Students' Research Convention 2021

IIT Kanpur

Abstract Book

Mechanical Engineering and Design

Abstract 1

Title: Design and Manufacturing of Toy Parts using CAD/CAM software in India
Author: Shrishti Massey

Description

The launch of Vocal for local has brought a wave of changes in the thought of the people of India. These changes should be assisted with more advanced and technical ideas for the beneficial growth of the country. After the conflict issues between India and China, India has decided to upgrade its design and manufacturing industries in the field of toys and accessories. This paper presents the concept for the design and manufacturing of toy parts using CAD/CAM in India. Using such advanced software merged with additive manufacturing can produce improved and detailed qualities of toys. The software can be a great advantage for customized toys. Moreover, private production can be utilized using additive manufacturing. This paper also includes a small survey which is conducted among a certain group of people to collect their opinion regarding the demand for toys, their specialties, their preferred brands, qualities, and features. Furthermore, a statistical analysis is carried out on the results obtained from the survey.

Abstract 2

Title: Development of grinding wheel loading assessment system using USB camera and Python programming.
Author: Ranjith Kulal, Yashawant Kamat, Sudarshan Shanbhag, Babaprahlad M Pai

Description

Grinding is an abrasive machining process which can produce fine surfaces with form accuracy at desired material removal rates. Grinding wheel having abrasives held on bond, engages with the work to produce the desired quality of surface. Grinding performance deteriorates with the time due to entrapment of grinding debris in the porous wheel known as wheel loading. Identification of wheel loading is an important issue for optimizing the dressing intervals which help to bring back the cutting action. Generally, the operator measures surface finish and form accuracy on the ground parts to assess the wheel loading. This kind of assessment is not only a qualitative but also consumes time and incorrect assessment also leads to rejection of ground parts.

This work reports about the efforts made in developing a method of On-line wheel loading assessment system. It uses a portable USB microscopic camera mounted on a precision fixture in proximity with the grinding wheel and focusses on the specified area of the grinding wheel. The python code is used to convert the captured image to a gray scale image and then with the use of thresholding techniques developed exclusively for the image data analysis helps in quantitatively assessing the amount of debris entrapment.
Following are the salient features of the developed system:

- The small size of the camera and the fixture enable the assembly of this system directly on the grinding machine without affecting the grinding operations.
- As the system helps in identifying the wheel loading on the machine itself, the rejection of the ground parts gets reduced.

Abstract 3

Title: Dynamics of thermoacoustic instability with inverse diffusion flame
Author: Arijit Bhattacharya

Description

Inverse diffusion flame (IDF) is a reliable low NOX technology that is suitable for various industrial applications including gas turbines. However, a confined IDF may exhibit thermoacoustic instability, a kind of dynamic instability characterized by catastrophically large amplitude pressure oscillations. Transition to such instability for an inverse diffusion flame is less explored compared to other types of flame. In the present study, thermoacoustic instability in a Rijke tube with IDF is achieved by varying air flow rate and input power independently, and the dynamics of thermoacoustic instability is examined with recurrence network analysis. During the transition to thermoacoustic instability, we find a few novel routes and intermediate states. We observe significant differences in dynamics of thermoacoustic instability for IDF with that for premixed flames, reported earlier.

Abstract 4

Title: Design direction to develop assistive mobility device in Indian context
Author: Ankit Basak, Dr. Prabir Mukhopadhyay

Description

The field of assistive mobility has seen much technological advancement in recent years, which has helped crutch or prosthesis users to overcome their physical disabilities. Although this has made daily life easier for disabled people globally, it has somewhat failed in India. Institutional policies to aid people with disability have been unable to provide them with a sense of normality. There exists ample research on the functioning of assistive mobility products and the psychosocial well-being of people with disabilities. However, there is a dearth of data that talks about the unification of these fields.

This study attempts to understand the needs and expectations of a person with locomotive disability. It aims to create guidelines that will help develop an assistive mobility device suitable for the Indian context.

Along with the literature review and market study, the target audience was interviewed to collect qualitative data for designing an inclusive assistive mobility device.

A majority of the interviewees (13 out of 16) felt that due to a lack of disabled-friendly infrastructure, it is difficult for them to participate in social interactions with their able-bodied counterparts. Interviewees (4 out of 16) also stated that products available in the market fail to accommodate the drastic changes in their lifestyle if their disability was caused by accident. Affirmative action through government policies may also lead the majority to feel excluded or discriminated against, leading to animosity towards the disabled audience.

In conclusion, this study aims to create guidelines to help build an environment where the disabled are identified by their capability and not their disability.

Abstract 5

Title: Numerical Analysis of Solar Chimney power plant ; Energy,Exergy
Author: Kirtan Kanani, Aditya Gupta, Dharmik Raval

Description

To pertain the generation from present to future exploitation of limitless solar energy is essential. Solar chimney technology for power generation is one of the solar energy harvesting techniques that absorbs both direct and scattered solar radiation. Solar chimneys have been shown to be successful in the production of electricity, and they are a promising solution to future energy generation plans. Solar chimney power plant performance is numerically investigated under the effects of turbine pressure drop, solar radiation, and energy storage layer porosity, geometrical parameters.
Recent studies have shown that the influence of solar radiation and pressure drop across the turbine is considerable. Significant losses take place due to incomplete heat utilization from outgoing fluid, and the canopy also causes a considerable amount of energy loss. Decreasing the heat losses in the above processes, researching the interactions between the atmospheric environment and the system based on the thermodynamic processes in different solar chimney systems.
We aim to identify the loss of exergy at the outlet in the form of hot air together with including the transient effect of ambient conditions such as temperature, humidity, and solar radiation.

Abstract 6

Title: Pipe Leakage detection and repair robot
Author: Ankitkumar Nikum, Aditya Gupta, Rajatkumar Singh

Description

Pipelines are commonly used to move fluids for thousands of miles around the world. The pipelines' systems are designed to withstand a variety of environmental loading conditions, ensuring secure and efficient delivery from the point of production to the shore or distribution depot. Leaks in pipeline networks, on the other hand, are a significant source of innumerable losses for pipeline operators and the environment. Pipeline failures can cause severe environmental disasters, human injuries, and financial losses. Pipeline leak detection has been the subject of extensive studies in order to prevent such a threat and maintain a secure and effective pipeline system.

In this work, we propose a new robot design for automated inspection and upkeep for sewer pipes of water supply. This invention relates to the Electro-Mechanical / Robotics system, specifically designed to detect Leakages in Pipes and repair them simultaneously in the initial stage of the crack propagation. It also contains a semi-fluid which is to be applied at the leak locations. The design has applicability in the civil water distribution network and industrial pipe network used for transporting various fluids. After reviewing several works, our robot's uniqueness is that it has mechanisms that help turn into pipes and inspect pipes of different diameters within range. This robot is fully automated, having 4 degrees of freedom, and a Live camera feed is continuously available via a wireless network, and manual control is fitted to control it manually if there is some issue in automation. Ultrasonics will automatically detect the leaks within the pipe and, along with some mechanisms and also cracks, can be repaired on the spot. The prototype of the robot is currently in the developing stage.

Finally, we aim experiments and real-world tests to assess our proposed inspection and cleaning processes' efficiency.

Abstract 7

Title: Milling Tool Health Monitoring through Interface of MEMS Accelerometer-Arduino-Python & Induction of K* Classifier

Author: Naman Bajaj, Abhishek Patange, R. Jegadeeshwaran, Suhas Deshmukh, Sujit Pardeshi

Description

Industry 4.0 is the on-going automation of traditional industrial practices and manufacturing technologies for making them ‘smart’. This drives the need for ‘self-monitoring’ that demands machines to investigate and diagnose issues without human intervention. In this context, the health monitoring of cutting tools is essential for the prognosis of in-process development of any fault to avoid interruptions in near future. In regard to the economics of the event-driven condition monitoring, the existing instrumentation inclines to be more reserved and costlier. Also as far as age-old machine tools from small/medium industry are considered, with their budget it is difficult for them to upgrade the system to cope up with the requirements of Industry 4.0. This stimulates opting emergent open-design movement to create an instrumental framework by deploying open-source hardware and software. A micro-electro-mechanical (MEMS) based accelerometer (ADXL335) is interfaced to an open-source electronic board (Arduino ATMega2560) and the vibration signal is then communicated to Python. The system is implemented on Vertical Machining Centre (VMC) for health monitoring of milling tool inserts during the face milling operation. The defect-free and various defective conditions of carbide coated inserts are considered in the study. The statistical approach followed by induction of the K* algorithm is incorporated for the classification of insert conditions. Finally, the validation with the conventional instrumentation is presented to showcase the potential of the proposed framework. A cheaper and competent data acquisition system and Machine Learning (ML) framework presented herein would assist health monitoring in age-old machines and add some value.

