COGNITION

Quarterly Research Newsletter of NIT Raipur VOLUME 3, ISSUE 2, JULY 2023



NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR G.E. ROAD, RAIPUR - 492 010















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DIRECTOR'S MESSAGE



Dear Readers of Cognition,

It is a great pleasure for me to assume charge as the Director of the National Institute of Technology (NIT) Raipur.The Institute, since its inception, has made significant headway in academics, research, and innovation. NIT Raipur's core values of excellence, integrity, transparency, and accountability have played a major role in this direction.

In order to be consistent in these efforts, NIT Raipur has strategized its approach through Vision 2030 Document and which also aligns with NEP 2020. The Institute is thus progressing with the aim to make teaching more learning-centric, create an environment that offers vibrant interdisciplinary research, encourage entrepreneurship and innovation, etc.

At NIT Raipur, we have a committed and dedicated faculty, staff, and students who have been tirelessly working for further strengthening research and innovation at the campus. I must mention that the Institute has a good record of research publications, research projects, patents, and placements. I am hopeful that the Institute will further excel in all these areas. However, in the coming months, our prime focus will be to generate state-of-the-art infrastructure that results in ideation, high-quality research, and development. By doing so, viable solutions to many social and scientific problems will be arrived at and that will bring general good to the society.

Considering all this, I am sure that NIT Raipur will outshine the field of academics and research in the coming years.

With this, I would like to wish all the readers of Cognition happiness and success.

Also, I congratulate the entire editorial team of Cognition for their hard work and dedication in publishing this issue of the research newsletter.

Dr. N.V. Ramana Rao Director NIT Raipur

Editorial Note : COGNITION Volume 3, Issue 2



Dear Reader,

To begin with, we are grateful for having Dr. N.V. Ramana Rao as the present Director of NIT Raipur. He is an academic and administrator of great excellence. Under his effective leadership and industriousness, the Institute aims at being more productive and contributive to society. We take pleasure in welcoming him to the Institute!

Volume 3, Issue 2 of Cognition brings to you the Institute's achievements in academics and research during the second quarter of the year, i.e., from April 2023 – June 2023. During this short span of three months, the Institute was dextrous in publishing numerous research articles in various high-impact factor journals, books, chapters, etc. It was possible with the sheer dedication of our faculty, research scholars, and undergraduate students.

This Issue highlights these efforts and also various other vital developments in the Institute. It also shares the details of various research projects approved or sanctioned, patents awarded; MoUs signed; conferences, seminars, and STTPs organized; start-ups initiated, and innovation executed, etc. We are sure that this Issue will be informative and relevant to you. We would once again like to extend our good wishes to Dr. N.V. Ramana Rao, Director, NIT Raipur. We are certain that with his vision the Institute will achieve extraordinary heights.

We are also grateful to our respected Deans, Heads of all the departments, faculty, researchers, scholars, and administrative and non-teaching staff for all their support.

With this, we wish you a happy reading!

We would appreciate it if you let us know your queries, inputs, or concerns. We can be contacted at: cognition@nitrr.ac.in.

Team Cognition wishes you a great year ahead!

Warm regards!

Editorial Team

Cognition

HEAD



Dr. Ayush Khare Associate Professor Department of Physics

MEMBER

Dr. A. K. Dash

Assistant Professor

Department of ME





Dr. Moksha Singh Assistant Professor Department of HSS

MEMBER



Dr. Deepak Singh Assistant Professor Department of CSE

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X-PERT GRAPHICS, Raipur (C.G.)



PATENTS GRANTED TO NIT RAIPUR

1. Title: Fish Pond Water Quality Monitoring Device

Names of inventor(s): Dr. Arepalli Peda Gopi and Dr. K. Jairam Naik

Patent granting authority: Government of India

Patent No.: 375537-001

Status: Published

Month and year of granting: January, 2023

Summary of the invention

The invented design is for monitoring the water quality in fish pond. This device consists of water quality sensors to detect the pH level, dissolved oxygen (DO), ammonia, temperature, nitrate, turbidity, and manganese in the fish pond. The hardware configurations of sensors, ARDUINO board, and NODE MCU are used to collect data from fishponds, store that data in the cloud, and analyze that data using the convolution neural network model to classify water quality concerning aquatic species life. It collects data collection and analysis is based on IoT and deep learning.

2. Title: Stirrer for Casting of Composite Materials

Names of inventor(s): Dr. Lakshman Sondhi, Dr. Royal Madan, Dr. Shubhankar Bhowmick, Dr. Pratap B Deshmukh, Dr. Sanjay Yadav, Mr. Sanjay Kumar Singh, Mr. Birendra Gurung, Mr. Harsh Tripathi and Mr. Abhishek Sahu

Patent granting authority: Government of India

Patent No.: 377279-001

Status: Published

Month and year of granting: March, 2023

Summary of the invention

One of the major concerns of alloy and composite castings is the distribution of reinforcement material in the matrix for establishing constant strength. There should be unform distribution of the reinforcement material. To fulfill this requirement, an adjustable, portable, heat-resistant, and mechanically operated gear-based stirrer has been designed that can be used for the mixing molten metals generally for aluminium alloy casting. A mechanically adjustable geared-stirrer setup has been designed that can be easily adjusted at any position or height for producing a thorough stir-casting composite.

PUBLISHED BOOKS & BOOK CHAPTERS

Title of book: Big Data Analytics in Fog-Enabled IoT Networks: Towards a Privacy and Security Perspective

Publisher: CRC Press

ISBN: 9781003264545

Month and year of publication: April 2023

Authors: Govind P. Gupta, Rakesh Tripathi, Brij B. Gupta and Kwok Tai Chui



About the book

The integration of fog computing with the resource-limited Internet of Things (IoT) network formulates the concept of the fog-enabled IoT system. Due to a large number of IoT devices, the IoT is a main source of Big Data. A large volume of sensing data is generated by IoT systems such as smart cities and smart-grid applications. A fundamental research issue is how to provide a fast and efficient data analytics solution for fog-enabled IoT systems. Big Data Analytics in Fog-Enabled IoT Networks: Towards a Privacy and Security Perspective focuses on Big Data analytics in a fog-enabled-IoT system and provides a comprehensive collection of chapters that touch on different issues related to healthcare systems, cyber-threat detection, malware detection, and the security and privacy of IoT Big Data and IoT networks.

This book also emphasizes and facilitates a greater understanding of various security and privacy approaches using advanced artificial intelligence and Big Data technologies such as machine and deep learning, federated learning, blockchain, and edge computing, as well as the countermeasures to overcome the vulnerabilities of the fog-enabled IoT system.

