IISconnect

Book of Abstracts for Research Careers [March 2017]

INDIAN INSTITUTE OF SCIENCE

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Office of Career Counselling and Placement

Indian Institute of Science

BANGALORE

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Preface

It gives us great pleasure to present before you an abridged version of the outcome of the high quality research of a set of students of the Indian Institute of Science (IISc). This is an initiative of the Office of Career Counselling and Placement to facilitate employment in Industries, for our research students. The present booklet is the second in the series under the banner of **IISconnect,** formally launched in October 2016. Students whose work is presented here, are all expected to leave the Institute in the coming months, and are highly interested in a suitable career in industries.

Students from our research programs such as PhD or MSc(Engg) and various Masters programs have submitted their details to be included in this booklet. This booklet is divided into Clusters, corresponding to various industry sectors. We request the reader to go through these and identify ones suitable for your current/immediate requirements. If you find someone may be more suitable for a colleague, please feel free to refer to them.

The student is identified by the name and a code. Kindly write back to us, if you wish to consider one or more candidates for a prospective position. We will be happy to send the full CV of the student, and assist you in further steps towards potential employment. Alternately, your company may post job descriptions in our portal, for visibility among a larger pool of our students.

If you have any other questions of comments, please feel free to revert back to us.

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Cluster A: Aerospace Structures /Defence Electronics & Aerospace Systems

A.01 Abhishek Khatta PhD

Title: Experimental studies on shock-shock interactions in hypersonic shock tunnels

Keywords/skills: fluid mechanics; thermodynamics; aerodynamics; unsteady flows; computational fluid dynamics; wind tunnel testing

The work undertaken concerns with the aerodynamic heating of the vehicles flying at hypersonic Mach numbers. The physical problem addressed is that of shock-shock interactions, which are most of the time, an unavoidable phenomenon in the high speed flows. The shock-shock interactions lead to impulsive thermal and pressure loads on the vehicle surface and also affects the overall performance and sustainability of the vehicle. In the lab experiments conducted in shock tunnels, the wall heat flux were measured on the surface of a hemispherical body in the presence of shock-shock interaction environment using Platinum thin film gauges. High speed visualization was used to understand the critical flow features. The work concluded with the characterization of the unsteadiness in the flowfield and corresponding thermal loads on the vehicle surface.

A.02 Akhil G PhD

Title: Time-Optimal Path for Autonomous Vehicles with Terminal Angle Requirement

Keywords/skills: path planning; guidance and control; trajectory optimization; control systems; autonomous vehicles; aerospace engineering

A specific terminal heading angle is essential for various missions involving autonomous-underwater, ground, aerial, and space vehicles. Problem of finding time-optimal path to intercept a moving target at a desired terminal angle is considered. First, a specific case of lateral interception is solved using the concept of Dubins paths. Dubins paths are curvature constrained paths made of circular arcs of minimum turn radius and straight line segments. Existence of Dubins paths is established and it is proven that the shortest path belongs to the Dubins set. A classification for the initial geometries is analyzed for deducing the time-optimal path. Further, the concept of an equivalent virtual target is introduced to solve the problem of impact at a general angle. The developed method is capable of obtaining the minimum-time interception point from the information of initial engagement geometry and target speed. The performance of the strategy is also analyzed considering practical limitations on the field-of-view angle.

A.03 Bharathi R PhD

Title: Developing Vanadium Dioxide Thin Films for Infrared Applications

Keywords/skills: Materials characterization. Thin Film Deposition

Vanadium dioxide (VO2) is a well-known, strongly correlated system that exhibits first order Semiconductor-Metal transition (SMT). During the first order SMT, there is a concomitant change in crystal structure which makes it functional for many switching applications. In the times of energy crisis, when nearly half of the total global energy is accounted for commercial and modern buildings, this phase change material VO2 can play a crucial role in “smart window” and many other sensing applications. Different studies have also shown that SMT characteristics like transition temperature can be manipulated by tweaking the defect concentration.

A.04 Bharathkumar Hegde PhD

Title: Ferrofluid pump using switched DC magnetic field

Keywords/skills: Mechatronics; Electronic System Design; Instrumentation; Control Systems; Medical Electronics; Circuit Design; Ferrofluid; Sensors and Actuators

The thesis presents a novel mechanism to pump ferrofluid based on the principle of variable reluctance, in an external magnetic field. The static and dynamic pressure behavior of ferrofluid in a switched DC magnetic field gives an insight into the variable reluctance behavior of ferrofluid. A ferrofluid pump based on the principle of variable reluctance of ferrofluid subjected to an external magnetic field, is developed and hence the pump is named as Variable Reluctance Ferrofluid Pump (VRFP). Three configurations of VRFP are developed: 1) Single stage one-phase VRFP 2) Single stage two phase VRFP 3) Multi-stage VRFP.

A one-phase VRFP consisting of a check valve along with an electromagnet is designed. The valve is modeled and its transfer function is estimated using System Identification method. This model is then used in the simulation model of the pump. The pump is modeled based on the hydraulic-electric analogies.

A two phase VRFP is implemented with two electromagnets on either side of the valve around the tube. Two types of magnetic actuation methods are introduced based on the switching sequences of the two electromagnets, namely Full Step Sequencing and Half Step Sequencing. Simulations and experiments were conducted for different pumping conditions. The one phase and two phase VRFPs are single stage structures.

A multi-stage VRFP concept, in which the ferrofluid flow channel (tube) is looped through the electromagnets multiple times, is introduced. For the implementation purpose, a two-stage VRFP is discussed in this thesis. Simulations and experiments resulted in significant improvement in case of two-stage VRFP in the pump performance compared to that of single-stage VRFPs. The work presents a simple and novel design of a ferrofluid pump, which is capable of higher flow rates and pumping against higher back pressure compared to the ferrofluid pumps reported in literature.

A.05 Dhairyashil Ghatage PhD

Title: Soft-Spring Wall model as non-periodic boundary condition and corner flow study using molecular dynamics simulations

Keywords/skills: CFD; CAE; fluid mechanics; thermal engineering>

We present Spring Wall (SW) model as a novel non-periodic boundary condition for molecular dynamics (MD) simulations. Finite atomistic domains have been in extensive use for variety of MD simulations over the time, recently in multiscale atomistic-continuum simulations. The use of only specular surfaces to contain the fluid results in undesirable density fluctuations. Available methods addressing this issue have sophisticated algorithms containing feedback mechanism. With the new Spring Wall model we bring average density fluctuations near the boundary within 1 percent of the mean fluid density. Three layers of boundary atoms attached to a simple cubic lattice with soft springs account for the absent atomistic region. The effectiveness of the model as a thermostat for the simulation domain is shown with shear flow test case. The simulations for hybrid atomistic-continuum approach and spherical geometry with present Spring Wall model demonstrate its versatile utility for wide range of MD simulations. Further, the corner flow is studied with MD simulations. The continuum analysis with no-slip boundary condition for a sliding plate over a stationary wall shows up unbounded stresses. The fluid slip is observed in near corner region on both moving and stationary walls with MD simulations. A comparative study is done between MD results and continuum analysis with slip velocity from MD.

A.06 Earu Banoth PhD

Title: Absorption Flow-Cytometry for Point-of-Care Diagnostics

Keywords/skills: Developing hand held diagnostic tool for Bio-medical Application like malaria diagnosis. Microfluidics, Microscopy, Microfabrication, Quantitative diagnosis on single cell basis, Digital Holography (DHI and DHM) and Non destructive testings etc.

Fast and automated diagnostic devices are bound to play a significant role in the on-going efforts toward diseases eradication. In this article, we present the realization of a portable device for quantitative malaria diagnostic testing at the point-of-care. The device measures optical absorbance (at λ = 405 nm) of single cells flowing through a custom-designed microfluidic channel. The device incorporates the required functionality to align the microfluidic channel with the optical interrogation region. Variation in optical absorbance is used to differentiate red blood cells (both healthy and infected) from other cellular components of whole blood. Using the instrument, we have measured single-cell optical absorbance levels of different types of cells present in blood.

High-throughput single-cell-level measurements facilitated by the device enable detection of malaria, even from a few microliters of blood. Further, we demonstrate the detection of malaria from a suspension containing all cellular components of whole blood, which validates its usability in real-world diagnostic scenarios.

A.07 Keshava Kumar S PhD

Title: Structural Health Monitoring of Composite Structures

Keywords/skills: Structural Mechanics, Structural Dynamics, Finite Element Methods, Composite Structures, Fractals, FORTRAN, C, MATLAB, COMSOL

Generalized fractal dimension is used to detect the presence of partial delamination in a composite laminated beam. The effect of boundary conditions and location of delamination on the fractal dimension curve is studied. Appropriability of higher mode shape data for detection of delamination in the beam is evaluated. It is shown that fractal dimension measure can be used to detect the presence of partial delamination in composite beams. It is found that the torsional mode shape is well suited for delamination detection in beams. First natural frequency of delaminated beam is found to be higher than the healthy beam for certain small and partial width delaminations and some boundary conditions. An explanation towards this counter intuitive phenomenon is provided.

A.08 P Shivashankar PhD

Title: Analytical Modeling and Non-linear characterization of piezoelectric materials for vibration control of beams

Keywords/skills: Mathematical Modeling, Modal analysis, Vibration Testing, Optimization and Signal Processing

The use of Piezoelectric materials to actuate or control beam vibrations is the subject of study in my study. Piezoelectric materials, bonded to a vibrating structure, convert mechanical energy to electrical energy. The converted electrical energy can be dissipated by a resistor to achieve additional damping. The amount of additional damping (or the attenuation in vibration) achieved depend on the following three parameters (1) the dimensions of the piezoelectric, (2) its location on the host structure, and (3) the value of the shunted resistance. The values of these parameters are selected with an intent to maximize the added damping. Hence, to find the optimal parameters and to understand the dynamics of the piezoelectric beam, an analytical mode was derived. The model presented in this thesis is apt in describing the structure compared to the other available models. The optimal resistance is derived from the base-damping included analytical model. Also, the nature of the fixed-point was explored, and the criteria for the existence of a fixed-point in dynamical systems was established. The piezoelectric patches are widely believed to behave in a linear manner at moderate strains and for weak electric field excitations. However, recent studies have found non-linear behavior at weak electric field excitations. Different non-linear terms are used to represent the piezoelectric behavior in different articles, and higher modes were not studied (in the experiments) in the literature. To identify the types of material and electromechanical non-linearity in the piezoelectric actuator, a two-step experimentation was conducted on the first, second and third modes of a piezoelectric-beam. A family of displacement curves were obtained for base-excitation and voltage excitation, and the backbone curves of the displacement curves were used to identify the type of non-linearities. The non-linear governing differential equation was solved using the harmonic-balance method.

A.09 Prashanth R PhD

Title: Silicon photonic microring refractive index sensor

Keywords/skills: Optics; Photonics; Semiconductor devices; Matlab; COMSOL; Electromagnetics

Silicon photonics based sensors offer high performance refractive index sensing capability for potential applications in healthcare, defence, chemical analysis and other fields. My PhD thesis research involves design, fabrication and experimental characterization of silicon photonic micro-ring resonator based sensors. Specifically, I have devised methods to enhance the precision of refractive index measurements while reducing the cost of sensor operation. During my PhD, I have acquired experience in integrated photonic device design, fabrication, characterization and analysis. This includes over four years of handling various equipment such as Lithography (Electron beam and UV based), Dry and Wet etching, Film deposition and SEM etc.

A.10 R B Ashith Shyam PhD

Title: Design & Development of a 3-DOF parallel manipulator for tracking Sun in Concentrated Solar Power Towers

Keywords/skills: Robotics, Dynamics, Vibrations, Algorithm development

A three degree-of-freedom parallel manipulators, the 3-RPS, has been proposed to track the sun in central receiver systems. The algorithm for sun tracking is developed, extensive simulation study with respect to actuation required, variation of joint angles, spillage loss and leg intersection has been carried out. Using FEA, it is shown that for same sized mirror, wind loading of 22 m/s and maximum deflection requirement (2 mrad), the weight of the support structure is between 15-60% less with the parallel manipulators when compared to Az-El or T-A configurations. A comprehensive study on stroke minimization of prismatic joints is carried out. It is found that a stroke of 700 mm is required for a 2 m x 2 m heliostat at Bangalore when the farthest heliostat is at a distance of 300 m from the tower. Although, there is an extra motor required to track the sun, the 3-RPS manipulator is better than the conventional methods if the mirror area per actuator criteria is taken into consideration.

A prototype of the Az-El and 3-RPS heliostats are made having a mirror size of 1 m x 1 m. A PID controller implemented using MATLAB-Simulink and a low cost, custom made motor driver circuit is used to control the motion of the 3-RPS heliostat. The algorithm developed is tested on the prototype by tracking a point marked on the wall of the lab space and is found to have a maximum tracking error of 7.1 mrad. Finally, the actual sun tracking is carried out on the roof of a building reflecting the sun-light to a wall situated 6.4 m above. The images are captured at various instances of time from 11:30 a.m. to 3:30 p.m. on October 15th and November 10th, 2016, tracking errors are quantified and it is demonstrated that the proposed 3-RPS parallel manipulator can be used as a heliostat in central receiver solar thermal plants

A.11 Raviteja Chanumolu PhD

Title: A Novel Hybrid Vehicle Architecture: Modeling, Simulation and Experiments

Keywords/skills: Mechanical Design, modelling, control, robotics

"Electric and hybrid vehicles are particularly suited for use in urban areas since city transportation is mainly characterized by relatively short driving distances, low continuous power requirements, long idling times and high availability of regenerative braking energy. These characteristics, when carefully incorporated into the design process, create valuable opportunities for developing clean, efficient and cost effective urban vehicle propulsion systems. In the first part of the thesis, we present data collected in the city of Bangalore

One of the main objective of this work is to study and compare the performance of the above novel speed-addition and compare with the typical torque-addition configuration. A MATLAB/Simulink model for both the configurations, with DC hub motor and a small IC engine, has been created and the fuel consumption has been calculated. It is shown that the proposed speed-addition concept gives better fuel efficiency for the standard modified Indian Driving Cycle. The models have also been compared for actual driving data and an optimal control strategy has been developed using dynamic programming. It is again shown that the proposed speed-addition concept results in better fuel economy.

In the last part of the thesis, a low cost experimental test-bed consisting of an auto-rickshaw IC engine, a CVT and a 2 kW DC hub motor has been developed to validate the speed-addition concept and compare with the torque-addition configuration. The torque-speed curves of the IC engine, the DC motor and both of them together, in the speed and torque-addition configuration, have been obtained. It is shown that the speed-addition concept does indeed work and the obtained results are significantly different from the torque-addition configuration.

A.12 sanjay kumar shukla PhD

Title: Flow Induced Vibration- A Study of Fluids Structures Interaction

Keywords/skills: Fluid Mechanics

Fluctuating forces in wake of a circular cylinder are controlled by means of flexible splitter plate/flap have been presented. In this work, two cases of flaps length to cylinder diameter ratio, L/D namely long flaps, L/D =5.0, & short flaps, L/D = 2.0, have thoroughly been investigated. In particular, the main parameters involved are flexural-rigidity, EI, flap length to cylinder diameter ratio, L / D and the Reynolds number, Re = UD/v. By using these parameters a non-dimensional bending stiffness, K* = EI/0.5ρ U2L3 of the cylinder-flap system has been defined, which is found to be a response parameter similar to the reduced velocity (U/fn D) used in VIV problem.