Abstract 8

Title: Effect of Bragg resonance on Stokes drift
Author: Akanksha Gupta and Anirban Guha

Description

In this paper, we show that Stokes drift may be significantly affected when an incident intermediate or shallow water surface wave travels over a corrugated sea floor.

The underlying mechanism is Bragg resonance: reflected waves generated via nonlinear resonant interactions between an incident wave and a rippled bottom. We theoretically explain the fundamental effect of two counterpropagating Stokes waves on Stokes drift and then perform numerical simulations of Bragg resonance using the high-order spectral method. A monochromatic incident wave on interaction with a patch of bottom ripple yields a complex interference between the incident and reflected waves. When the velocity induced by the reflected waves exceeds that of the incident, particle trajectories reverse, leading to a backward drift. Lagrangian and Lagrangian-mean trajectories reveal that surface particles near the up-wave side of the patch are either trapped or reflected, implying that the rippled patch acts as a non-surface-invasive particle trap or reflector. On increasing the length and amplitude of the rippled patch, reflection, and thus the effectiveness of the patch, increases. The inclusion of realistic constant current shows noticeable differences between Lagrangian-mean trajectories with and without the rippled patch. Theoretical analysis reveals additional terms in the Stokes drift arising from the particular solution due to mean-current–bottom-ripple interactions, irrespective of whether Bragg resonance condition is met. Our analyses may be useful for designing artificial, corrugated sea-floor patches for mitigating microplastics and other forms of ocean pollution. We also expect that sea-floor corrugations, especially in the near-shore region, may significantly affect oceanic tracer transport.

Abstract 9

Title: CORROSION PREDICTION OF ADDITIVELY MANUFACTURED INCONEL 718 USING MACHINE LEARNING

Author: Mythreyi O V , Rohith Srinivaas M

Description

The present work adopts machine learning technique to predict the corrosion behavior of additively manufactured and post processed IN718. Selective laser melted IN718 samples were subjected to two forms of post processing – heat treatment and shot peening. Potentiodynamic polarization and electrochemical impedance spectroscopy testing were performed to assess the corrosion behavior in both as built and post processed conditions. The experimental data from these tests were implemented in four different algorithms and predictive machine learning models were developed. Efficiency of the developed models was calculated by standard metrics and compared with actual data. The best model was selected to perform the feature importance analysis. The post processing parameters that influenced the outcome in corrosion resistance were determined and correlated with the experimental findings. This work demonstrates the adoption of machine learning as a suitable tool for prediction of degradation behavior of material in aggressive environmental conditions.

Abstract 10

Title: Effect of Severe Plastic Deformation on Mechanical Properties of Al6061
Author: VAGISH D. MISHRA, Dr. K. Palaniappan, Prof. BALKRISHNA C. RAO, Prof. H. MURTHY

Description

Large plastic deformation through cold-rolling refines microstructure through the accumulation of plastic strains over multiple stages. Machining achieves similar large plastic strains (1–10) in a single stage to produce ultra-fine-grained chips. Effect of cold-rolling and machining on microstructure and mechanical properties of A16061 was investigated. As-received, solution heat-treated, and peak-aged plates were cold-rolled to 30, 50, and 70% thickness reductions. Ultra-fine-grained chips were produced from low-speed orthogonal-machining under plane-strain condition, using a restricted contact tool to minimize the chip curvature. Grains were equiaxed in as-received, solution heat-treated, and peak-aged bulk samples, while they were elongated in cold-rolled bulk. In chips, grains were elongated in one direction due to severe plastic flow. Hardness and ultimate tensile strength increased with thickness reduction. Chip hardness is 60% more than as-received material due to microstructure refinement. Metal cutting (single-stage process) and thickness reduction greater than 50% by cold-rolling (multi-stage) provide nearly the same enhancement in mechanical properties (40% more than bulk).

Abstract 11

Title: Enhancement of Mechanical Properties by Cold-Rolling of Al6061
Author: VAGISH D. MISHRA, Prof. H. Murthy, Prof. Balkrishna C. Rao

Description

In the present effort, enhancement of mechanical properties of Aluminium alloy, Al6061, due to cold-rolling is compared with that due to peak-ageing. Heat treatable Al6061 was cold-rolled with different pre-rolling conditions. Since different peak-ageing conditions are given in literature, a systematic study was conducted to determine the peak-ageing conditions for the procured aluminium alloy. Micro-Vickers hardness tests as well as uniaxial tensile tests were conducted to evaluate the mechanical properties. Cold-rolling to higher thickness reductions resulted in a significant improvement in hardness and tensile strength as compared to peak-aged samples. Artificial peak-ageing before cold-rolling did not have a significant effect on the properties after cold-rolling. Enhancement of properties was comparable to the more complex severe plastic deformation process of cryo-rolling followed by warm-rolling. Cold-rolling could be used as a simpler and effective method to enhance mechanical properties of Al6061. No significant difference was found in the tensile strength between rolling and transverse directions.

Abstract 12

Title: Understanding the Micro and Nano Mechanics of Pb and Pb-free Piezoceramics for High Temperature Defence Applications

Author: V.S. Kathavate, B. Praveen Kumar, I. Singh and K. Eswara Prasad

Description

Microstructural aspects that span across several length scales, particularly grain and grain boundaries at μm scale to ferroelectric domains at the nm scale, play a decisive role in electromechanical behaviour of piezoelectric materials. Recent and past studies have indicated that size, shape and interdomain spacing have a pronounced influence on the structural properties of the piezoceramic materials though their role on mechanical behaviour is not well understood. In this work, we alter the size, shape and interdomain spacing of the nano-assembled ferroelectric domains to obtain the different domain configurations via domain engineering (DE) technique. The DE technique on piezoceramics is implemented by selectively annealing the as poled samples below and above their Curie temperature, Tc. The differences in domain configurations are probed using piezoresponse force microscopy (PFM), which further indicates that the degree of disorderness in ferroelectric domains increases with increase in annealing temperature. The effect of DE on the mechanical response of piezoceramics is established by performing a series of nanoindentation experiments. We report ~ 40% enhancement in mechanical properties after DE, indicating that mechanical response of piezoceramics is sensitive to the differences in domain configurations. The possible mechanisms such as indentation-induced domain switching and domain rearrangement in the indentation zone are also explored.

Abstract 13

Title: Design and control of mobile robots with two and four independent rotatable power wheels.

Author: Divyansh Khare, Kausadikar Varad Prashant, Santhakumar Mohan

Description

This paper analyzes two and four-independent steerable power wheel configurations based on vehicle design and dynamic control aspects. Three types of systems were designed and analyzed for the purpose of power transmission and steering. The first design consisted of a bevel gear arrangement for steering the wheels and a spur gear train for power transmission, as easy mounting of the steering motor in the horizontal direction is possible. Major drawbacks of this design include the fact that bevel gears experience a separating axial force, the mounting has to be precise, high speed reduction is not possible which might be required for steering purposes, system is fairly heavy, due to the implemented gear-train any vibration/shock experienced at the wheel will be directly transmitted to the motors and it's difficult for the system to handle any misalignments which may arise during assembly or the actual operation. In the second design, the bevel gears were replaced with a set of spur gears for the purpose of steering, to achieve easy mounting and higher speed reduction, whereas the power transmission system was kept the same. The design still suffers from weight and vibration limitations. In the third and the final design, timing belts and pulleys were used for both the purposes of steering and power transmission. This arrangement allows for precise control with a degree of vibration absorption and misalignment between different parts. A scissors mechanism is also planned to be implemented with a top platform so as to equip the robot with lifting and transportation capabilities. With these two, the robot can be used in a warehouse or a similar environment. From the controls point of view, two models are analyzed based on their total number of control inputs. The first been the two-wheel model in which the total number of control inputs are four i.e., two (steering input for each wheel) + two (power input for each wheel) thus, resulting in a holonomic/omni-directional system on a regular 2D workspace having three degrees of freedom as, the number of control inputs are greater than the degree of freedom. Similarly, in the second model, four wheels are used in which the total number of control inputs is eight, thus also resulting in a holonomic/omnidirectional system. As compared to the first model the latter has an advantage of having a greater number of control inputs and thus can afford a wide range of actuator failure, of course in a proper combination to operate correctly. An integral sliding mode control along with disturbance compensation scheme is used as a motion control of these two configurations, the robustness and controller performance of the proposed control schemes on these two configurations are verified with the help of computer-based simulations.
(images)