Purchase link:

https://www.routledge.com/Big-Data-Analytics-in-Fog-Enabled-IoT-Networks-Towards-a-Privacy-and-Security/Gupta-Tripathi-Gupta-Chui/p/book/9781032206448

Title of book: Conference Proceedings of International Conference on Applied Computational Intelligence and Analytics (ACIA-2022)

Publisher: AIP Publishing

ISBN: 9780735445024

Month and year of publication: June 2023

Authors : Govind P. Gupta, Satya Prakash Sahu, Rakesh Tripathi and Tirath Prasad Sahu

About the book

The theme of this international conference was Computational Intelligence and its application in different domains such as data

science and analytics, cyber security, network and system. The main aim of the ACIA-2022 conference was to select and share quality research articles based on the current scientific developments on computational Intelligence and its application. There were mainly three tracks based on the application of Computation Intelligence that were discussed in this conference. These inculded Data Science and Analytics, Network and System, and Cyber Security.

Purchase link: https://pubs.aip.org/aip/acp/issue/2705/1

Title of book: Multimodal Affective Computing: Affective Information Representation, Modelling, and Analysis Publisher: Bentham Books ISBN: 978-981-5124-46-0 (Print), 978-981-5124-45-3 (Online) Month and year of publication: April 2023 Author: Gyanendra K. Verma About the book

Affective computing is an emerging field situated at the intersection of artificial intelligence and behavioral science. Affective computing refers to studying and developing systems that recognize, interpret, process, and simulate human emotions. It has recently seen significant advances from exploratory studies to real-world applications.

Multimodal Affective Computing offers readers a concise overview of the state-of-the-art and emerging themes in affective computing, including a comprehensive review of the existing approaches in applied affective computing systems and social signal processing. It covers affective facial expression and recognition, affective body expression and recognition, affective speech processing, affective text, and dialogue processing, recognizing affect using physiological measures, computational models of emotion and theoretical foundations, and affective sound and music processing.

This book identifies future directions for the field and summarizes a set of guidelines for developing next-generation affective computing systems that are effective, safe, and humancentered. The book is an informative resource for academicians, professionals, researchers, and students at engineering and medical institutions working in the areas of applied affective computing, sentiment analysis, and emotion recognition.

Purchase link: https://benthambooks.com/book/9789815124453/preface/







Title of book: Prediction of Growth and Review of Factors influencing the Transmission of COVID19

Publisher: Springer

ISBN: 978-3-031-33183-1

Month and year of publication: August 2023

Author: Gyanendra K. Verma

About the book

The coronavirus (SARS-CoV-2) emerged in China and quickly broke out into a pandemic around the world. The virus has neither a carrier nor a vector. The medium of the spread is personal contact to infected human via droplets oozed out from respiratory channels,

contaminated hands or surfaces. There are claims that high temperature effectively reduces the transmission of the new coronavirus (COVID-19). But this study is inclined to differ. We in this chapter state that the reproductive ratio, R0 plays a significant role in the transmission of COVID19. The factor R0 depends on the two parameters namely i) E, the average number of people infected/exposed and ii) p, the probability such a person causing a new infection. We have formulated the prediction of the exponential growth of infected cases of COVID19 based on the above parameters. Moreover, we have also reviewed the effect of temperature and humidity and social distancing in the spread of COVID19. Our findings indicate that high temperatures and high humidity yield the weak inference in reducing the transmission of COVID19; however, the transmission of COVID19 depends on only two factors E and p in the subtropical countries such as Malaysia, Indonesia, Thailand and India. Complete social distancing is only effective option for containment of the spread of COVID19.

Purchase link: https://link.springer.com/book/9783031331824

Title of book: Enhanced Hybrid Optimization Technique to Find Optimal Solutions for Task Scheduling in Cloud-Fog Computing Environments. Internet of Things. ICIoT 2022. Communications in Computer and Information Science,

Publisher: Springer

ISBN: 1.978-3-031-28475-5

Month and year of publication: March 2023 Authors: A. Patle, S.D. Kanaparthi and K.J. Naik

About the book

Edge-cloud computing business models rely on the ability to create

effective collaboration between the edge and the cloud. Assign the administration of wholesale and buyback schemes to the edge servers and the determination of the wholesale price to the cloud server to maximize the utilization of computing resources through the minimized computational delay. Two techniques namely, (i) Zero profit exchange between the cloud server and the edge server and (ii) Profits transferring between the cloud server are proposed for optimizing the computer resource sharing.

Purchase link : https://doi.org/10.1007/978-3-031-28475-5_10





Title of book: Linear Regression Model for Predicting Virtual Machine Consolidation Within the Cloud Data Centers (LrmP_VMC). Machine Intelligence Techniques for Data Analysis and Signal Processing. Lecture Notes in Electrical Engineering, vol 997.

Publisher: Springer

ISBN: 978-981-99-0085-5

Month and year of publication: May 2023

Authors: M. Tejaswini, T. Hari Sumanth and K. Jairam Naik

About the book

We proposed the model (LrmP_VMC), we used the Roulette–Roulette Wheel Method, in which the virtual machine selects a certain instance type and the physical machine using this Roulette Wheel Selection Mechanism. We put forward an approach where the allocation of virtual machines is done, but the genetic approach reduces energy consumption and consolidates the whole process of virtual machine placement. The LrmP_VMC approach is 15% more efficient with higher number of VMs compared to Random Forest Method on the basis of accuracy when a large number of inputs are taken.

Purchase link: https://doi.org/10.1007/978-981-99-0085-5_7

Title of book: Efficient Computing Resource Sharing for Mobile Edge-Cloud Computing Networks Publisher: Springer

ISBN: 978-981-19-5191-6

Month and year of publication: April 2023

Authors: M. Tejaswini, T. Hari Sumanth and K. Jairam Naik

About the book

A fog node serves like cloud and brings the remote like services closer to the point of data creation and consumption. This architecture provides a flexible and efficient system for handling IoT tasks as per their resource requirements. We propose a hybrid optimization technique which combines the Optimization Algorithm based on Artificial Ecosystem (AEO) as well as the widely popular Algorithm based on Salp-Swarm together to improve the exploitation abilities of AEO. The layers of the architecture interact with each other to create an efficient architecture where optimization techniques can be applied to develop optimal task scheduling.

Purchase link : https://doi.org/10.1007/978-981-19-5191-6_42



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AWARDS AND RECOGNITION Chhattisgarh Young Scientist Congress (CYSC-2023) Awardees

Ms. Shyamantika Sarkar from Architecture and Ms. Ayushi Sharma from Electrical



Ms. Shyamantika Sarkar



Ms. Ayushi Sharma

Engineering Department, respectively were awarded with Chhattisgarh Young Scientist Award during 18th Chhattisgarh Young Scientist Congress (CYSC-2023) organized by Chhattisgarh Council of Science and Technology (CCOST) for the year 2023. This event was organized at Pt. R.S. University, Raipur during May 3-4, 2023. CCOST provides incentives to awardees, which includes their single visit in AC-3 tier class train fare with dearness allowance of Rs. 400.00 per day for a maximum of two months duration to any national institute, National

Research Center, University or National Laboratory engaged in Advanced Scientific Research in India. This facility can be availed by the awardees within 02 years from the date of receipt of Chhattisgarh Young Scientist Award.