Measurements have demonstrated that the response of the both long and short flaps exhibit a different regime of the flapping Modes used to classified the flow regimes in term of the response parameter K* of the cylinder-flap system. Experiments show two periodic regimes of travelling wave motion of long flaps referred to modes I \& II. The periodic mode I, occurs at sufficiently large values of K*, K* = 1.45 x 10-03, exhibits a peak in the amplitude response. In contrast, the periodic mode II, occurs for very low regime of the K*, K* ≤ 3.0 x 10 -05, demonstrate a saturated state of the response wherein response of the flaps are no longer affected by K*. Similar to response of the long flaps, short flaps show a symmetric flapping Mode A, which exhibits a periodic oscillation of travelling wave motion of the flap for K* < 5.78 x 10-04. This symmetric configuration of the flapping Mode A and periodic mode II of the short and long flaps are followed by asymmetric regime of flapping Modes B, C \& D wherein the flap motions are passing through several changes in the modes of flapping with K* is defined as regime of mode competency or mode transition found for 5.78 x 10-04 < K* < 2.1 x 10-01.

A.13 Sri Ram Shankar R. PhD

Title: Development of advanced probing system for dynamic mode atomic force microscopy

Keywords/skills: Instrumentation>,<Nanotechnology>,<Scanning Probe Microscopy>,<Micro-systems>,<MEMS>,<Optics>,<Structural Dynamics>,<LabVIEW>,<LabVIEW FPGA>,<Simulations>,<MATLAB>,<Simulink

The dynamic mode atomic force microscope (AFM) is a versatile tool that uses a resonantly excited micro-cantilever probe to obtain a sample's topography and to characterize its material properties. To improve the speed of imaging and to enhance its sensitivity to material properties, new designs have been investigated for the probes and a novel probing system has been developed.

To perform high speed imaging, an integrated high-bandwidth magnetic actuation system is designed and developed. Special designs are proposed for the probe and the actuator to achieve adequate range, high eigen-frequencies and low ohmic heating. To achieve enhanced sensitivity to material properties, a systematic approach is proposed

to design flexural and torsional harmonic probes that were further developed and evaluated.

To effectively exploit the high speed and sensitivity of the developed probes, a custom AFM system is designed and developed. This includes a novel high bandwidth Z-magnetic actuation system and an XY nano-positioning system both suitable for video-rate imaging. A novel optical measurement system is proposed to measure the XY-motion of the positioner. High speed control hardware based on FPGA has been used for data acquisition and real-time control, with update rates exceeding 4 MHz. All the subsystems are experimentally calibrated for their high bandwidths, and the overall developed system was evaluated to be more than 100 times faster than conventional AFM systems.

A.14 Albin Varghese MSc(Engg.)
Title: Computational and Experimental Studies on ESTS lobed nozzles

Keywords/skills: Fluid Mechanics, CFD, Experimentation

In order to enhance the spreading and mixing of mixing layers from supersonic nozzles various active and passive methods have been deviced. To achieve enhanced mixing an innovative nozzle named as the Elliptic Sharp Tipped Shallow (ESTS) lobed nozzle has been developed in L.H.S.R., I.I.Sc., India Rao & Jagadeesh (2014). Visualisation, velocimetry, acoustic and density measurement using background oriented schlieren technique were conducted. Simulations using FLUENT and CFX5 softwares were performed. The nozzle with best spreading characteristics was found to be 4 lobed. This nozzle also showed reduction in sound pressure levels and screech tone elimination.

A.15 Varun Seshadrinathan MSc(Engg.)
Title: Simulations of a jet in supersonic flow on adaptively redistributed grids

Keywords/skills: fluid mechanics; C. F. D.; simulations; mathematical methods; c language

Jet injected in a supersonic flow finds applications in scramjet engines where a fuel is injected into an incoming supersonic stream of air. The challenge in simulating these flows is to capture shocks while maintaining high resolution in regions with finer flow details. The work done in this thesis employs a moving mesh partial differential equation (MMPDE) technique where the grid is redistributed such that a higher resolution is maintained in regions where it is required (like in regions of shocks), while maintaining a coarse grid everywhere else. This is done by solving the governing (Euler's) equations on a transformed fixed computational domain. The transformation is done using an MMPDE that relates the physical and computational domains, which is responsible for the mesh redistribution. The numerical technique used in the transformed computational domain is a finite volume method that involves a shock capturing high order WENO (Weighted Essentially Non-Oscillatory) reconstruction and a rotated HLLC Riemann solver to compute the fluxes at the interface. The problem is simulated in 2-D and the mixing of the jet and the cross-flow is measured for different injection angles.

A.16 K.SRIDHAR ME/MTech.
Title: DYNAMIC BEHAVIOUR OF AIRCRAFT UNDERGOING OSCILLATIONS

Keywords/skills: flight mechanics; computation of viscous flows; fluid mechanics; gas dynamics; space flight dynamics

Stability of the aircraft is the key essential of the flight. A fighter aircraft must be stable and controllable in all regimes of maneuvering. A sinusoidal signal is given to aircraft model to simulate oscillations in subsonic wind tunnel. Experimental data of forces and moments are collected. Depending on motion (pitch,roll,yaw) particular equation of motion (mathematical model) are derived. Using mathematical aids dynamic derivative in equation are estimated from data. The estimated dynamic derivatives are substituted into mathematical model. Check for how well results of mathematical model is agreeing with experimental results. The estimated dynamic derivatives gives information about aircraft dynamic behavior.

A.17 Nithin Raj ME/MTech.
Title: Applications of multivariate statistical methods in structural dynamics

Keywords/skills: Civil Engineering; Structural Engineering

Use of a blind source separation technique called Independent Component Analysis (ICA) for modal parameter estimation which has great significance in the fields of Structural Health Monitoring and damage detection.

A.18 Rohin Moses ME/MTech.
Title: Estimation of Aerodynamic Damping of Aerospace Vechiles using Forced Oscillation Technique

Keywords/skills: structural dynamics

While designing an aircraft it is essential to have the ability to determine the aerodynamic derivatives and parameters through wind tunnel testing. These studies are intended to provide better knowledge of aircraft handling and recovery procedures required during rough air flight. The main objectives in this study includes understanding the importance of aerodynamic damping for aerospace vehicles. A glance through of how the vehicle design parameter as well as different environmental parameters affects the aerodynamic damping of different aerospace vehicles.

The model of the aerospace vehicle used for wind tunnel test was made to pitch up and down about its center of gravity. We are incorporating aerodynamic damping in the dynamics of a single DOF for a bluff body. The tests are intended to provide a consistent set of experimentally determined aerodynamic parameters in subsonic region. Tests were carried out under oscillatory amplitudes by using forced oscillation technique. The model was tested for two conditions: wind-off and wind-on condition. The wind off condition was done to find out the weight distribution as well as stiffness and damping generated by the model. The wind-on testing was done to estimate the effect of aerodynamic damping on the model

A.19 SASIDHARAN SANDEEP ME/MTech.

Title: Fracture model for multifunctional and multilayered composite structures for energy storage

Keywords/skills: fracture mechanics, finite element analysis(FEA), solid mechanics, thermal analysis, composites

"The fiber of the multi-functional composite is multilayered with energy carrying materials and load carrying core metal. Due to the diffusion process, stresses are induced and this acts as fatigue load due to charging and discharging on the fiber. This may lead to fracture in the fiber. The work is about developing a fracture model for multi-functional composites that can store energy and can carry loads. This is done using Finite element analysis(FEA) starting by finding the Diffusion induced(DI) stresses which is analogous to Thermal stresses. The DI stresses and mechanical stresses are then coupled. Then the fracture model is developed using cohesive modeling.

A.20 Vinay Pandu M.Des.

Title: Ventilated Socket for Prosthesis

Keywords/skills: Product Design; Mechanical Engineering; Bio-Medical Devices; Ergonomics; Anthropometry

It is estimated that current world has a 6.7 billion people with amputees. Lower limb amputation cases are way above the upper extremity cases and below amputations are grater in number. The current market has variety of prosthesis and are with better comfort and better grip.

A study has revealed that 53% of amputee experience heat, perspiration and a state of uncomfortable inside their prosthesis. Skin has to breath constantly, but when closed with prosthesis over the stump, it affects its function and results in increase of temperature, which leads to tissue stress & friction blisters. Moisture builds up and is not let out, this leads to unpleasant odour, discomfort and may lead to fungus growth infection and further skin related issues.

An amputee finds too difficult to perform his day to day activities without his missing led. He finds it even more difficult if the prosthesis being in use is of no aid rather it provides more discomfort. The price range of an artificial limb also vary largely starting with Jaipur foot. But these still address the discomfort are of issues. Ventilation being our prime importance and to reduce the pressure points, we are developing this socket.

Rural part of India is taken into account for the measuring affordability criteria. The socket we have developed in CPDM, IISc is frugal, simple in design and still addressing the ventilation & pressure issues. The objective of this application for ethical approval is to do user testing on the transtibial amputee and get feedback on the developed socket.

A.21 vivek kumar gupta ME/MTech.

Title: Rheological model for fracture process zone formed in concrete during its fracture.

Keywords/skills: Fracture mechanics ; Finite element analysis; Optimization methods

During fracture of concrete a softening behavior is observed which is attributed to the formation of fracture process zone(FPZ) which behaves inelastically and hinders the application of the concepts of Linear Elastic Fracture Mechanics (LEFM) to Concrete. There is no proper work done to find the behavior and size of FPZ. This work gives a model through we can capture softening and FPZ behavior and hence we predict the behavior of concrete of different grades under different conditions of loading.

The approach is to use a rheological model and to find out stress intensity factor (SIF) and energy dissipated and hence to plot load vs crack mouth opening displacement

(CMOD) curve and hence to verify this curve through experiments done on three point bend beam of different dimensions.

Till date the load vs CMOD curve is obtained through model and its experimental verification is to be done. For construction industries this work can be quite useful as we can know the amount of deflection which the concrete structure can undergo for a given load during its fracture. Not only this but also we can play with the concrete ingredients in order to improve its behavior during its fracture based on the modifications in the simple rheological model.

Cluster B: CS Theory & Algorithms/ Information Technology/ Data Science/ Machine Learning / Analytics/ Communication Systems/ Telecom/ Networks

B.01 Anjani Priyadarsini PhD
Title: Efficient Quantum Algorithms for Linear Algebra Problems

Keywords/skills: Quantum Algorithms

We show how computation of matrix inverse based on the Newton-Raphson method; Hamiltonian evolution based on Grover's algorithm; Estimation of Expectation value by using Pauli measurements; can be efficiently implemented on a quantum computer. And how these Quantum algorithms are exponentially superior to the existing classical algorithms.

B.02 BHAWANI SHANKAR LEELAR PhD
Title: Big data integration and normalization using symbol algebra to provide common platform for system or big data applications.

Keywords/skills: Machine Learning; Big Data; Data Science

Today large amounts of valuable data and sensor information remain unused or are limited to specific application domains due to the large number of specific technologies and formats. The data needs to be processed, aggregated and higher-level abstractions need to be created from the data to make it suitable for the event processing, knowledge extractions and event processing applications that enable intelligent applications and services for smart city platforms. Data needs to be integrated from various domains and the resulting knowledge exposed to various domains in a federated fashion. It is necessary to normalize the output range and make them unit independent when processing the output data with multiple sensors. It gives the system a common platform to interact with sensors and having a unified access allows modelling the resources in a manner to access these resources systematically in interoperable way. Using symbolic descriptions for sensor data enables representation, formalization and enhanced interoperability of sensor data. The symbols for the output range of each sensor need to be defined within the environment. We assume the sensor data is noisy and used Bayesian Machine Learning approach to predict the status of the air quality with a large dataset. With our proposed framework, we skip the necessity of domain knowledge once the data is symbolized. We have shown the improvement in the prediction efficiency while using the symbols over the integer dataset. The processing complexity is reduced if the data is from different types of sensors and have different range and units.

B.03 Madhusudanan N PhD
Title: Knowledge Acquisition From Text Documents To Diagnose Issues in the Domain of Aircraft Assembly

Keywords/skills: Knowledge Based Engineering; Smart Manufacturing; Natural Language Processing and Understanding

The role of expert knowledge in the lifecycle of a product is well acknowledged. It is possible to reuse domain knowledge in Computer Aided Design and Planning Systems, as well as in PLM tools. However the acquisition of such knowledge is still manual, and time consuming, but important for domains like aircraft assembly.

It is intended to acquire diagnostic knowledge in an automated manner from text containing such knowledge. Methods from Natural Language Understanding are used. Some examples of such methods and tools are Semantic Analysis, Sentiment Analysis, and Anaphora Resolution. A pipeline of such tools is used, so that the required knowledge can be acquired.

So far, we have targeted the acquisition of knowledge about problems in manufacturing and assembly. Hence, domain specific resources and tools have been developed, with aircraft assembly as the application domain. Initial results show increasing accuracies in segregation of relevant text and identification of problems.

A varied set of Natural Language Understanding and Processing tools have been employed to acquire knowledge from manufacturing-related documents, and application of such tools has yielded results in acquiring problem-related knowledge till now.

B.04 shruti kulkarni PhD
Title: Incorporating institutional pressures and Corporate sustainability: Exploring the responsiveness to climate change regulatory risks and opportunities

Keywords/skills: Applied statistics; Operations Research; R ; Matlab; C; quantitative analysis; Qualtitative research

Climate Change is undoubtedly the major environmental and social challenge of this century. Until now, global deliberation efforts have failed to change humanity's direction and reduce GHG emissions. In an attempt to explore whether regulatory intervention and anticipation of climate change risks and opportunities are related to corporate sustainability reputation, this study adapted the institutional governance framework to gain insights from the predictions emanating from both the political economy and strategic management perspectives. This study focused on the largest 500 corporations in India because of their wide visibility and economic impact to capture corporate response on climate change during the period of 2011 to 2016. The hypotheses were introduced to characterize patterns of corporate climate change activities with respect to four quadrants of institutional governance systems which are used by Griffiths et al (2007) viz., State governance, joint governance, market governance and corporate governance. The result suggests that higher state involvement through regulatory legislations could induce deter corporate climate change response. Since too much intervention make anticipation of climate change risks as a threat to superior performance. The study concludes that the optimum governance system would be one of joint governance where the government, through regulatory intervention, and proactive firms (i.e. those who are anticipating climate change opportunities) work together to improve overall performance and progressively achieve 'sustainable development'. [1. Griffiths, A. Haigh, N. & Rassias, J. (2007). 'A framework for understanding institutional governance systems and climate change: The case of Australia', European Management Journal, 25:6, 415-427.]