Abstract 14

Title: Mitigation of Lean Blow-out in Combustors: A Challenge to Operate Engines at Lean Fuel-Air ratios

Author: Somnath De, Arijit Bhattacharya, Achinya Mukhopadhyay, Swarnendu Sen

Description

The concept of lean burn (LB) or dry low NOx (DLN) or lean premixed (LP) or lean partially premixed (LPP) combustion has been proposed in the industrial burners, land based and aero-engines due to the emission of low NOx. The transformation from non-premixed or diffusion combustion to the lean combustion technology has been observed as Wold Pollution Control Board has imposed the stringent norms on the NOx emission considering its adverse effect on human life. However, operating the combustion at lean fuel-air ratio (or low equivalence ratio), flame becomes susceptible to the local extinction which leads to the complete flame loss in the combustion zone. The global flame speed or chemical reaction rate becomes low as the operating equivalence ratio of the combustion process gradually decreases. Therefore, at a particular low equivalence ratio, chemical reaction reduces to such extent when flame inside the combustion chamber is about to get out of the combustor due to the high moment of inertia of the unburnt mixture. The phenomenon of such flame extinction is known as lean blowout or LBO. The effect of lean blowout is very severe which is not limited to the land based engines, power plants and aero-engines. The mitigation of such disaster is possible only when operator has a robust method to identify the process approaching towards LBO and also has sufficient lead time in hand to execute the commands. The current invention has been proposed based on the online sensing of the colour emission of the flame. The optical sensing method has an advantage of getting proper dynamical information as the extraction of pixel information from the flame finds out the local information of the characteristics. However, in this invention, effort is provided to identify the dynamics of the flame at a particular equivalence ratio by averaging the pixel information. Thus, the method is simple and on the other hand, able to predict the dynamics correctly. The extracted images are processed instantaneously with the help of an in-house algorithm made in NI LabVIEW. The colour signal is used to extract the RGB (red, green and blue) components from which we can obtain a primary colour emission ratio between red and blue. A threshold is pre-set in the algorithm. When the prescribed colour ratio value crosses the threshold, a command goes to the solenoid control drive through a digital input/output module. The 24 V battery operated valve driver actuates the solenoid valves according to the feedback. As per the information obtained from the instantaneous colour ratio, solenoid valves operate the secondary fuel path (or pilot, separate from primary fuel path). A minimum pilot fuel is observed to help in enhancement of the flame dynamics and to avoid the lean blowout phenomenon. The percentage of extension of LBO limit is seen by about 30% in few cases. This online LBO mitigation technique seems to be very useful which is not limited in our tested model gas turbine combustor and can be extended to any lean combustion burner.

Abstract 15

Title: Koch Infinite Fractal Curve Implementation for the Space Filling Problem in Manufacturing

Author: Tanmay Debnath

Description

The space-filling problem has been one of the most intriguing problems in the domain of manufacturing science and engineering. Several approaches have been applied to solve the problem, ranging from infinite curves (Gospel Curve) to straight-line approaches. This paper introduces a new approach to space-filling using fractal curves. Fractal curves are defined as mathematical curves whose shape retains the same general pattern of irregularity, regardless of how much magnified the shape has been considered, basically the shape of a fractal. These curves are widespread in nature and hence using the same, a novel method has been prepared for generating a fractal curve to be implemented in the additive manufacturing process.

Biological Science and Bio-Engineering

Abstract 1

Title: Network pathway analysis of Autism Spectrum Disorder and its comorbid conditions

Author: Aditya Agarwal, Aaryan Gupta

Description

In recent years, several studies have been conducted to study the conditions that are comorbid to Autism Spectrum Disorder (ASD). However, they have been directed towards studying the occurrence of the comorbid condition in isolation. Here, we present a holistic approach to study the complex network pathways, protein-protein interactions involved in the occurrence of each of the comorbid conditions along with ASD. We begin with the study of sleep disorders that have high comorbidity with ASD and a possible underlying genetic/molecular basis. By performing a thorough literature survey of the literature (including the most recent GWAS studies) associated with the genetics of sleep disorders, we curated a list of genes and proteins that are either experimentally proven or statistically found to be associated with the occurrence of sleep disorders. With the help of bioinformatics tools (STRING and KEGG Pathways), we then performed network pathway analysis for sleep disorders using our curated list of genes and proteins as input. Analysis of the network pathways reveals protein-protein interactions and possible connecting links (in terms of genes and pathways) between ASD and sleep disorders that could provide useful insights for explaining the underlying genetic and pathophysiological causes of the comorbidity of sleep disorders with ASD. For our analysis, we have used the Autism Database (AutDB) as the reference for querying human genes associated with ASD.

Abstract 2

Title: MACHINE LEARNING BASED MODEL FOR IDENTIFICATION OF NEW ANTITUBERCULAR MOLECULES
Author: Animesh Gaur, Sandeep Sundriyal

Description

In 2018, an estimated 10 million people fell ill with tuberculosis (TB) worldwide. Multidrug-resistant TB (MDR-TB) remains a public health crisis and health security threat.1 Thus, many large-scale phenotypic assays and many thousands of new active compounds found have resulted in the need to find new therapies for those infected with Mycobacterium tuberculosis (Mtb) but with limitations in funding and resources makes it challenging to discover novel active molecules. Discovering a drug involves multiple disciplines and interests. Usually, a large number of compounds are evaluated during the discovery phase, for pharmacological activities.

The applications of artificial intelligence (AI) in pharmaceutical research have emerged in recent years. It has been shown that many computational machine learning methods have good results and hit rates. We will use machine learning techniques to develop a classification model that can distinguish between active and inactive anti-TB molecules. Making such models can be used for scoring molecules during the initial stages of drug discovery.

Here, we have compared different machine learning algorithms. We have also compared our test and training sets to show they were suitably diverse and different to represent useful evaluation sets. One binary-class Random Forest model with an activity threshold of 10 uM yielded the following metrics on the test data: accuracy = 0.87, F-measure=87%, Cohen's kappa = 0.744 and One 3-class Random Forest model with an activity threshold of 1 uM for active, 10-100 uM for partially active which yielded the following metrics on the test data: accuracy = 0.82, F-measure=80%, Cohen's kappa = 0.73. Such Mtb machine learning models could help prioritize compounds in the early stages of drug discovery.

Abstract 3

Title: MCV Large T antigen disrupts DREAM target expression
Author: S.Prahalad

Description

Merkel Cell Polyomavirus (MCPyV), an oncovirus discovered in 2008, is found to be clonally integrated into 80% of Merkel Cell Carcinoma (MCC) tumors. MCPyV is a virus with a circular dsDNA with one region coding for the large T (LT) antigen, small T (ST) antigen, 57kT antigen, and a protein from an alternative LT Open reading frame (ALTO). The LT and ST antigens are the major players in MCV mediated tumorigenesis and cause Merkel tumors by disrupting several essential pathways in the cell that, among others, regulate cell-cycle, autophagy, translation. MCPyV, like the High-risk Human Papillomavirus E7 oncogene, has been shown to abrogate the p53-p21-DREAM pathway. The p53–DREAM pathway controls p53-dependent repression. Also, it takes part in the control of checkpoints, including G1/S, G2/M, and spindle assembly checkpoints, by down-regulating the gene expression products of over 250 genes that are primarily associated with the cell cycle. As a result, any defect in the p53- DREAM pathway may lead to cell cycle arrest and a loss in checkpoint control. In our study, we investigated how MCV targets the p53-p21-DREAM pathway. We collated data from genome-wide expression profiling datasets of LT-expressing fibroblasts and keratinocytes. We focused on 250 genes, shown to be targeted by the p53- DREAM pathway previously by Engeland, to establish a definite correlation between the expression of the genes mentioned above and MCPyV LT.