Ms. Shyamantika Sarkar won the award for her work on "Critical assessment of Affordable Housing Scenario in Raipur, Chhattisgarh" while **Ms. Ayushi Sharma** bagged the award for her work on "An accurate Fractional Order Model of Lithium-Ion Battery". Ms.

Shyamantika Sarkar and Ms. Ayushi Sharma are pursuing their research under the supervision of Dr. D. Sanyal and Dr. Sachin Jain, respectively.

Memorandum of Understanding (MoU) (April 2023-June 2023)

Name of Organization: CIPET: Institute of Petrochemicals Technology (IPT), Raipur-CHHATTISGARH

Date of MOU: June 02, 2023

Purpose of MOU

1. Sharing of the Facilities: These institutes agreed to share their important R&D facilities by signing a Non-Disclosure Agreement (NDA) of the generated intellectual property. The testing and consultancy work can be performed jointly if needed.

2. Joint Research Projects: The faculty/ employees shall explore opportunities of undertaking joint research projects and may seek research funding from external agencies.

3. Skill Enhancement/Placement Assistance of Students: Institutes shall actively engage to deliver the training to students at both institutes to bridge the skill gap and make them industry oriented. Both Institutes will also provide the necessary support and assistance for internships and placements of students.

4. Joint Academic Activities and Events: Institutes may formulate joint academic activities such as short-term courses, training programmes, seminars, participation and access to workshops and conferences based on mutual interests and available expertise in both the institutions.

SPONSORED RESEARCH PROJECTS (April 2023-June 2023)

Title of the project: Design and Development of an Interactive System for Early Diagnosis of ASD using DL and FL Models for Rural Community in Chhattisgarh State

Sponsoring agency: SERB(EEQ)-DST, New Delhi

Duration: 2023-2026

Sanctioned Amount: Rs. 22.66 Lakhs

Principal Investigatior (PI): Dr. Chandrashekar Jatoth, Department of Information Technology

Co-PI: NA

Project Summary

Autism Spectrum Disorder (ASD) is a developmental disorder that describes certain challenges associated with communication (verbal and non-verbal), social skills, and repetitive behaviours. In India, rural communities face challenges in proper access to the resources for screening, diagnosing, treatment and services for individuals with ASD. The factors that contribute towards it include unawareness, low accessibility to health care professionals, and geographical and cultural aspects. These factors together lead to delay in screening or no diagnosis for ASD. Presently, the screening of ASD is done manually with the help of questionnaires provided by doctors, volunteers, and special educators, however, these methods are time consuming and might miss crucial information required for the effective screening. To overcome the above-mentioned limitation of the current screening methods, we are proposing the project on developing and validating a mobile/web application based on video analysis and questionnaires based on gold-standard diagnostic instruments using Machine learning feature extraction model.

Title of the project: Development of an Adaptive Smart City Framework to solve urban area problems using Internet of Things

Sponsoring agency: SERB-DST, New Delhi

Duration: 03 years

Sanctioned Amount: Rs. 22.5 Lakhs

Principal Investigatior (PI): Dr. Veena Anand, Department of Computer Science and Engineering

Co-PI: NA

Project Summary

Smart cities create a sustainable and effective infrastructure for the nation. By creating intelligent infrastructure, earlier designs and constructions are made more efficient and conservative. To save energy and make systems ecologically friendly, smart infrastructure must be put in place. Many IoT applications are incorporated into smart infrastructure to make systems smart in various spheres, including business, industry, and the environment. The communication devices that are connected to IoT are used to set up all the present applications, including smart waste management and smart parking. We propose an intelligent smart city framework which takes advantage of Internet of Things and machine learning to solve various problems of urban areas.

PUBLISHED RESEARCH ARTICLES (April 2023-June 2023)

Title: Sodium Lignosulfonate Causes Cell Membrane Perturbation in the Human Fungal Pathogen Candida Albicans Authors: Anubhuti Jha, Awanish Kumar Journal: World Journal of Microbiology and Biotechnology Volume & Year: 39 (2023) Web link: https://doi.org/10.1007/s11274-023-03609-0

Title: Combinatorial Enzyme Therapy: A Promising Neoteric Approach for Bacterial Biofilm Disruption Authors: Aditya Upadhyay, Dharm Pal, Awanish Kumar Journal: Process Biochemistry Volume & Year:129 (2023) Web link: https://doi.org/10.1016/j.procbio.2023.02.022

Title: Ayurveda and in Silico Approach: A Challenging Proficient Confluence for Better Development of Effective Traditional Medicine Spotlighting Network Pharmacology Authors: Rashmi Sahu, Prashant Kumar Gupta, Amit Mishra & Awanish Kumar Journal: Chinese Journal of Integrative Medicine Volume & Year: 29 (2023) Web link: https://doi.org/10.1007/s11655-022-3584-x

Title: Empirical Wavelet Transform-Based Differential Protection Scheme for Micro-Grid Authors: B. K. Chaitanya & Anamika Yadav Journal: Journal of the Institution of Engineers (India): Series B Volume & Year: 104 (2023) Web link: https://doi.org/10.1007/s40031-023-00869-0

Title: CuO Film as a Recombination Blocking Layer: a Unique Approach for the Efficiency Improvement of Si Solar Cells Authors: G. S. Sahoo, C. Harini, N. Mahadevi, P. S. Nethra, A. Tripathy, M. Verma & G. P. Mishra Journal: Silicon Volume & Year: 15 (2023) Web link: https://doi.org/10.1007/s12633-023-02331-8

Title: Design and Investigation of a Single Gate Heterostructure Junctionless Tunnel FET for the Gas Detection Authors: Shwetapadma Panda, G. P. Mishra, Sidhartha Dash. Journal: ECS Journal of Solid State Science and Technology Volume & Year: 12 (2023) Web link: https://doi.org/10.1149/2162-8777/accb65



Title: Convolutional Neural Network in Medical Image Analysis: A Review Authors: Sapna Singh Kshatri & Deepak Singh Journal: Archives of Computational Methods in Engineering Volume & Year: 30 (2023) Web link: https://doi.org/10.1007/s11831-023-09898-w

Title: High throughput Compact Area Architecture of XXTEA for IoT Application Authors: Zeesha Mishra & Bibhudendra Acharya Journal: Sadhana Volume & Year: 48 (2023) Web link: https://doi.org/10.1007/s12046-023-02135-x

Title: High-throughput and Area-Efficient Architectures for Image Encryption using PRINCE Cipher
Authors: Abhiram Kumar, Pulkit Singh, K Abhimanyu Kumar Patro, BibhudendraAcharya.
Journal: Integration
Volume & Year: 90 (2023)
Web link: https://doi.org/10.1016/j.vlsi.2023.01.011