B.05 Anusha Posinasetty MSc(Engg.)
Title: Multi-label classification with multiple label correlation orders and structures

Keywords/skills: C; C++(MPI); Java; ASP.NET; Machine learning: LIBSVM, MULAN

Multilabel classification has attracted much interest in recent times due to the wide applicability of the problem and the challenges involved in learning a classifier for multilabeled data. A crucial aspect of multilabel classification is to discover the structure and order of correlations among labels and their effect on the quality of the classifier. In this work, we propose a structural Support Vector Machine (structural SVM) based framework which enables us to systematically investigate the importance of label correlations in multi-label classification. The proposed framework is very flexible and provides a unified approach to handle multiple correlation orders and structures in an adaptive manner and helps to effectively assess the importance of label correlations in improving the generalization performance. We perform extensive empirical evaluation on several datasets from different domains and present results on various performance metrics. Our experiments provide for the first time, interesting insights into the following questions: a) Are label correlations always beneficial in multilabel classification? b) What effect do label correlations have on multiple performance metrics typically used in multilabel classification? c) Is label correlation order significant and if so, what would be the favorable correlation order for a given dataset and a given performance metric? and d) Can we make useful suggestions on the label correlation structure?

B.06 Ajay Keerthi M.Mgmt.
Title: Technology forecasting amd mapping for strategic decisions and management

Keywords/skills: general management; marketing; analytics; strategy; technology magament; brand management; business development

Exploring new trends in technology forecasting methods. Evaluating and comparing them. See the applicability of the particular methods in various areas of the technology and the method of applying it.

B.07 D Prakash ME/MTech.
Title: Effect of Standard Penetration Test Hammer Energy Measurement on Liquefaction

Keywords/skills: Project involves sound knowledge of geotechical engineering, wave propagation, two sensors, handling huge data sample through excel and MATLAB. Apart from that I have good communication skill with great aptitude to work in team.

Standard Penetration Test Energy Measurement is very crucial for Geophysical studies. Hence two instrumented rods have been used to get force and acceleration plot wrt time and numerically integrated to get actual energy. This energy is used for estimation of of Liquefaction Potential Uncertainty.

B.08 Ranjesh Sisodiya ME/MTech.
Title: Geometric hitting set via local search

Keywords/skills: java; Python; Sql; Html; latex; mysql; Shell Scripting; Jupiter noteboo

In computational geometry one of the popular problem is to compute minimum geometric hitting set. Given a set of points and a set of geometric objects task is to compute smallest subset of points that hit all the geometric objects.The problem belong to NP-hard class and various efforts have been made to find approximation algorithm that compute minimum hitting set in polynomial time.

Two approaches became popular to approximate hitting set one rounds via (net) given by Bronnimann and Goodrich[1] and other is using local search given by Mustafa and Ray[2]. Local search is consider as good approximation approach to achieve better approximation for various geometric problems including hitting set. The goal of this project is to apply local search to hitting set problem for different geometric objects like squares, rectangle, disks etc., and empirically examine the approximation ratio with respect to optimal hitting set.

B.09 SASIDHARAN SANDEEP ME/MTech.

Title: Fracture model for multifunctional and multilayered composite structures for energy storage

Keywords/skills: fracture mechanics, finite element analysis(FEA), solid mechanics, thermal analysis, composites

The fiber of the multi-functional composite is multilayered with energy carrying materials and load carrying core metal. Due to the diffusion process, stresses are induced and this acts as fatigue load due to charging and discharging on the fiber. This may lead to fracture in the fiber.

The work is about developing a fracture model for multi-functional composites that can store energy and can carry loads. This is done using Finite element analysis(FEA) starting by finding the Diffusion induced(DI) stresses which is analogous to Thermal stresses. The DI stresses and mechanical stresses are then coupled. Then the fracture model is developed using cohesive modeling.

B.10 Vaisakh Pradeep M.Des.

Title: UI/UX to design to facilitate placement coordination in the campus

Keywords/skills: UI/UX design; User interface; User Experience; Digital product design; Visual design; Design thinking

The project evolved from identifying the problems faced by the students and the placement coordinators during the placement season. A solid design process assisted by design thinking was followed to thoroughly identify the problem, draw insights from it, identify the pain-points and the final solution is the outcome of multiple iterations with users being involved at each point of the process to bridge the gap between the user and the product. The final product is a mobile application which would potentially solve the problems identified.

Cluster C: Computer Systems & Software/Embedded Systems/ Power Electronics & Systems/ Semiconductor Processing

C.01 Anjani Priyadarsini PhD
Title: Efficient Quantum Algorithms for Linear Algebra Problems

Keywords/skills: Quantum Algorithms

We show how computation of matrix inverse based on the Newton-Raphson method; Hamiltonian evolution based on Grover's algorithm; Estimation of Expectation value by using Pauli measurements; can be efficiently implemented on a quantum computer. And how these Quantum algorithms are exponentially superior to the existing classical algorithms.

C.02 BHAWANI SHANKAR LEELAR PhD
Title: Big data integration and normalization using symbol algebra to provide common platform for system or big data applications.

Keywords/skills: Machine Learning, Big Data, Data Science

Today large amounts of valuable data and sensor information remain unused or are limited to specific application domains due to the large number of specific technologies and formats. The data needs to be processed, aggregated and higher-level abstractions need to be created from the data to make it suitable for the event processing, knowledge extractions and event processing applications that enable intelligent applications and services for smart city platforms. Data needs to be integrated from various domains and the resulting knowledge exposed to various domains in a federated fashion. It is necessary to normalize the output range and make them unit independent when processing the output data with multiple sensors. It gives the system a common platform to interact with sensors and having a unified access allows modelling the resources in a manner to access these resources systematically in interoperable way. Using symbolic descriptions for sensor data enables representation, formalization and enhanced interoperability of sensor data. The symbols for the output range of each sensor need to be defined within the environment. We assume the sensor data is noisy and used Bayesian Machine Learning approach to predict the status of the air quality with a large dataset. With our proposed framework, we skip the necessity of domain knowledge once the data is symbolized. We have shown the improvement in the prediction efficiency while using the symbols over the integer dataset. The processing complexity is reduced if the data is from different types of sensors and have different range and units.

C.03 Dhairyashil Ghatage PhD
Title: Soft-Spring Wall model as non-periodic boundary condition and corner flow study using molecular dynamics simulations

Keywords/skills: CFD; CAE; fluid mechanics; thermal engineering>

We present Spring Wall (SW) model as a novel non-periodic boundary condition for molecular dynamics (MD) simulations. Finite atomistic domains have been in extensive use for variety of MD simulations over the time, recently in multiscale atomistic-continuum simulations. The use of only specular surfaces to contain the fluid results in undesirable density fluctuations. Available methods addressing this issue have sophisticated algorithms containing feedback mechanism. With the new Spring Wall model we bring average density fluctuations near the boundary within 1 percent of the mean fluid density. Three layers of boundary atoms attached to a simple cubic lattice with soft springs account for the absent atomistic region. The effectiveness of the model as a thermostat for the simulation domain is shown with shear flow test case. The simulations for hybrid atomistic-continuum approach and spherical geometry with present Spring Wall model demonstrate its versatile utility for wide range of MD simulations. Further, the corner flow is studied with MD simulations. The continuum analysis with no-slip boundary condition for a sliding plate over a stationary wall shows up unbounded stresses. The fluid slip is observed in near corner region on both moving and stationary walls with MD simulations. A comparative study is done between MD results and continuum analysis with slip velocity from MD.

C.04 Jayanarayan T Tudu PhD
Title: Joint-scan DFT Architecture for SoC

Keywords/skills: Digital VLSI Design and Test; Low Power Design; Computer Architecture; Processor Design

Testing of a large SoC design is now a mandatory task as the transistor size goes down to nano meter scale. The traditional serial scan based architectures has confronted with several issues like test power, time, and test data volume. We have developed a new scan architecture which promise to overcome the limitation of serial scan design.

C.05 Keshava Kumar S PhD
Title: Structural Health Monitoring of Composite Structures

Keywords/skills: Structural Mechanics, Structural Dynamics, Finite Element Methods, Composite Structures, Fractals, FORTRAN, C, MATLAB, COMSOL

Generalized fractal dimension is used to detect the presence of partial delamination in a composite laminated beam. The effect of boundary conditions and location of delamination on the fractal dimension curve is studied. Appropriability of higher mode shape data for detection of delamination in the beam is evaluated. It is shown that fractal dimension measure can be used to detect the presence of partial delamination in composite beams. It is found that the torsional mode shape is well suited for delamination detection in beams. First natural frequency of delaminated beam is found to be higher than the healthy beam for certain small and partial width delaminations and some boundary conditions. An explanation towards this counter intuitive phenomenon is provided.

C.06 Nimesh V PhD
Title: Dual Comparison One Cycle Conrol for Grid Connected Converters

Keywords/skills: Power Electronics, Hardware skills, troubleshotting skills

Conventional one cycle control suffers from light load instability, steady state dc offset in current drawn and non-zero displacement angle. In literature, the issues of light load instability and steady state dc offset in current is treated as separate issue and solution to each of these presented separately. We proposed a new control strategy which addresses these issues and provides a single solution for both these issues. A novel method to compensate for non-zero displacement angle is proposed. Minor modifications to controller structure enables bi-directional power flow, variable power factor and statcom operation as well.

C.07 Prashanth R PhD
Title: Silicon photonic microring refractive index sensor

Keywords/skills: Optics; Photonics; Semiconductor devices; Matlab; COMSOL; Electromagnetics

Silicon photonics based sensors offer high performance refractive index sensing capability for potential applications in healthcare, defence, chemical analysis and other fields. My PhD thesis research involves design, fabrication and experimental characterization of silicon photonic micro-ring resonator based sensors. Specifically, I have devised methods to enhance the precision of refractive index measurements while reducing the cost of sensor operation. During my PhD, I have acquired experience in integrated photonic device design, fabrication, characterization and analysis. This includes over four years of handling various equipment such as Lithography (Electron beam and UV based), Dry and Wet etching, Film deposition and SEM etc.

C.08 Shwetha G. Bhat PhD
Title: Fabrication of magnetic thin films and devices for sensors & storage applications

Keywords/skills: Thin film fabrications; physical vapor depositions; ultra-high vacuum handling; multi-layer thin films; storage and sensor device testing; lithography; dry-etching; I-V characterization; electrical transport; XRD; SEM; AFM; SQUID-VSM; XPS

Spintronics based GMR magnetic devices have turned the investigation on magnetic thin films & their hetero-structures to be popular among the R&D community for sensors and storage applications. In this regard, I have worked on material device fabrication addressing specific issues of injecting carriers from oxide magnetic materials to semiconductors with higher efficiency when compared with metallic magnetic materials of lower efficiency. During my Ph.D, I had the opportunity to get hands-on-experience on developing a very good quality of Fe3O4(30nm)/MgO(2nm)/GaAs stack optimized using PVD technique. Substantial structural and magnetic analysis of thin films were carried out using X-ray diffraction(XRD), Atomic Force Microscopy(AFM), Scanning Electron Microscopy(SEM) and SQUID-VSM(2K-300K) techniques helped me to understand the material growth. Design of device demands the sizes to be at-least microscopic. Hence I extensive optimized the optical lithography in clean-room conditions. Multiple devices were successfully tested at lower and room temperature, resulting in international peer-reviewed publications. I also have an extensive 3 years of experience in developing, fabricating and testing of TMR devices. Sputter deposited Au/Co/Al2O3/NiFe/Au films were lithographically tailored to obtain microscopic hetero-structure devices. With all experience & expertise, I am confident in tackling growth & device fabrication issues with different perspectives and approaches.

C.09 Sri Ram Shankar R. PhD
Title: Development of advanced probing system for dynamic mode atomic force microscopy

Keywords/skills: Instrumentation; Nanotechnology; Scanning Probe Microscopy; Micro-systems; MEMS; Optics; Structural Dynamics; LabVIEW; LabVIEW FPGA; Simulations; MATLAB; Simulink

The dynamic mode atomic force microscope (AFM) is a versatile tool that uses a resonantly excited micro-cantilever probe to obtain a sample's topography and to characterize its material properties. To improve the speed of imaging and to enhance its sensitivity to material properties, new designs have been investigated for the probes and a novel probing system has been developed.

To perform high speed imaging, an integrated high-bandwidth magnetic actuation system is designed and developed. Special designs are proposed for the probe and the actuator to achieve adequate range, high eigen-frequencies and low ohmic heating. To achieve enhanced sensitivity to material properties, a systematic approach is proposed to design flexural and torsional harmonic probes that were further developed and evaluated.

To effectively exploit the high speed and sensitivity of the developed probes, a custom AFM system is designed and developed. This includes a novel high bandwidth Z-magnetic actuation system and an XY nano-positioning system both suitable for video-rate imaging. A novel optical measurement system is proposed to measure the XY-motion of the positioner. High speed control hardware based on FPGA has been used for data acquisition and real-time control, with update rates exceeding 4 MHz. All the subsystems are experimentally calibrated for their high bandwidths, and the overall developed system was evaluated to be more than 100 times faster than conventional AFM systems.

C.10 Anusha Posinasetty MSc(Engg.)

Title: Multi-label classification with multiple label correlation orders and structures

Keywords/skills: C, C++(MPI); Java; ASP.NET; Machine learning: LIBSVM, MULAN

Multilabel classification has attracted much interest in recent times due to the wide applicability of the problem and the challenges involved in learning a classifier for multilabeled data. A crucial aspect of multilabel classification is to discover the structure and order of correlations among labels and their effect on the quality of the classifier. In this work, we propose a structural Support Vector Machine (structural SVM) based framework which enables us to systematically investigate the importance of label correlations in multi-label classification. The proposed framework is very flexible and provides a unified approach to handle multiple correlation orders and structures in an adaptive manner and helps to effectively assess the importance of label correlations in improving the generalization performance. We perform extensive empirical evaluation on several datasets from different domains and present results on various performance metrics. Our experiments provide for the first time, interesting insights into the following questions: a) Are label correlations always beneficial in multilabel classification? b) What effect do label correlations have on multiple performance metrics typically used in multilabel classification? c) Is label correlation order significant and if so, what would be the favorable correlation order for a given dataset and a given performance metric? and d) Can we make useful suggestions on the label correlation structure?

C.11 A T Shashidhar Reddy ME/MTech.

Title: Electrical studies of silicon surfaces electrochemically modified by using monolayers of organic molecules.

Keywords/skills: Materials Engineering; Chemical Engineering; Electrochemical Engineering; Semiconductor device physics; Efficient team player; self motivated quick learner; strong communication skills; AFM, SEM, Electrochemical station; MS office, origin

The semiconductor industry is going through an inexorable process of miniaturization of electronic devices. But this process cannot continue in perpetuity due to binding physical constraints like extreme heat losses in nanoscale devices, change in physical band structure in the nanoscale regime and unfavorable economics in the fabrication of nanoscale devices. These problems can be overcome by using the molecular electronics approach of fabricating electronic devices wherein each molecule or a group of few molecules acts as an electronic device. This approach has an inherent advantage since the molecular properties are tunable over a broad range through molecular design and synthesis. In this study, porphyrin-based molecules have been electro-grafted on silicon substrates using the cyclic voltammetry approach through an electrochemical station. The silicon substrate acts as a working electrode, and the porphyrin based molecules are dissolved in the electrolyte solution. The desired molecules form a self-assembled monolayer on the silicon substrate on the application of voltage through the cyclic voltammetry approach. Electrical studies have been carried on the fabricated device (self-assembled monolayer on a silicon substrate) by forming a metal/molecule/Si (n++) junction structure, using a potentiostat/galvanostat system. The electrical

characterization of the fabricated devices has revealed the rectification behaviour of the junction structure under study.