Abstract 4

Title: In-silico modelling of chemical reaction networks of molecules of prebiotic interest.
Author: Aayush Arya, Jessica Ray, Siddhant Sharma, Eduardo Alejandro Lozano Garcia, Romulo Cruz, Jakob Andersen, Huan Chen, Rana Dogan, Henderson Cleaves

Description

Carbanaceous meteorites provide a fossil record of the extraterrestrial chemistry that happened early in our solar system. Studies on samples of the Murchison meteorite have reported the presence of life-essential compounds such as sugars, amino acids and nucleobases (Pizzarello & Shock, 2010). However, most of the compounds in these samples have not yet been fully characterized and the synthesis mechanism of many of these compounds is still unclear. Although mass spectroscopic analyses provide information about presence of species of a certain mass, the space of possible compounds for a given monoisotopic mass is immense and the possibilties vary depending on the chemistries involved. We have created a computational workflow to constrain the chemical space of such species. We used MØD, a chemical graph theory based tool to simulate plausible chemistries that may account for the organic diversity seen in the meteorite samples. As a preliminary test, we modelled the alkaline hydrolysis of glucose and found that our workflow was able to explain 96% of the compounds reported in analytical studies (e.g. Yang and Montgomery, 1996). When we applied the same workflow to formose chemistry, we were able to match all the structures reported by Decker & Schweer (1982) and Omran et. al. (2020). Knowledge of possible compounds involved in such reaction networks can guide future untargeted searches for the analysis of organics in cometary, meteorite and extraterrestrial planetary samples and provide new insights into the origin of life.

Abstract 5

Title: Development and Validation of Spectrophotometric Method for the Estimation of Rotigotine

Author: Paramita Saha, Dr. Murali M. Pandey

Description

Simple, accurate and sensitive spectrophotometric method was developed and validated for estimation of rotigotine (RTG). RTG is a dopamine receptor agonist approved for the treatment of Parkinson's disease and restless leg syndrome. For development of the method, RTG was dissolved in acetonitrile and further dilutions were made in phosphate buffer saline (PBS) pH 7.4. The absorption maxima (λmax) of pure RTG was observed at 222 nm (Fig. 1). The calibration curve of developed UV-Visible spectrophotometric method showed linearity over a range of 10-60 µg/mL with a R2 value of 0.9995. The developed method was validated as per ICH Q2(R1) guidelines. Limit of detection and limit of quantitation values were found to be 2.66 and 8.05 µg/mL respectively. The developed method was found to be accurate and precise with good reproducibility. The validated method was successfully applied for the estimation of RTG in the presence of in-house nanoformulations excipients.

Abstract 6

Title: Assessment of Thermal Degradation of SBS polymers in Bio-Based Encapsulated Bitumen

Author: Greena Maria Sunny, Sridhar Raju

Description

Bitumen used for road construction is transported and stored at high temperature ranging from 1200C - 1900C depending on the type and grade of bitumen; this process leads to the ageing of bitumen. Heating the bitumen results in releasing large amounts of carbon dioxide into the atmosphere, thereby contributing to global warming. In this study, an alternate method is explored, wherein a bio-based thin film is coated over a solidified bitumen. The encapsulated bitumen can be stored and transported at room temperatures and is added to aggregates without prior heating. Rheological and FTIR studies after short term ageing showed that encapsulated bitumen aged less than nonencapsulated bitumen. Further, the encapsulation process was extended to SBS modified bitumen to study its benefits to prevent thermal degradation of SBS polymers during transportation and storage. The bitumen with optimum polymer content was stored in a sealed metal container at 1800C for 14 days. The rheological analysis showed a rapid decrease in the properties of SBS modified bitumen after 3 days of storage; this will affect the performance of flexible pavements and lead to premature failure. FTIR results show that encapsulation of SBS modified bitumen did not alter the properties of SBS polymers before or after short term ageing. Instead, it helped retain its properties from exposure to high temperatures during storage, as seen in the rheological analysis. The carbon emissions during the production of encapsulated bitumen are lower than the traditional transportation and storage method; also, this method is cost effective on an operational level. Therefore, encapsulation of bitumen with a bio-based thin film help in maintaining the properties of SBS modified bitumen and reduce the carbon footprint of bitumen manufacture.

Chemistry and Chemical Engineering

Abstract 1

Title: Carbon Nanomaterials as Electrocatalysts in Metal-Air Batteries
Author: Manleen Kaur, Padhmapriya N

Description

Considering the global concerns regarding climate change and pollution associated with fossil fuels and energy, metal-air batteries (MABs) are among the most promising energy storage devices to meet the growing demand for electrification of vehicles and smart power grids. MABs exhibit five times higher theoretical energy density as compared to the existing Li-ion batteries that have already reached their performance limit. The review paper presents information about the MABs, their reaction mechanism, their major types and provides an in-depth analysis of aqueous (Zn-air batteries) and non-aqueous batteries (Li-air batteries), the challenges faced and the feasible solutions to be implemented. Despite the recent progress of the MABs, certain critical factors affect the batteries' performance: passive layer formation at anodes, growth of dendrites degrading the battery efficiency, lack of suitable electrolytes and cathodic reaction material instability. Carbon nanomaterials are an ideal catalyst for the MABs due to their large surface area, low cost, mesoporous structure and high bifunctional catalytic activities. Thus, a comparative quantitative study has been established by studying various properties on bifunctional catalysts, focusing on the carbon nanomaterials and composites for efficient catalysis, to increase the Oxygen Evolution Reaction (OER) and Oxygen Reduction Reaction (ORR) rates. To overcome these challenges, various strategies and recommendations have been devised for controlled electrocatalysis. Successful implementation of the studies and more research and development in this emerging field will be of practical significance and application, building this study into a commercial reality.

Abstract 2

Title: Characterization of the Moroccan Phosphogypsum
Author: YASSINE ENNACIRI, MOHAMMED BETTACH

Description

The wet phosphoric acid production in the world generates a huge quantity of a by-product named phosphogypsum (PG). Although, PG is mainly formed by calcium sulphate beside other impurities such as phosphates, fluoride, organics matters, heavy metals and radioactive elements. At present, the PG management rest a difficult problem to solve and the rejection of this by-product without any pre-treatment may be caused several environmental problems in long period. The main objective of this work is to present and discuss the results of the characterization of the Moroccan PG. According to these results, the nature and the physico-chemical properties of this PG sample are similar to those of other PGs of sedimentary origin in the world. In addition the impurities contained in this PG rest generally low.

Abstract 3

Title: Molecular Memory Device Based on a Tetranuclear Organotin Sulfide Cage
Author: Abhishek Mishra, Dr. Ramesh K. Metre

Description

To overcome the problem of data storage and data handling various electronic devices at molecular level are being explored continuously. Molecular organometallic complexes have been considered as the potential candidates for the molecular materials to be used in these devices for their ease of processing, flexibility, being light weight, solubility, stability, and versatility to design. 1 Azoaromatic compounds are known to show switching behaviour2,3 which encouraged us design a tetranuclear monoorganotin sulfide cage [(RSnIV)4(μ- S)6]·2CHCl3·4H2O (1) (R = 2-phenylazophenyl) exploiting the intramolecular N→Sn coordination. It consists of an interesting Sn4S6 double decker cage like core in which Sn centers are bridged through μ2-S units. The single crystal x-ray diffraction analysis revealed that it contains four identical Sn possessing distorted trigonal bipyramidal geometry. The complex 1 is further explored as active material for the fabrication of solution-processable resistive memory switching device. I-V characteristics of the device showed an excellent memory behaviour with low write voltage i.e., -1.4 V. The device showed a good ON/OFF ratio of 103 with retention time of 10000s.4 The complex 1 is the first organotin complex to exhibit the memristive behaviour.