Title: A Systematic Approach to Design Amplitude Estimators for NTD-PLL: Performance Improvement Under Abnormal Grid Disturbances

Authors: Mohd. Afroz Akhtar, Suman Saha, Dibyendu Pal, Anant Kumar Verma, Zoheir Tir Journal: IEEE Transactions on Power Electronics Volume & Year: 38 (2023) Web link: https://doi.org/10.1109/TPEL.2022.3226242

Title: PCcS-RAU-Net: Automated Parcellated Corpus Callosum Segmentation from Brain MRI Images using Modified Residual Attention U-Net
Authors: Anjali Chandra, Shrish Verma, A.S. Raghuvanshi, Narendra Kuber Bodhey.
Journal: Biocybernetics and Biomedical Engineering
Volume & Year: 43 (2023)
Web link: https://doi.org/10.1016/j.bbe.2023.02.003

Title: Classification of Focal and Non-focal EEG Signals using Optimal Geometrical Features Derived from a Second-order Difference Plot of FBSE-EWT rhythms Authors: Arti Anuragi, Dilip Singh Sisodia, Ram Bilas Pachori. Journal: Artificial Intelligence in Medicine Volume & Year: 139 (2023) Web link: https://doi.org/10.1016/j.artmed.2023.102542

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Title: DISET: A Distance Based Semi-supervised Self-training for Automated Users' Agent Activity Detection from Web Access Log Authors: Rikhi Ram Jagat, Dilip Singh Sisodia & Pradeep Singh Journal: Multimedia Tools and Applications Volume & Year: 82 (2023) Web link: https://doi.org/10.1007/s11042-022-14258-0

Title: An Intuitionistic Fuzzy Representation Based Software Bug Severity Prediction Approach for Imbalanced Severity Classes Authors: Rama Ranjan Panda, Naresh Kumar Nagwani Journal: Engineering Applications of Artificial Intelligence Volume & Year: 122 (2023) Web link: https://doi.org/10.1016/j.engappai.2023.106110

Title: Detecting Influential Nodes with Topological Structure via Graph Neural Network approach in Social Networks Authors: Riju Bhattacharya, Naresh Kumar Nagwani & Sarsij Tripathi Journal: International Journal of Information Technology Volume & Year: 15 (2023) Web link: https://doi.org/10.1007/s41870-023-01271-1

Title: An Artificial Intelligence Framework on Software Bug Triaging, Technological Evolution, and Future Challenges: A review Authors: Naresh Kumar Nagwani, Jasjit S. Suri. Journal: International Journal of Information Management Data Insights Volume & Year: 3 (2023) Web link: https://doi.org/10.1016/j.jjimei.2022.100153

Title: A Metaheuristic-based Ensemble Feature Selection Framework for Cyber Threat Detection in IoT-enabled Networks Authors: Arun Kumar Dey, Govind P. Gupta, Satya Prakash Sahu Journal: Decision Analytics Journal Volume & Year: 7 (2023) Web link: https://doi.org/10.1016/j.dajour.2023.100206

Title: Two-Stage Hybrid Feature Selection Approach Using Levy's Flight Based Chicken Swarm Optimization for Stock Market Forecasting Authors: Satya Verma, Satya Prakash Sahu and Tirath Prasad Sahu Journal: Computational Economics Volume & Year: 5 (2023) Web link: https://doi.org/10.1007/s10614-023-10400-8 Title: MCSO: Levy's Flight Guided Modified Chicken Swarm Optimization Authors: Satya Verma, Satya Prakash Sahu and Tirath Prasad Sahu Journal: IETE Journal of Research Volume & Year: 4 (2023) Web link: https://doi.org/10.1080/03772063.2023.2194265

Title: AI-empowered Malware Detection System for Industrial Internet of Things Authors: Santosh K. Smmarwar, Govind P. Gupta, Sanjay Kumar Journal: Computers and Electrical Engineering Volume & Year: 108 (2023) Web link: https://doi.org/10.1016/j.compeleceng.2023.108731

Title: Study of Dynamical Behaviour of Prepared Mechanoluminescence Impact Sensor Based on ZnS:Mn and SrAl2O4:Eu, Yb Phosphors Authors: Piyush Jha, Ayush Khare, Pranav Singh, V.K. Chandra Journal: Journal of Luminescence Volume & Year: 258 (2023) Web link: https://doi.org/10.1016/j.jlumin.2023.119805

Title: Can Imaging Spectroscopy Divulge the Process Mechanism of Mineralization? Inferences from the Talc Mineralization, Jahazpur, India
Authors: Hrishikesh Kumar, Desikan Ramakrishnan, Ronak Jain, Himanshu Govil
Journal: Remote Sensing
Volume & Year: 15 (2023)
Web link: https://doi.org/10.3390/rs15092394

Title: A Deep Residual Convolutional Neural Network for Mineral Classification Authors: Neelam Agrawal, Himanshu Govil Journal: Advances in Space Research Volume & Year: 71 (2023) Web link: https://doi.org/10.1016/j.asr.2022.12.028

Title: EEG based Classification of Children with Learning Disabilities using Shallow and Deep Neural Network
Authors: Guhan Seshadri N.P., Sneha Agrawal , Bikesh Kumar Singh, Geethanjali B., Mahesh V., Ram Bilas Pachori
Journal: Biomedical Signal Processing and Control
Volume & Year: 82 (2023)
Web link: https://doi.org/10.1016/j.bspc.2022.104553

Title: Optimal Threshold-Based High Impedance Arc Fault Detection Approach for Renewable Penetrated Distribution System
Authors: Ch.Durga Prasad, Monalisa Biswal, Manohar Mishra, Josep M. Guerrero, Om P. Malik.
Journal: IEEE Systems Journal
Volume & Year: 17 (2023)
Web link: https://doi.org/10.1109/JSYST.2022.3202809

Title: Maximum Power Point Tracking Algorithm based on Fuzzy Logic Control using P-V and I-V Characteristics for PV Array Authors: Avinash Kumar Pandey, Varsha, Singh, Sachin Jain Journal: IEEE Transactions on Industry Applications Volume & Year: (2023) Web link: https://doi.org/10.1109/TIA.2023.3272536

Title: FAT-ETO: Fuzzy-AHP-TOPSIS-Based Efficient Task Offloading Algorithm for Scientific Workflows in Heterogeneous Fog–Cloud Environment
Authors: Prashant Shukla, Sudhakar Pandey, Pranshul Hatwar & Anushka Pant
Journal: Proceedings of the National Academy of Sciences India Section A - Physical Sciences
Volume & Year: 93 (2023)
Web link: https://doi.org/10.1007/s40010-023-00809-z