C.12 Ranjesh Sisodiya ME/MTech.
Title: Geometric hitting set via local search

Keywords/skills: java; Python; Sql; Html; latex; mysql; Shell Scripting; Jupiter noteboo

In computational geometry one of the popular problem is to compute minimum geometric hitting set. Given a set of points and a set of geometric objects task is to compute smallest subset of points that hit all the geometric objects. The problem belong to NP-hard class and various efforts have been made to find approximation algorithm that compute minimum hitting set in polynomial time.

Two approaches became popular to approximate hitting set one rounds via (net) given by Bronnimann and Goodrich[1] and other is using local search given by Mustafa and Ray[2]. Local search is consider as good approximation approach to achieve better approximation for various geometric problems including hitting set. The goal of this project is to apply local search to hitting set problem for different geometric objects like squares, rectangle, disks etc., and empirically examine the approximation ratio with respect to optimal hitting set.

C.13 Vaisakh Pradeep M.Des.
Title: UI/UX to design to facilitate placement coordination in the campus

Keywords/skills: UI/UX design; User interface; User Experience; Digital product design; Visual design; Design thinking

The project evolved from identifying the problems faced by the students and the placement coordinators during the placement season. A solid design process assisted by design thinking was followed to thoroughly identify the problem, draw insights from it, identify the pain-points and the final solution is the outcome of multiple iterations with users being involved at each point of the process to bridge the gap between the user and the product. The final product is a mobile application which would potentially solve the problems identified.

Cluster D: Consumer goods / Food Processing

D.01 Anup Kumar Pramanik PhD

Title: Cytotoxicity Study of Anticancer Active Complexes and Their Targeted Delivery Using Nanoparticles

Keywords/skills: organic synthesis; coordination chemistry; air and moisture sensitive reactions; nanomaterials; drug delivery; handling various analytical instruments

Cancer is a noncommunicable disease and is the 2nd largest cause of death worldwide. Among other metal complexes, a copper bis(thiosemicarbazone) (64CuATSM) complex is in clinical trials as a chemo-radio pharmaceutical for the treatment of cervical cancer.

In an attempt to improve effectiveness of the copper bis(thiosemicarbazone) drugs, a complex with a redox active cleavable disulfide linker was synthesised. The complex was linked to PEG coated gold nanoparticle for the delivery to the targeted site with biotin (vitamin) as a targeting ligand. The conjugates showed very good cytotoxicity in vitro as well as in vivo study using HeLa cell xenograft model. Four fold inhibition of tumor progression was achieved by drug conjugates compared to the control group. No significant change in mice body weight was observed. To improve the activity of copper complexes, a dual drug approach was adopted in which copper bis(thiosemicarbazone) was linked to an oxidised cisplatin with the expectation that within the cellular medium it will be reduced by intrinsic reducing agents. The dual drug showed excellent in vitro activity against HeLa cells and was found to be much better than the combination of corresponding copper complex and cisplatin. PEGylated dendrimers or gold nanoparticles conjugates of dual drugs along with biotin as targeting agent showed very good anticancer activity. Synthesised drugs were less cytotoxic to normal cells (HaCaT) than to cancer cells. The good activity and slow release profile of the complex from these conjugates will be beneficent for in vivo studies where the concentration of the drug has to be maintained within the therapeutic window of the drug.

D.02 Prasanna K PhD

Title: Isotopic homogenization and scrambling associated with oxygen isotopic exchange on hot platinum: studies on gas pairs (O2, CO2) and (CO, CO2)

Keywords/skills: Instrumental analysis, process synthesis, Environmental monitoring

The catalytic exchange between O2 and CO2 on hot platinum leads to isotope scrambling in CO2 and homogenization of the oxygen isotopes in the two phases (O2 and CO2) even though the two gases could be widely different in isotope ratios from each other (e.g., about 45 per mil in d18O) before the exchange. After the exchange, the d18O values of the gases become close to each other (within 2 per mil) depending on the time and temperature. The clumped-isotope analysis of the post-exchange CO2 samples shows that the D47 values (relative to the pre-exchange values) decrease with increase in temperature from near zero (at ~25 C) to about -0.8 0.1& (at ~700C). The low value of -0.8 per mil equals the values typically obtained for pure CO2 heated to 1000 C inside quartz tubes suggesting a scrambled state. If the catalytic exchange between CO2 and O2 is associated with isotopic scrambling (or random mixing) a microscopic mechanism of isotopic mixing can be inferred. It seems that CO2 and O2 dissociate in the adsorbed state on platinum (or quartz surfaces) and the product CO molecules and O atoms mix uniformly while doing a random walk on the hot surface and produce two reservoirs (CO and O) where the three oxygen isotopes are randomly distributed. This can produce the observed internal isotopic scrambling in CO2 when CO and O recombine to form CO2 molecules on the platinum surface and desorb. Experiments using CO–CO2 gas pairs over hot platinum also show homogenization showing exchange of CO as a molecular entity and supporting the suggested mechanism.

D.03 Ajay Keerthi M.Mgmt.

Title: Technology forecasting amd mapping for strategic decisions and management

Keywords/skills: general management; marketing; analytics; strategy; technology magament; brand management; business development

Exploring new trends in technology forecasting methods. Evaluating and comparing them. See the applicability of the particular methods in various areas of the technology and the method of applying it.

D.04 Vinay Pandu M.Des.

Title: Ventilated Socket for Prosthesis

Keywords/skills: Product Design; Mechanical Engineering; Bio-Medical Devices; Ergonomics; Anthropometry

It is estimated that current world has a 6.7 billion people with amputees. Lower limb amputation cases are way above the upper extremity cases and below amputations are grater in number. The current market has variety of prosthesis and are with better comfort and better grip.

A study has revealed that 53% of amputee experience heat, perspiration and a state of uncomfortable inside their prosthesis. Skin has to breath constantly, but when closed with prosthesis over the stump, it affects its function and results in increase of temperature, which leads to tissue stress & friction blisters. Moisture builds up and is not let out, this leads to unpleasant odour, discomfort and may lead to fungus growth infection and further skin related issues.

An amputee finds too difficult to perform his day to day activities without his missing led. He finds it even more difficult if the prosthesis being in use is of no aid rather it provides more discomfort. The price range of an artificial limb also vary largely starting with Jaipur foot. But these still address the discomfort are of issues. Ventilation being our prime importance and to reduce the pressure points, we are developing this socket.

Rural part of India is taken into account for the measuring affordability criteria. The socket we have developed in CPDM, IISc is frugal, simple in design and still addressing the ventilation & pressure issues. The objective of this application for ethical approval is to do user testing on the transtibial amputee and get feedback on the developed socket.

Cluster E: Geotechnics/ Smart City Infrastructure/ Construction

E.01 Prasanna K PhD

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Keywords/skills: Instrumental analysis, process synthesis, Environmental monitoring

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E.02 Bitopan Gogoi ME/MTech.

Title: Formation Temperature of Methane Related Authigenic Carbonates from the KG Basin, Bay of Bengal

Keywords/skills: programming; petroleum engineering; gas hydrate; hydrocarbon exploration; geology

Methane related authigenic carbonates from KG basin, Bay of Bengal have been studied using clumped isotope thermometry to obtain precipitation temperature along with isotopic composition of carbon and oxygen. Samples for the study are from the most depleted site (site 8) among the sites drilled by R/V Marion Dufresne (MD 161: May, 2007). Very depleted nature of carbon isotopic composition (~-50‰) of the calcite samples confirms their origin related to methane, especially in biogenic nature. Further, clumped isotope analysis of 9 samples predicts wide range of their precipitation temperatures. A depth-wise variation of precipitation temperature indicates changes in methane seep conditions during the timeframe of authigenic carbonate deposition.

E.03 D Prakash ME/MTech.

Title: Effect of Standard Penetration Test Hammer Energy Measurement on Liquefaction

Keywords/skills: Project involves sound knowledge of geotechical engineering, wave propagation, two sensors, handling huge data sample through excel and MATLAB. Apart from that I have good communication skill with great aptitude to work in team.

Standard Penetration Test Energy Measurement is very crucial for Geophysical studies. Hence two instrumented rods have been used to get force and acceleration plot wrt time and numerically integrated to get actual energy. This energy is used for estimation of of Liquefaction Potential Uncertainty.

E.04 Nithin Raj ME/MTech.

Title: Applications of multivariate statistical methods in structural dynamics

Keywords/skills: Civil Engineering; StructuralEngineering

Use of a blind source separation technique called Independent Component Analysis (ICA) for modal parameter estimation which has great significance in the fields of Structural Health Monitoring and damage detection.

E.05 vivek kumar gupta ME/MTech.

Title: Rheological model for fracture process zone formed in concrete during its fracture.

Keywords/skills: Fracture mechanics ; Finite element analysis; Optimization methods

During fracture of concrete a softening behavior is observed which is attributed to the formation of fracture process zone(FPZ) which behaves inelastically and hinders the application of the concepts of Linear Elastic Fracture Mechanics (LEFM) to Concrete. There is no proper work done to find the behavior and size of FPZ. This work gives a model through we can capture softening and FPZ behavior and hence we predict the behavior of concrete of different grades under different conditions of loading.

The approach is to use a rheological model and to find out stress intensity factor (SIF) and energy dissipated and hence to plot load vs crack mouth opening displacement (CMOD) curve and hence to verify this curve through experiments done on three point bend beam of different dimensions.

Till date the load vs CMOD curve is obtained through model and its experimental verification is to be done.

For construction industries this work can be quite useful as we can know the amount of deflection which the concrete structure can undergo for a given load during its fracture. Not only this but also we can play with the concrete ingredients in order to improve its behavior during its fracture based on the modifications in the simple rheological model.

Cluster F: Health care / Biomedical Systems / Pharma/ Life Sciences

F.01 Anup Kumar Pramanik PhD

Title: Cytotoxicity Study of Anticancer Active Complexes and Their Targeted Delivery Using Nanoparticles

Keywords/skills: organic synthesis; coordination chemistry; air and moisture sensitive reactions; nanomaterials; drug delivery; handling various analytical instruments

Cancer is a noncommunicable disease and is the 2nd largest cause of death worldwide. Among other metal complexes, a copper bis(thiosemicarbazone) (64CuATSM) complex is in clinical trials as a chemo-radio pharmaceutical for the treatment of cervical cancer.

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F.02 Bharathi R PhD

Title: Developing Vanadium Dioxide Thin Films for Infrared Applications

Keywords/skills: Materials characterization. Thin Film Deposition

Vanadium dioxide (VO2) is a well-known, strongly correlated system that exhibits first order Semiconductor-Metal transition (SMT). During the first order SMT, there is a concomitant change in crystal structure which makes it functional for many switching applications. In the times of energy crisis, when nearly half of the total global energy is accounted for commercial and modern buildings, this phase change material VO2 can play a crucial role in “smart window” and many other sensing applications. Different studies have also shown that SMT characteristics like transition temperature can be manipulated by tweaking the defect concentration.

F.03 Bharathkumar Hegde PhD

Title: Ferrofluid pump using switched DC magnetic field

Keywords/skills: Mechatronics; Electronic System Design; Instrumentation; Control Systems; Medical Electronics; Circuit Design; Ferrofluid; Sensors and Actuators

The thesis presents a novel mechanism to pump ferrofluid based on the principle of variable reluctance, in an external magnetic field. The static and dynamic pressure behavior of ferrofluid in a switched DC magnetic field gives an insight into the variable reluctance behavior of ferrofluid. A ferrofluid pump based on the principle of variable reluctance of ferrofluid subjected to an external magnetic field, is developed and hence the pump is named as Variable Reluctance Ferrofluid Pump (VRFP). Three configurations of VRFP are developed: 1) Single stage one-phase VRFP, 2) Single stage two phase VRFP, 3) Multi-stage VRFP.

A one-phase VRFP consisting of a check valve along with an electromagnet is designed. The valve is modeled and its transfer function is estimated using System Identification method. This model is then used in the simulation model of the pump. The pump is modeled based on the hydraulic-electric analogies.

A two phase VRFP is implemented with two electromagnets on either side of the valve around the tube. Two types of magnetic actuation methods are introduced based on the switching sequences of the two electromagnets, namely Full Step Sequencing and Half Step Sequencing. Simulations and experiments were conducted for different pumping conditions. The one phase and two phase VRFPs are single stage structures.

A multi-stage VRFP concept, in which the ferrofluid flow channel (tube) is looped through the electromagnets multiple times, is introduced. For the implementation purpose, a two-stage VRFP is discussed in this thesis. Simulations and experiments resulted in significant improvement in case of two-stage VRFP in the pump performance

compared to that of single-stage VRFPs. The work presents a simple and novel design of a ferrofluid pump, which is capable of higher flow rates and pumping against higher back pressure compared to the ferrofluid pumps reported in literature.

F.04 Earu Banoth PhD
Title: Absorption Flow-Cytometry for Point-of-Care Diagnostics

Keywords/skills: Developing hand held diagnostic tool for Bio-medical Application like malaria diagnosis. Microfluidics, Microscopy, Microfabrication, Quantitative diagnosis on single cell basis, Digital Holography (DHI and DHM) and Non destructive testings etc.

Fast and automated diagnostic devices are bound to play a significant role in the on-going efforts toward diseases eradication. In this article, we present the realization of a portable device for quantitative malaria diagnostic testing at the point-of-care. The device measures optical absorbance (at λ = 405 nm) of single cells flowing through a custom-designed microfluidic channel. The device incorporates the required functionality to align the microfluidic channel with the optical interrogation region. Variation in optical absorbance is used to differentiate red blood cells (both healthy and infected) from other cellular components of whole blood. Using the instrument, we have measured single-cell optical absorbance levels of different types of cells present in blood.

High-throughput single-cell-level measurements facilitated by the device enable detection of malaria, even from a few microliters of blood. Further, we demonstrate the detection of malaria from a suspension containing all cellular components of whole blood, which validates its usability in real-world diagnostic scenarios.

F.05 P Shivashankar PhD
Title: Analytical Modeling and Non-linear characterization of piezoelectric materials for vibration control of beams

Keywords/skills: Mathematical Modeling, Modal analysis, Vibration Testing, Optimization and Signal Processing

The use of Piezoelectric materials to actuate or control beam vibrations is the subject of study in my study. Piezoelectric materials, bonded to a vibrating structure, convert mechanical energy to electrical energy. The converted electrical energy can be dissipated by a resistor to achieve additional damping. The amount of additional damping (or the attenuation in vibration) achieved depend on the following three parameters (1) the dimensions of the piezoelectric, (2) its location on the host structure, and (3) the value of the shunted resistance. The values of these parameters are selected with an intent to maximize the added damping. Hence, to find the optimal parameters and to understand the dynamics of the piezoelectric beam, an analytical mode was derived. The model presented in this thesis is apt in describing the structure compared to the other available models. The optimal resistance is derived from the base-damping included analytical model. Also, the nature of the fixed-point was explored, and the criteria for the existence of a fixed-point in dynamical systems was established. The piezoelectric patches are widely believed to behave in a linear manner at moderate strains and for weak electric field excitations. However, recent studies have found non-linear behavior at weak electric field excitations. Different non-linear terms are used to represent the piezoelectric behavior in different articles, and higher modes were not studied (in the experiments) in the literature. To identify the types of material and electromechanical non-linearity in the piezoelectric actuator, a two-step experimentation was conducted on the first, second and third modes of a piezoelectric-beam. A family of displacement curves were obtained for base-excitation and voltage excitation, and the backbone curves of the displacement curves were used to identify the type of non-linearities. The non-linear governing differential equation was solved using the harmonic-balance method.

