SURGE 2013

Annual Report

Office of Resources & Alumni
Indian Institute of Technology Kanpur
Kanpur 208016

From the desk of DORA

Dear SURGE Friends,

Congratulations to all the 2013 SURGE Students and their mentors !!!

I am very happy to announce that SURGE program is getting very popular amongst the students and the faculty . SURGE gives undergraduate students a great opportunity to access the finest research facilities in the world and the personal mentoring from professors at IIT Kanpur.

This year SURGE was open for all colleges and approximately 1,875 applications were received from different institutions. The committee had a tough time in selecting the proposals and had to turn down many good proposals. After much consideration committee selected 64 excellent proposals on the basis of academic performance and the technical proposal for the research.

I would like to congratulate all the members of SURGE family who made this summer successful. Thanks to the SURGE Committee for their invaluable leadership. Thanks to the 63 mentors who took time out of their busy summers to direct the enthusiasm of the students .

I thank all of you for making SURGE a very successful program . I applaud all of your magnanimity and I am sure and confident to receive your participation in the future too.

Thank you!
Prabhat Munshi
Dean of Resources and Alumni

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SURGE program- An overview

SURGE is evidence of the close student-faculty collaboration opportunities, for hands on experience and quest for new knowledge that characterize IITK education. It develops the agenda of undergraduate research and promotes a culture of research and interdisciplinary education in the new generation.

Undergraduate research fosters collegiality and welcomes students into the community of researchers and scholars. It promotes self-discovery, helps to bridge the gap between class-room and real world, and leads to social, professional and educational development of the student. Undergraduate research at IIT Kanpur must present opportunities for students to do research under the mentorship of senior researchers at the frontiers of engineering and science.

The program is being received very well both by students and mentors. The students experience a challenging and exciting method of learning which encompasses multiple levels of educational experience .

Allied Programs such as Research Talks and Lab Visits provided students an opportunity to learn about research across the campus and space to interact with each other.

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Funding SURGE

The participating students receive a stipend of Rs 12,500 for the ten-week summer program from the funds raised from external sources. The Dean of Resources and Alumni Office raises funds to support SURGE students from a variety of sources including gifts from individuals, foundations, and corporations. SURGE depends upon the generosity of its many friends for annual gifts or for contributions to the SURGE endowment to build a robust financial base. We thank the donors who have supported SURGE 2013 and beyond! Endowments help to ensure the future of the SURGE program and provide students with unparalleled research opportunities.

Special Thanks to:

Mr. Narayan Murthy

Batch 1977

Opportunities still available for new endowments

Individuals or batches may support in several ways to establish endowments—they may be paid in full at creation, given in installments over a period. The contributors can be proud of the investment they have made in the future of bright and talented students, and the donors gain the personal satisfaction from playing an important part in the formation of young people, many of whom will make significant contributions to the nation and the world.

Participants of SURGE 2013 from IITK

S.No	Name of the Participant	Project	Mentor
1	Vaibhav Gupta Aerospace Engineering	Aero acoustics - Study of noise generated by Helicopter rotor blades.	Dr. C. Venkatesan Aerospace Engineering
2	Chahat Upreti Biological Sciences & Bioengineering	Preparation and Characterization of Nanoparticles loaded with aggregation inhibitors for Huntington's Disease treatment	Dr. Ashwani Kumar Thakur Biological Sciences & Bioengineering
3	Eeshit Dhaval Vaishnav Biological Sciences & Bioengineering	Photovoltaic Properties of a Silk Cocoon extract	Dr. Mainak Das Biological Sciences & Bioengineering
4	Prince Kumar Lat Biological Sciences & Bioengineering	Molecular Understanding of Bone Development	Dr. Amitabha Bandopadhyay Biological Sciences & Bioengineering
5	Anmol Awasthi Chemical Engineering	Micro-scale free surface flow over non-uniformly heated surface	Dr. Naveen Tiwari Chemical Engineering
6	Ashutosh Kumar Chemical Engineering	Fluid Transport in Paper Based Microfluidics	Dr. Siddhartha Panda Chemical Engineering
7	Devesh Goyal Chemical Engineering	Hydrodynamic Instabilities in Soft Tubes	Dr. V. Shankar Chemical Engineering
8	Jai Prakash Menaria Chemical Engineering	Exergy analysis of cogeneration of chemicals with distilled water using renewable solar energy.	Dr. Raj Ganesh S. Pala Chemical Engineering
9	Prakhar Agarwal Chemical Engineering	Development of a Computer Code for simulating liquid-liquid PUREX Extraction process	Dr. Ashok Khanna Chemical Engineering
10	Pratikshit Sharma Chemical Engineering	Preparation of nitrogen incorporated carbon nanofibers(CNFs) in novel single step method	Dr. Nishith Verma Chemical Engineering
11	Arjun Halder Chemistry	DNA Binding Study Of Transition Metal Complexes Having N,N'-Heterocyclic Bases	Dr. Ashis Kumar Patra Chemistry
12	Banshi Das Chemistry	Test of Non Equilibrium Theorems on Terrace -Step -Kink Model of Crystal Growth	Dr. Madhav Ranganathan Chemistry
13	Sourav Ghorai Chemistry	Journey Towards the Total Synthesisof Mutisianthol	Dr. Dattatraya H. Dethe Chemistry
14	Amanpreet Singh Civil Engineering	Seismic evaluation of masonry arch gate – Rumi Darwaza	Dr. Durgesh C. Rai Civil Engineering
15	Aniruddha Baral Civil Engineering	Studying the Properties of Normal Concrete and SFRC under Impact Loading	Dr. K K Bajpai Civil Engineering

16	Kishlay Kumar Civil Engineering	Characterisation of Emissions from Incense with Varyingh/C Ratio	Dr. Anubha Goel Civil Engineering
17	Subhajit Mohanty Civil Engineering	Rehabilitation of damaged concrete using FRP	Dr. Sudhir Misra Civil Engineering
18	Gaganpreet Singh Kalra Computer Science & Engineering	Simulation and Solving Substitution Codes	Dr. Somenath Biswas Computer Science & Engineering
19	Ganesh Kumar Baskar Computer Science & Engineering	Determination of the Shape of a Dynamically Deforming Surface	Dr. Debopam Das Aerospace Engineering
20	Mohit Sharma Computer Science & Engineering	C programs on MIPS processor and performance enhancements	Dr. Mainak Chaudhuri Computer Science & Engineering
21	Parth Tripathi Computer Science & Engineering	Extended Universal Relation	Dr. Manindra Agrawal Computer Science & Engineering
22	Rohit Kumar Jha Computer Science & Engineering	Implementation of Integer Multiplication	Dr. Piyush P. Kurur Computer Science & Engineering
23	Tanvi Soni Computer Science & Engineering	Construction of Normal Numbers In Polynomial Sized Circuit Classes	Dr. Satyadev Nandakumar Computer Science & Engineering
24	Utkarsh Patange Computer Science & Engineering	Shortest Time Path in Railway Network	Dr. Ajay Jain Computer Science & Engineering
25	Ashish Raj Electrical Engineering	Fault Detection and Diagnosis of Four Wheel Independently Actuated Electric Vehicle	Dr. Ramprasad Potluri Electrical Engineering
26	Chaitanya Ahuja Electrical Engineering	On-Line Modeling of the pinna for fast computation of HRTFs in rendering 3D Audio	Dr. Rajesh M Hegde Electrical Engineering
27	Himanshu Agarwal Electrical Engineering	Development of a Matlab based open -source module for power System state estimation	Dr. Saikat Chakrabarti Electrical Engineering
28	Krishna Chaitanya K Electrical Engineering	Opportunistic Scheduling for Efficient Utilization of time resource in Wireless Networks	Dr. Aditya K Jagannatham Electrical Engineering
29	Monika Mahto Electrical Engineering	Connected Component Labelling	Dr. K. S. Venkatesh Electrical Engineering
30	Shreshth Gandhi Electrical Engineering	Simulation and Modelling of SG-FETs and other steep sub-threshold slope device	Dr. Yogesh Singh Chauhan Electrical Engineering
31	Sohum Datta Electrical Engineering	Design of Power Divider based on Substrate Integrated Waveguide Technology	Dr. Animesh Biswas Electrical Engineering

32	Unnat Jain Electrical Engineering	Dynamic IP networks path selection	Dr. Ketan Rajawat Electrical Engineering
33	Vipul Gupta Electrical Engineering	Sphere Decoding for MIMO Systems using Efficient Matrix Inversion	Dr. Ajit K. Chaturvedi Electrical Engineering
34	Abhishek Gaurav Humanities & Social Sciences	Relationship among Inflation, Interest rate and Output: A Case Study of India	Dr. Surajit Sinha Humanities & Social Sciences
35	Ankit Prahalad Das Choudhary Humanities & Social Sciences	Market Structure and Performance of Microfinance Institutions: A Cross-Country Empirical Study	Dr. Praveen Kulshreshtha Humanities & Social Sciences
36	Tejasvi Rana Humanities & Social Sciences	An economic study of low price housing market of Kanpur : A Hedonic Approach	Dr. Vimal Kumar Humanities & Social Sciences
37	Aditya Bhardwaj Material Science and Engineering	Computing Fraction of Light Intensity Emitted due to a Photon Generated in an Oled	Dr. Deepak Gupta Material Science and Engineering
38	Arpit Agarwal Material Science and Engineering	Simulating transmission electron microscope images from first principles	Dr. Somnath Bhowmick Material Science and Engineering
39	Sukriti Mantri Material Science and Engineering	Nanowire Oscillator for Sensors and Generators	Dr. Sarang Ingole Material Science and Engineering
40	Khagesh Patel Mathematics & Statistics	Statistical Learning Methods and Artificial Neural Networks - a comparative performance analysis	Dr. Sharmishtha Mitra & Dr. Akash Mathematics & Statistics
41	Abhinav Gupta Mechanical Engineering	Suppression of vortex shedding around square cylinder using control cylinder	Dr. Arun K. Saha Mechanical Engineering
42	Ankit Shrivastava Mechanical Engineering	Suppression of Vortex Shedding Around a Square Cylinder using Blowing	Dr. Malay K Das Mechanical Engineering
43	Deepak Kumar Dalakoti Mechanical Engineering	Experimental Investigation of Combustion, Performance and Emission of Biodiesel HCCI Engine	Dr. Avinash Kumar Agarwal Mechanical Engineering
44	Dhrupal R Shah Mechanical Engineering	Health Monitoring of a Small Indian Family Car	Dr. Nalinaksh S. Vyas Mechanical Engineering
45	Kshitij Agarwal Mechanical Engineering	Acoustic Analysis of Speech for Different Emotional Conditions in Hindi language	Dr. Nachiketa Tiwari Mechanical Engineering
46	Riya Khurana Mechanical Engineering	Fabrication of micro-channels over silicon substrate to be used for optical sensing applications	Dr. Shantanu Bhatacharya Mechanical Engineering

Note: The sequence followed in the table is in the alphabetical order of department and name of the participants.