Abstract 4

Title: Nano-catalysis - Synthesis of Ni Mo promoted Hierarchical ZSM-5 nano-zeolite Catalyst using Biogenic Silica Nanoparticle from Waste Rice Husk for Hydrocracking of Heavier Molecular Weight Hydrocarbons to Diesel Oil
Author: SOUVIK DINDA

Description

There is a huge demand of diesel oil in market due to larger number of vehicles made of diesel engine. Researchers are trying to develop a catalyst which is efficient for conversion of crude oil to diesel oil. Petroleum refineries buy crude oil and distil out fuel oil by applying higher temperature depending upon boiling point of hydrocarbons. After distillation huge amount of crude oil remains left as residue in column. Residue oil contains heavier molecular weight hydrocarbons. These hydrocarbons(>C18) can't be distilled out and we can't use those directly as fuels. If we don't know the use of these residue oil, lots of oil and money will be wasted. So researchers are trying to convert those residue oil to useable fuel oil like diesel. Hydrocracking process is used for conversion of heavier hydrocarbons to lighter hydrocarbons in presence of H2. Biogenic silica nanoparticle (70 nm diameter, 269 m2/g surface area) are synthesized from waste rice husks (RH). Using this silica precursor ZSM-5(4.2 nm diameter, 319 m2/g surface area) zeolite is hydrothermally prepared. Heavier hydrocarbons enter through pore of ZSM-5 and are cracked or isomerised in the presence of acidic sites. Using wet impregnation technique Ni(5wt%) & Mo(15wt%) metal oxides are deposited on ZSM-5 where Ni(NO3)2 & (NH4)6Mo7O24 are precursors respectively. Ni & Mo metals helps for dehydrogenation-hydrogenation reaction. NiMo/HZSM-5 nano-catalyst shows selective catalytic activity for efficient hydrocracking.

Abstract 5

Title: Mechanistic Investigation of Oxidative Dehydrogenation of Propane to Propene over Ni Doped Ceria Nanorods
Author: Anoop P Pushkar

Description

Light olefins are one of the most important feedstocks for the polymer industry. Among these ethylene and propylene are highly desirable, as they undergo polymerization to give two of the most widely used polymers in the world, polyethylene and polypropylene. It has been estimated that India would run into propylene deficit by 2030, as the propylene demand would hit 10 million tonnes per annum. To meet this growing propylene demand, better alternatives to the conventional cracking processes need to be developed as these cracking processes are highly energy demanding and give low olefinic selectivity. Hence, direct dehydrogenation technologies for producing light alkenes, have gained much attention. Among these, the Oxidative Dehydrogenation (ODH) process is a promising candidate for obtaining light alkenes. But the major challenge of ODH is overoxidation of the products and thereby low alkene selectivity. Ceria (CeO2) based materials are one of the promising oxidation catalysts and their potential in catalysing light alkane ODH has not been explored extensively. In this context, the proposed research work aims at developing detailed mechanistic insights into the Propane ODH process over Ni doped Ceria nanorods from first principles methodologies under Density Functional Theory (DFT) framework. This would involve computational design of Ni doped Ceria nanorods using Ab initio thermodynamic studies, Computational Raman spectroscopic studies and Descriptor based catalyst design methodologiesin conjugation with DFT simulations. Further, detailed mechanisms for Propane ODH, deep dehydrogenation and oxidation at oxygen rich conditions have been developed. The reaction networks generated from these mechanistic studies can be further subjected to detailed mesoscopic kinetic studies.

Abstract 6

Title: Analysis of Charge Storage Behavior in Redox-electrolyte Based Battery-like-supercapacitors

Author: Sourav Ghosh, Dr. Tiju Thomas, Dr. G. Ranga Rao

Description

Redox-additives are used as a cost-effective means to improve low-temperature charge-storage capacity for aqueous-super- capacitors. From a technology-development standpoint, there are challenges associated with a lack of standard techniques to measure the redox-additive based device-parameters. This, in turn, yields a relatively poor understanding of the charge- storage processes, especially in battery-like supercapacitors. With this as a backdrop, this work undertakes an analysis of Ce0.9Zr0.1O2@Ni-foam/KOH-K3Fe(CN)6 electrode/electrolyte sys- tem. Here, a method is presented that enables the delineation of the contribution of the effective-mass of the redox-additive on the electrode-surface. This method demonstrates that the effective electrolyte-mass has a ~38.5 to ~15% contribution toward charge-storage with increasing scan rates (1 to 80 mVs @1). The diffusion-controlled trends are duly analyzed using the well-established Trasatti analysis; these also serve as a reasonable benchmark for the method reported here. Hence the method is expected to be of use for other hybrid- supercapacitor systems as well.

Computer Science and Machine Learning

Abstract 1

Title: ABLE: Attention Based Learning for Enzyme Classification
Author: Rohit Dwivedula, Vamsi Nallapareddy

Description

Classifying proteins into their respective enzyme class is an interesting question for researchers for a variety of reasons. The open source Protein Data Bank (PDB) contains more than 1,60,000 structures, with more being added everyday. This paper proposes an attention-based bidirectional-LSTM model (ABLE) trained on oversampled data generated by SMOTE to classify a protein into one of the six enzyme classes or a negative class. We use only the primary structure of the protein described as a string by the FASTA sequence as an input. We achieve the highest F1-score of 0.834 using our proposed model on a dataset of proteins from the PDB. We baseline our model against seventeen other machine learning and deep learning models, including CNN, LSTM, BILSTM and GRU. We perform extensive experimentation and statistical testing to corroborate our results.

Abstract 2

Title: Modeling procrastination as rational meta reasoning about task effort
Author: Shobhit Jagga, Nisheeth Srivastava, Narayanan Srinivasan

Description

Current theories of procrastination argue that people put things off into the future with the expectation that they will be better able to do them later. In our work, we rationalize such expectations within the framework of evidence accumulation models of the choice process. Specifically, we show that it is rational for observers to adopt lower decision thresholds for choices with weak evidence for any alternative and that observers learning to estimate optimal decision thresholds for tasks that involve decisions will find it reasonable to put the tasks off until the threshold has been sufficiently lowered by time-varying urgency. The explanation is that people rationally believe that it is inefficient to begin a task that contains choices for which they possess insufficient evidence. For such choices, we show that the speed-accuracy trade-off asymmetrically leans towards speed, in the sense that the marginal value of spending more time in making such decisions is low because low evidence will lead to high error rates anyway. Thus, we propose that procrastination is primarily caused by people believing that they will be more efficient in doing something later; this belief is justified for tasks that are characterized by difficulty in making choices. Since choice difficulty plays a central role in our explanation for the mechanism of procrastination, we tested its effect on procrastination with an experiment that is designed with the basic aim of differentiating generic task difficulty from choice difficulty. To achieve this differentiation, we developed a grid-search game, inspired by the spatial foraging paradigm of Hills and Hertwig, wherein participants flip over grid cells and see what reward each cell contains. Both simulation and experimental results support our proposal, indicating a large role of choice difficulty in people's self-assessed estimates for how likely they are to procrastinate any given task.

Abstract 3

Title: SNN
Author: Tejas Ketkar

Description

With the advent of mobile technology and IoT, there has been an ever-increasing demand for performing in-memory computation for fast, compact and energy-efficient training of machine learning models. Spiking Neural Networks (SNN) utilising emerging non-volatile memories are arguably the most energy-efficient implementation of the central nervous system. However the intrinsic variability of the memory devices lead to unbalanced learning of weights in the network. My research analysed the impact of several experimentally observed learning windows on the performance accuracy of the SNNs. This detailed analysis may provide holistic design guidelines for the hardware implementation of SNNs.

Abstract 4

Title: A Gated and Bifurcated Stacked U-Net Module for Document Image Dewarping
Author: Hmrishav Bandyopadhyay

Description

Capturing images of documents is one of the easiest and most used methods of recording them. These images however, being captured with the help of handheld devices, often lead to undesirable distortions that are hard to remove. We propose a supervised Gated and Bifurcated Stacked U-Net module to predict a dewarping grid and create a distortion free image from the input. While the network is trained on synthetically warped document images, results are calculated on the basis of real world images. The novelty in our methods exists not only in a bifurcation of the U-Net to help eliminate the intermingling of the grid coordinates, but also in the use of a gated network which adds boundary and other minute line level details to the model. The end-to-end pipeline proposed by us achieves state-of-the-art performance on the DocUNet dataset after being trained on just 8 percent of the data used in previous methods.