F.06 Prashanth R PhD
Title: Silicon photonic microring refractive index sensor

Keywords/skills: Optics; Photonics; Semiconductor devices; Matlab; COMSOL; Electromagnetics

Silicon photonics based sensors offer high performance refractive index sensing capability for potential applications in healthcare, defence, chemical analysis and other fields. My PhD thesis research involves design, fabrication and experimental characterization of silicon photonic micro-ring resonator based sensors. Specifically, I have devised methods to enhance the precision of refractive index measurements while reducing the cost of sensor operation. During my PhD, I have acquired experience in integrated photonic device design, fabrication, characterization and analysis. This includes over four years of handling various equipment such as Lithography (Electron beam and UV based), Dry and Wet etching, Film deposition and SEM etc.

F.07 Pushkaraj Joshi PhD
Title: Inkjet Printed Nanostructured films for Chemical and Mechanical Sensing

Keywords/skills: Chemical Engineering, Point-of-Care Diagnostics, Wearable Devices

The market for disposable devices, such as point-of-care diagnostic kits, wearable sensors, SERS (Surface Enhanced Raman Spectroscopy) swabs for identifying molecules etc. is forecast to be 37 billion USD by 2021. A common feature of such devices is the requirement of forming electrically conducting patterns on paper/plastic substrates. Printing, the preffered route for low-cost processing, using silver nanoparticle/ nanowire based inks followed by various means of sintering is the typical route followed to fabricate conducting patterns. Their widespread adaptation is hindered by difficulties in ink formulation, complexity involved and compatibility of sintering processes used. Reactive inkjet printing is an alternative approach, wherein nanoparticles can be formed in situ on the substrate. However, it is tedious and over 100 printing cycles are required to form reasonably conducting patterns.

In this work, I will present a simple two-step process, based on silver halide photography, to form a percolating network of silver nanowires. The patterns are generated using a desktop inkjet printer. The process is optimized for paper as well as plastic substrates. Silver nanowire patterns formed on paper were used as SERS swab substrates for detecting residual pesticides on fruits with an enhancement factor of about 106. A unique feature of this method is that the printed films have shelf-life of more than 2 years. Furthermore, conductive patterns can be patterned on plastic as well as elastomeric PDMS substrates for flexible and stretchable devices.

F.08 Simna Manoharan PhD

Title: Glycoengineering Pichia Pastoris- Expanding the repertoire of protein expression tool box

Keywords/skills: Molecular cloning; Bacterial and yeast protein expression ; , protein expression and purifications; chromatography

Proteins, participating in a myriad of biological function, are at the core of all cellular activities occurring within living organisms.Therapeutic proteins, hence constitute a major part of the pharmaceutical industry. With advances in molecular biology, genetic and protein engineering, recombinant proteins production, for clinical application, have seen a giant leap. Methylotropic yeast, Pichiapastoris, is a popular industrial protein production host. One of the major drawbacks of yeast cells is its inability to perform post-translational modifications as found in higher eukaryotes.In the present work, a method to engineer the Pichia N-glycosyaltion machinery, in order to achieve human like complex glycan was developed.The ability of these engineered strains to express bioactive therapeutic proteins was tested using glycoprotein hormones. Large scale expression of follicle stimulating hormone (FSH)and human chorionic gonadotropin(CG)in the glycoengineeredPichia cells were done in fermenter cultures. Downstream processing leading to purified proteins was achieved in a two-step chromatography.The recombinant hormones were found to be structurally similar to the native hormones by biochemical analysis and wereable to elicit responses in animal models such as rats and monkeys.Hence, an engineered yeast expressionsystemwith ability to perform human like post-translation modifications was developed enabling large scale production of any therapeutic glycoprotein.

F.09 Suman Pahal PhD

Title: Bio-Molecular Transport across Polyelectrolyte Multilayers

Keywords/skills: Polymer Chemistry, Molecular Biology, Drug Delivery

Layer-by-layer assembly of polyelectrolytes is a simple technique based on the self-assembly of polycations and polyanions mainly by electrostatic interactions, which has gained considerable scientific interest for its versatility of applications. Ease of fabrication process, inexpensive approach and use to coat surfaces with various geometries prompts the researchers to select this technique not only for the surface modification applications but also to study the processes which exploit the 3D matrix properties of polyelectrolyte multilayer films (PEMs). Recent advances have been made where PEMs coatings have been utilized for their bio-applications like drug delivery and in tissue engineering for modifying the biomaterial's surfaces. In the field of drug delivery and tissue engineering the location and availability of the constituent molecules is very important, which is defined by their ability to diffuse through the encapsulating material or reservoir. So the main objective of this thesis is to understand the transport of molecules in ultrathin Polyelectrolyte Multilayer Films in lateral as well as transverse direction to the substrate. To study this transport behaviour in PEMs, we have employed various strategies which can enhance or suppress the diffusivity across PEMs. Thus, understanding the diffusion at nanoscale resolution will lead us to design better host materials for loading of drugs and growth factors for various biomedical applications.

F.10 CHADARAM SAI KUMAR ME/MTech.

Title: Catalytic isomerization in 1-pentene: Density functional investigation

Keywords/skills: Molecular modelling> of zeolite catalyst for isomerization of 1-pentene through <Density Functional Theory

Light naptha (C5-C6 hydrocarbon range) isomerization by zeolite acid catalysts is an important process in petroleum refineries to enhance the octane number of gasoline. Over the past few decades, quantum chemical methods are widely empolyed to study these zeolite catalysed hydrocarbon reactions on a molecular level. We propose density functional insights on modelling the catalytic isomerization of alkene. The prototype reaction selected for the present study is isomerization of 1-pentene to cis-2-pentene using the cluster model approach. Energetically equally favourable reaction pathway where 1-pentene undergo isomerization to trans-2-pentene has also been explored. We compare the results of three popular density functionals namely B3LYP, PBE0 and M06-2X in conjugation with two different basis sets, namely, a computationally manageable 6-31G**, and an extensive triple-zeta, def2-TZVP. Thus we have total 6 model chemistries. The performance of these methods with reference to activation energies, isomerization will be discussed. The present approach was further extended to investigate the reaction with the larger catalyst viz. inside a cage of zeolite-Y. The initial results of large cage calculations are encouraging.

F.11 Vinay Pandu M.Des.
Title: Ventilated Socket for Prosthesis

Keywords/skills: Product Design; Mechanical Engineering; Bio-Medical Devices; Ergonomics; Anthropometry

"It is estimated that current world has a 6.7 billion people with amputees. Lower limb amputation cases are way above the upper extremity cases and below amputations are grater in number. The current market has variety of prosthesis and are with better comfort and better grip.

A study has revealed that 53% of amputee experience heat, perspiration and a state of uncomfortable inside their prosthesis. Skin has to breath constantly, but when closed with prosthesis over the stump, it affects its function and results in increase of temperature, which leads to tissue stress & friction blisters. Moisture builds up and is not let out, this leads to unpleasant odour, discomfort and may lead to fungus growth infection and further skin related issues.

An amputee finds too difficult to perform his day to day activities without his missing led. He finds it even more difficult if the prosthesis being in use is of no aid rather it provides more discomfort. The price range of an artificial limb also vary largely starting with Jaipur foot. But these still address the discomfort are of issues. Ventilation being our prime importance and to reduce the pressure points, we are developing this socket.

Rural part of India is taken into account for the measuring affordability criteria. The socket we have developed in CPDM, IISc is frugal, simple in design and still addressing the ventilation & pressure issues. The objective of this application for ethical approval is to do user testing on the transtibial amputee and get feedback on the developed socket.

Cluster G: Materials /Metallurgy,

G.01 Adarsh K. Hegde PhD
Title: Reinforcing Mg alloys to withstand engine tribology

Keywords/skills: FIB, SEM, XRD, nano/micro-indentation, tension/compression testing, wear testing, non-contact optical profilometry, Raman spectroscopy, XPS, metallography

Mg alloys reinforced with alumina fibres offer the possibility of using a soft but low density matrix in automotive engine cylinders. In the present work, Saffil short fibre reinforced AZ91D Mg composite prepared by squeeze casting is investigated. The wear experienced in application was simulated by conducting dry sliding tests on composite disc using diamond-like carbon (DLC) coated and uncoated steel balls in ambient atmosphere. The worn disc and ball were characterised by optical profilometry, SEM and FIB. The effect of fibre distribution and orientation on wear of the composite was studied. In contrast to unreinforced AZ91D Mg alloy which undergoes extensive wear, the uncoated steel ball was machined by hard alumina fibres protruding out of the matrix. The generated wear debris formed a compacted transfer layer. On continued sliding, transfer layer wears out and matrix underwent tribo-induced oxidation. Abrasive wear was dominant wear mechanism, however there was some evidence of adhesive wear. At higher loads, the reinforcement proves to be detrimental for the tribo-system once the three-body wear kicks in. The composite exhibits higher wear resistance when slid against a DLC counterface due to the ease of interfacial sliding between the C-rich transfer layer and DLC; furthermore the transition from ultra-mild to mild wear was suppressed to higher loads.

G.02 Anup Kumar Pramanik PhD
Title: Cytotoxicity Study of Anticancer Active Complexes and Their Targeted Delivery Using Nanoparticles

Keywords/skills: organic synthesis; coordination chemistry; air and moisture sensitive reactions; nanomaterials; drug delivery; handling various analytical instruments

"Cancer is a noncommunicable disease and is the 2nd largest cause of death worldwide. Among other metal complexes, a copper bis(thiosemicarbazone) (64CuATSM) complex is in clinical trials as a chemo-radio pharmaceutical for the treatment of cervical cancer.

In an attempt to improve effectiveness of the copper bis(thiosemicarbazone) drugs, a complex with a redox active cleavable disulfide linker was synthesised. The complex was linked to PEG coated gold nanoparticle for the delivery to the targeted site with biotin (vitamin) as a targeting ligand. The conjugates showed very good cytotoxicity in vitro as well as in vivo study using HeLa cell xenograft model. Four fold inhibition of tumor progression was achieved by drug conjugates compared to the control group. No significant change in mice body weight was observed. To improve the activity of copper complexes, a dual drug approach was adopted in which copper bis(thiosemicarbazone) was linked to an oxidised cisplatin with the expectation that within the cellular medium it will be reduced by intrinsic reducing agents. The dual drug showed excellent in vitro activity against HeLa cells and was found to be much better than the combination of corresponding copper complex and cisplatin. PEGylated dendrimers or gold nanoparticles conjugates of dual drugs along with biotin as targeting agent showed very good anticancer activity. Synthesised drugs were less cytotoxic to normal cells (HaCaT) than to cancer cells. The good activity and slow release profile of the complex from these conjugates will be beneficent for in vivo studies where the concentration of the drug has to be maintained within the therapeutic window of the drug."

G.03 Bharathi R PhD
Title: Developing Vanadium Dioxide Thin Films for Infrared Applications

Keywords/skills: Materials characterization. Thin Film Deposition

Vanadium dioxide (VO2) is a well-known, strongly correlated system that exhibits first order Semiconductor-Metal transition (SMT). During the first order SMT, there is a concomitant change in crystal structure which makes it functional for many switching applications. In the times of energy crisis, when nearly half of the total global energy is accounted for commercial and modern buildings, this phase change material VO2 can play a crucial role in “smart window” and many other sensing applications. Different studies have also shown that SMT characteristics like transition temperature can be manipulated by tweaking the defect concentration.

G.04 Dhairyashil Ghatage PhD
Title: Soft-Spring Wall model as non-periodic boundary condition and corner flow study using molecular dynamics simulations

Keywords/skills: CFD; CAE; fluid mechanics; thermal engineering>

We present Spring Wall (SW) model as a novel non-periodic boundary condition for molecular dynamics (MD) simulations. Finite atomistic domains have been in extensive use for variety of MD simulations over the time, recently in multiscale atomistic-continuum simulations. The use of only specular surfaces to contain the fluid results in undesirable density fluctuations. Available methods addressing this issue have sophisticated algorithms containing feedback mechanism. With the new Spring Wall model we bring average density fluctuations near the boundary within 1 percent of the mean fluid density. Three layers of boundary atoms attached to a simple cubic lattice with soft springs account for the absent atomistic region. The effectiveness of the model as a thermostat for the simulation domain is shown with shear flow test case. The simulations for hybrid atomistic-continuum approach and spherical geometry with present Spring Wall model demonstrate its versatile utility for wide range of MD simulations. Further, the corner flow is studied with MD simulations. The continuum analysis with no-slip boundary condition for a sliding plate over a stationary wall shows up unbounded stresses. The fluid slip is observed in near corner region on both moving and stationary walls with MD simulations. A comparative study is done between MD results and continuum analysis with slip velocity from MD.

G.05 Pushkaraj Joshi PhD

Title: Inkjet Printed Nanostructured films for Chemical and Mechanical Sensing

Keywords/skills: Chemical Engineering, Point-of-Care Diagnostics, Wearable Devices

"The market for disposable devices, such as point-of-care diagnostic kits, wearable sensors, SERS (Surface Enhanced Raman Spectroscopy) swabs for identifying molecules etc. is forecast to be 37 billion USD by 2021. A common feature of such devices is the requirement of forming electrically conducting patterns on paper/plastic substrates. Printing, the preffered route for low-cost processing, using silver nanoparticle/ nanowire based inks followed by various means of sintering is the typical route followed to fabricate conducting patterns. Their widespread adaptation is hindered by difficulties in ink formulation, complexity involved and compatibility of sintering processes used. Reactive inkjet printing is an alternative approach, wherein nanoparticles can be formed in situ on the substrate. However, it is tedious and over 100 printing cycles are required to form reasonably conducting patterns.

In this work, I will present a simple two-step process, based on silver halide photography, to form a percolating network of silver nanowires. The patterns are generated using a desktop inkjet printer. The process is optimized for paper as well as plastic substrates. Silver nanowire patterns formed on paper were used as SERS swab substrates for detecting residual pesticides on fruits with an enhancement factor of about 106. A unique feature of this method is that the printed films have shelf-life of more than 2 years. Furthermore, conductive patterns can be patterned on plastic as well as elastomeric PDMS substrates for flexible and stretchable devices.