S.No	Name of the Participant	Project	Mentor
	Participants of SURGE 2013 at IITK from other universities		
1	Bhupesh Verma Aerospace Engineering	Studyof Vortex Ring Structure in an Impulsive Started Flow Field	Dr. Ashoke De Aerospace Engineering
2	Moubashsir Jawed Aerospace Engineering	Instabilities in Y-shaped Air-Intake for Aircraft Engines	Dr. Sanjay Mittal Aerospace Engineering
3	Rahul Ajay Deshpande Aerospace Engineering	Flow Past Two Cylinders in Tandem Arrangement At Low Reynolds Number	Dr. Sanjay Mittal Aerospace Engineering
4	Rohit Gupta Aerospace Engineering	Design of a Coaxial Mono Tiltrotor MAV	Dr. Abhishek Aerospace Engineering
5	Swastik Basu Aerospace Engineering	Design and Performance Estimation of a Vertical Axis Wind Turbine with Dynamic Pitch change	Dr. Abhishek Aerospace Engineering
6	Vinodhini C Aerospace Engineering	Velocity and Position Estimation of Autonomous Helicopter using IMU and GPS data	Dr. C. Venkatesan Aerospace Engineering
7	Bibek Dutta Biological Sciences & Bioengineering	Chromosomal Instability (CIN): A cause or consequence of epithelial tumor progression in *Drosophila*	Dr. Pradip Sinha Biological Sciences & Bioengineering
8	Richa Sharma Biological Sciences & Bioengineering	Understanding Spontaneous Aggregation Behavior of Polyglutamine Peptides	Dr. Ashwani Kumar Thakur Biological Sciences & Bioengineering
9	Tatsat Banerjee Chemical Engineering	Fabrication of Photonic Crystal	Dr. Sri Sivakumar Chemical Engineering
10	Priyanka Samanta Chemistry	Study Of Gallium Nitride Using Quantum Mechanical Calculations	Dr. Madhav Ranganathan Chemistry
11	Niharika Gupta Computer Science & Engineering	Inference of gene interaction using text mining	Dr. Harish Karnick Computer Science & Engineering
12	Mohit Sharma Electrical Engineering	Simulation of wireless channels	Dr. Govind Sharma Electrical Engineering

13	Pratibha Garg Electrical Engineering	New Algorithms for Video De-interlacing	Dr. K S Venkatesh Electrical Engineering
14	Aniruddha Bhattacharya Electrical Engineering	Design and Implementation of Diamond Colorimeter	Dr. Pradeep Kumar K Electrical Engineering
15	Ayan Ghosh Material Science and Engineering	The evolution of strain at different length scales in Zinc	Dr. Nilesh Gurao Material Science and Engineering
16	Avinaw Pansari Material Science and Engineering	Role of Ceria in Afecting the Microstructure & Ionic Conductivity of Yttria Stabilized Zirconia	Dr. Kantesh Balani Material Science and Engineering
17	Kaustubh Krishna Bawane Material Science and Engineering	Effect of Secondary Dendrite Arm Spacing on Solutionizing Kinetics of Cast Aluminium Alloys	Dr. Kaustubh Kulkarni Material Science and Engineering
18	Pranjali Nanda Material Science and Engineering	Modifying Bacterial Cellulose for Applications in Composites and Tissu Engineering	Dr. Vivek Verma Material Science and Engineering
19	Shivani Gour Material Science and Engineering	Study of Tension and Compression Anisotropy In Mg and Mg Alloys Using Viscoplastic Self-consistent Simulations	Dr. Nilesh Gurao Material Science and Engineering
20	Prasanta Lenka Mathematics & Statistics	Barie Category Theorem and its Applications	Dr. Rama Rawat Mathematics & Statistics
21	Abhimonyu Dutta Mechanical Engineering	Design, fabrication and performance characterization of a dip-coating machine	Dr. Sujeet Sinha Mechanical Engineering
22	Dipayan Mukherjee Mechanical Engineering	On Dynamics of Some Curious Toys	Dr. Ishan Sharma Mechanical Engineering
23	G Hemanth Raghav Mechanical Engineering	Experimental Investigation into the Heat Transfer During Pool Boiling of Ethanol-Water Mixtures at Low Pressures	Dr. Sameer Khandekar Mechanical Engineering
24	Ramsubramanian P Mechanical Engineering	Fabrication and analysis of micro circuit elements using nanosecond UV laser	Dr. J. Ramkumar Mechanical Engineering

Note: The sequence followed in the table is in the alphabetical order of department and name of the participants.

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S.No	Name of the participant	Name of the Institute	Project	Mentor
			Participants of SURGE 2013 from IITK to Overseas Universities	
1	Amish Goel Electrical Engineering	Melbourne School of Engineering, University of Melbourne	Control Design for Non-overshooting Response of Hard-disk Drives and Buck Converter Circuits	Dr. Robert Schmid Electrical Engineering
2	Gaurav Sachdeva Civil Engineering	Melbourne School of Engineering, University of Melbourne	Model Design for Shake Table test	Dr. Helen Goldsworthy Civil Engineering
3	Prabhanshu Pavecha Mechanical Engineering	Melbourne School of Engineering, University of Melbourne	Turbulent Natural Convection in a Vertical Channel	Dr. Andrew Ooi Mechanical Engineering
4	Vijin Venu Physics	Ecole Centrale Paris	Study of optical heating of Gold Nanoparticles by Lock-In detection enabled Pump-probe spectroscopy	Dr. Bruno Palpant,Dr. Nadia Djellali Physics

Note: The sequence followed in the table is in the alphabetical order of department and name of the participants.

Design, fabrication and performance characterization of a dip-coating machine
Abhimonyu Dutta
Dr. Sujeet K. Sinha
This project involves the design of a dip-coating machine used for the application of ultra-thin coatings on a substrate. It may also be used for depositing nano-lubricants on devices such as magnetic hard disks and silicon wafers for MEMS applications. The pivotal element in the design of the machine constitutes of a guide plate mounted on a lead screw and supported on two guide rods by rubber bushings. The substrate to be coated is fixed to the guide plate which moves linearly up or down, depending on direction of rotation of lead screw connected to a motor. After the design of the machine was completed, the fabrication of the components was carried out by a local company. Subsequently, upon completion of the assembly of the dip-coater, calibration of the machine was carried out to determine the performance of the machine. Furthermore, some preliminary dip-coating tests were performed to analyze the effect of linear speed of substrate on the thickness of coating deposited.

Suppression of vortex shedding around square cylinder using control cylinder
Abhinav Gupta
Dr. Arun K. Saha
Suppression of vortex shedding is attempted using a passive method, by placing a small control cylinder in the near wake of main cylinder. Direct numerical simulation (DNS) of two-dimensional, unsteady, incompressible flow past a square cylinder at a Reynolds numbers of 100 is carried out with a square control cylinder of side 20% of the main cylinder, at various positions in the wake. The Navier-Stokes equations are solved using higher order spatial and temporal discretizations. Numerical simulations are carried out using MAC algorithm. In the present study numerous simulations were performed with control cylinder at different positions in the near wake of main cylinder. It has been observed that there exists an explicit spatial domain in the near wake where the placement of control cylinder guarantees complete suppression, and this explicit domain lies on the edge of shear layer. In an endeavour to explain the mechanism of suppression of vortex shedding using control cylinder, a plot of variation of vortices in the transverse direction was plotted in the near wake of the main cylinder for various cases with and without control cylinder. The mechanism of suppression can be attributed to effective diffusion of vortices in separating shear layer by the control cylinder. A remarkable drag reduction of the main cylinder was also achieved with suppression.

Relationship among inflation, interest rate and output: A case study of India
Abhishek Gaurav
Dr. Surajit Sinha
The objective of the study is to examine the relationship between the key macroeconomic variables inflation, interest rate and output in the context of a developing economy like India. Economic literature is replete with papers examining the trade-offs that exist between growth and inflation and the role that the interest rate plays in optimizing it. Building upon such theoretical framework, the paper utilizes time series models to analyse the data .The results establish that there is, indeed a trade-off, however, the monetary institutions, can through an effective interest rate management policy, stimulate growth without compromising with the price level. An important point to note is that the relationship differs in the long run and short run analysis. The paper, in addition to dealing with the causal relationships among the variables, also discusses the forecast about these variables and the extent of their variability.

Computing fraction of light intensity emitted due to a photon generated in an Oled
Aditya Bhardwaj
Dr. Deepak Gupta
Led is a device that emits photon on application of electric field. The aim of our project is to find an algorithm to compute fraction of light intensity emitted due to a photon generated in an oled using the algorithm we made a programme in c language to compute the efficiency. We traced all the reflected and transmitted rays applying formulae of optics and worked on it to get the intensity of transmitted rays from front surface .With help of this programme we can find efficiency of various configurations of oled in terms of length, thickness, no of interface, type of interface etc. We can also have an understanding of how each ray is moving inside the oled in terms of its coordinates and region in which it is present. This will help us in designing more efficient oleds.

Seismic evaluation of masonry arch gate – Rumi Darwaza
Amanpreet Singh
Dr. Durgesh C. Rai
The report summarizes the ambient vibration based assessment of a historical monument – Rumi Darwaza, Lucknow, built in 1784. The monument is about 20 meters high and is characterized by a half dome supported by a masonry arch. On-site ambient vibration tests were conducted on the monument and the recorded data was analyzed. The *Complex Mode Indicator Function* (CMIF) technique was used to extract the modal parameters from the ambient vibration test measurements. Three-dimensional finite element modeling of the structure was done in ABAQUS using the material properties reported in the literature. The frequencies and mode shapes were obtained using Eigen value Analysis.

Studying the properties of normal concrete and SFRC under impact loading
Aniruddh Baral
Dr. K.K. Bajpai & Dr. Sudhir Misra
Importance of studying the effect of impact and impulse loads in concrete is immense. In cases such as study of projectile and fragment impacts, it is known that the depth of penetration is mainly influenced by the pressure and strain rate behaviour of concrete. Also, tensile strength, fracture energy and the strain rate in tension are the major factors to decide crack generation for a certain impact load. It may be noted that no standard method for the impact testing of concrete is available at present. This project focuses on better understanding the relationship of the impact strength of different types of concrete to more commonly used quality parameters such as compressive strength, tensile strength. Specimens with normal concrete and fibre reinforced concrete were prepared and tested using a new 'drop impact' method. Ultrasonic pulse velocity was used as a measure of 'deformation' and the concrete response to such loading. Concrete cubes were given compressive load (a fraction of the ultimate compressive strength) and damage was measured using UPV and the damage was compared for different types of concrete.

Design and implementation of diamond colorimeter
Aniruddha Bhattacharya
Dr. Pradeep Kumar K
In this project, we examine the spatial distribution of optical intensity as well as chromaticity components due to scattering of light by diamonds. Our objective in this study was the realization of a novel design of a compact user-friendly and rather inexpensive diamond colorimeter to determine the GIA colour grade of diamonds employing white light. The gemstone was measured in the transmittance configuration and the resultant spatial optical distribution upon a hemispherical dome was recorded employing a large-area silicon photodiode. The very same set-up was then imaged by monochrome as well as colour digital camera which was followed by digital image processing techniques in MATLAB® to gauge the spatial optical intensity as well as chromaticity component distribution in order to suitably position the detector in the actual diamond colorimeter to maximize the light collection in variable luminance levels. The strategy is to transform the standard RGB values from the output of a digital colour CCD camera in the colorimeter to normalized trichromatic coefficients (xy colour space) which will then be used to calibrate the various types of diamonds. The proposed novel design of diamond colorimeter is compact, user-friendly, quick and rather inexpensive as it does away with complicated and involved spectro photometric techniques and bulky integrating spheres.