Title: Optimized Throwbox Deployment for Enhancing Delivery Ratio and Overhead Cost Performance in VDTN Authors: Vishakha Chourasia, Sudhakar Pandey & Sanjay Kumar Journal: Wireless Personal Communications Volume & Year: 129 (2023) Web link: https://doi.org/10.1007/s11277-023-10219-4

Title: DISET: A Distance based Semi-supervised Self-training for Automated Users' Agent Activity Detection from Web Access Log Authors: Rikhi Ram Jagat, Dilip Singh Sisodia & Pradeep Singh Journal: Multimedia Tools and Applications Volume & Year: 82 (2023) Web link: https://doi.org/10.1007/s11042-022-14258-0

Title: Automated Epilepsy Seizure detection from EEG Signal based on Hybrid CNN and LSTM Model Authors: Saroj Kumar Pandey, Rekh Ram Janghel, Pankaj Kumar Mishra & Mitul Kumar Ahirwal Journal: Signal, Image and Video Processing Volume & Year: 17 (2023) Web link: https://doi.org/10.1007/s11760-022-02318-9 Title: Facile Synthesis of Bismuth Tungstate Modified MIL-53(Al) and its Application for Electrochemical Energy Storage Device
Authors: Sneha Tomar, V.K. Singh
Journal: Journal of the Indian Chemical Society
Volume & Year: 100 (2023)
Web link: https://doi.org/10.1016/j.jics.2023.101021

Title: Multicore based Least Confidence Query Sampling Strategy to Speed up Active Learning Approach for Named Entity Recognition Authors: Ankit Agrawal, Sarsij Tripathi & Manu Vardhan Journal: Computing Volume & Year: 105 (2023) Web link: https://doi.org/10.1007/s00607-021-01000-1

Title: Biowaste Materials Derived Activated Carbon (BMDAC) Electrodes for Removal of Pollutant Ions using Capacitive Deionization: A Mini Review Authors: Laxmi Kant Pandey, Mahendra S. Gaikwad, Parmesh K. Chaudhari Journal: Materials Letters Volume & Year: 340 (2023) Web link: https://doi.org/10.1016/j.matlet.2023.134165

Title: Design and Performance Evaluation of a Novel Dual Tunneling based TFET Considering Trap Charges for Reliability Improvement Authors: Priyanka Kwatra, Kaushal Nigam & Sajai Vir Singh Journal: Silicon Volume & Year: 15 (2023) Web link: https://doi.org/10.1007/s12633-022-02188-3

Title: Combinatorial Enzyme Therapy: A Promising Neoteric Approach for Bacterial Biofilm Disruption Authors: Aditya Upadhyay, Dharm Pal, Awanish Kumar Journal: Process Biochemistry Volume & Year: 129 (2023) Web link: https://doi.org/10.1016/j.procbio.2023.02.022

Title: A Common Ground Switched Capacitor-based Single-phase Five-level Transformerless Inverter for Photovoltaic Application Authors: Sukhdev Singh Neti, Varsha Singh Journal: International Journal of Circuit Theory and Applications Volume & Year: 51 (2023) Web link: httpd://doi.org/10.1002/cta.3552 Title: Impact of Interface Trap Charges on Analog/RF and Linearity Performances of PGP Negative Capacitance FET Authors: Shalini Chaudhary, Basudha Dewan, Devenderpal Singh, Chitrakant Sahu, Menka Yadav Journal: Microelectronics Reliability Volume & Year: 143 (2023) Web link: https://doi.org/10.1016/j.microrel.2023.114954

Title: Towards the Design of Vision-based Intelligent Vehicle System: Methodologies and Challenges
Authors: Deepak Kumar Dewangan & Satya Prakash Sahu
Journal: Evolutionary Intelligence
Volume & Year: 16 (2023)
Web link: https://doi.org/10.1007/s12065-022-00713-2

Title: Utilization of Ferrous Slags as Coagulants, Filters, Adsorbents, Neutralizers/Stabilizers, Catalysts, Additives, and Bed Materials for Water and Wastewater Treatment: A review
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Title: Spectroscopic Characterization and Luminescence Study of Zinc Aluminate Nanocrystals Prepared by Microwave Combustion Method using Natural Black Pepper as Combustion Agent Authors: Vikas, Rajnee Yadav, Vikas Lahariya, Raunak Kumar Tamrakar, Saral Kumar Gupta and Ayush Khare Journal: Journal of Electronic Materials Volume & Year: 2023 Web link: https://doi.org/10.1007/s11664-023-10445-3

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Title: Data Regarding Anti-quorum Sensing and Antimicrobial Activity of Melaleuca Alternifolia and Salvia Sclarea Essential Oil against Pseudomonas Aeruginosa Authors: Anmol Srivastava, Vivek Kumar, Deepmala Sharma, Vishnu Agarwal Journal: Data in Brief Volume & Year: 48 (2023) Web link: doi.org/10.1016/j.dib.2023.109145

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Title: Minimization of Carrier Recombination in La2NiMnO6 Double Perovskite Solar Cells by Optimizing Defects and Band offsets Authors: Neetika Yadav and Ayush Khare Journal: Physica Scripta Volume & Year: 98 (7) (2023) Web link: 10.1088/1402-4896/acd902

Title: Tunable white-light emission and afterglow of Eu3+ doped Gd2Zr2O7 phosphors
Authors: Piyush Jha, Ayush Khare, Pranav Singh and V. K. Chandra
Journal: Materials Letters
Volume & Year: 347 (2023)
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Title: Application of Convolutional Neural Networks for COVID-19 Detection in X-ray Images Using InceptionV3 and U-Net
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Title: Single Image Deraining using Modified Bilateral Recurrent Network (modified_BRN) Authors: Mamidipaka Tejaswini, T. Hari Sumanth, K. Jairam Naik Journal: Multimedia Tools and Applications, Journal by Springer Nature Volume & Year: 2023 Web link: https://doi.org/10.1007/s11042-023-15276-2

Title: Quality Analysis of Aquatic-water Data using Time Series-Convolution Neural Network in an IoT Framework Authors: Peda Gopi. A, Jairam Naik. K Journal: Environmental Science and Pollution Research, Journal by Springer Nature Volume & Year: 2023 Web link: https://doi.org/10.1007/s11356-023-27922-1

Title: Effect of Inoculums Type and Optimization of Inoculum to Substrate Ratio on the Kinetics of Biogas Production of Fruit and Vegetable Waste Authors: Akanksha Agrawal, Parmesh Kumar Chaudhari, Prabir Ghosh Journal: Environmental Engineering Research Volume & Year: 29 (2023) Web link: https://doi.org/10.4491/eer.2022.518

Conferences / STTPs / FDPs / Workshops Organized (April 2023-June 2023)

Title of event: Certificate Course on "Applied Data Analytics: A Practical Approach".
 Duration: May 22- June 21, 2023

Organizing department: Continuing Education Cell, NIT Raipur

Course coordinators: Dr. Govind Gupta and Dr. Mridu Sahu

Chairman: Dr. Subhojit Ghosh

Course Fee: Students of NIT Raipur Rs. 750 + 18% GST, Outside Students (other than NIT Raipur) Rs. 1000 + 18% GST, Faculty/ Industry Personnel Rs. 2500 + 18% GST

Brief information about the event

The main objective of the course was to help the participants in developing a solid understanding of the data science and analytics techniques like data pre-processing, predictive analysis, fundamental of data statistics, machine learning techniques and data visualization etc., with help of emerging data analytics tools like Python/R. The mathematical foundation for analyzing the data added more knowledge about the data and this will help for decision support systems. This certificate course helped to enhance the knowledge of the participants in the field data science and analytics. It focused on the delivery of the lectures with full practical approach, case studies and by hands-on practical sessions on diversified range of topics related to data science and analytics.