G.06 Shital Patangrao Pawar PhD

Title: Electromagnetic Interference (EMI) Shielding Materials Derived from Lightweight Polymeric Blends Containing Engineered Nanoparticles

Keywords/skills: Polymer nanocomposites, Polymer processing, Polymer Chemistry, Nanomaterials synthesis and chemistry, EMI shielding, Conducting polymers

In recent years, due to sophisticated lifestyle and automation, the ever-growing use of multifunctional electronic devices and wireless operations resulted in unavoidable electromagnetic (EM) pollution which has a significant impact on civil and military sectors. Considering the foremost requirement, huge efforts were invested in the development of EM interference shielding which can attenuate microwave radiation mainly through absorption rather that reflection. Hence, the demand for multifunctional, lightweight, low cost and materials with design flexibility is quite high. By considering the foremost requirement, in my Ph.D. thesis, we have made an attempt to design EMI shielding materials with exceptional microwave attenuation ability derived from Polycarbonate (PC)/ Polystyrene acrylonitrile (SAN) based blends. Herein, a unique strategy of designing co-continuous micro-phase separated blend structures with selective localization of microwave active nanoparticles in one of the phases was used to achieve enhanced microwave attenuation over PC or SAN composites. My Ph.D. thesis entitled “EMI Shielding Materials Derived from PC/SAN Blends Containing Engineered Nanoparticles” systematically studies the effect of multi-walled carbon nanotubes (MWNTs) and different engineered nanoparticles developed according to specific intrinsic properties towards EMI shielding performance of PC/SAN blends. Since most of the polymers are insulators, the desired electrical conductivity required for microwave attenuation was rendered by dispersing high aspect ratio conducting MWNTs in a given component of a binary polymer blend. Moreover, different magnetic particles

and engineered nanoparticles comprising of conducting and magnetic materials were developed and their EMI shielding ability was assessed in PC/SAN blends.

G.07 Shwetha G. Bhat PhD

Title: Fabrication of magnetic thin films and devices for sensors & storage applications

Keywords/skills: Thin film fabrications; physical vapor depositions; ultra-high vacuum handling; multi-layer thin films; storage and sensor device testing; lithography; dry-etching; I-V characterization; electrical transport; XRD; SEM; AFM; SQUID-VSM; XPS

Spintronics based GMR magnetic devices have turned the investigation on magnetic thin films & their hetero-structures to be popular among the R&D community for sensors and storage applications. In this regard, I have worked on material device fabrication addressing specific issues of injecting carriers from oxide magnetic materials to semiconductors with higher efficiency when compared with metallic magnetic materials of lower efficiency. During my Ph.D, I had the opportunity to get hands-on-experience on developing a very good quality of Fe3O4(30nm)/MgO(2nm)/GaAs stack optimized using PVD technique. Substantial structural and magnetic analysis of thin films were carried out using X-ray diffraction(XRD), Atomic Force Microscopy(AFM), Scanning Electron Microscopy(SEM) and SQUID-VSM(2K-300K) techniques helped me to understand the material growth. Design of device demands the sizes to be at-least microscopic. Hence I extensive optimized the optical lithography in clean-room conditions. Multiple devices were successfully tested at lower and room temperature, resulting in international peer-reviewed publications. I also have an extensive 3 years of experience in developing, fabricating and testing of TMR devices. Sputter deposited Au/Co/Al2O3/NiFe/Au films were lithographically tailored to obtain microscopic hetero-structure devices. With all experience & expertise, I am confident in tackling growth & device fabrication issues with different perspectives and approaches.

G.08 Sri Ram Shankar R. PhD

Title: Development of advanced probing system for dynamic mode atomic force microscopy

Keywords/skills: Instrumentation; Nanotechnology; Scanning Probe Microscopy; Micro-systems; MEMS; Optics; Structural Dynamics; LabVIEW; LabVIEW FPGA; Simulations; MATLAB; Simulink

"The dynamic mode atomic force microscope (AFM) is a versatile tool that uses a resonantly excited micro-cantilever probe to obtain a sample's topography and to characterize its material properties. To improve the speed of imaging and to enhance its sensitivity to material properties, new designs have been investigated for the probes and a novel probing system has been developed.

To perform high speed imaging, an integrated high-bandwidth magnetic actuation system is designed and developed. Special designs are proposed for the probe and the actuator to achieve adequate range, high eigen-frequencies and low ohmic heating. To achieve enhanced sensitivity to material properties, a systematic approach is proposed to design flexural and torsional harmonic probes that were further developed and evaluated.

To effectively exploit the high speed and sensitivity of the developed probes, a custom AFM system is designed and developed. This includes a novel high bandwidth Z-magnetic actuation system and an XY nano-positioning system both suitable for video-rate imaging. A novel optical measurement system is proposed to measure the XY-motion of the positioner. High speed control hardware based on FPGA has been used for data acquisition and real-time control, with update rates exceeding 4 MHz. All the subsystems are experimentally calibrated for their high bandwidths, and the overall developed system was evaluated to be more than 100 times faster than conventional AFM systems.

G.09 Sudipta Dutta PhD

Title: Fabrication and characterizations of ordered magnetic nanostructures

Keywords/skills: Anodisation of aluminium; Electrodeposition>, <carbon nanotube CVD; nanowire, nanotube,nanoparticles; SEM; AFM; E-beam-lithography; ACimpedance measurement; Development TRibo ECR and Nano ECR; Nanoindentation; AFM; XRD; PPMS; Labview; Matlab

Development of ordered magnetic coating based on alumina and metal nano composite using anodization. Reduction of magnetic dipolar interaction between neighboring nanostructures withing coating for magnetic storage application. Mechanical and tribological property study of the composite to understand life time and reliability. It is found that developed coating has a very high friction resistance. Development of tribometer for measurement of constriction resistance, to understand formation of dynamic contact area. Electrical and magnetic property of the developed composite is also studied. Fabrication of single suspended structure using lithography and lift-off.

Measurement of stiffness, conductivity and magnetic domain imaging of individual nano structures. Part of the research work also involves stiffness study of biological systems using AFM F-D spectroscopy

G.10 A T Shashidhar Reddy ME/MTech.

Title: Electrical studies of silicon surfaces electrochemically modified by using monolayers of organic molecules.

Keywords/skills: Materials Engineering; Chemical Engineering; Electrochemical Engineering; Semiconductor device physics; Efficient team player; self motivated quick learner; strong communication skills; AFM, SEM, Electrochemical station; MS office, origin

The semiconductor industry is going through an inexorable process of miniaturization of electronic devices. But this process cannot continue in perpetuity due to binding physical constraints like extreme heat losses in nanoscale devices, change in physical band structure in the nanoscale regime and unfavorable economics in the fabrication of nanoscale devices. These problems can be overcome by using the molecular electronics approach of fabricating electronic devices wherein each molecule or a group of few molecules acts as an electronic device. This approach has an inherent advantage since the molecular properties are tunable over a broad range through molecular design and synthesis. In this study, porphyrin-based molecules have been electro-grafted on silicon substrates using the cyclic voltammetry approach through an electrochemical station. The silicon substrate acts as a working electrode, and the porphyrin based molecules are dissolved in the electrolyte solution. The desired molecules form a self-assembled monolayer on the silicon substrate on the application of voltage through the cyclic voltammetry approach. Electrical studies have been carried on the fabricated device (self-assembled monolayer on a silicon substrate) by forming a metal/molecule/Si (n++) junction structure, using a potentiostat/galvanostat system. The electrical characterization of the fabricated devices has revealed the rectification behaviour of the junction structure under study.

G.11 Ankush Raina ME/MTech.

Title: Experimental study of four phase flow in a moving bed with Lateral Gas Injection

Keywords/skills: Autocad 2D; 3D; autodesk inventor; ces edu pack; C; C++; simulation and modelling; material selection; phase transformation; fluid mechanics

Its a cold model of blast furnace designed to study thr behaviour of solid-gas-fine-liquid flow so to find the interaction forces between different phases and then correlation can be developed.

G.12 CHADARAM SAI KUMAR ME/MTech.

Title: Catalytic isomerization in 1-pentene: Density functional investigation

Keywords/skills: Molecular modelling> of zeolite catalyst for isomerization of 1-pentene through <Density Functional Theory

Light naptha (C5-C6 hydrocarbon range) isomerization by zeolite acid catalysts is an important process in petroleum refineries to enhance the octane number of gasoline. Over the past few decades, quantum chemical methods are widely empolyed to study these zeolite catalysed hydrocarbon reactions on a molecular level. We propose density functional insights on modelling the catalytic isomerization of alkene. The prototype reaction selected for the present study is isomerization of 1-pentene to cis-2-pentene using the cluster model approach. Energetically equally favourable reaction pathway where 1-pentene undergo isomerization to trans-2-pentene has also been explored. We compare the results of three popular density functionals namely B3LYP, PBE0 and M06-2X in conjugation with two different basis sets, namely, a computationally manageable 6-31G**, and an extensive triple-zeta, def2-TZVP. Thus we have total 6 model chemistries. The performance of these methods with reference to activation energies, isomerization will be discussed. The present approach was further extended to investigate the reaction with the larger catalyst viz. inside a cage of zeolite-Y. The initial results of large cage calculations are encouraging.

G.13 SASIDHARAN SANDEEP ME/MTech.

Title: Fracture model for multifunctional and multilayered composite structures for energy storage

Keywords/skills: fracture mechanics, finite element analysis(FEA), solid mechanics, thermal analysis, composites

The fiber of the multi-functional composite is multilayered with energy carrying materials and load carrying core metal. Due to the diffusion process, stresses are induced and this acts as fatigue load due to charging and discharging on the fiber. This may lead to fracture in the fiber.

The work is about developing a fracture model for multi-functional composites that can store energy and can carry loads. This is done using Finite element analysis(FEA) starting by finding the Diffusion induced(DI) stresses which is analogous to Thermal stresses. The DI stresses and mechanical stresses are then coupled. Then the fracture model is developed using cohesive modeling.

Cluster H: Petrochemicals/ Chemical/ Process/ Energy

H.01 Anup Kumar Pramanik PhD

Title: Cytotoxicity Study of Anticancer Active Complexes and Their Targeted Delivery Using Nanoparticles

Keywords/skills: organic synthesis; coordination chemistry; air and moisture sensitive reactions; nanomaterials; drug delivery; handling various analytical instruments

"Cancer is a noncommunicable disease and is the 2nd largest cause of death worldwide. Among other metal complexes, a copper bis(thiosemicarbazone) (64CuATSM) complex is in clinical trials as a chemo-radio pharmaceutical for the treatment of cervical cancer.

In an attempt to improve effectiveness of the copper bis(thiosemicarbazone) drugs, a complex with a redox active cleavable disulfide linker was synthesised. The complex was linked to PEG coated gold nanoparticle for the delivery to the targeted site with biotin (vitamin) as a targeting ligand. The conjugates showed very good cytotoxicity in vitro as well as in vivo study using HeLa cell xenograft model. Four fold inhibition of tumor progression was achieved by drug conjugates compared to the control group. No significant change in mice body weight was observed. To improve the activity of copper complexes, a dual drug approach was adopted in which copper bis(thiosemicarbazone) was linked to an oxidised cisplatin with the expectation that within the cellular medium it will be reduced by intrinsic reducing agents. The dual drug showed excellent in vitro activity against HeLa cells and was found to be much better than the combination of corresponding copper complex and cisplatin. PEGylated dendrimers or gold nanoparticles conjugates of dual drugs along with biotin as targeting agent showed very good anticancer activity. Synthesised drugs were less cytotoxic to normal cells (HaCaT) than to cancer cells. The good activity and slow release profile of the complex from these conjugates will be beneficent for in vivo studies where the concentration of the drug has to be maintained within the therapeutic window of the drug.

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H.03 Prasanna K PhD

Title: Isotopic homogenization and scrambling associated with oxygen isotopic exchange on hot platinum: studies on gas pairs (O2, CO2) and (CO, CO2)

Keywords/skills: Instrumental analysis, process synthesis, Environmental monitoring

The catalytic exchange between O2 and CO2 on hot platinum leads to isotope scrambling in CO2 and homogenization of the oxygen isotopes in the two phases (O2 and CO2) even though the two gases could be widely different in isotope ratios from each other (e.g., about 45 per mil in d18O) before the exchange. After the exchange, the d18O values of the gases become close to each other (within 2 per mil) depending on the time and temperature. The clumped-isotope analysis of the post-exchange CO2 samples shows that the D47 values (relative to the pre-exchange values) decrease with increase in temperature from near zero (at ~25 C) to about -0.8 0.1& (at ~700C). The low value of -0.8 per mil equals the values typically obtained for pure CO2 heated to 1000 C inside quartz tubes suggesting a scrambled state. If the catalytic exchange between CO2 and O2 is associated with isotopic scrambling (or random mixing) a microscopic mechanism of isotopic mixing can be inferred. It seems that CO2 and O2 dissociate in the adsorbed state on platinum (or quartz surfaces) and the product CO

molecules and O atoms mix uniformly while doing a random walk on the hot surface and produce two reservoirs (CO and O) where the three oxygen isotopes are randomly distributed. This can produce the observed internal isotopic scrambling in CO2 when CO and O recombine to form CO2 molecules on the platinum surface and desorb. Experiments using CO–CO2 gas pairs over hot platinum also show homogenization showing exchange of CO as a molecular entity and supporting the suggested mechanism.

H.04 Pushkaraj Joshi PhD

Title: Inkjet Printed Nanostructured films for Chemical and Mechanical Sensing

Keywords/skills: Chemical Engineering, Point-of-Care Diagnostics, Wearable Devices

The market for disposable devices, such as point-of-care diagnostic kits, wearable sensors, SERS (Surface Enhanced Raman Spectroscopy) swabs for identifying molecules etc. is forecast to be 37 billion USD by 2021. A common feature of such devices is the requirement of forming electrically conducting patterns on paper/plastic substrates. Printing, the preffered route for low-cost processing, using silver nanoparticle/ nanowire based inks followed by various means of sintering is the typical route followed to fabricate conducting patterns. Their widespread adaptation is hindered by difficulties in ink formulation, complexity involved and compatibility of sintering processes used. Reactive inkjet printing is an alternative approach, wherein nanoparticles can be formed in situ on the substrate. However, it is tedious and over 100 printing cycles are required to form reasonably conducting patterns.

In this work, I will present a simple two-step process, based on silver halide photography, to form a percolating network of silver nanowires. The patterns are generated using a desktop inkjet printer. The process is optimized for paper as well as plastic substrates. Silver nanowire patterns formed on paper were used as SERS swab substrates for detecting residual pesticides on fruits with an enhancement factor of about 106. A unique feature of this method is that the printed films have shelf-life of more than 2 years. Furthermore, conductive patterns can be patterned on plastic as well as elastomeric PDMS substrates for flexible and stretchable devices.

H.05 Ramaraj A PhD

Title: Small Molecule Activation and Functionalization Using Transition Metal Catalysts

Keywords/skills: I have trained to handle compounds in inert atmosphere either using Schlenk line techniques or glove box. I have extensively used NMR, X-ray diffraction, UV-Vis, IR, Parr hydrogenation apparatus, High pressure NMR experiments during my Ph D.

Activation and functionalization of small molecules such as H2, N2, O2, CO, CO2 and CH4 etc., using transition metal complexes would greatly aid in the utilization of abundant resources. The ultimate aim of our group is to functionalize these molecules using transition metal complexes. In my work, Ru, Rh and Ir complexes supported by pincer ligand (R-N(CH2CH2PPh2)2) have been synthesized, characterized by multinuclear NMR spectroscopy and X-ray crystallography. The reactivity of metal complexes have been explored with H2, O2, N2, CO2, R3SiH, BH3, HBcat and CH4 molecules. In addition, CO2 activation has been observed using RuH and IrH complexes. By combining CO2 and H2, a rational Ir based system for the generation of formate (HCOO-) has been identified.