Market structure and performance of microfinance institutions: A cross-country empirical study

Ankit Prahalad Das Choudhary
Dr. Praveen Kulshreshtha

In spite of conflicting views on the effect of market structure on the performance of microfinance institutions (MFIs), no empirical study has been carried out to examine this relationship with real-world data. This study attempts to empirically analyze the effect of market structure on the performance of MFIs. The empirical investigation is based on the data pertaining to 334 MFIs from 26 countries during 2007-11. For market structure, a dummy variable for concentration index is constructed using number of active borrowers. To avoid the biased results due to presence of correlation between unobserved effect and firm-specific variables, Hausman-Taylor estimation method is used instead of the random effect model. We find that market concentration has a positive effect on the outreach of MFIs, while it has a negative effect on the operational sustainability of MFIs. A dummy for regulatory status is used, which shows that regulation does not affect the operational sustainability of the MFIs. The above result is consistent with the finding obtained by Barth et. al (2004) for banks in general. However, contrary to Hartaska and Nadolyak's (2007) study which found that regulation may have an indirect effect on the outreach of MFIs, our study shows that regulation has a direct and positive effect on the outreach of MFIs.

Suppression of vortex shedding around a square cylinder using blowing

Ankit Shrivastava
Dr. Malay K Das

The effect of blowing through jets at the rear face of a non-porous square cylinder on vortex shedding has been investigated numerically in the present study. Direct numerical simulations (DNS) have been performed at a Reynolds number of 100 for different blowing velocities, different number of jets and two velocity profiles-uniform and parabolic at the jet exit. Complete suppression of vortex shedding has been achieved in all the cases. The investigation also shows a remarkable reduction in mean drag if the effect of the momentum of jet is taken into account. Parabolic velocity profile requiring lesser volume flux has been found to be more effective in suppressing the vortex shedding as compared to the uniform velocity profile case. The study also reveals that there is considerable effect of the number of jets on the volume flux required to completely suppress vortex shedding.

Micro-scale free surface flow over non-uniformly heated surface

Anmol Awasthi
Dr. Naveen Tiwari

We have considered the problem of a thin film flow driven by gravity and flowing over a heterogeneously heated substrate. The dynamics of such a film has been analysed through mathematical modelling. The governing fourth order partial differential equation (PDE) has been discretized using finite-element method with the numerical scheme coded in MATLAB. The results from this code have been compared to those obtained from the commercially available software COMSOL which also employs finite-element method. Further, linear and non-linear stability analysis of the film profile has been performed using finite difference methods and matrix theory.

DNA binding study of transition metal complexes having N,N'-heterocyclic bases

 Arjun Halder
Dr. Ashish Kumar Patra

We have already known that initially discovered Platinum containing drug Cisplatin [Pt(NH3)2Cl2] and its other analogous have shown potential anticancer activity towards the cancer cells. Though these are very much promising for the treatment of testicular and ovarian cancers etc. but these drugs are not free from toxicity and thus less selective. These are responsible for damaging the healthy cells along with the targeted tumour affected cells. So here is a promising challenge for the selection of more selective and less toxic metallic-drugs. So here we have concentrated over some biologically more acceptable metals (such as Cu, Co etc.) having surrounded by N,N'-heterocyclic planar aromatic systems such as DPQ,DPPZ, substituted DPPZ etc. These complexes may have more specificity towards the affected cells causing minimal damage to the healthy cells. Here we have thought about such kinds of metal and ligand containing complexes; their preparation, characterization, spectral analysis and finally the photo physical studies after binding with DNA.

Simulating transmission electron microscope images from first principles

 Arpit Agarwal
Dr. Somnath Bhowmick

Transmission electron microscope (TEM) is one of the most popular devices used for materials characterization, as it is capable of providing several information's such as topography, morphology, composition, crystal structure etc. A typical TEM has a very high resolution of the order of 1 nm. At higher resolutions, experimental artifacts can complicate image analysis to a great extent. Using computer simulations to overcome such difficulties have become a common practice now-a-days. In this project, we have calculated transmission electron microscope images from first principle calculations. A code has been developed, which can simulate TEM images and diffraction patterns, using atomic potentials (calculated from first principles density functional theory calculations). We have tested the code for Body Centered Cubic (Fe) using plane waves and focused beam like Gaussian beam. Further, we have examined the propagation of recently discovered electron vortex beams through this material.

Fault detection and diagnosis of four wheel independently actuated electric vehicle

Ashish Raj

Dr. Ramprasad Potluri

We have considered the problem of fault detection and diagnosis of loss-of-effectiveness in the actuator of a four wheel drive independently actuated electric vehicle. The existing solutions to this problem are mathematics sophisticated ones. We have tried to provide an easily comprehensible scheme for FDD based on DOB. It is a modular solution to a bigger problem of fault detection, diagnosis and tolerance.

Fluid transport in paper based micro fluidics

Ashutosh Kumar

Dr. Siddhartha Panda

Paper-based micro fluidics" or "lab on paper," is a burgeoning research field and provides a novel system for fluid handling and fluid analysis for a variety of applications including health diagnostics, environmental monitoring as well as food quality testing. It is comparatively cheaper, accurate, can be used by anyone and can reach places where sophisticated instruments cannot. All these features make it an attractive field of research and development. It can be utilized to detect the presence of PSA antigen in the serum which is indicative of prostate cancer. Here, in this report BSA has been taken rather than PSA as both show the same results. An effort has been made to make an effective device for such. We started with a device which employed a single step plotting using a permanent marker. The test was based on the principle of sandwich immunoassay for determination of BSA in serum. Monoclonal and polyclonal antibodies were employed to identify BSA specifically. The results were acceptable but the device required a larger dose of sample and reagents .The need was to ensure their minimum use within an acceptable time limit and detection range. To do so an experimental study of flow rate and capillary length of water and PBS on two different types of papers (Whatman Grade 1 and Grade 41) was carried out. Paper of finite width was taken and a small amount of PBS/Water (1-15 µl) was dropped to one end and the time for the flow to die out and the capillary length was noted. The flow rate proved very difficult to measure accurately since it decayed exponentially as the liquid moved farther along the membrane. An easier parameter to measure was the capillary flow time, the time required for liquid to move along and fill completely a strip of defined length. Based on the results the previous device was replaced by a strip of Whatman grade 1 paper of finite width and length. The distance between the Reaction, Test and Control zones were varied to increase/decrease the sensitivity of the device. The sensitivity of the test can be set to 4 ng/ml which is taken as a decisive level for prostate cancer.

Role of ceria in affecting the microstructure & ionic conductivity of yttria Stabilized zirconia

Avinaw Pansari
Dr. Kantesh Balani

In the present work, solid solution of μ-8YSZ was developed with μ-10GDC, μ-CeO$_2$ and n-CeO$_2$ via Multi-stage Conventional Sintering. The average particle size and specific surface area of pure powders were estimated through particle size analyser and BET. Phase analysis of pure powders, blended powder mixture and sintered pellet indicate the stability of cubic phase of 8YSZ throughout the processing and the formation of 8YSZ-10GDC and 8YSZ-CeO$_2$ solid solution with the dilation of 8YSZ lattice. Microstructure analysis of sintered pellet revealed a marginal increase in grain size of 8YSZ from 2.22μm to 2.36μm and 2.44μm and decrease in the % relative Archimedes density of 8YSZ by 0.5% and 1.3% upon the addition of 10GDC and CeO$_2$. Micro Vickers hardness of 8YSZ was found to degrade by 9% to 16% upon 10GDC and CeO$_2$ addition. Fracture toughness of 8YSZ measured through Vickers indentation method was also found to decrease by 10% upon 10GDC addition where as a marginal increase in the fracture toughness was observed upon CeO$_2$ addition which may be attributed to the presence of high porosity and restriction offered by pores to crack propagation. No significant grain growth was observed in the sintered pellets when further annealed at 1200°C, 1300°C and 1400°C separately for 3hrs. Ionic conductivity measured using two point probe Impedance Spectroscopy technique in the temperature range of 370°C to 470°C showed the increase in activation energy for oxide ion migration in 8YSZ from 1.69eV to 1.79eV and 2.01eV on doping of 10GDC and μ-CeO$_2$. This may be attributed to the formation of clusters such as (- −) and reduction in the reduction energy of Ce^{4+} to Ce^3.

The evolution of strain at different length scales in zinc

Ayan Ghosh
Dr. Nilesh Gurao

Hexagonal close packed (HCP) metals and their alloys find extensive applications, for example, Mg alloys for automobile and computer, communication and consumer electronic appliances, Ti alloys for aerospace and aircraft industry and zinc for hot galvanizing of steel. HCP metals are different from cubic metals due to the limited slip systems and the activation of twinning if looked at it from a mechanistic point of view.HCP metals and their alloys, owing to its poor ductility undergo only moderate amount of plasticity at room temperature before failing by fracture. The pronounced twinning as seen in HCP materials puts a higher level of complexity in evolution of strain at different levels of deformation. The strains required to cause failure in tension, rolling and bending are all generally lower at room temperature than strains required in case of common ductile metals. Stress certainly exists but we cannot measure it directly as it is an instantaneous entity. So what we do is measure the strain of the material which is a response to the stress applied. The objective of this project is to measure the strain evolution at different length scales in the zinc coating of hot-dip galvanized steel using X- ray peak shift and peak broadening, Electron backscatter diffraction (EBSD) and Digital Image Correlation (DIC) techniques.

Test of non equilibrium theorems on terrace -step -kink model of crystal growth
Banshi Das
Dr. Madhav Ranganathan

The goal of this work is to investigate various theorems in nonequilibrium statistical mechanics using the terrace-step-kink (TSK) model of crystal growth. The main theorems we are testing are theorems of nonequilibrium steady states (NESS). The NESS is characterized by probability currents which play a role similar to probabilities in equilibrium systems. Here we simulate the TSK model of crystal growth using a Monte Carlo program and directly calculate mass fluxes. For a single step simulation, these currents are shown to satisfy the NESS theorems. Further to this work, we plan to extend to multiple steps where the role of the noncrossing rule of step motion plays a role in the currents .

Study of vortex ring structure in an impulsive started flow field
Bhupesh Verma
Dr. Ashoke De

Vortex ring structures are important to various fluid mechanical phenomenon that occurs in many industries. This project primarily deals with the numerical study of the vortex structure and behaviour of the vortex rings, formed when fluid passes through a constant diameter pipe and an orifice under same boundary conditions with same geometric dimensions of the computational domain. This study is done for air in the 3-D, laminar, incompressible flow regime. A time varying inlet boundary condition is used to produce impulsive flow of fluid in the computational domain. The problem is solved numerically using an open source, finite volume based solver, Open foam . For the present unsteady calculations, PISO algorithm is used. The grid independence test has been performed using three different grids and, consequently, grid independent results have been produced. The results show that the vortex structures formed downstream of the pipe are found to be more stable than those formed downstream of the orifice. Also, the differences are observed in the strength and the distance travelled by the vortex core for the two cases, namely, a pipe and an orifice. This can help to make a choice among these configuration.

