_2025_097

Enhancing gas turbine performance by compressor inlet air cooling methods

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Abstract

This study investigates the enhancement of gas turbine performance in hot and humid climates by integrating advanced cooling and dehumidification systems. Focusing on the Basin Bridge gas turbine in South India, the research employs DWSIM simulations to compare baseline performance with an optimized system utilizing a Maisotsenko Cycle (M-Cycle) cooler and a desiccant dehumidifier. The M-Cycle cooler reduces inlet air temperature via indirect and direct evaporative cooling, while the dehumidifier effectively removes moisture, improving air density and combustion efficiency. Results demonstrate significant improvements in turbine performance, including a 9 MW increase in net power output and enhanced thermal efficiency, underscoring the potential of these technologies for power generation optimization in challenging climates.

Keywords: Gas turbine performance, compressor inlet air cooling, Maisotsenko Cycle (M-Cycle) cooler, desiccant dehumidifier, evaporative cooling, hot and humid climates, power generation efficiency, thermal efficiency, DWSIM simulation, combustion efficiency, air density optimization, renewable cooling techniques.

ICRAMEN_2025_101

Optimizing Cooling Performance in Work Roll and Backup Roll Bearings with Experimental Computational and Industrial Approaches

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Abstract

This review presents a comprehensive analysis of recent advancements in cooling strategies for work roll and backup roll bearings in rolling mills. Efficient thermal management is critical in maintaining dimensional accuracy, minimizing bearing wear, and extending component life under high mechanical loads and elevated temperatures. Traditional methods, including water jet cooling and oil-air mist lubrication, have provided baseline solutions, but often fall short under extreme operating conditions. Emerging technologies such as nanofluid-enhanced lubricants, cryogenic sprays, and thermoelectric cooling systems demonstrate superior heat dissipation and reduced thermal fatigue. Computational techniques, including Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA), have enabled precise modeling of fluid flow and temperature gradients. In parallel, AI-driven predictive systems and IoT-based thermal monitoring offer real-time control over cooling parameters, improving process efficiency and reducing unplanned downtime. Industrial case studies validate these methods, showcasing enhanced performance, energy savings, and reduced environmental impact. Challenges remain in cost-effective implementation, lubricant stability, and environmental sustainability. Future directions emphasize the development of AI-integrated, adaptive cooling systems, hybrid lubrication strategies, and eco-friendly thermal management solutions. This review consolidates experimental findings, simulation approaches, and industrial practices, providing a roadmap for the next generation of intelligent and efficient cooling systems in modern rolling mill operations.

Keywords- Rolling Mill Bearings, Work Roll cooling, Backup Roll Cooling, Lubrication, Heat Dissipation, Computational Modeling.

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Optimized Charging Strategies and Energy Consumption Analysis for Electric Buses: Enhancing Grid Stability and Sustainable Public Transport

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Abstract

As the public transport sector continues to expand, the adoption of electric buses is steadily increasing. Consumers are increasingly accepting e-buses as a viable mobility option. This shift plays a crucial role in promoting an eco-friendly environment and supporting a sustainable and healthy atmosphere. This paper aims to analyze the energy consumption patterns of electric buses, focusing on key issues such as battery management, grid stability, load distribution, and related factors. Addressing these challenges requires the implementation of a robust real-time data monitoring framework. Furthermore, optimized charging schedules can facilitate structured charging based on operational needs, resulting in greater cost-efficiency. For maintaining grid stability, a balanced charging strategy — particularly scheduling bus charging during nighttime hours — emerges as a highly effective and economical approach. Such a strategy not only minimizes charging costs but also helps mitigate peak demand issues arising from the increasing integration of electric buses into public transport systems.

Keywords: Electric Vehicles, Tariff, Time-based Charging, Charging Station.

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Immersive Fitness: The Impact of VR/AR-Based Training on Physical Performance and Motivation Attainment of Program Outcomes in Outcome Based Education

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Abstract

This study paper explores the effect of Virtual Reality and Augmented Reality on real-time performance and motivation in the context of fitness training. The immersed environments of fitness, created with VR/AR, prove to magnify engagement, enjoyment, and adherence to fitness programs. The practice of visually appealing environments and the facilitation of real-time feedback further support user motivation and overall physical performance on VR/AR-based platforms. The benefits of aggregating multiple studies the paper sought to integrate will depict an improvement in muscular strength, balance, and the eagerness to continue using such. On this basis, a conceptual system architecture is proposed, and from this, its methodological foundation and implementation strategy are subjected to analysis. Results indicate how while a great promise lies in VR/AR-based fitness systems, challenges remain in the shape of motion sickness, very expensive hardware, and very long-term engagement.

Keywords— Augmented Reality (AR), Virtual Reality (VR), immersive fitness, exergaming, VR fitness training, gamification, physical activity, user engagement.

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