H.06 Raviteja Chanumolu PhD

Title: A Novel Hybrid Vehicle Architecture: Modeling, Simulation and Experiments

Keywords/skills: Mechanical Design, modelling, control, robotics

Electric and hybrid vehicles are particularly suited for use in urban areas since city transportation is mainly characterized by relatively short driving distances, low continuous power requirements, long idling times and high availability of regenerative braking energy. These characteristics, when carefully incorporated into the design process, create valuable opportunities for developing clean, efficient and cost effective urban vehicle propulsion systems. In the first part of the thesis, we present data collected in the city of Bangalore

One of the the main objective of this work is to study and compare the performance of the above novel speed-addition and compare with the typical torque-addition configuration. A MATLAB/Simulink model for both the configurations, with DC hub motor and a small IC engine, has been created and the fuel consumption has been calculated. It is shown that the proposed speed-addition concept gives better fuel efficiency for the standard modified Indian Driving Cycle. The models have also been compared for actual driving data and an optimal control strategy has been developed using dynamic programming. It is again shown that the proposed speed-addition concept results in better fuel economy.

In the last part of the thesis, a low cost experimental test-bed consisting of an auto-rickshaw IC engine, a CVT and a 2 kW DC hub motor has been developed to validate the speed-addition concept and compare with the torque-addition configuration. The torque-speed curves of the IC engine, the DC motor and both of them together, in the speed and torque-addition configuration, have been obtained. It is shown that the speed-addition concept does indeed work and the obtained results are significantly different from the torque-addition configuration.

H.07 sanjay kumar shukla PhD
Title: Flow Induced Vibration- A Study of Fluids Structures Interaction

Keywords/skills: Fluid Mechanics

Fluctuating forces in wake of a circular cylinder are controlled by means of flexible splitter plate/flap have been presented. In this work, two cases of flaps length to cylinder diameter ratio, L/D namely long flaps, L/D =5.0, & short flaps, L/D = 2.0, have thoroughly been investigated. In particular, the main parameters involved are flexural-rigidity, EI, flap length to cylinder diameter ratio, L / D and the Reynolds number, Re = UD/v. By using these parameters a non-dimensional bending stiffness, K* = EI/0.5ρ U2L3 of the cylinder-flap system has been defined, which is found to be a response parameter similar to the reduced velocity (U/fn D) used in VIV problem.

Measurements have demonstrated that the response of the both long and short flaps exhibit a different regime of the flapping Modes used to classified the flow regimes in term of the response parameter K* of the cylinder-flap system. Experiments show two periodic regimes of travelling wave motion of long flaps referred to modes I \& II. The periodic mode I, occurs at sufficiently large values of K*, K* = 1.45 x 10-03, exhibits a peak in the amplitude response. In contrast, the periodic mode II, occurs for very low regime of the K*, K*≦ 3.0 x 10 -05, demonstrate a saturated state of the response wherein response of the flaps are no longer affected by K*. Similar to response of the long flaps, short flaps show a symmetric flapping Mode A, which exhibits a periodic oscillation of travelling wave motion of the flap for K* < 5.78 x 10-04. This symmetric configuration of the flapping Mode A and periodic mode II of the short and long flaps are followed by asymmetric regime of flapping Modes B, C \& D wherein the flap motions are passing through several changes in the modes of flapping with K* is defined as regime of mode competency or mode transition found for 5.78 x 10-04 < K* < 2.1 x 10-01. "

H.08 Sudipta Dutta PhD
Title: Fabrication and characterizations of ordered magnetic nanostructures

Keywords/skills: Anodisation of aluminium; Electrodeposition>, <carbon nanotube CVD; nanowire, nanotube,nanoparticles; SEM; AFM; E-beam-lithography; ACimpedance measurement; Development TRibo ECR and Nano ECR; Nanoindentation; AFM; XRD; PPMS; Labview; Matlab

Development of ordered magnetic coating based on alumina and metal nano composite using anodization. Reduction of magnetic dipolar interaction between neighboring nanostructures withing coating for magnetic storage application. Mechanical and tribological property study of the composite to understand life time and reliability. It is found that developed coating has a very high friction resistance. Development of tribometer for measurement of constriction resistance, to understand formation of dynamic contact area. Electrical and magnetic property of the developed composite is also studied. Fabrication of single suspended structure using lithography and lift-off. Measurement of stiffness, conductivity and magnetic domain imaging of individual nano structures. Part of the research work also involves stiffness study of biological systems using AFM F-D spectroscopy

H.09 Varun Seshadrinathan MSc(Engg.)
Title: Simulations of a jet in supersonic flow on adaptively redistributed grids

Keywords/skills: fluid mechanics; C. F. D.; simulations; mathematical methods; c language

Jet injected in a supersonic flow finds applications in scramjet engines where a fuel is injected into an incoming supersonic stream of air. The challenge in simulating these flows is to capture shocks while maintaining high resolution in regions with finer flow details. The work done in this thesis employs a moving mesh partial differential equation (MMPDE) technique where the grid is redistributed such that a higher resolution is maintained in regions where it is required (like in regions of shocks), while maintaining a coarse grid everywhere else. This is done by solving the governing (Euler's) equations on a transformed fixed computational domain. The transformation is done using an MMPDE that relates the physical and computational domains, which is responsible for the mesh redistribution. The numerical technique used in the transformed computational domain is a finite volume method that involves a shock capturing high order WENO (Weighted Essentially Non-Oscillatory) reconstruction and a rotated HLLC Riemann solver to compute the fluxes at the interface. The problem is simulated in 2-D and the mixing of the jet and the cross-flow is measured for different injection angles.

H.10 A T Shashidhar Reddy ME/MTech.

Title: Electrical studies of silicon surfaces electrochemically modified by using monolayers of organic molecules.

Keywords/skills: Materials Engineering; Chemical Engineering; Electrochemical Engineering; Semiconductor device physics; Efficient team player; self motivated quick learner; strong communication skills; AFM, SEM, Electrochemical station; MS office, origin

The semiconductor industry is going through an inexorable process of miniaturization of electronic devices. But this process cannot continue in perpetuity due to binding physical constraints like extreme heat losses in nanoscale devices, change in physical band structure in the nanoscale regime and unfavorable economics in the fabrication of nanoscale devices. These problems can be overcome by using the molecular electronics approach of fabricating electronic devices wherein each molecule or a group of few molecules acts as an electronic device. This approach has an inherent advantage since the molecular properties are tunable over a broad range through molecular design and synthesis. In this study, porphyrin-based molecules have been electro-grafted on silicon substrates using the cyclic voltammetry approach through an electrochemical station. The silicon substrate acts as a working electrode, and the porphyrin based molecules are dissolved in the electrolyte solution. The desired molecules form a self-assembled monolayer on the silicon substrate on the application of voltage through the cyclic voltammetry approach. Electrical studies have been carried on the fabricated device (self-assembled monolayer on a silicon substrate) by forming a metal/molecule/Si (n++) junction structure, using a potentiostat/galvanostat system. The electrical characterization of the fabricated devices has revealed the rectification behaviour of the junction structure under study.

H.11 Bitopan Gogoi ME/MTech.

Title: Formation Temperature of Methane Related Authigenic Carbonates from the KG Basin, Bay of Bengal

Keywords/skills: programming; petroleum engineering; gas hydrate; hydrocarbon exploration; geology

Methane related authigenic carbonates from KG basin, Bay of Bengal have been studied using clumped isotope thermometry to obtain precipitation temperature along with isotopic composition of carbon and oxygen. Samples for the study are from the most depleted site (site 8) among the sites drilled by R/V Marion Dufresne (MD 161: May, 2007). Very depleted nature of carbon isotopic composition (~-50‰) of the calcite samples confirms their origin related to methane, especially in biogenic nature. Further, clumped isotope analysis of 9 samples predicts wide range of their precipitation temperatures. A depth-wise variation of precipitation temperature indicates changes in methane seep conditions during the timeframe of authigenic carbonate deposition.

H.12 CHADARAM SAI KUMAR ME/MTech.

Title: Catalytic isomerization in 1-pentene: Density functional investigation

Keywords/skills: Molecular modelling> of zeolite catalyst for isomerization of 1-pentene through <Density Functional Theory

Light naptha (C5-C6 hydrocarbon range) isomerization by zeolite acid catalysts is an important process in petroleum refineries to enhance the octane number of gasoline. Over the past few decades, quantum chemical methods are widely empolyed to study these zeolite catalysed hydrocarbon reactions on a molecular level. We propose density functional insights on modelling the catalytic isomerization of alkene. The prototype reaction selected for the present study is isomerization of 1-pentene to cis-2-pentene using the cluster model approach. Energetically equally favourable reaction pathway where 1-pentene undergo isomerization to trans-2-pentene has also been explored. We compare the results of three popular density functionals namely B3LYP, PBE0 and M06-2X in conjugation with two different basis sets, namely, a computationally manageable 6-31G**, and an extensive triple-zeta, def2-TZVP. Thus we have total 6 model chemistries. The performance of these methods with reference to activation energies, isomerization will be discussed. The present approach was further extended to investigate the reaction with the larger catalyst viz. inside a cage of zeolite-Y. The initial results of large cage calculations are encouraging.

Cluster J: Product Design/ Machines and Manufacturing/ Automobiles

J.01 Adarsh K. Hegde PhD
Title: Reinforcing Mg alloys to withstand engine tribology

Keywords/skills: FIB, SEM, XRD, nano/micro-indentation, tension/compression testing, wear testing, non-contact optical profilometry, Raman spectroscopy, XPS, metallography

Mg alloys reinforced with alumina fibres offer the possibility of using a soft but low density matrix in automotive engine cylinders. In the present work, Saffil short fibre reinforced AZ91D Mg composite prepared by squeeze casting is investigated. The wear experienced in application was simulated by conducting dry sliding tests on composite disc using diamond-like carbon (DLC) coated and uncoated steel balls in ambient atmosphere. The worn disc and ball were characterised by optical profilometry, SEM and FIB. The effect of fibre distribution and orientation on wear of the composite was studied. In contrast to unreinforced AZ91D Mg alloy which undergoes extensive wear, the uncoated steel ball was machined by hard alumina fibres protruding out of the matrix. The generated wear debris formed a compacted transfer layer. On continued sliding, transfer layer wears out and matrix underwent tribo-induced oxidation. Abrasive wear was dominant wear mechanism, however there was some evidence of adhesive wear. At higher loads, the reinforcement proves to be detrimental for the tribo-system once the three-body wear kicks in. The composite exhibits higher wear resistance when slid against a DLC counterface due to the ease of interfacial sliding between the C-rich transfer layer and DLC; furthermore the transition from ultra-mild to mild wear was suppressed to higher loads.

J.02 Bharathkumar Hegde PhD
Title: Ferrofluid pump using switched DC magnetic field

Keywords/skills: Mechatronics; Electronic System Design; Instrumentation; Control Systems; Medical Electronics; Circuit Design; Ferrofluid; Sensors and Actuators

"The thesis presents a novel mechanism to pump ferrofluid based on the principle of variable reluctance, in an external magnetic field. The static and dynamic pressure behavior of ferrofluid in a switched DC magnetic field gives an insight into the variable reluctance behavior of ferrofluid. A ferrofluid pump based on the principle of variable reluctance of ferrofluid subjected to an external magnetic field, is developed and hence the pump is named as Variable Reluctance Ferrofluid Pump (VRFP).Three configurations of VRFP are developed: 1) Single stage one-phase VRFP 2) Single stage two phase VRFP 3) Multi-stage VRFP

A one-phase VRFP consisting of a check valve along with an electromagnet is designed. The valve is modeled and its transfer function is estimated using System Identification method. This model is then used in the simulation model of the pump. The pump is modeled based on the hydraulic-electric analogies.

A two phase VRFP is implemented with two electromagnets on either side of the valve around the tube. Two types of magnetic actuation methods are introduced based on the switching sequences of the two electromagnets, namely Full Step Sequencing and Half Step Sequencing. Simulations and experiments were conducted for different pumping conditions. The one phase and two phase VRFPs are single stage structures.

A multi-stage VRFP concept, in which the ferrofluid flow channel (tube) is looped through the electromagnets multiple times, is introduced. For the implementation purpose, a two-stage VRFP is discussed in this thesis. Simulations and experiments resulted in significant improvement in case of two-stage VRFP in the pump performance compared to that of single-stage VRFPs. The work presents a simple and novel design of a ferrofluid pump, which is capable of higher flow rates and pumping against higher back pressure compared to the ferrofluid pumps reported in literature.

J.03 Madhusudanan N PhD
Title: Knowledge Acquisition From Text Documents To Diagnose Issues in the Domain of Aircraft Assembly

Keywords/skills: Knowledge Based Engineering; Smart Manufacturing; Natural Language Processing and Understanding>

The role of expert knowledge in the lifecycle of a product is well acknowledged. It is possible to reuse domain knowledge in Computer Aided Design and Planning Systems, as well as in PLM tools. However the acquisition of such knowledge is still manual, and time consuming, but important for domains like aircraft assembly.

It is intended to acquire diagnostic knowledge in an automated manner from text containing such knowledge. Methods from Natural Language Understanding are used. Some examples of such methods and tools are Semantic Analysis, Sentiment Analysis, and Anaphora Resolution. A pipeline of such tools is used, so that the required knowledge can be acquired.

So far, we have targeted the acquisition of knowledge about problems in manufacturing and assembly. Hence, domain specific resources and tools have been developed, with aircraft assembly as the application domain. Initial results show increasing accuracies in segregation of relevant text and identification of problems.

A varied set of Natural Language Understanding and Processing tools have been employed to acquire knowledge from manufacturing-related documents, and application of such tools has yielded results in acquiring problem-related knowledge till now.

J.04 P Shivashankar PhD

Title: Analytical Modeling and Non-linear characterization of piezoelectric materials for vibration control of beams

Keywords/skills: Mathematical Modeling, Modal analysis, Vibration Testing, Optimization and Signal Processing

The use of Piezoelectric materials to actuate or control beam vibrations is the subject of study in my study. Piezoelectric materials, bonded to a vibrating structure, convert mechanical energy to electrical energy. The converted electrical energy can be dissipated by a resistor to achieve additional damping. The amount of additional damping (or the attenuation in vibration) achieved depend on the following three parameters (1) the dimensions of the piezoelectric, (2) its location on the host structure, and (3) the value of the shunted resistance. The values of these parameters are selected with an intent to maximize the added damping. Hence, to find the optimal parameters and to understand the dynamics of the piezoelectric beam, an analytical mode was derived. The model presented in this thesis is apt in describing the structure compared to the other available models. The optimal resistance is derived from the base-damping included analytical model. Also, the nature of the fixed-point was explored, and the criteria for the existence of a fixed-point in dynamical systems was established. The piezoelectric patches are widely believed to behave in a linear manner at moderate strains and for weak electric field excitations. However, recent studies have found non-linear behavior at weak electric field excitations. Different non-linear terms are used to represent the piezoelectric behavior in different articles, and higher modes were not studied (in the experiments) in the literature. To identify the types of material and electromechanical non-linearity in the piezoelectric actuator, a two-step experimentation was conducted on the first, second and third modes of a piezoelectric-beam. A family of displacement curves were obtained for base-excitation and voltage excitation, and the backbone curves of the displacement curves were used to identify the type of non-linearities. The non-linear governing differential equation was solved using the harmonic-balance method.