Chromosomal Instability (CIN): A cause or consequence of epithelial tumor progression in drosophila

Bibek Dutta
Dr. Pradip Sinha

Chromosomal instability (CIN) such as Aneuploidy refers to changes in chromosomal numbers- either in their individual numbers or in entire set. CIN is seen during tumour progression thereby raising the possibility that it could be a driver for tumour progression. In a recent study it was shown that CIN caused by loss of function of mutation in genes that are involved in chromosomal segregation can induce neoplastic transformation in imaginable discs, the adult epithelial primordial of *Drosophila* (Dekanty et al., 2012). In *Drosophila*, loss of Lethal giant larvae (lgl), a neoplastic tumor suppressor, involved in maintaining epithelial cell polarity, also give rise to larval neuroblastomas and imaginable disc tumours (Gateff, 1978). Earlier studies suggest that neuroblastomas accumulate chromosomal abnormalities at later stage when transplanted in adult flies (Caussinus and Gonzalez, 2005) although these neuroblastomas (Radhakrishan and Sinha, 1987) or imaginable disc tumours (Mishra et al., 1997) did not display CIN. The role of CIN in *Drosophila* epithelial tumours as driver for its progression still remains unresolved. Here I have examined this question using *in vivo* transplantation technique that permits progression of imaginable disc tumours of somatically induced *lgl* mutant clones in combination with a cooperative deregulation of Hippo signalling (Khan et al., 2013). My study involves a combination of *in vivo* transplantation and genetic mosaic techniques.

Preparation and characterization of nanoparticles loaded with aggregation inhibitors for Huntington's Disease treatment

Chahat Upreti
Dr. Ashwani Kumar Thakur

In this work, we report the fabrication of nano particles loaded with two novel peptides which have been shown to be effective inhibitors of poly glutamine aggregation which is considered to be the prime cause for Huntington's disease symptoms. We incorporated the nano precipitation method for nano particle synthesis. Employing this procedure, we were successful in fabricating PLGA nano particles loaded with these peptide molecules. We could restrict the size of the nano particles to less than 200 nm which is desirable as it allows the nano particles to cross through the Blood Brain Barrier and enter the brain. The Zeta Potential of the nano particles was found to be -20 to -30 mV, which suggests that the designed nano particle suspension is quite stable. The Encapsulation Efficiency studies showed that the encapsulation was about 70-83% which is at par with the existing literature. We were also able to achieve release of the peptides from the nano particles which went up to 20% of the total peptide content. Thus we were able to design a robust nano particulate system suitable for Blood Brain Barrier uptake and loaded with releasable peptide content.

On-Line modeling of the Pinna for fast computation of HRTFs in rendering 3D audio
Chaitanya Ahuja
 Dr. Rajesh M Hegde
Individualized HRTF measurement is a strenuous process for both the subject and the person conducting the process. But Individualized HRTF is an essential requirement for accurate virtualization of sound. Prominent features of a HRTF namely "Spectral Notches" must be obtained to reconstruct the HRTF accurately. This article proposes a significantly better method, compared to its predecessors, for extracting frequencies of spectral notches. In doing so, a new quantity called Cosine Cestrum has been defined which will be used at a crucial step in the algorithm. Finally Batteau's Reflection model has been used to plot the spectral notches on the pinna. This brings us one more step closer from obtaining individualized HRTF from Pinna geometry and an existing database of HRTFs.

Experimental investigation of combustion, performance and emission of biodiesel HCCI engine
Deepak Kumar Dalakoti
 Dr. Avinash Kumar Agarwal
The objective of this study is to experimentally investigate the combustion, performance and emission of a Diesel Homogenous Charge Compression Ignition(HCCI) Engine. HCCI technology is one of the novel technology for engine combustion and a lot of research is being done worldwide in this field. It is like a hybrid of Compression Ignition(CI) and Spark Ignition(SI) engines as it gives higher thermal efficiencies, which is a characteristic of CI engine while at the same time reduces pollutants, which is a characteristic of SI engine. In this technology a premixed charge is burned in the combustion cylinder as opposed to the compression and spark ignition engines which use inhomogeneous charge. The homogeneity of charge leads to simultaneous start of combustion at multiple sites with no flame front thus reducing in cylinder combustion temperatures. This technology gives ultra low level of NOx and also resolves NOx-soot paradox. The experiments were performed in a 2 cylinder diesel engine with one cylinder modified to work in HCCI mode. The setup is present in Engine Research Laboratory. In cylinder pressure was measured using a pressure transducer connected to a charge amplifier. Combustion and performance data was acquired using a dedicated data acquisition system. The experiments were carried varying air fuel ratio, fuel and EGR(Exhaust Gas Recirculation) levels.

Hydrodynamic Instabilities in soft tubes
 Devesh Goyal
 Dr. V. Shankar

Our aim is to analyze and manipulate the instabilities in the soft tubes. Soft tubes are the tubes which have low shear modulus. These tubes can be made from substances such as silicone elastomeric poly(dimethylsiloxane) (PDMS). Instability criterion vary hugely for rigid tubes and for soft tubes. Analyzing and manipulating the instability will help us to control the formation of droplets. We derived the capillary instability criterion for an in viscid jet in vacuum and the instability criterion for viscous jet in vacuum. By using Mathematica, we got the solutions for the Ordinary Differential Equations which we obtained during the above mentioned derivations. In future work of this project, we will be using these concepts and will be deriving the criterion for instability in soft tubes.

Health monitoring of a small Indian family car
 Dhrupal R Shah
 Dr. Nalinaksh S. Vyas

The project work deals with the development of a Health monitoring system for a small Indian family car. A small passenger car 'Tata Indica' has been instrumented with various sensors like accelerometer, speed sensor, thermocouple, microphone, and torque sensor etc. for data acquisition in running condition. The data acquisition system visualizes and logs all the required sensor data in on-board computer. The data is being plotted for various sensors to verify their signal accuracy and correlation.

On dynamics of some curious toys
 Dipayan Mukherjee
 Dr. Ishan Sharma

There are some Toys which shows curious behavior on spinning on a flat surface, apparently showing violation of the basic principles of physics. 'The Rattleback' is one of such toys. When it is kept on a at surface, and rotated, it shows preference to one direction, i.e. if it is rotated in its 'preferred' direction, it continues to rotate and ultimately comes to rest due to dissipative effects. But, if it is rotated in the other direction, within few seconds, it stops rotating, oscillates longitudinally, and starts rotating in its 'preferred' direction. The hard-boiled egg shows very interesting features. If it is given a spin, keeping its longest symmetry axis horizontal, after some time, it stands up, i.e its longest symmetry axis becomes vertical and continues to spin about its longest axis. 'The Tipped Top' inverts itself momentarily, when it is given spin and starts rotating on its stem. In this project the mathematical modeling of these toys are done and by numerical simulation the actual behavior, which the toys exhibit, is obtained.

Photovoltaic properties of a silk cocoon extract
 Eeshit Dhaval Vaishnav
 Dr. Mainak Das

Unlike Conventional solar cells that convert light into electricity by exploiting the photo-voltaic effect that exists at the junction of the semi-conductor, a dye-based nano-crystalline solar cell(also called the Gratzel Cell) transfers an electron excited by a dye to the semi conducting Titanium Oxide layer which facilitates the electron transport to the conducting layer of a glass. Here, we attempt to characterize and document the photo-voltaic properties of a silk cocoon extract. The best available dyes in a gratzel cell currently give a conversion efficiency of 7% - 10%.The silk cocoon extract was successfully isolated from a semi-domesticated, reared variety of DABA Tsar silkworm (Antheraeamylitta Drury). The silk cocoon extract showed photovoltaic behavior when used as dye in a dye-sensitized solar cell(DSSC).DSSCs are cost efficient when compared to conventional solar cells, meaning, they require lower costs to produce one unit of power due to the easily available raw material, but they are not energy efficient when compared to them(they give a lower quantum yield for a given amount of incident solar energy).

Experimental investigation into the heat transfer during pool boiling of ethanol-water mixtures at low pressures
 G Hemanth Raghav
 Dr. Sameer Khandekar

The objective of this investigation was to study the available pool boiling correlation model's ability to predict heat transfer coefficients of a binary mixture of ethanol-water at various sub-atmospheric pressures. The effect of sub-atmospheric pressures on the heat transfer coefficient of Ethanol-water binary mixture was predicted by investigating different mixture Correlations. Stephan Abdelsalam's correlation model is employed to derive the heat flux and the correlations of Stephan and Korner, Thome and Modified Thome are used to predict the nature of mixture heat transfer coefficient. Two liquids ethanol and water boiling at low pressures from 0.29 bar to 0.72 bar were considered for a heat flux from 25505 to 123808 W. The experimental data were predicted with an accuracy of ± 15.55% by the correlation of Thome, ± 18.9% by the correlation of Stephan–Korner and ± 22.22% by modified Thome's correlation for ethanol-water mixture in the investigated range mole fraction. The present correlation of Thome showed a good agreement with the experimental data which was conducted to calculate the mixture pool boiling heat transfer coefficient.

Simulation and solving substitution codes
 Gaganpreet Singh Kalrav
 Dr. Somenath Biswas

The problem of solving substitution ciphers has been very popular. In this project, we are trying to use a randomized algorithm based on Markov Chain Monte Carlo Simulation to solve substitution ciphers. Some statistics of English Language are used, combined with Monte Carlo Simulations to solve. The aim is to provide a bound to the expected number of steps, the algorithm takes to solve and hence also try to have a formal explanation on why the algorithm works.

Determination of the shape of a dynamically deforming surface
Ganesh Kumar Baskar
Dr. Debopam Das

The goal of this project is to experimentally determine the shape change of a dynamically deforming surface by determining the 3D coordinates of points located in the surface(In this project a flapping wing) using stereo photogrammetric. Photos of the flapping wing(with dots) are taken by two high speed Nano sense cameras at a stereoscopic angle with each other. From the photos of flapping wing, background is eliminated and the dots in the wing are identified using pixel brightness of dots and the average diameter of the dots based on the assumption that the displacement of a dot in between two frames is much less compared to any inter-dot distance. The 3D coordinates of dots were calculated from the tracking data and calibration parameters using stereo triangulation function of MATLAB stereovision toolbox.

Development of a matlab based open -source module for power system state estimation
Himanshu Agarwal
Dr. Saikat Chakrabarti

A simulative study of state estimation in power systems was done. The main objective of the study was to devise a state-estimation model that could estimate the best possible state of the power system. For the same, Weighted Least Squares (WLS) state estimation algorithm was chosen and measurements were generated through simulation. Noise was introduced in the true measurements obtained from load flow, to incorporate the effect of telemetry noise, random data errors, etc. and then these measurements were processed to get the real picture of the state of the power system. Finally, some results describing the accuracy characteristics of the algorithm for various bus systems such as 6-bus, 14-bus, 30-bus, 57-bus, 118-bus system were obtained.

Energy analysis of cogeneration of chemicals with distilled water using renewable solar energy
Jai Prakash Menaria
Dr. Raj Ganesh S. Pala

The objective of this work is to cogenerate chemicals via solar energy. The solar distillation systems coupled to an electrolyser is used for the purpose of generating the chlor-alkai chemicals namely, NaOH, $H_2$and Cl_2 along with clean distilled water. The hot and concentrated brine from the solar stills poses a serious problem for the aquatic flora and fauna if released directly and also the energy contained in the hot and concentrated brine is lost. The research aimed at the energy analysis of the combined solar distillation and chlor-alkali system. The efficiencies calculated demonstrate a scope of improvement in the system. The energy analysis of this system, in future, will lead us to consider the ecological aspects and reducing the footprint of the system.