2. Title of event: Testing of Geo-materials for Geotechnical and Transportation Engineering Applications

Duration: June 26 – July 7, 2023

Organizing department: Civil Engineering

Chairman: Dr. N.V. Ramana Rao

Organizing secretaries: Dr. Laxmikant Yadu and Dr. Sunny Deol G.

Brief information about the event

National Institute of Technology Raipur's Department of Civil Engineering, in association with the Indian Geotechnical Society (IGS), Raipur Chapter organized a twoweek long hands-on training program titled "Testing of Geo-materials for Geo-technical and Transportation Engineering Applications" during June 26-July 7, 2023. The aim of the training program was to provide hands-on training about conventional and state-of-art laboratory and field tests involved in various areas of Civil Engineering like Geotechnical Engineering and Highway Engineering. Shri K. K. Katare, Chief Engineer, Rural Connectivity Training & Research Centre (RCTRC), Naya Raipur & Alumnus, (Civil Engineering/1990) was the Chief Guest of the inaugural ceremony. Dr. N. V. Ramana Rao, Director, NIT Raipur presided over the ceremony as Chief Patron. Dr. Prabhat Diwan, Dean (Research & Consultancy) was the Patron of the event. Dr. L. Yadu, Associate Professor, Civil Engineering and Dr. Sunny Deol G., Assistant Professor, Civil Engineering were the coordinators of the program. Dr. Sandeep K. Chouksey, Assistant Professor, Civil Engineering was the co-coordinator of the program. A total of 27 participants attended the training programme, which included field engineers, faculty members from engineering and polytechnic colleges, technical and laboratory staff of engineering colleges & field laboratories, PhD scholars, M. Tech Scholars, and B. Tech students.



3. Title of event: 2nd Research Scholars' Conclave (RSC-2023)

Duration: July 11-13, 2023

Organizing department: Office of Dean (Research & Consultancy) NIT Raipur

Chairman: Dr. Prabhat Diwan

Organizing secretaries: Dr. Anamika Yadav, Dr. J. Anandkumar, Dr. Awanish Kumar and Dr. Tirath Prasad Sahu

Brief information about the event

National Institute of Technology Raipur organized 2nd Research Scholar's Conclave during July 11-13, 2023. This three-day event served as a multidisciplinary Research Conclave exclusively for the institute's Ph.D. scholars. It offered a valuable platform for them to present their research findings and fosteran environment that encourages accelerated research and innovation in various sectors of Research & Development. Dr. N. V. Ramana Rao, Director, NIT Raipur served as the Chief Patron of the event, while Dr. A. B. Soni, Professor, Chemical engineering, NIT Raipur, acted as the Patron. Dr. Prabhat Diwan, Dean (Research & Consultancy), assumed the role of Chairperson for the event. The organizing committee consisted of four members: Dr. Anamika Yadav, Associate Professor, Electrical Engineering, Dr. J. Anandkumar, Associate Professor, Chemical Engineering, Dr. Awanish Kumar, Associate Professor, Biotechnology, and Dr. Tirath Prasad Sahu, Assistant Professor, Information Technology. Ms. Aishwarya Nayal, Customer Consultant, Elsevier Publisher (South Asia), New Delhi, delivered an engaging keynote address at the event. She discussed various topics, including interdisciplinary research papers and the impact of the New Education Policy (NEP) 2020. The scholars of defferent departments were divided into five groups.

In Group 1, the award went to Tanvir Haider from the Applied Geology Department. In Group 2, Ms. Divya Khosle from the Chemical Engineering Department received recognition for her outstanding presentation. Ms. Anjali Rajak from the Information Technology Department stood out in Group 3 with her remarkable presentation. In Group 4, Mr. Nilesh Jatta from the Electrical Engineering Department received the award for his impressive presentation. Lastly, Mr. Labhish Baid from the department of Physics was acknowledged with the best research award in Group 5.



UPCOMING EVENTS (Conference/Seminar/STTP/Workshop, etc.)

1. Title of event: 6th International and 21st National Conference on Machines and Mechanisms

Duration: December 7-9, 2023

Organizing department: Mechanical Engineering

Patron: Dr. N.V. Ramana Rao

Organizing secretaries: Dr. Shubhashis Sanyal, Dr. S Bhowmick, Dr. R Suresh Kumar and Dr. N V Swamy Naidu

Course fee: Students and Research Scholars: Rs. 3000, Faculty: Rs. 6000, Industry Personnel: Rs. 8000, IFToMM members: Rs. 5000

Brief information about the event

Department of Mechanical Engineering, NIT Raipur under the aegis of Association for Machines and Mechanisms (AMM) is organizing the iNaCoMM-2023 at NIT Raipur. The conference aims at bringing together researchers, industry experts and students working in various aspects of design and analysis of machines and mechanisms. The conference also includes a Students' Mechanism Design Contest (SMDC) where the students from India will participate and produce the mechanisms developed by them in the event.

 Title of event: 19th International Conference on Information Systems Security (ICISS-2023)

Duration: December 16-20, 2023

Organizing department: Information Technology

Chairperson: Dr. Rakesh Tripathi

Organizing secretaries: Dr. C. Jatoth, Rajesh Doriya and Dr. T.P. Sahu

Course fee: International participants: \$250, Persons from academia/R&D: Rs. 8,000, Industry Personnel: Rs. 12,000

Brief information about the event

This annual conference will provide a forum for researchers and industry practitioners of security to present their cutting-edge research and use case experiences. We solicit previously unpublished technical papers in the field of Security Privacy. Papers that involve innovative solutions, usability studies, longitudinal studies, industrial use cases, and SoK are welcome.