Abstract 5

Title: A Comparative Study of Image Data Augmentation
Technique for Detection of COVID 19 Cases from the X-Ray Images
Author: KAUSHAL DEVRARI , KARTHIK NAUTIYAL

Description

In the present day, scenario COVID 19 pandemic has made a remarkable impact on the society and has impacted the whole world with its adverse and deadly effects, at present 22.4 million people are affected with it and 788k being dead from this pandemic making it world's deadliest pandemic ever. The scariest part of COVID is it's extreme and unambiguous nature in which people show different symptoms and even those symptoms are not common, so that makes it difficult to find out whether the patient is affected by the coronavirus or something else. The main issue of this virus is the testing part where we test the patient based on some common symptoms such as flu, fever, cough, etc but over the period even the COVID positive patients don't show these symptoms, Currently, the test available for COVID is a diagnostic test for which we require advanced labs and will give result in 24-36 hrs. The second test is an antibody test that only tells about the presence of the virus in the body specifically not coronavirus. So after the deep diagnosis of the COVID 19 patients by the researchers and doctors worldwide, it has been found that the COVID 19 patients can be diagnosed by their X-ray and CT scan images, but unfortunately we neither have that much data nor we have a model to automate the process. Data in our case means images of the patients (CT scan and X-ray). So we have come out with an idea of replicating the data (images) of the confirmed patients with the help of a technique known to be Data Augmentation in deep learning. In Data Augmentation we primarily boost our dataset i.e. increasing the no of images to a certain extent so that it can be helpful for the deep neural network to process the data, as deep neural networks require huge data to process so that it doesn't lead to overfitting. For modelling , we will be scripting it in python and the model will be a MobileNetV2 , VGG16, and InceptionV3 model on the training dataset. By this, our proposed model of testing coronavirus will not require any advanced labs and will give the results immediately.

Abstract 6

Title: Development of Traffic Noise Prediction Model Using Multiple Linear Regression
Author: Ramesh Ranpise, Bhaven Tandel

Description

In a developing country like India, traffic noise pollution is becoming a severe problem due to inefficient public transport in urban areas. The number of personal vehicles is increasing due to the lack of convenient public transportation. The study of urban road traffic noise is an important issue. Traffic noise prediction models are playing a very important role in the decision making and proper implementation of rules and regulation for a certain area. This research work was carried out to develop traffic noise prediction model for two rigid and one flexible pavement road of Surat city using Multiple Linear Regression. Significant factors affecting traffic noise such as classified traffic volume count, road width and average building height were selected as input parameters for a detailed survey. Models have been developed using the data of three roads separately and one final model has also been developed using the data of all three roads. According to the data obtained from the detailed survey, it is found that the minimum equivalent traffic noise level is exceeding the permissible limits at all roads. Among the prediction in three urban roads, the predicted output result from MLR model showed poor correlation with an average absolute % error of 2.065 & R 2 value of 0.25. But with the combined road there is slight improvement in the statistical values viz. average absolute % error 2.27and R 2 =0.51. This also proves that dependent variable equivalent noise (Leq) is not linearly dependent on independent variables, classified traffic volume count, road width and average building height. Road traffic noise prediction model may be developed using evolutionary computing tools like genetic algorithm, neural networks etc.

Abstract 7

Title: Fuzziness in the Covid19 World: A Review
Author: Iman Aqeel Khan

Description

The paper presents an overview of the current work in Fuzzy Logic to derive out solutions in the Covid-19 Pandemic. Several computational and electronic solutions have been developed to combat the spread of coronavirus. A number of AI based diagnosis tools employing Deep Learning to classify healthy & diseased lung CT- scans & X-rays have been built. Other solutions have been developed to aid with the issue of contact tracing, like the Aarogya Setu App in India. Real-time tracking dashboards, like the one from Johns Hopkins University have been set up to record the statistical spread of the pandemic, recording the daily number of cases, predicting future growth rate and so on. Of these however, Fuzzy Logic has been quite absent from the limelight, despite the fact that Fuzzy based systems hold great potential, especially in light of the uncertain nature of this disaster. In this review we attempt to present an overview of the recent works in the field that draw out solutions to the various dilemmas brought out by the Covid-19 pandemic. This will not only draw attention to the vast potential offered by Fuzzy Sets & Systems based on those, but also uncover the niche in the field that can be addressed by future researchers, Computer Scientists and developers.

Nanomaterials and Material Engineering

Abstract 1

Title: Facile ultrathin film of silver nanoparticles for bacteria sensing.
Author: Parul Taneja

DESCRIPTION

Silver nanoparticles (AgNPs) exhibit excellent anti-microbial and bactericidal properties. Due to bacterial abhorrence for AgNPs, it is difficult to develop a label-free, sensitive and low-cost bacteria sensor using them. In the present article, we report that an ultrathin and uniform Langmuir–Schaefer (LS) film of thiol functionalized AgNPs (f-AgNps) can be employed for bacteria sensing effectively as compared to that of non-uniform and randomly distributed f-AgNPs in spin coated film. The uniformly distributed f-AgNPs in the Langmuir–Schaefer (LS) film offer a relatively larger contact surface for bacteria as compared to that of spin coated film. Due to higher contact surface, adsorption of the bacteria on LS film is strongly preferable as compared to that of spin coated film leading to an enhanced sensing performance of the LS film than that of spin coated film. The Soil bacteria was culture by the standard protocol and were utilized as model system for bacteria sensing application. The soil bacteria sensing was done by monitoring the piezoresponse and dissipation parameters using a quartz crystal microbalance-dissipation (QCM-D) sensor module, simultaneously. Our study indicates that the LS film of f-AgNPs not only facilitates the adsorption of the soil bacteria but also kills them.

Abstract 2

Title: Classification on Surface conductivity of Epoxy nanocomposites-based Insulation structures exposed to coal atmosphere using Machine Learning Techniques.
Author: Sneha Jayaganthan, Myneni Sukesh Babu, Ramanujam Sarathi, Takahiro Imai

DESCRIPTION

Deposition of coal on insulators is one of the major issues in the location such as coal mining areas, thermal power plants and brick kilns, which degrade the surface properties of insulation structures. Epoxy micro-nanocomposite specimens incorporated with 66 wt% of silica micro fillers and 0.7 wt% of ion trapping particles as nano fillers, are coated with four different variants of coal. Laser induced breakdown spectroscopy (LIBS) was used to determine plasma temperature, electron density of the coal deposited epoxy micro-nanocomposite insulator. The epoxy micro-nanocomposite specimens coated with different variants of coals are classified using its conductivity measured through LIBS by using Machine learning techniques such as
random forest and support vector machine (SVM) algorithms. The experimental LIBS data are splitted in to two parts such as training data (75%) and test data (25%) and used for training and realizing the predictive capability of accurate classification made by both random forest and SVM, respectively, in the present work. The accuracy and predictive capability of ML techniques on the degradation of insulation structures are substantiated, which would serve as a cost-effective tool to minimize the need for performing large number of experimentations on insulation structures.

Abstract 3

Title: Investigation of global model in plasma aided deterministic nanofabrication
Author: Dr Dhananjay Gopal, Aniruddha Deshmukh, Vishal Agarwal.

DESCRIPTION

A comprehensive study of global models leading to a deterministic plasma aided nanofabrication scheme is carried out. It supplements a multi-hybrid simulation approach for enabling the nanoassembly processes by exploiting surface science and plasma, for applications in fabrication of quantum dots. The global plasma model being employed in the current study, provides densities and energies of plasma species as functions of operating parameters. It is based on a set of particle balanced equations, power balance equations and the charge neutrality condition. The model allows to formulate conditions required to estimate the growth and shrinking of certain islands, and relate them to the process control parameters. Investigation of various changes in the plasma parameters with the input power and pressure is being carried out considering Maxwellian energy distribution of electron.