Effect of secondary dendrite arm spacing on solutionizing kinetics of cast aluminium alloys
Kaustubh Krishna Bawane
Dr. Kaustubh Kulkarni

Cast aluminium alloys are widely used in the field of automobiles especially for engine component applications like cylinder heads, engine blocks, chassis, and cast alloy wheels etc. Secondary Dendrite Arm Spacing (SDAS) is found to have considerable effect on the heat treatment kinetics of these alloys. Here the effect SDAS on solution kinetics of Modified A354 Cast aluminium alloy has been investigated by using hardness measurements, SEM and EDAX analysis. Two types of heat treatments had been used here, first, solution at 495 °C for different solution times ranging from 10 min to 64 hr and second, solution for 24 hr at different temperatures ranging from 490 °C to 523 °C. For temperatures above 500 °C two stage heat treatment was used. Results show that hardness increases as time of solution treatment increases and samples with lower SDAS shows high hardness and superior kinetics of solution treatment as compared to higher SDAS samples. Also for second treatment hardness increases with temperature and lower SDAS samples shows high hardness values than others. The plot of maximum Cu % dissolved within α-aluminium matrix with respect to temperature shows that the maximum Cu % actually decreases after solution at higher temperatures. This result is in accordance with the thermodynamic calculations.

Statistical learning methods and artificial neural networks - a comparative performance analysis
Khagesh Patel
Dr. Sharmishtha Mitra & Dr. Akash Anand

Problem of prediction of unseen data from the seen data is of considerable importance in many fields. Constant research is being carried out to select or develop methods suitable for diverse field of prediction. Objective of this project is to compare qualitative performance of statistical methods and artificial neural networks in the domain of hand written digits recognition. MNIST database of hand-written digits is used as a benchmark in this project. Both computational complexity and accuracy of these methods is discussed. Methods explored are Fisher Linear and Quadratic Discriminator, K-NN Classifier, Naive-Bayes Classifier, Support Vector Machines, Feed Forward Neural Networks, Restricted Boltzmann Machines and Deep Belief Network. Possible improvements and applicability of each method is also discussed.

Characterization of emissions from incense with varying H/C ratio
Kishlay Kumar
Dr. Anubha Goel

The generation rate (μg/min), emission factor (μg/g), mass concentration (μg/m^3) and number concentration (Number/cm^3) variation of the ultrafine particulate matter (below 1 μm diameter) were assessed in laboratory setting. Scanning Mobility Particle Sizer (SMPS) was used in long DMA range (14nm-670nm) to get the particle mass and number concentration of the emissions from the incense burnt in a chamber. In addition to the Particulate Matter assessment, the relation between the atomic Hydrogen Carbon ratio (using CHN analyses) and various emission characteristics of the five different incenses were determined. The inflow of particle free air using High Efficiency Particulate Filter was kept constant at 5 liters per minute and atmospheric pressure and ambient temperature was ensured inside the cubical chamber. Generation rate and emission factor was found to be minimum for sample having lowest H/C ratio. For the samples having the same atomic H/C ratio, though different in many physical aspects, the generation rate, emission factor and particle size distribution were almost same. The emission factor of incenses showed linear variation with the atomic Hydrogen Carbon ratio (in the range of H/C atomic ratio -1.38-1.59).

Opportunistic scheduling for efficient utilization of time resource in wireless networks
Krishna Chaitanya K
Dr. Aditya K Jagannatham

In today's world, the demand for wireless communication is overwhelming. However, wireless frequency is a scarce resource .Scheduling policies are thus critical to improve efficiency and utilization of resources in wireless communication. An opportunistic scheduling scheme should be able to exploit the time varying channel conditions .In this report, we present few such opportunistic scheduling schemes that attempt to maximize the throughput under a constraint of user time fraction allocation to ensure fairness .We build upon an existing opportunistic scheme that requires online updating of parameters to generate schemes that give a closed form solution and make use of the Rayleigh distribution of the wireless channel. Through simulation results, we show that schemes satisfactorily meet the constraint and perform better than the round robin scheme.

Acoustic analysis of speech for different emotional conditions in hindi language
Kshitij Agarwal
Dr. Nachiketa Tiwari

Many musicians have claimed that pitch intervals tend to communicate emotions. Prosody refers to the communication of emotions through speech and one of its components is intonation, others being rhythm and stress. This project aims to verify whether emotions are conveyed by certain specific pitch intervals. This is done by carrying out acoustic analysis on recorded speech samples uttered under different emotional conditions. This kind of study is done by Meagan E. Curtis and Jamshed J. Bharucha, Tufts University for English language. Prosody varies from one language to the other. Little has been done in this regard for Hindi. This project tends to investigate the claim for Hindi language. Seven major emotions that are Questioning, happiness, sadness, surprise or Shock, Teasing, Whining and anger are chosen. These emotions are chosen because they are significantly distinct from each other and belong to different valence of emotions. One more kind of utterance is recorded and that is emotionless. Nine appropriate sentences are chosen, having different syllabic content. One is monosyllabic, two are bisyllable , two are trisyllable, one is a trisyllable Hindi numeral and three are polysyllabic. The sentences are uttered by five actors, all Hindi speaking. These nine sentences are recorded for all six participants for all eight categories. If different ways of saying a particular sentence in a particular emotion is possible for a participant, the variants are also recorded. Also, multiple trials of every kind of utterance are recorded. Multiple trials are recorded so that human variation could be monitored and averaged out as all other factors are kept constant. Recording is done using B&K microphone. These speech samples are subjected to a series of acoustic analysis. A syllable generally has one perceptually salient pitch. Computational models like Audacity and Praat are adopted to study the pitch patterns. For every emotion perceived pitch intervals are calculated in terms of semitones. Distribution of pitch intervals with respect to their frequency of occurrence is identified and it has been tried to establish a correlation between pitch intervals and the emotion conveyed. Also, separate analysis for each emotion has been done and We have tried to find out the variations in emotions conveying between boys and girls participants as they have fundamentally different pitches.

Extended universal relation
Parth Tripathi
Dr. Manindra Agrawal

Through this paper we wish to extend the concept of Universal Relation which was introduced by Prof. Manindra Agrawal and Prof. Somnath Biswas, in their paper titled "Universal Relation". The paper established three structural properties of NP-complete problems: join ability , culpability and building block. We test whether these properties hold for Randomized Reducible NP-complete problems and, if not so, then which suitable modification of these properties would be satisfied by this set of problems. In my research I have focused on two very famous Randomized Reducible NP-complete problems namely : The Unique Satisfied ability Problem and The Shortest Lattice Vector Problem.

C programs on MIPS processor and performance enhancements
Mohit Sharma
Dr. Mainak Chaudhuri

MIPS or Microprocessor without Interlocked Pipelined Stages is a RISC (Reduced Instruction Set Computer) instruction set architecture(ISA) which means each of its instructions perform a single simple task in contrast to instruction of CISC(Complex Instruction Set Computer) ISA which involve executing multiple simple tasks. RISC ISA builds on the philosophy of simpler is faster. Execution of a program requires execution of MIPS instruction that are generated by that program for the MIPS processor through a compiler. The time taken by a program to execute is a major concern of study and we have implemented two well known techniques in this project to speed up a basic MIPS processor: Pipelining and Caching. Pipelining of a processor increases its throughput i.e. an increase in number of instructions executed per unit time without having any effect on execution time of a single instruction. Caching improvises the execution time of an instruction by reducing the time taken to access memory which is generally the slowest step in execution of an instruction. We varied cache size, block size and memory to cache mapping method and wrote C programs to check the effects of these changes. We measured performance of the processor at every step. We also tried to draw conclusions on degree of reduction in execution time of certain category of C programs after each step of improvisation of the processor.

Simulation of wireless channels
Mohit Sharma
Dr. Govind Sharma

In present scenario wireless channel is the most widely used medium for communication. Besides its lot of merits, wireless channels posses some problems during communication. One of these problems posed by wireless channel is their unpredictable behavior, as their characteristics keeps on changing frequently in a random manner. So, it becomes very important to study communication systems for reliable communication over wireless channel. This can be accomplished either by physically setting the system and testing its performance or by simulating the wireless channel for analyzing communication system. Analysis by simulation is preferred over physical analyses method as it is time saving and less expensive. In this report various methods for modeling the wireless channel have been implemented via computer simulation and their performance comparison has been studied.

Connected component labeling

Monika Mahto

Dr. K. S. Venkatesh

The objective of this project is to work out a faster algorithm for connected component labeling which is very important tool in image processing and is a very significant system in many computer vision systems. It uses the two-pass algorithm as the basic algorithm. This project consists of two parts. The first part includes speeding up the algorithm by parallelizing. The image is divided into parts and then the time of execution is reduced by either parallelizing or by applying the two-pass algorithm to each part and then finally merging the results. The second part includes decreasing the execution time for connected component labeling by reducing the resolution of the image. This further includes two parts, one for the images having components far away from each other and the other in which components are close enough. The first one reduces the resolution of the image, applies the algorithm for connected component labeling in the image with reduced resolution and then finally gets back to the original image. The second one has an added step to check for the merging of components when the resolution is reduced. This algorithm of resolution reduction can speed up any algorithm for connected labeling. Finally, in the project there is a check for the image, whether it has components far away or close enough for us to restrict from using the algorithm for images having far away components.

Instabilities in Y-shaped air-intake for aircraft engines

Moubashsir Jawed

Dr. Sanjay Mittal

Numerical Simulation of the flow in a two-dimensional Y-shaped air-intake for aircraft engine is carried out by solving unsteady viscous compressible equation using a stabilized finite element method. Computations are done with Re = 1×10^5 and Mach number 1.5. Back-pressure is specified at the exit of the intake except when the outflow is supersonic. Instabilities are observed for low back-pressure ratios. Effect of initial conditions is studied when back-pressure is ramped from two different initial values. Increase in total pressure recovery and decrease in distortion index are observed with increase in back-pressure. Flow is solved for non-zero side-slip cases at different values of back-pressure. Flow is seen to be choking in wind-ward side with increase in side-slip angle. Asymmetry in two limbs and small oscillations in mass flow rate is observed.

Journey towards the total synthesis of mutisianthol

Sourav Ghorai

Dr. Dattatraya H. Dethe

Indanes appear to be of great interest not only for their unique structural feature but also their pharmaceutical and therapeutic activity. The synthesis of Me protected mutisianthol has been accomplished in 6 steps from the readily available carbon. Both diastereomer is formed in equal amount. A novel approach has developed for the synthesis of indane derivative using Cu(OTf)$_2$ catalyzed Fridel Craft alkylation type reaction. Target molecule has potent anti- tumor activity against the human tumor cell lines brain (SF-295), colon carcinoma (HCT-8) and melanoma (MDA-MB-435).

Inference of gene interaction using text mining
 Niharika Gupta
 Dr. Harish Karnick

One of the emerging technologies in computational biology is text mining which includes natural language processing. This technology enables extraction of relevant biological knowledge from large volume of scientific documents in an automated fashion. In this report, a pragmatic strategy to perform extraction of directed gene interactions from sentences in Medline abstracts has been presented. This task was seen as a classification problem: the system must be trained to separate the interacting pairs of genes according to positive or negative interactions and the non-interacting ones. POS Tagging has been accomplished by Stanford Parser. It helps in retrieval of the named biological entities i.e. genes and the interaction keyword. The approach has been verified on existing standard datasets. This work would help biologists and medical scientists to save lot of time and paving way for more focused and detailed follow-up research.