ARTICLES OF PRIME RELEVANCE

Microbial Biofilm Cause Biological Fouling of Materials

Dijendra Nath Roy

Department of Biotechnology, NIT Raipur

In the majority of natural, clinical, and industrial settings, microorganisms exist through the formation of three-dimensional biofilms that can be attached to biotic and abiotic surfaces. Biofilms are the prevailing lifestyle of microbes in most natural environments, usually at solid-liquid interfaces. These biofilm scan be formed by single/multiple-species or polymicrobial communities. Interestingly, this sort of microbial community is embedded in a self-produced matrix that too enables the intercellular exchange of metabolites, genetic material, and signaling molecules for better survival. The dormant lifestyle of microbial cells living in such a densely packed matrix acts as a diffusion barrier and is responsible for their high tolerance to environmental stresses. In addition, these microbial consortia assist in protecting themselves from any attack of predators or any treatment of chemicals (such as antimicrobial agents). Cells present inside the biofilms are supposed to get protection 100 to 1,000 times more than planktonic cells (free cells) from antimicrobial agents/treatments. This microbial biofilm is also popularly known as microbial ecology. Importantly, most natural biofilms are polymicrobial, which is having different major microbes staying together such as bacteria, fungi, algae, etc. It is worth mentioning microbial growth and colonization (biofilm formation) on the adhered surface of biomaterials used in medical application lead to pathogenic infection, a life-threatening concern to patients. Similarly, biofilm also causes damage to marine vessels.



Figure 1 (A & B) Biofilm on biomedical devices; (C) Marine biofilm

Biofilm formation consists of five main stages, which are depicted in Figure 2. In stage one, individual planktonic cells migrate and adhere to a surface; then, these adherent cells begin to form biofilm on the surface and emerge as wrapped exopolymeric material in miniature parts. In stage two, adherent cells exhibit an extracellular polymeric substance (EPS) to develop attachment on the surface, cell aggregation, and matrix formation. In stage three, biofilm reforms more layers meanwhile initiate maturation by generating microcolonies and water channel composition. In stage four, the completely grown-up biofilm comes to its zenith cell density, thus treated as a three-dimensional community. In stage five, the fully grown-up biofilm unleashes microcolonies of cells from the leading community and forthwith, free to roam to different surfaces of more distinct places. This final stage acts to further transmit the spreading conditions of microbial colonies on the same surface or nearby different surfaces.



Figure 2 Different stages of biofilm formation

As per the 2020 report, it is uncertain how cells, in the beginning, sense the surface, which eventually leads to phenotypic adjustment from the planktonic (suspended) to the sessile (surface-attached) state, involving substantial changes in gene expression leading to molecular adjustment on the cellular surface itself. Additionally, this matter varies from microbes to microbes. The main explanation for this limited knowledge possibly exists in the challenge to experimentally investigate the dynamic response of single cells over a very short period during the transition between these two states.

Now, the question comes to our mind how the microbes attach to the surface. If we consider bacteria as of now, the answer is the attachment of cell appendages to the biotic/abiotic cell surface. When bacteria move toward a surface, the following cell appendages will stick to it. (1) Flagella: Surface adhesion is supported by flagella, which due to their hydrophobic nature particularly adheres to hydrophobic surfaces. Flagella also helps to rotate the bacteria for better adhesion on the surface. It is experimentally established that E. coli mutants with non-functional flagella are impaired in biofilm formation and detach more readily compared to the wild-type. (2) Pili: In addition to flagella, also pili (fimbriae) attach to surfaces and support biofilm development. For example, E. coli's curli (a type of pili) sticks to surfaces and is highly beneficial for adhesion. Increased production of curli through a point mutation in the ompR gene has been shown to enhance surface attachment, while mutations generating curli-deficient cells were found to result in a more than 50% reduction in biofilm formation.(3) Cell body: In addition to surface attachment via cell appendages, also the cell body helps in the attachment of bacteria to the surface. Majorly the adhesion to a surface is mediated by Van der Waals, electrostatic and acid-base interactions between the bacterium and the biotic/abiotic surfaces, in which microbes act as colloidal particles.

Now, it is of utmost importance to understand the detachment of microbes to material surfaces, which ultimately stops the biological fouling of materials. There are several techniques for antimicrobial surface development, which are carried out by the industry and scientists of different research organizations, but not yet much successful. In a nutshell, the major effort lies to prepare the anti-biofilm surface of materials, which is fabricated by using certain other materials on the surface of main materials. These materials can create noncharged surfaces or highly hydrated surfaces, or superhydrophobic surfaces - such surface results in bacterial detachment and anti-biofilm activity. Thus, it is of utmost necessity to repress microbial growth on the surfaces of materials by applying several techniques, which are mentioned in Figure 3. Improved materials' performance, durability, and safe conditions without any side effects lead to the preparation of perfect materials. The decay of the surface of the materials with time is a significant constraint. In particular, surfaces with nanoscale designing can hold the current material status to stop microorganism-mediated biofouling. It should be noted that numerous techniques have been devised for the surface modification of diverse biomaterials, but still, there is a need for further research. In addition to these, the biomimetic surface may be developed on the materials to reduce microbial-mediated corrosion. The biomimetic surface has drawn considerable interest in the surface preparation of biomaterials due to their easiness, flexibility, and high steadiness under biological environments and environmental conditions, as well as their favorable interactions with the

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surrounding environment. This line of work needs further research and development for a better mode of surface preparation and its utilization.



Figure 3 A schematic diagram of techniques applied for the development of anti-microbial surfaces of biomaterials.

[Source: Kumar et. al (2021).Colloid and Interface Science Communications]

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Future Aspects of Bioresorbable Implants

GV Jagadeesh and Srinivasu Gangi Seeti Mechanical Engineering, NIT Raipur

A biomaterial can be synthetic or natural material designed to interact with the human physiological system through implants. These implants improve the quality life of patients by replacing, restoring and generating traumatized tissues or organs. The selection of biomaterial is based on the suitability in the human body and also, depends on physical, chemical, mechanical and tribological properties along with biocompatibility and patient health condition. The two broad classifications of biomaterials can be: i) Traditional metallic implant materials and ii) Bioresorbable metallic implant materials. The most commonly used traditional metallic implant materials were Stainless steel, Titanium alloys and Cobalt-Chromium alloys. Stainless steel possesses excellent ductility, work hardenability and fatigue properties. Stainless steel is being used for fabrication of orthopedic prosthesis, cardiovascular stents, valves, hard tissue repair, craniofacial surgery, dentistry and otorhinology applications. However, the application of stainless steel as implant material was restricted due to lack of bio-functionality, anti-fouling properties, blood and body compatibility. Titanium alloys are known for their, low density and corrosion resistance. Therefore, lightweight implants with high strength can be manufactured with Titanium alloys. Additionally, Titanium alloys are bioinert and maintain excellent biocompatibility by forming stable surface oxides. Although titanium alloys have low hardening coefficient and wear resistance, they yield high toxicity in the body during corrosion. Cobalt-chromium alloy possesses low wear resistance, superior corrosion resistance and good biocompatibility. However, Cobalt-chromium implants demands for specialized and customized manufacturing methods because of high strength. Additionally, leaching of metallic ions such as cobalt, nickel and chromium into the bloodstream can prompt the undesirable immune reactions, which reduces the biocompatibility of cobalt-chromium implants.