Abstract 4

Title: A Thermodynamic Framework for Additive Manufacturing, using Amorphous Polymers, Capable of Predicting Residual Stress, Warpage and Shrinkage
Author: Sreejith Pillai, Krishna Kannan and Kumbakonam Rajagopal

DESCRIPTION

A thermodynamic framework has been developed for a class of amorphous polymers used in fused deposition modeling (FDM), in order to predict the residual stresses and the accompanying distortion of the geometry of the printed part (warping). When a polymeric melt is cooled, the in-homogeneous distribution of temperature causes spatially varying volumetric shrinkage resulting in the generation of residual stresses. Shrinkage is incorporated into the framework by introducing an isotropic volumetric expansion/contraction in the kinematics of the body. We show that the parameter for shrinkage also appears in the systematically derived rate-type constitutive relation for the stress. The solidification of the melt around the glass transition temperature is emulated by drastically increasing the viscosity of the melt.
In order to illustrate the usefulness and efficacy of the derived constitutive relation, we consider four ribbons of polymeric melt stacked on each other such as those extruded using a flat nozzle: each layer laid instantaneously and allowed to cool for one second before another layer is laid on it. Each layer cools, shrinks and warps until a new layer is laid, at which time the heat from the newly laid layer flows and heats up the bottom layers. The residual stresses of the existing and newly laid layers readjust to satisfy equilibrium. Such mechanical and thermal interactions amongst layers result in a complex distribution of residual stresses. The plane strain approximation predicts nearly equi-biaxial tensile stress conditions in the core region of the solidified part, implying that a preexisting crack in that region is likely to propagate and cause failure of the part during service. The free-end of the interface between the first and the second layer is subjected to the largest magnitude of combined shear and tension in the plane with a propensity for delamination.

Abstract 5

Title: Experimental and theoretical study of reinforced concrete column specimens at elevated temperatures.

Author: Dr. Shujaat Hussain, Abdul Waris, Sherien Anab, Zubair Ahmad Dar, Tawqeer Nabi, Mehreen Farooq, Zakir Mir

DESCRIPTION

Certain parameters of Reinforced Concrete columns subjected to elevated temperatures are a matter of study. This work was performed in two phases, one being the experimental phase and the other being the theoretical phase. In experimental phase, the effect of 'transverse reinforcement spacings' and 'concrete grades' on the properties of RC column specimens was studied. The investigation was done by studying the internal cracking patterns, surface cracking patterns and spalling behaviour. The comparative rate of temperature increase and temperature
difference was also studied between the fire-exposed surface and the top fire-insulated surface of the different column specimens, via the temperature-time graphs.

The second phase of the work focussed on compilation of previous test results from literature on RC columns subjected to fire conditions. This data was utilized to plot bivariate statistical models so as to get better picture of the general trendline between Fire resistance and Volumetric ratio. This was done in an attempt to expand the sample space, as previous work done on this subject was scarce and whatever experiments were performed comprised of only a small number of columns. Thus, a large sample space would help in a better understanding of the general trend in such bivariate scatterplots. It was generally observed that smaller transverse reinforcement spacing aided in increasing the fire resistance of the RC columns.

Abstract 6

Title: Dynamic Modeling of undulatory IPMC actuator for biomimetic ribbon fin underwater propulsor
Author: Ankur Gupta

DESCRIPTION

Currently, underwater robotics inspires to have more efficient systems by making a critical transition to adapt from nature. Natured inspired robotics demand for biological muscle-like featured actuators that can provide underwater propulsion. A novel smart material that is soft, lightweight and capable to produce large deflection under the application of applied electric potential is ionic polymer-metal composite (IPMC). IPMC is an ideal artificial muscle that can be used as an underwater propulsor for efficient and highly maneuverable bioinspired underwater robots.
In this research, electro-mechanical dynamic modeling of a biomimetic propulsor based on undulating ribbon fin is proposed. Kinematics of the system is considered as the sinusoidal undulating motion of the ribbon fin which is guided by the actuating ionic polymer-metal composite material. This is a smart material that actuates when an input voltage is applied and composed of a simple RC circuit. Elongated body theory is used to produce system dynamics considering the kinematics and also the hydrodynamic parameters like drag are undertaken as the application aspect is the underwater environment. The proposed model has been used to evaluate the speed and thrust of the biomimetic system. Also, the thrust efficiency can be obtained for the different input frequencies. The proposed model may contribute to the understanding of an undulating ribbon fin inspired by IPMC for underwater locomotion.

Abstract 7

Title: Low velocity impact analysis on laminated structures using damage meso model approach.

Author: Semayat Fanta

DESCRIPTION

Damage meso-model for laminates (DML) is one the most widely applicable approach in fiber- reinforced polymeric composite analysis. It has been developed over the last two decades considering the various works of authors in both experimental and theoretical that have been carried out in both micromechanics as well as meso-mechanics approaches. The DML is developed based on the micromechanical description that aims predicting the damage initiation, damage evolution until the failure of fiber reinforced composite structure. This work is aimed to connect the micromechanics and meso-mechanics of laminated composite structure. In the model we considered two meso constituents such as composite lamina and cohesive interface for the analysis of intralaminar and interlaminar damage imparted form low velocity impact on laminated fiber reinforced composite structure. The martial model for meso constituents is defined using a user defined material subroutine VUMAT and is implemented in ABAQUS/Explicit finite element tool. The model predicts the damages in the meso constituents accurately and considered the most effective technique of modeling low velocity impact problem of composite structure.

Engineering and Theoretical Physics

Abstract 1

Title: Quantum Bourneville Model: On the Quantum Mechanical Nature of Dark Triad.
Author: Ajay Agarwal

Description

The malevolent behavior of human beings has gathered exponential interest from the research community since the introduction of the Dark Triad trait of personalities in 2002. With publications of different modalities filling the shelves of existing literature, it was only time that a critical appraisal of the state-of-progress was done. Miller et al. in 2019 took toward this necessary challenge and posed critical questions that were meant to be addressed. While psychologists ponder on the ways to create models that include the multi-dimensionality of a field with growing features every day, it was peculiar to see the dearth of any interdisciplinary tools being utilized for the same. Consequently, I present how Dark Triad can take aid from Quantum Mechanics to finish the puzzle. This paper presents a thought experiment that eventually paves the way for establishing a quantum mechanical model, named consciously to allow for de-labeling of the field, Quantum Bournville, for interpreting the notion of the Dark Triad whilst addressing all the concerns mentioned in Miller et al.(2019). The principles of Quantum Superposition and Quantum Hyperentanglement are utilized to build quantum mechanical models that provide extensive space for any new features that are yet to be discovered in the field. The questions on quantum measurement and the interpretation of the same from different schools of thought like the Copenhagen Interpretation are also considered. The frequent question of identification of any empirical proof is rendered moot for this model given its vast intuitive appeal and philosophical foundation. While the author welcomes any attempts possible to provide solid, empirical proof of this quantum Dark Triad model, it is to be noted that the author considers attempts for the same to take into consideration the questions of formalism and determinism as expected from any scientific theory.

Abstract 2

Title: Nanowire based size-dependent Photoluminescence and Raman studies of N type porous silicon etched under illumination of varying wavelengths.
Author: Mohammad Zaid, S. S. Islam, Mohd. Mudassir Husain

Description

A comparative study of N type porous silicon (PS) morphology by using Field Emission Scanning Electron Microscope (FESEM) Imaging, Raman Spectroscopy and Photoluminescence (PL) spectroscopy analysis. Samples of crystalline silicon were electrochemically etched at a constant current density and a constant anodization time illuminated under different wavelengths of visible light emitted by LEDs to convert them into nanowire-based PS wafers. FESEM characterization showed formation of nanowires of different porosities on the wafer for varying wavelengths subjected to the samples during etching. Raman spectroscopy further showed right shift in Raman peaks of the amorphous silicon wafer while PL spectroscopy concluded in tuning of energy band gap of the samples illuminated under different wavelengths of light. In this work, we show the differences obtained in the behaviour of PS when etched under different degrees of illumination for further application in fabrication of integrated silicon-based optoelectronic systems as the properties of a porous silicon such as porosity, pore diameter and thickness depend heavily on the fabrication process and can be comfortably controlled.

Abstract 3

Title: A Circularly Polarized Quad-band Annular Ring Antenna with Asymmetric Ground Plane using Theory of Characteristic Modes.