Development of a computer code for simulating liquid-liquid purex extraction process
 Prakhar Agarwal
 Dr. Ashok Khanna

The objective of this work is to develop a computer program to simulate the flow of uranium, plutonium, neptunium and the fission products (FP) while extraction by PUREX method. It will be able to predict transient behavior and profiles at equilibrium of uranium, plutonium, neptunium and fission products in several units of pulsed columns and mixer-settlers, which are connected each other in the PUREX plant. The program is being developed in FORTRAN language.With this program it will be possible to combine pulse column and mixer settler and carryout simulation analysis of the plant. User will be able to select rate of reaction, oxidation reduction reaction, calculate aqueous phase organic phase mass transfer for each chemical type selected, also it will have an output function for the concentration distribution of each step of extractor for a given time (transient calculation function). In addition, it will be possible (stationary calculation function) to calculate a state where the whole process has reached equilibrium on the basis of the result of transient calculation. While a code named PULCO to simulate this process has already been created, but because of its limitations and some accuracy issues, it is being modified. Another important aspect is to install definition of 29 components as the chemical types as opposed to the earlier 8 components handled by the PULCO code. It would also incorporate 27 chemical reactions as opposed to 11 in the PULCO code. In the future, this code is expected to rationalize operating conditions of the extraction facility and examination of safety improvement, furthermore contributing to the research and development of new extraction processes.

Modifying bacterial cellulose for applications in composites and tissue engineering

Pranjali Nanda

Dr. Vivek Verma

In the present work Bacterial cellulose (BC) was developed using the traditional method but owing to various challenges, including fungal contamination, it was carried out in conical flask to reduce the contamination. For further optimization, 4 different media were used of which Corn Steep Liquor (CSL)-Fructose media showed the best result. Further contamination was avoided by use of cotton plug. Bacterial cellulose was extracted after 7-10 days of cultivation in incubator at 30°C and washed. Since porous BC is desirable for both composite and tissue applications, HDPE beads were coated with 0.5% w/v agarose gel to increase the hydrophilicity and hence incorporate porosity into the BC film. Sample was removed of excess moisture and then coated with PVA and PVDF. To change orientation of fiber alignment of BC, electric field was applied in the media with insulated copper plates at around 25V to result in unidirectional fiber alignment.

Barie category theorem and its applications

Prasanta Lenka

Dr. Rama Rawat

The object of my work is fully concentrated on a beautiful Category Theorem called Baire Category Theorem. The observation was how this theorem works as an important tool in analysis. I also have taken up the study of metric spaces as part of my SURGE Programme. A metric space (X,d) is a set X equipped with a metric d. The metric'd' is a generalization of the familiar notion of distance as in the Euclidean plane or space. As a result many concepts central to real analysis like namely Continuity, Connectedness, Completeness, and Compactness can be defined and studied on the metric spaces. These notions culminate in a beautiful category theorem called the Baire Category Theorem. This theorem is a powerful tool in existence/non existence of certain kind of functions or sets. It finds applications in many branches of analysis. This theorem provides an new proof that R is uncountable. Non existence of any function f : R→R s.t R \Q ≠ D(f).Also existence of a continuous function whose Fourier series diverges at a point. Fourier series have some important applications on Physics as well as Mathematics. This theorem gives information about the behaviour of Fourier analysis. This theorem gives further strategy to prove so many results in analysis.

New algorithms for video de-interlacing
Pratibha Garg
Dr. K S Venkatesh

The project deals with the problem of De-Interlacing of an interlaced video sequence. Interlaced video consists of 2 fields –even field/odd field which scans only half of the lines at a time resulting in poor image quality and motion artifacts in the video. Therefore, De-Interlacing becomes necessary in digital video processing especially with upcoming of LCD and plasma TVs. The report is focused on studying different de-interlacing methods used till date and proposing a better and robust method in terms of improving the image quality and reducing the computational complexity. It describe 3 methods based on linear warping ,inter-field and intra-field de-interlacing techniques and most recent Isophote approximation based method to produce improved performance. Second method called as 'Spatio-Temporal Difference' make use of simple motion estimation to obtain static and dynamic regions in the image and apply the temporal averaging and spatial averaging techniques in both the regions respectively. Third method called as 'Isophote Difference' uses the same technique of motion detection and apply isophote approximation temporally and spatially to obtain high clarity near fine edges. These methods were compared with the existing approaches and third method was found to be better in terms of visual quality and peak signal-to-noise ratio(PSNR) while second method was found most appropriate one to de-interlace an interlaced video as it performed better in terms of PSNR ratio along with decreased computational complexity.

Preparation of nitrogen incorporated carbon nanofibers(CNFs) in novel single step method
Pratikshit Sharma
Dr. Nishith Verma

The objective of the project is to develop the nitrogen-doped carbon nanofibers (CNFs) in a novel single step method and to optimize the controlling conditions and setup for high quality CNFs and nitrogen content. The process used for growing CNFs is chemical vapor deposition (CVD) which decomposes hydrocarbon precursors in elemental carbon for nanofibers production. These N-doped CNFs have various applications in such as adsorbents, metal catalyst supports, biosensors, electronic applications such as displays and computer chips, sites to adsorb acidic gases such as H_2S and CO_2, CO and CO_2 adsorption, emission reduction of NOx and SO_2, for lithium storage in high capacities in LICs, adsorption of Pt, oxidative dehydrogenation of propane etc.We have tried to prepare nitrogen doped CNFs in a single step method using a single source which acts as carbon as well as nitrogen source. Also, the substrate used for metal catalyst support ACFs allows low impurity levels in CNFs as compared to other substrate such as silica etc. This method can be used to avoid use of NH3 gas for N-doping in CNF as well as other multi step methods which are difficult to operate.

Molecular understanding of bone development

Prince Kumar Lat

Dr. Amitabha Bandopadhyay

BMP signalling has been shown to be necessary and sufficient for bone formation. Other than BMP, TGF-β, FGF, Hedgehog and Wnt signalling pathways have also been shown to be important for bone formation. However, what is not clear is the inter-relationship between these signalling pathways or the hierarchy of action of these different signalling pathways leading to bone formation. The objective of this project is to address these issues using a cell culture based model system. Bone marrow-derived stem cells can form bone nodules if cultured in the presence of oestrogenic media for 16 days. Using these cell lines, an *in vitro* setup has been developed where role of these signalling pathways can be addressed by adding either activator or inhibitor of these signalling pathways. Phenotype was observed by well established classical histological staining techniques such as Alkaline Phosphates(ALP), Alizarin Red(ALZ) and Von Kossa. My preliminary data suggest that BMP signalling is required only in the initial phase of in vitro bone differentiation while inhibition of FGF during the same period causes significant up regulation of oestrogenic activity. Independently, I have observed that a combination of three transcription factors, namely Runx2, Osterix and Tieg1, is sufficient to drive a muscle progenitor cell C2C12 into oestrogenic fate.

Study of gallium nitride using quantum mechanical calculations

Priyanka Samanta

Dr. Madhav Ranganathan

We have performed Quantum Mechanical Calculations on Wurtzite form of GaN crystal structure using Density Functional Theory. The methodology involves the use of a software package known as PWSCF(plane wave self-consistent field). It is a DFT based package that uses a plane-wave basis and. pseudo potentials to solve the Schrodinger equation for periodic systems. The goal of this work was to calculate the surface energies and the surface diffusion barriers on GaN(0001) surfaces with different configurations. These diffusion barriers play an important role in the morphology of the growing GaN crystal. Towards this end, we performed calculations for surfaces using a slab geometry. We optimized the parameters used in the calculations like the number of plane waves and the pseudo potentials used. These calculations are very time-consuming and we were not able to extend them to calculate surface energies within the time-frame of the SURGE project.

Flow past two cylinders in tandem arrangement at low reynolds number
Rahul Ajay Deshpande
Dr. Sanjay Mittal

The flow past two identical/different cylinders in tandem arrangement at low Reynolds number, Re = 100, is numerically investigated via two-dimensional computations. The Re is based on the larger diameter for each case. The study concentrates on understanding the nature of variation of aerodynamic coefficients with the corresponding change in the diameter ratio (D_2/D_1) and gap-width ratio (G/D_1). It is observed that the physical quantities such as coefficient of lift, coefficient of drag and the Strohal number (non-dimensional vortex shedding frequency) follow a hysteretic nature of variation in the region around the critical gap-width ratio. The hysteresis is said to exist owing to the inertia that a flow possesses when subjected to the cylinder arrangement. The critical gap-width sees a transition in flow regime for the tandem cylinders with Karman vortex shedding from both the cylinders which otherwise showed shedding only behind the downstream cylinder. It is also observed that the hysteresis region's width increases with increase in the diameter ratio.

Fabrication and analysis of micro circuit elements using nanosecond UV laser
Ramsubramanian P
Dr. J. Ramkumar

Objective of this work is to fabricate and analyse the micro-circuit element using nanosecond UV laser. Excimer laser micro-machining has applications in micro-electro mechanical systems (MEMS), micro-opto-electro-mechanical systems (MOEMS), micro-systems technology (MST), and lithography and Biomedical industries. Excimer laser machining with mask projection technique is used to fabricate the micro-circuit elements. The CNC codes for micro-circuit elements are generated by manual tool path generation using AutoCAD and Excel. Electronic circuit is designed to switch the laser off during the rapid transverse move. Machined features are analysed for overcut using optical microscopy. The edge roughness is measured offline using the code generated in MATLAB. For micro components manual tool path generation is preferred one, the edge roughness is reduced to 0.311μm from 0.826 μm.

Implementation of integer multiplication
Rohit Kumar Jha
Dr. Piyush P. Kurur

Computing the product of two N-bit integers is nearly a ubiquitous operation in algorithm design. Large integer multiplication forms the foundation of many modern day public-key cryptosystems, like RSA. One of the most notable applications is the RSA cryptosystem, where it is required to multiply two primes that are hundreds or thousands of bits long. The larger these primes the harder it is to factor their product, which in turn makes the RSA extremely secure in practice. Our aim is to implement Integer Multiplication algorithm primarily based on DKSS Algorithm to achieve better running time than previous implementations of Integer Multiplication, especially for 1024, 2048 and 4096 bit integer multiplication as these are primarily used in cryptosystems. Furthermore, we plan to get this implementation included in GMP library.

Understanding spontaneous aggregation behaviour of polyglutamine peptides
Richa Sharma
 Dr. Ashwani Kumar Thakur

Polyglutamine expansion diseases are neurodegenerative disorders caused by expanded CAG repeats encoding glutamine residues. The pathogenesis of polyglutamine repeat arises from its ability to aggregate. Aggregation, thus plays a major role in the context of the disease. The aggregates formed by polyglutamine peptides are beta sheet rich. In this project, different polyglutamine peptides with point mutations at strategic positions were studied for their aggregation behaviour using HPLC sedimentation assay and fluorescence spectroscopy . Also a quantitative method was developed for monitoring the aggregation kinetics of polyglutamine peptides using fluorescamine dye. It was found that the behaviour of the Alanine mutant was quite similar to the wild type polyglutamine peptide, thus suggesting that alanine readily fits into the beta sheet structure. The standard curves were obtained for the reaction of model protein Bovine serum albumin (BSA), different mutants of polyglutamine peptides, polyglutamine peptide(wild type) and Exon1 with fluorescamine dye. Incubation time required for the completion of reaction of BSA, polyglutamine peptide mutants polyglutamine peptide(wild type) and Exon1 with fluorescamine dye was also determined.

Fabrication of micro-channels over silicon substrate to be used for optical sensing applications
Riya Khurana
 Dr. Shantanu Bhatacharya

We propose a simple method for fabrication of micro-channels over the surface of p type (100) silicon substrate, which will further be used for developing a sensing platform. Fabrication of micro-channel will be performed by photolithography followed by wet etching process in alkaline solutions (KOH & TMAH). Wet etching often causes surface roughness's which adversely affect the performance of a device such as wave guide, to be used for bio-sensing application. So to acquire the greater finish, comparative analysis has been performed using some etchant bath additives such as isopropyl alcohol (IPA), tetra methyl ammonium hydroxide(TMAH) and potassium ferricyanide ($K_3Fe(CN)_6$) with varying concentration and temperature. Micro channel with optimized parameters is then coated by low refractive index porous silica film which will be used for guiding light waves inside the micro channel which further will be used for optical bio sensing applications.