With the limitations of existing traditional metallic implant materials, a new generation of biomaterials, called bioresorbable materials were being synthesized. Bioresorbable materials can be a scientific breakthrough in biomedical industry. Bioresorbable materials are the materials that degrade gradually inside the human body without producing any toxic elements and integrate with the host tissues by promoting cell growth and cell inhibition. In short, a biomaterial should be biodegradable, biocompatible and bioactive in nature. Till date, bioresorbable materials identified were: Magnesium alloys, Iron alloys and Zinc alloys.Magnesium alloys as bioresorbable materials exhibited remarkable advantages over Zinc and Iron alloys. The prescribed daily consumption of magnesium (240–420 mg/day) is almost 52.5 times higher than that of iron (8–18 mg/day) and zinc (8–11 mg/day) for an adult. Hence, pure iron and zinc implants can induce severe health problems for patients due to high consumption. Therefore, magnesium alloys as potential bioresorbable materials were being explored mainly for temporary orthopaedic implants and also, for cardiovascular stents and wound closing applications in biomedical industry.

Broadly, orthopaedic metallic implants were classified as: i) Permanent and ii) Temporary implants. Temporary implants were plates, rods, screws, pins, etc. Temporary orthopaedic implants are the implants that support the human bone till it regains its original strength and functionality, and removed afterwards by a secondary operation. There are several problems associated with the use of traditional metallic implant materials for temporary orthopaedic implants. The mechanical mismatch of natural bone and traditional metallic alloysleads to clinical phenomena called stress shielding. The relatively high Elastic moduli of traditional metallic implant materials compared to human bone leads to stress shielding effect, bone resorption and subsequently loosening and failure of the implant. The mechanical mismatch might propel the resorption of surrounding bone tissue, inability to adapt to growth, permanent physical irritation, endothelial dysfunction, thrombogenicity, chronic inflammatory reactions, restenosis or re-stenting. Also, the traditional metallic implants possess poor wear and corrosion resistance during long term association with the body. The above problems can be addressed by using bioresorbable metallic implant materials such as magnesium alloy for temporary orthopaedic implant applications. The properties of magnesium alloys such as density (ρ =1.74–1.84 g/cc) and Elastic modulus (E=41-45 GPa) are quite similar to that of human bone (ρ =1.8-2.1 g/cc & E=15-25 GPa). The mechanical mismatch and stress shielding effect can be eliminated with the use of magnesium alloys. Secondly, magnesium alloys degrade under human physiological system without producing any toxic elements. As magnesium alloys degrade completely, the secondary surgical process for removing the implant can be eliminated thereby decreasing the trauma and medical expenses of the patients significantly. Also, magnesium alloys found to promote osteoconductivity. With the advantages of biodegradable, biocompatible and bioactive nature, magnesium alloys can be ideal bioresorbable materials for temporary orthopaedic implants. Despite many advantages, the major limitation of magnesium alloys as bioresorbable materials is their high corrosion rate and hydrogen evolution especially in the early stage of implantation. Due to rapid corrosion rate, the mechanical strength was degrading with time and couldn't able to support the damaged bone till its service life.

To overcome the rapid corrosion of magnesium alloys, different techniques were employed. The major techniques were: i) Alloying, ii) Surface modification iii) Bulk processing and iv) Additive manufacturing. Alloying is a process of combining two or more metals to create a new material with enhanced properties. Magnesium, as a metal, is often alloyed with other elements to improve its mechanical, thermal, and chemical properties. The most common elements used for alloying magnesium include aluminum, zinc, manganese, and rare earth metals such as cerium and zirconium. The alloying of magnesium offers several advantages. It can increase the strength, hardness, and corrosion resistance by precipitation hardening, grain-refinement and solid solution strengthening. Among all the alloys developed, rare earth based alloys exhibited better corrosion performance followed by zinc based alloys. Overall, the alloying of magnesium is a versatile process that allows for the creation of a wide range of alloys with tailored properties to meet specific application requirements. However, improvement was not substantial enough for application range. Therefore, further processing was crucial. Surface modification and bulk processing can play a crucial role in altering the degradation behavior and also in improving the biocompatibility of magnesium alloys. Surface modification of magnesium alloys is a process that involves altering the surface characteristics of the alloys to enhance their performance and functionality. This can be done through various techniques and treatments. The common methods of surface modification for magnesium alloys are Conversion coatings, Electroplating, Organic coatings, Surface Alloying, Surface Roughening, Surface Passivation, Anodizing. Conversion coatings are formed by chemical treatments such as chromate, phosphate, or silicate conversion coatings. Electroplating is the process of electrochemical deposition of metals such as chromium, nickel, or zinc onto the magnesium alloy surface. Organic coatings apply organic polymer coatings, such as epoxy, polyurethane, or powder coatings. Surface Alloying: Introducing specific elements onto the surface of magnesium alloys through techniques like diffusion or ion implantation. Surface Roughening creates a controlled roughness on the surface of magnesium alloys can improve their bonding with coatings, enhance adhesion, and provide a larger surface area for better interaction with the environment. Surface Passivation is the application of passivation treatments, such as chromate or phosphate conversion coatings. Anodizing is an electrochemical process that involves the formation of a controlled oxide layer on the surface of magnesium alloys. These surface modification techniques can be tailored to specific requirements and applications. The choice of method depends on the desired surface properties and the intended use of the magnesium alloy. Bulk processing of magnesium alloys refers to the manufacturing methods used to shape and form these alloys into finished components or products. Several common bulk processing techniques for magnesium alloys include casting, extrusion, forging, and rolling. Each method has its own advantages and is suitable for different applications. Additive manufacturing, also known as 3D printing, is an emerging technique that enables the production of complex shapes and structures by adding material layer by layer. While additive manufacturing has been widely utilized for various metals, the use of magnesium alloys in this process is still in its early stages. However, there have been significant advancements and ongoing research in additive manufacturing of magnesium alloys by elective laser melting (SLM) and electron beam melting (EBM). However, additive manufacturing of magnesium alloys presents some challenges due to the unique properties of magnesium such as low melting point, high reactivity with oxygen, and high thermal conductivity, making it susceptible to oxidation and thermal distortion during the printing process. Also, developing high-quality magnesium alloy powders suitable for additive manufacturing is crucial. Therefore, specialized processing techniques and equipment are required to overcome these challenges. With all these efforts of alloying, surface modification, bulk processing and additive manufacturing, the corrosion resistance of magnesium has been improved many folds. However, long way to go to make magnesium as a potential candidate for bioresorbable implants.





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