Author: Reshmi Dhara (NIT Sikkim)*, Dr. Sanjeev Yadav (GWEC Ajmer), Prof. Mahendra Mohan Sharma (MNIT Jaipur), Dr. Sanjay Kumar Jana (NIT Sikkim), Prof. Mahesh Chandra Govil (NIT Sikkim and MNIT Jaipur)

Description

Herein, a theory of characteristic mode (TCM)-based design of a circularly-polarized (CP) quad-band compact microstrip antenna is proposed [1]. It involves one annular ring radiator with eight symmetrical slots along its boundary and three circular closed ring resonators (CRRs) on the substrate's bottom side. Initially, CM analysis was carried out for the radiator without a feeding structure to determine the modal currents and their corresponding modal fields (radiation patterns) of existing modes. This helped recognize the symmetric modes to be selectively excited by the feed to furnish CP and gave direction for selecting asymmetric CPW-fed structure as the feed of choice. The series of parasitic strips along the annular radiator's edge enhanced CP radiation and eliminated ripples in the radiation pattern. An asymmetric cross-shaped slit at the center of the annular radiator and coupling effect between a smaller open-loop resonator placed near the right corner of this main radiator played pivotal roles in obtaining circular polarization bands at 7.69 GHz and 9.91 GHz, respectively. The tuning stub on the feed furnished another CP band at 12.09 GHz and further widened the IBW. Asymmetric CPW-fed technique has been used for feeding to excite the desired symmetric modes and create optimized perturbations required to obtain another CP band at 5.63 GHz. The measured quad CP bands are well inside the ranges of measured and simulated IBW. Simulations were carried out using Ansys Electronics Desktop 2020R1 based on the Finite Element Method (FEM). A low-cost FR-4 substrate is used to fabricate the antenna with an optimized dimension of 35301.6 mm 3 . The measured IBW ranges from 4.36-4.82 GHz, 5.50-5.78 GHz, and 5.95-beyond 14 GHz. The proposed antenna may find suitable applications in the C band, X band, and 5GHz WLAN devices.

Abstract 4

Title: Performance Investigation of III-V material over Convectional Silicon in Nanoelectronic Devices.
Author: Ankit Dixit

Description

In the Initial work of the thesis, the device performance of a three-dimensional (3D) SOI-FinFET is investigated under the influence of Low Doped Drain (LDD) architecture. First time, Effect of LDD has been incorporated in the device modelling parameter such as capacitance, drain current and subthreshold slope. A detailed device level and circuit level performance has been studied by deigning the mixed mode inverter circuit (Section I). The property of novel III-V materials such as InAs, InGaAs and GaAsSb have been studied as comparison of conventional Silicon material in device performance. It has been found that III-V material have higher On and off-state current due to their larger electron mobility. It has been also observe that these property can easily be modulated based on fraction of mole fraction used in the compound (Section II). Finally, GaAsSb material has been chosen over the other studied III-V material and detailed investigation has been performed.(Section III)

Economics, Finance and Management

Abstract 1

Title: **Economic Development and other determinants of Public Debt Accumulation: Structural Equation Modelling Approach**.

Author: Pratibha Saini

Description

This article presents a different approach to explore the various determinants of public debt using Structural Equation Modelling (SEM). The analysis of the study is limited to India, starting from 1985 to 2018. The study is partially confirmatory and partially exploratory as it also inspects the interaction between economic development and public debt. The findings suggest that, among various macroeconomic variables, debt servicing, inflation, and military expenditure are the critical factors of the debt accumulation in case of India. Furthermore, economic development has a negative relation with public debt which depicts that with the rise in economic development, there will be a decrease in the public debt accumulation. Reason being, the improvement in socioeconomic conditions of the population, enhances the overall performance of the economy and make the economy self-reliant and more productive. From the policy perspective, more focus should be given to internal and ground-level factors.

Abstract 2

Title: **The Output-Inflation Trade-off as a Result of Inflation Targeting**

Author: **Pratik Kamdar, Dr Rishi Kumar**

Description

Non-inflationary growth is the primary aim of various policymakers and economists worldwide, and there is substantial literature on how ‘Inflation Targeting’ can help achieve this goal. Inflation targeting makes price stability the single objective of monetary policy and gives the central bank great independence. But this comes at the cost as reforms of this nature may lead to a higher short-run output-inflation trade-off by altering optimal stabilisation policy and wage indexation. In this paper, we show that while Inflation Targeting doesn't impact 'Most Developed' countries in the short run that is not the case for developing countries, i.e., there is no evidence for a short run output-inflation trade-off in 'Most Developed' countries, whereas the developing countries indicate the presence of such a trade-off. We obtain a mixed result for other countries. Further, the long-run dynamics for these countries after inflation targeting was adopted have also been studied

Abstract 3

Title: **The Impact of the Global Financial Crisis on Stock Market Efficiency: Analysis Based on Fourier Unit Root Tests**

Author: **Pratik Kamdar, Dr Muneer Shaik**

Description

This paper examines the weak-form Efficient Market Hypothesis on the stock prices of sixteen countries spread globally, by using a battery of Fourier unit root tests that allows smooth structural breaks developed by Becker et al. (2006), Rodrigues and Taylor (2012),

Enders and Lee (2012a, 2012b). Considering daily, weekly and monthly frequency data, we have conducted the Fourier unit root tests during different sub-sample time periods of global financial crisis to check for robustness. In particular, we have found that in the overall sample period (2000-2020) seven stock markets and during the pre-crisis period (2000-2007), twelve stock markets are weak-form efficient across different frequencies. Whereas during the post-crisis period (2008-2020), only four stock market indices out of sixteen are found to be weak-form efficient. Our study reveals empirically that the global financial crisis has led to weak form inefficiency in the majority of global stock markets due to which the investors may get a stream of arbitrage benefits post-crisis period.

Abstract 4

Title: **A three-pronged approach for revival of MSMEs in India**

Author: **Unnikrishnan.PM, Jyoti Tikoria, Arun Kumar Agariya**

Description

The micro, small and medium enterprises (MSME) plays a very crucial role in the socio-economic growth and development of majority of the developing countries in the world. MSMEs in India contributes significantly to the Indian economy by way of employment generation, enhancing manufacturing, service and export potential throughout the country without any demarcation between the rural and urban areas and there by contributing to the national GDP. Changes in the business environment such as economic liberalization, globalization, privatization and ease in international trade barriers has posed huge challenges on MSMEs today. This study aims to explore the major challenges and issues faced by the Indian MSMEs today and suggests a simple approach to help them to face the challenges, initiate improvement actions and enhance performance. A comprehensive literature review is carried out on the topics of MSMEs in India, business excellence practices, Industry 4.0 and technological revolution. A mixed research methodology of literature review and empirical research is used for carrying out this study. A questionnaire survey is conducted in select MSMEs in India to understand the issues and challenges faced by them and also know the awareness of practices such as business excellence in Indian MSMEs. The findings of the study clearly reveals that the majority of MSMEs in India are struggling to survive as a result of the intense competition, poor quality products, use of outdated technology, low productivity, higher cost of manufacturing and inadequate finance for running the business. The study results shows the need for adopting a technological revolution both in terms of automation and digitization of Indian MSME sector to compete successfully in today's highly competitive global market. Indian MSMEs also have to enhance their business performance by adopting improvement tools and techniques such as business excellence models to be at par or ahead of their competition for achieving continued success and growth and to strengthen their financial position. The study suggests a three pronged approach of adopting business excellence practices, embracing technology and acquiring financial strength to make Indian MSMEs stronger to face today's challenges, enhance their competitiveness and to be successful in the long run.

Abstract 5

Title: **Transmission Channels of Monetary Policy Empirical Analysis from India**

Author: **Sayar Ahmad Shah**

Description

Micro, as well as macroeconomic stabilization demands sound policy formulation within the competitive environment. The existence of competitive and well-integrated capital market guarantees the economic prosperity of a nation. This paper explores the implications of the reformative changes in the Indian monetary policy and its resultant effect on monetary policy transmission most predominantly within the context of predominant channels of monetary policy transmission during post-reform periods. It highlights the changing nature of capital markets and the importance of financial deepening with its resultant effect on economic growth. Furthermore, the current study highlights the importance of capital markets and monetary policy autonomy for the efficient transmission mechanism. Using the path analysis approach with inclusion of predominant macroeconomic variables mainly in the form of Gross Domestic Product (GDP), Broad Money Supply (BM), Bombay Stock exchange (BSE), Gross fixed capital formation (GFCF) and private final consumption expenditure (PFCE), the paper highlights the importance of changes in assets prices as a result of monetary policy intervention with its resultant effect on the consumer expenditure. Finally, certain policy suggestion and recommendation has been put forth after observing specific limitation which are still existent in contemporary Indian monetary policy and which hinders the efficient conduct of Monetary Policy in India.