Design of a coaxial mono tiltrotor MAV
Rohit Gupta
 Dr. Abhishek

The preliminary design of a Coaxial Tilt Rotor MAV has been presented here. The Coaxial Tiltrotor is an aircraft that combines the vertical takeoff capabilities of a rotary wing aircraft with the cruise efficiency of a fixed wing aircraft. A thorough literature survey of different tiltrotor configurations was done and a unique hybrid tiltrotor/tiltwing configuration has been proposed. Trade-off studies were conducted with Weight, Structural and Performance constraints to select critical parameters for the airframe design. A detailed design, stability, and computational analysis of the aircraft has been conducted. A novel hovering configuration has been proposed with the emphasis to reduce instability during transition from rotary wing to fixed wing configuration. Momentum theory based calculations were done for performance comparison between a coaxial tiltrotor and a conventional helicopter. A prototype was fabricated and flight tests were conducted.

Study of tension and compression anisotropy In Mg and Mg alloys using viscoplastic self-consistent simulations
Shivani Gour
 Dr. Nilesh Gurao

Magnesium and its alloys have tremendous potential for various applications in automobile and aerospace industries, as well as structural applications in electronic industry due to their low density, high strength to weight ratios and high recyclability. However, the poor ductility of magnesium and its alloys due to limited number of slip systems has been the Achilles heel for their extensive use in aforementioned industries. The basal , prismatic and pyramidal <a> slip systems do not satisfy the von Mises criterion of 5 independent slip modes required for deformation. So, the plasticity observed at room temperature can be attributed to pyramidal <c+a> slip as well as extension twinning and contraction twinning. Twinning unlike slip is polar in nature and has a strong dependence on preferred crystallographic orientation or texture and direction of loading. Extension twins lead to an increase in uniform elongation in tensile test while contraction double twins lead to a decrease in uniform elongation, shear failure at low strains and work softening during compression and rolling. Thus for a given texture, the direction of straining plays an important role in determining the deformation behaviour of magnesium. This is of practical importance as in-service components . In-service components are subjected to both tensile as well as compressive loads. Also, the material is subjected to both tensile and compressive loads which is important severe plastic deformation(SPD) techniques like triaxial compression. In the present investigation, the effect of tension and compression on the mechanical behaviour of Mg will be analysed at significant plastic strain using viscoplastic self-consistent simulations.

Simulation and modelling of SG-FETs and other steep sub-threshold slope device
Shreshth Gandhi
 Dr. Yogesh Singh Chauhan
The suspended gate field effect transistor (SGFET) is a hybrid Micro-Electro-Mechanical (MEM)-solid state device with a variety of applications such as sensing, abrupt switching, low-power DRAM or NV memory applications. Our work deals with studying the this device, simulating a MOSFET device, investigating the dependence of pull-in voltage on the gate-support geometry such as support height, beam length and width as well as support configuration. COMSOL multiphysics has been used for making the model file required for the simulations. The model for the MOSFET uses the drift-diffusion approximation and Shockley-Read-Hall recombination. The model for the bendable gate uses the standard Euler beam equation for computing the gate deformation along with Poisson's equation for computing the electric field in the air gap. Pull-in voltage can be estimated by checking the point at which the beam becomes unstable and collapses. The inferences drawn from these relationships would be useful in designing gate geometries for desired pull-in voltages and also for predicting pull-in voltage by knowing the gate geometry.

Design of power divider based on substrate integrated waveguide technology
Sohum Datta
 Dr. Animesh Biswas
Power dividers are passive components used for power division in microwave circuits. The input signal in the component is divided into two or more signals of less power. The most common power divider is designed to generate equal power division at each output port. However, unequal power division is also possible. A wide variety of power divider circuits based on both conventional rectangular waveguide and planar micro strip technology has been invented and can be found in many literatures e.g. E- / H- plane waveguide TEE junction, Wilkinson power divider, Bethe hole coupler, directional coupler etc. Both technologies have their own merits and demerits. The waveguide components have several advantages over other components e.g. high Q, high power handling capability, good electromagnetic shielding, low loss etc. But, these components are bulky, non-planar in nature and are not easily integrable with other planar circuits. On the other hand, planar micro strip technology is preferred due to its easy fabrication process, less difficulty in design and integration but it also has several demerits like low Q, less power handling capability etc.Recently, a new technology called Substrate Integrated Circuits has been developed which bridges the gap between these two technologies. In this technology, different non-planar metallic waveguide components are realized in planar circuits by means of incorporating periodic via structure in copper-cladded dielectric sheets. Several microwave components using this technology have been reported in recent research works. The purpose of the proposed research work is to implement different topologies of power divider using Substrate Integrated Waveguide technology to operate in X Band (8 GHz-12 GHz).Different configuration of power divider circuits like tee junction will be designed, fabricated and characterized using measurement data.

Rehabilitation of damaged concrete using FRP
Subhajit Mohanty
 Dr. Sudhir Misra

Repair, strengthening and improving serviceability of damaged, deteriorated and substandard structures has become an important challenge worldwide. Engineers have considered different materials and methods for this purpose and fiber reinforced plastics (FRP) has emerged as a very viable option to ensure rapid and effective repair. Though a lot of work has been done in the area there is limited information and data available on the confining effect of FRP sheets wrapped around damaged concrete. The proposed work was carried out using FRP sheets wound around partially damaged concrete cylinders with different levels of induced damage. The method and extent and angle of wrapping were also varied. These confined specimens were then tested in compression to study the behavior of 'repaired' concrete under applied load. Strain gauges were applied to each cylinder and appropriate analysis was done to design stress-strain characteristics of confined concrete using matlab.In this manner, it is believed that a contribution has been made towards improvement of design tools for repair of damaged or deteriorated concrete structures.

Nanowire oscillator for Sensors and generators
Sukriti Mantri
 Dr. Sarang Ingole

Nano-Electromechanical systems are system that involves nano-size mechanical components, Actuators, Transducers and sensors. These systems are becoming highly popular for their applications in detection or sensing. Structures have been already made that can detect force, pressure, heat, mass, molecules etc. Using this idea, we are trying to fabricate motion sensor. This motion sensor will have capacitive detection for sensing and nanowire oscillator as mechanical component. Once successfully fabricated, they can be used as Seismic sensors for detecting small objects on the surface, underground or in water and for detecting footsteps signals. The nanowire oscillator will contain a nanowire with a metal blob on its top. The metal blob is to be put on top of nanowire so that the resonance frequency of nanowire lowers down. In addition, metal blob at top can help in capacitive displacement detection.We have used Metal assisted electro less etching (MACE) for fabricating nanowires. This technique has been used since it is simple and low cost method and also provides control over length and diameter of nanowires. In addition MACE involves use of a metal catalyst which enhances the etching tendency of etchant solution. Silver has been used as metal catalyst. Deposition of silver has been done by two methods-Electro-less solution method and thermal evaporation method. We have done the fabrication of the nanowires with MACE.Metal blob on the top of nanowire was deposited by electro deposition. We have been able to detect the presence of metal on tip of fabricated nanowires.

Design and performance estimation of a vertical axis wind turbine with dynamic pitch change
Swastik Basu
 Dr. Abhishek
The project deals with a systematic approach towards the design of a Vertical Axis Wind Turbine with variable blade pitching. Double Multiple Stream tube model has been applied to predict the performance of a variable pitch straight bladed VAWT using NACA 0015 airfoil. The analytical results have been validated by other predictions and comparison with available experimental data show good agreement, particularly in terms of the trend. This can make the model a powerful tool for the design of a variable pitch VAWT, eliminating the need for prior CFD analysis. A parametric study has been conducted using the DMST model. The results have been utilized to make an approach towards designing and fabrication of a variable pitch VAWT prototype with optimum aerodynamic performance.

Construction of normal numbers in polynomial sized circuit classes
Tanvi Soni
 Dr. Satyadev Nandakumar
A number is said to be normal to base r if every block of k digits appear in its fractional part with a frequency of r^{-k}.Our aim is to construct normal numbers in polynomial sized circuit classes and to find a lower bound for them. We give a polynomial time algorithm to construct base 2-normal Champernowne sequence and implement it in NC^1 class. The work also contains NC^1 construction of binary Besicovitch and Odd Parity sequence.By proving that infinitely often division can be constant depth reduced to computing Champernowne constant, we try to find AC^0 lower bound for Champernowne sequence. Martin Strauss' construction of number normal to base 2 in DLOGTIME-uniform-AC^0 circuit has been described in detail. We give an existential proof of base 3-normal numbers in non-uniform AC^0 circuit class that follows from Strauss' construction. In 2013, Elvira Mayordomo constructed absolutely normal number in $O(n^2log*n)$ time using martingale diagonalisation. Veronica Becher, Pablo Ariel Heiber and Theodore A. Slaman gave another polynomial time construction of absolutely normal number in the same year. However, despite the recent developments, the question that is there an absolutely normal number in AC^0 class, still remains unresolved.

Fabrication of photonic crystal by click chemistry
Tatsat Banerjee
Dr. Sri Sivakumar

We have demonstrated a simple and versatile approach for the fabrication of three dimensional photonic crystal using "Click" Chemistry. Azide functionalized silica nanoparticles were used to form monolayer on to alkynes functionalized glass substrate via Copper(I)-catalyzed-azide-alkyne Cycloaddition. As-prepared monolayer had free azide moieties on its surface and that is why we employed alkynes functionalized silica nanoparticles to form the second layer, utilizing the aforesaid reaction again. Repeating this deposition technique we have constructed multi layers of silica submicrospheres on to the glass substrate. Thus adopting this unique layer-by-layer way of colloidal self-assembly, we have successfully prepared a tailored nanostructure which exhibits photonic crystal properties.

An economic study of low price housing market of Kanpur: a hedonic approach
Tejasvi Rana
Dr. Vimal Kumar

The objective of the work is the demand analysis of various housing attributes for the low price housing market of Kanpur. The analysis requires the hedonic approach to be employed. The theoretical framework for hedonic pricing of heterogeneous goods developed by Rosen in 1974 has been studied. The primary data is required for estimating the hedonic price function and in turn the demand of housing attributes. Hence the questionnaire prepared for the survey enquires regarding the characteristics of the household and the structural, location and neighbourhood characteristics of the housing unit. The survey was conducted in the main market places of Kanpur in order to achieve the conditions of simple random sampling with repetition. The data is collected from 279 respondents and is classified on the basis of important variables for the study. Numerical data analysis and calculation of hedonic price function are the tasks for future study using collected data.

Dynamic IP networks path selection
Unnat Jain
 Dr. Ketan Rajawat

Path delays in IP networks are important to network operators for assessing, planning, and fault diagnosis. Making measurement at all paths is a waste of resources. The existing work suggests spatio-temporal kriged Kalman filtering approach to predict delays on remaining paths using measurements on only a few paths. The proposed algorithms improve on the accuracy of the existing greedy algorithm to minimize error in prediction by controlling the propagation of error to future time slots while minimizing the error at the present time slot. The aim is to minimize not the ith time slot prediction error but the sum of all time slot errors.