J.05 R B Ashith Shyam PhD

Title: Design & Development of a 3-DOF parallel manipulator for tracking Sun in Concentrated Solar Power Towers

Keywords/skills: Robotics, Dynamics, Vibrations, Algorithm development

A three degree-of-freedom parallel manipulators, the 3-RPS, has been proposed to track the sun in central receiver systems. The algorithm for sun tracking is developed, extensive simulation study with respect to actuation required, variation of joint angles, spillage loss and leg intersection has been carried out. Using FEA, it is shown that for same sized mirror, wind loading of 22 m/s and maximum deflection requirement (2 mrad), the weight of the support structure is between 15-60% less with the parallel manipulators when compared to Az-El or T-A configurations. A comprehensive study on stroke minimization of prismatic joints is carried out. It is found that a stroke of 700 mm is required for a 2 m x 2 m heliostat at Bangalore when the farthest heliostat is at a distance of 300 m from the tower. Although, there is an extra motor required to track the sun, the 3-RPS manipulator is better than the conventional methods if the mirror area per actuator criteria is taken into consideration.

A prototype of the Az-El and 3-RPS heliostats are made having a mirror size of 1 m x 1 m. A PID controller implemented using MATLAB-Simulink and a low cost, custom made motor driver circuit is used to control the motion of the 3-RPS heliostat. The algorithm developed is tested on the prototype by tracking a point marked on the wall of the lab space and is found to have a maximum tracking error of 7.1 mrad. Finally, the actual sun tracking is carried out on the roof of a building reflecting the sun-light to a wall situated 6.4 m above. The images are captured at various instances of time from 11:30 a.m. to 3:30 p.m. on October 15th and November 10th, 2016, tracking errors are quantified and it is demonstrated that the proposed 3-RPS parallel manipulator can be used as a heliostat in central receiver solar thermal plants

J.06 Raviteja Chanumolu PhD

Title: A Novel Hybrid Vehicle Architecture: Modeling, Simulation and Experiments

Keywords/skills: Mechanical Design, modelling, control, robotics

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One of the the main objective of this work is to study and compare the performance of the above novel speed-addition and compare with the typical torque-addition configuration. A MATLAB/Simulink model for both the configurations, with DC hub motor and a small IC engine, has been created and the fuel consumption has been calculated. It is shown that the proposed speed-addition concept gives better fuel efficiency for the standard modified Indian Driving Cycle. The models have also been compared for actual driving data and an optimal control strategy has been developed using dynamic programming. It is again shown that the proposed speed-addition concept results in better fuel economy.

In the last part of the thesis, a low cost experimental test-bed consisting of an auto-rickshaw IC engine, a CVT and a 2 kW DC hub motor has been developed to validate the speed-addition concept and compare with the torque-addition configuration. The torque-speed curves of the IC engine, the DC motor and both of them together, in the speed and torque-addition configuration, have been obtained. It is shown that the speed-addition concept does indeed work and the obtained results are significantly different from the torque-addition configuration.

J.07 sanjay kumar shukla PhD
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Keywords/skills: Fluid Mechanics

Fluctuating forces in wake of a circular cylinder are controlled by means of flexible splitter plate/flap have been presented. In this work, two cases of flaps length to cylinder diameter ratio, L/D namely long flaps, L/D =5.0, & short flaps, L/D = 2.0, have thoroughly been investigated. In particular, the main parameters involved are flexural-rigidity, EI, flap length to cylinder diameter ratio, L / D and the Reynolds number, Re = UD/v. By using these parameters a non-dimensional bending stiffness, K* = EI/0.5ρ U2L3 of the cylinder-flap system has been defined, which is found to be a response parameter similar to the reduced velocity (U/fn D) used in VIV problem.

Measurements have demonstrated that the response of the both long and short flaps exhibit a different regime of the flapping Modes used to classified the flow regimes in term of the response parameter K* of the cylinder-flap system. Experiments show two periodic regimes of travelling wave motion of long flaps referred to modes I \& II. The periodic mode I, occurs at sufficiently large values of K*, K* = 1.45 x 10-03, exhibits a peak in the amplitude response. In contrast, the periodic mode II, occurs for very low regime of the K*, K* ≤ 3.0 x 10 -05, demonstrate a saturated state of the response wherein response of the flaps are no longer affected by K*. Similar to response of the long flaps, short flaps show a symmetric flapping Mode A, which exhibits a periodic oscillation of travelling wave motion of the flap for K* < 5.78 x 10-04. This symmetric configuration of the flapping Mode A and periodic mode II of the short and long flaps are followed by asymmetric regime of flapping Modes B, C \& D wherein the flap motions are passing through several changes in the modes of flapping with K* is defined as regime of mode competency or mode transition found for 5.78 x 10-04 < K* < 2.1 x 10-01.

J.08 Sri Ram Shankar R. PhD
Title: Development of advanced probing system for dynamic mode atomic force microscopy

Keywords/skills: Instrumentation; Nanotechnology; Scanning Probe Microscopy; Micro-systems; MEMS; Optics; Structural Dynamics; LabVIEW; LabVIEW FPGA; Simulations; MATLAB; Simulink

The dynamic mode atomic force microscope (AFM) is a versatile tool that uses a resonantly excited micro-cantilever probe to obtain a sample's topography and to characterize its material properties. To improve the speed of imaging and to enhance its sensitivity to material properties, new designs have been investigated for the probes and a novel probing system has been developed.

To perform high speed imaging, an integrated high-bandwidth magnetic actuation system is designed and developed. Special designs are proposed for the probe and the actuator to achieve adequate range, high eigen-frequencies and low ohmic heating. To achieve enhanced sensitivity to material properties, a systematic approach is proposed

to design flexural and torsional harmonic probes that were further developed and evaluated.

To effectively exploit the high speed and sensitivity of the developed probes, a custom AFM system is designed and developed. This includes a novel high bandwidth Z-magnetic actuation system and an XY nano-positioning system both suitable for video-rate imaging. A novel optical measurement system is proposed to measure the XY-motion of the positioner. High speed control hardware based on FPGA has been used for data acquisition and real-time control, with update rates exceeding 4 MHz. All the subsystems are experimentally calibrated for their high bandwidths, and the overall developed system was evaluated to be more than 100 times faster than conventional AFM systems.

J.09 Sudipta Dutta PhD

Title: Fabrication and characterizations of ordered magnetic nanostructures

Keywords/skills: Anodisation of aluminium; Electrodeposition>, <carbon nanotube CVD; nanowire, nanotube,nanoparticles; SEM; AFM; E-beam-lithography; ACimpedance measurement; Development TRibo ECR and Nano ECR; Nanoindentation; AFM; XRD; PPMS; Labview; Matlab

Development of ordered magnetic coating based on alumina and metal nano composite using anodization. Reduction of magnetic dipolar interaction between neighboring nanostructures withing coating for magnetic storage application. Mechanical and tribological property study of the composite to understand life time and reliability. It is found that developed coating has a very high friction resistance. Development of tribometer for measurement of constriction resistance, to understand formation of dynamic contact area. Electrical and magnetic property of the developed composite is also studied. Fabrication of single suspended structure using lithography and lift-off. Measurement of stiffness, conductivity and magnetic domain imaging of individual nano structures. Part of the research work also involves stiffness study of biological systems using AFM F-D spectroscopy

J.10 Albin Varghese MSc(Engg.)
Title: Computational and Experimental Studies on ESTS lobed nozzles

Keywords/skills: Fluid Mechanics, CFD, Experimentation

In order to enhance the spreading and mixing of mixing layers from supersonic nozzles various active and passive methods have been deviced. To achieve enhanced mixing an innovative nozzle named as the Elliptic Sharp Tipped Shallow (ESTS) lobed nozzle has been developed in L.H.S.R., I.I.Sc., India Rao & Jagadeesh (2014). Visualisation, velocimetry, acoustic and density measurement using background oriented schlieren technique were conducted. Simulations using FLUENT and CFX5 softwares were performed. The nozzle with best spreading characteristics was found to be 4 lobed. This nozzle also showed reduction in sound pressure levels and screech tone elimination.

J.11 Varun Seshadrinathan MSc(Engg.)
Title: Simulations of a jet in supersonic flow on adaptively redistributed grids

Keywords/skills: fluid mechanics; C. F. D.; simulations; mathematical methods; c language

Jet injected in a supersonic flow finds applications in scramjet engines where a fuel is injected into an incoming supersonic stream of air. The challenge in simulating these flows is to capture shocks while maintaining high resolution in regions with finer flow details. The work done in this thesis employs a moving mesh partial differential equation (MMPDE) technique where the grid is redistributed such that a higher resolution is maintained in regions where it is required (like in regions of shocks), while maintaining a coarse grid everywhere else. This is done by solving the governing (Euler's) equations on a transformed fixed computational domain. The transformation is done using an MMPDE that relates the physical and computational domains, which is responsible for the mesh redistribution. The numerical technique used in the transformed computational domain is a finite volume method that involves a shock capturing high order WENO (Weighted Essentially Non-Oscillatory) reconstruction and a rotated HLLC Riemann solver to compute the fluxes at the interface. The problem is simulated in 2-D and the mixing of the jet and the cross-flow is measured for different injection angles.

J.12 Ajay Keerthi M.Mgmt.
Title: Technology forecasting amd mapping for strategic decisions and management

Keywords/skills: general management; marketing; analytics; strategy; technology magament; brand management; business development

Exploring new trends in technology forecasting methods. Evaluating and comparing them. See the applicability of the particular methods in various areas of the technology and the method of applying it.

J.13 Ankush Raina ME/MTech.

Title: Experimental study of four phase flow in a moving bed with Lateral Gas Injection

Keywords/skills: Autocad 2D, 3D; autodesk inventor; ces edu pack; C; C++; simulation and modelling; material selection; phase transformation; fluid mechanics

Its a cold model of blast furnace designed to study thr behaviour of solid-gas-fine-liquid flow so to find the interaction forces between different phases and then correlation can be developed.

J.14 SASIDHARAN SANDEEP ME/MTech.

Title: Fracture model for multifunctional and multilayered composite structures for energy storage

Keywords/skills: fracture mechanics, finite element analysis(FEA), solid mechanics, thermal analysis, composites

"The fiber of the multi-functional composite is multilayered with energy carrying materials and load carrying core metal. Due to the diffusion process, stresses are induced and this acts as fatigue load due to charging and discharging on the fiber. This may lead to fracture in the fiber.

The work is about developing a fracture model for multi-functional composites that can store energy and can carry loads. This is done using Finite element analysis(FEA) starting by finding the Diffusion induced(DI) stresses which is analogous to Thermal stresses. The DI stresses and mechanical stresses are then coupled. Then the fracture model is developed using cohesive modeling.

J.15 Vaisakh Pradeep M.Des.

Title: UI/UX to design to facilitate placement coordination in the campus

Keywords/skills: UI/UX design; User interface; User Experience; Digital product design; Visual design; Design thinking

The project evolved from identifying the problems faced by the students and the placement coordinators during the placement season. A solid design process assisted by design thinking was followed to thoroughly identify the problem, draw insights from it, identify the pain-points and the final solution is the outcome of multiple iterations with users being involved at each point of the process to bridge the gap between the user and the product. The final product is a mobile application which would potentially solve the problems identified.

J.16 Vinay Pandu M.Des.

Title: Ventilated Socket for Prosthesis

Keywords/skills: Product Design; Mechanical Engineering; Bio-Medical Devices; Ergonomics; Anthropometry

It is estimated that current world has a 6.7 billion people with amputees. Lower limb amputation cases are way above the upper extremity cases and below amputations are grater in number. The current market has variety of prosthesis and are with better comfort and better grip. A study has revealed that 53% of amputee experience heat, perspiration and a state of uncomfortable inside their prosthesis. Skin has to breath constantly, but when closed with prosthesis over the stump, it affects its function and results in increase of temperature, which leads to tissue stress & friction blisters. Moisture builds up and is not let out, this leads to unpleasant odour, discomfort and may lead to fungus growth infection and further skin related issues.

An amputee finds too difficult to perform his day to day activities without his missing led. He finds it even more difficult if the prosthesis being in use is of no aid rather it provides more discomfort. The price range of an artificial limb also vary largely starting with Jaipur foot. But these still address the discomfort are of issues. Ventilation being our prime importance and to reduce the pressure points, we are developing this socket.

Rural part of India is taken into account for the measuring affordability criteria. The socket we have developed in CPDM, IISc is frugal, simple in design and still addressing the ventilation & pressure issues. The objective of this application for ethical approval is to do user testing on the transtibial amputee and get feedback on the developed socket.

J.17 vivek kumar gupta ME/MTech.

Title: Rheological model for fracture process zone formed in concrete during its fracture.

Keywords/skills: Fracture mechanics ; Finite element analysis; Optimization methods

During fracture of concrete a softening behavior is observed which is attributed to the formation of fracture process zone(FPZ) which behaves inelastically and hinders the application of the concepts of Linear Elastic Fracture Mechanics (LEFM) to Concrete. There is no proper work done to find the behavior and size of FPZ. This work gives a model through we can capture softening and FPZ behavior and hence we predict the behavior of concrete of different grades under different conditions of loading.

The approach is to use a rheological model and to find out stress intensity factor (SIF) and energy dissipated and hence to plot load vs crack mouth opening displacement (CMOD) curve and hence to verify this curve through experiments done on three point bend beam of different dimensions.

Till date the load vs CMOD curve is obtained through model and its experimental verification is to be done. For construction industries this work can be quite useful as we can know the amount of deflection which the concrete structure can undergo for a given load during its fracture. Not only this but also we can play with the concrete ingredients in order to improve its behavior during its fracture based on the modifications in the simple rheological model.

About OCCaP

The Office of Career Counselling and Placement (OCCaP) was established in 2016 to support the graduating students secure a job of their interest. In addition to managing campus placement activities (primarily for Masters and undergraduate students) OCCaP plans to organize events to facilitate interaction between students and industries through special meetings in IISc or enabling internship visits to our students. In addition, OCCaP plans to support graduating students secure teaching or research jobs as well.

The Indian Institute of Science was founded by Jamshetji Nusserwanji Tata in 1909, to promote scientific temper and research aptitude in the nation.

A focus on excellence in research, the academic freedom it offers, coupled with a beautiful campus and a salubrious climate has meant that the Institute is the most sought after destination for top researchers and young minds.

With around forty departments and centres organized in to the six divisions of Biological, Chemical, Electrical, Mechanical, Physical & Mathematical and Interdisciplinary sciences, IISc offers an unmatched range of technical expertise and a large talent pool for industry to choose from.

The Institute has consistently topped national rankings and has made the nation proud by scoring high on many reputed international rankings.

It is our endeavour to make the Institute a natural destination for companies that put a premium on intellectual capital.

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