Shortest time path in railway network
Utkarsh Patange
 Dr. Ajay Jain

I intend to design a code that will determine the path from city A to city betaking minimum time. Main problem that arises in finding such a path is that many times, there is no direct train available from A to B. In such cases, one has to change trains midway. The program will take into account the time required by one to change platforms at such junctions, and amongst all the possible paths from A to B, it will output the path taking shortest time. Given enough data, even nights and buses can be taken into consideration by the program. In future, this program can be extended to find out shortest path with reservations available, again if enough data is provided. Problem Statement To determine the shortest time journey between two cities A and B given a graph with nodes as all the train stations in the country and edges as the train routes between all the stations with edge weight = time needed to reach from destination to source.

Aeroacoustics - Study of noise generated by helicopter rotor blades
Vaibhav Gupta
 Dr. C. Venkatesan

Helicopter noise reduction is a topic of research into designing helicopters which can be operated more quietly, reducing the public-relations problems with night- flying or expanding an airport. In addition, it is useful for military applications in which stealth is required: long-range propagation of helicopter noise can alert an enemy to an incoming helicopter in time to re-orient defenses.
This report contains detailed derivation of FW-H equation and solution of the equation. It talks about various source terms in the equation and solving them through collapsing sphere method.

Velocity and position estimation of autonomous helicopter using IMU and GPS data
Vinodhini C
Dr. C. Venkatesan

The objective of this project is to estimate the velocity and position of an autonomous mini helicopter using data from an Inertial Measurement Unit (IMU) and Global Positioning System (GPS). One of the major difficulties faced with an autonomous helicopter is to keep the vehicle hovering at a particular position and attitude in a stable manner, for which accurate position estimation is very critical. There are many limitations with the existing technologies, and hence, there is a need for a more reliable and more accurate method/technology. The concept of Kalman filtering and its applications in state estimations of vehicles have to be studied. Using test flight data (GPS and IMU outputs), position, velocity and acceleration of the helicopter have to be estimated through Kalman filter models. Since the sensors will be mounted on the helicopter and knowing the take-off position of the vehicle, i.e., the Initial Position, the Final Position of the vehicle in space can be determined at every instant of time during its motion/flight. Although GPS and IMU have been used in various applications like tracking human motion, navigation, etc., it has been observed that the errors are quite significant, thereby leading to incorrect results. Hence, it is highly essential that tests are carried out to determine if they can be used to estimate the helicopter's parameters. The next stage is aimed at state estimation without using GPS, cameras, or any other sensors except those which are currently mounted on the helicopter. This would ensure that the helicopter is robust and versatile.

Sphere decoding for MIMO systems using efficient matrix inversion
Vipul Gupta
Dr. Ajit K. Chaturvedi

Our work compares itself with an existing method for reducing the complexity of calculating the unconstrained solution in Sphere Decoding for Multiple-Input-Multiple-Output wireless communications. The unconstrained solution offers the possibility for flexible detector strategies. Finding unconstrained solution can be advantageous for low complexity lower performance detection in high-quality MIMO channels. Our work considers the application of Cholesky Decomposition to find the inverse of a positive definite Hermitical Matrix. It is shown that comparatively less number of floating point operations (FLOPs) are required to find the unconstrained solution, as compared with the existing method; however, yielding better performance.

Control design for non-overshooting response of hard-disk drives and buck converter circuits
Amish Goel
Dr. Robert Schmid

In several control applications, design of Non-overshooting response with a fast settling time is a crucial performance requirement. A method of NOUS(Non Overshooting and Undershooting) design has been proposed by R Schmid and L Ntogramatzidis[2010] to achieve such a good transient response on LTI MIMO and SISO systems. The research focused on investigating the performance of these state-space design techniques on real-world problems. Specifically, I focused on design of control for Hard-disk drive servo system and Dc-buck converter circuits. While implementing the design, several real-world effects like external disturbance, measurement noise and additional resonant modes of the plant were also considered. In the simulation of HD servo system, controller was designed using Reduced ordered estimator for the nominal plant model (double integrator).Both the problems of track seeking and track following were addressed. Additional resonant modes were also included in the plant-actuator model. Feedback gain matrix was obtained using the NOUS algorithm. To counter the effects of resonant modes a notch filter was also added. The simulation results which included settling time, gain-phase margin, sensitivity plots were compared with the more complicated nonlinear control technique of CNF(Composite Non-linear Feedback), RPT(Robust and Perfect tracking-linear)and MSC(Mode Switching Control). The NOUS algorithm showed performance inferior to CNF but superior to many of the other techniques. In case of Buck dc- converter circuit, the plant was modeled in Sims cape environment of Matlab and controller was designed as earlier but using a full order estimator. An additional low-pass filter was also designed using the Matlab SISO design tools and cascaded with the state-feedback controller to minimize the effects of measurement noise that could not be tackled by NOUS design alone. The results were then compared with feedback posicast based Control, and found to be superior.

Study of optical heating of Gold nanoparticles by Lock-In detection enabled pump-probe spectroscopy

Vijin Venu

Dr. Bruno Palpant, Dr. Nadia Djellali

The Research group of Prof. Bruno Palpant, at École Centrale Paris works in light-heat nano conversion and ultrafast plasmonics. The optical properties of noble metals which are linked with the plasmon resonance constitute a field of remarkable research today. Due to the plasmon resonance phenomenon, arising from the interaction of an electromagnetic wave and the electrons confined in metal nanoparticles, one can efficiently and quickly inject energy in the latter by light irradiation. In order to understand better the physical processes involved, it is relevant to study the optical response dynamics subsequent to the excitation of noble metal nanoparticles by a light pulse. Pump probe spectroscopy is one of the techniques used to study ultrafast electron dynamics. This technique uses subpicosecond laser pulses to realize both the perturbation and the subsequent measurement of the optical properties of matter along the relaxation. The perturbation here is the stronger part of the initial pulse which is used to excite the sample, generating a non-equilibrium state in the sample and is called the Pump pulse and the subsequent measuring pulse, which is the weaker part of the initial pulse which is used to monitor the pump-induced changes in the optical properties of the sample and is called the probe pulse. Measuring the changes in the optical constants as a function of time delay between the arrival of pump and probe pulses yields information about the relaxation of electronic states in the sample. During my internship, I designed and implemented a detection technique which improved the signal to noise ratio significantly and thus study the heating of Gold nanoparticle arrays. Synchronous detection techniques are widely used for low noise detection. A lock-in amplifier is typically used in cases when we have a very small signal buried in Noise. In our experimental set up we used model SR830 Lock in Amplifier by Stanford research systems. The initial data for test-run was collected from the ZnO sample with the Monochromatic coupled with Avalanche Photodiode detector. Notch filter at the lasing wavelength of the pump was used for improved detection. Signals for gold nanoparticle arrays was then obtained and studied. I also took part in experiments on study of stationary and ultrafast optical responses of Au nanoparticle arrays using normal pump-probe experiments.

Turbulent natural convection in a vertical channel
Prabhanshu Pavecha
Dr. Andrew Ooi

Present study investigates the shape and evolution of flow structures, which are inferred as the regions of high swirl strength in the present problem of turbulent natural convection in a vertical channel. Above mentioned swirl strength calculation is based on direct numerical simulation (DNS) data for Rayleigh numbers (Ra) 5.4×10^5, 2×10^6, 5×10^6 and 2×10^7. The flow structures were visualized as 3D iso surfaces of swirl strength in the vertical channel, which showed the evolution of finer structures with increasing Ra. A comparison between swirl strength and temperature cross-sections for different Ra shows that regions of high swirl are closely related to regions of high temperature gradients. We looked into the cross correlation profiles between stream wise velocity fluctuations u' and stream wise wall shear stress fluctuations τ_x', temperature fluctuations T' and fluctuations in heat flux through the wall q_w', u' and q_w' and finally wall normal velocity fluctuations w' and q_w'. Contour plots were plotted for these correlations which depicted that the profiles seem to orient themselves in the direction of gravity. These profiles give evidence of existence of coherent and organized structures in the present flow problem.The structure inclination angle ɸ for the correlation between u' and τ_x' for Ra = 5.4×10^5 was plotted against the wall normal distance which showed that ɸ seems to remain constant at ɸ ≈ 26° when 5 < Δz^x < 15. Comparison of cross correlation profiles suggested that ɸ is almost invariant of Ra. We also studied ɸ for various Prandtl numbers (Pr) 0.07, 0.709 and 7.0 for Ra = 5.4×10^5, which suggested that ɸ increases as Pr increases. ɸ was also studied for the correlation between T' and q_w' for various Pr for Ra = 5.4×10^5. Above mentioned study showed that ɸ decreases as Pr increases.

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Model design for shake table test
Gaurav Sachdeva
Dr. Helen Goldsworthy

Shake table tests on reduced-scale models are the primary means by which seismic performance can be assessed when complex systems are involved, or if there is a need to validate or calibrate analytical models. The models have utility in concept-learning also. In this paper, an effort has been made to design a scaled model that can be used on The University of Melbourne's shake table to demonstrate a few earthquake resistant design concepts. The Buckingham Pi theorem and the Similitude theory have been used to design the model. The time based scaling method has been adopted and the additional mass required at each floor has been calculated. The Finite Element Analysis of the model shows that the time period values of the model are as desired and the additional mass can be carried by the model. The design forces and moments are for a target performance of one percent inter-storey drift ratio. It has also been confirmed through the analysis that the contribution of floor slab in the lateral stiffness of the model is close to what it is in the real structures. The performance of the model under the action of scaled El Centro Earthquake ground motion has also been estimated analytically.

National wind tunnel facility

A group of SURGE students visited the National Wind Tunnel Facility (NWTF) on July 3, 2013.The National Wind Tunnel Facility (NWTF) was established in 1999 at IIT Kanpur to meet the national needs in areas of aeronautical and non-aeronautical R&D activities. It houses one of the most versatile and efficient wind tunnels in India. It has various simulation and measurement systems, with interchangeable test sections (cross-section 3.00 m x 2.25 m and length 8.75 m), and is capable of testing at wind speed up to 80 m/s. A group of SURGE 2013 students visited the National Wind Tunnel Facility(NWTF). The visit began with a presentation by Prof. Sanjay Mittal, Head, NWTF. The students were exposed to the history of the facility and its various capabilities. Several results from earlier tests were shown. Prof. Mittal also discussed the role of such a facility in executing projects of National importance. He also explained his research group's activities related to Computational Fluid Dynamics (CFD). The group was then taken for a visit. Dr. Rajeev Gupta led the visit to the test section while Dr. Chaturi Singh explained the conduct of a typical test from the control room and the related instrumentation. The entire group thoroughly enjoyed the walk in the tunnel circuit up to the large fan section.

Visit to engine research lab

SURGE students visited Engine Research Laboratory of Mechanical Engineering on 3rd July 2013. Faculty In-charge of Engine Research laboratory, Prof Avinash Kumar Agarwal and students of the lab showed various research facilities and explained the ongoing research projects. Some of the facilities seen by the students are :

Laser ignition of engine :
Lasers are emerging as strong contenders as alternative ignition source for spark engines. Short laser pulses of few nanoseconds pulse duration delivered by a Q-switched laser can be focused by an appropriate lens system inside the combustion chamber. If the peak intensity in the focal region exceeds threshold intensity level, plasma formation takes place. Plasma induced this way can be used to initiate the combustion of air-fuel mixtures in SI engines. Laser ignition has several advantages in terms of fuel efficiency and reduction in exhaust emissions.

Single cylinder optical research engine:
This is a flexible internal combustion engine system with provision to vary fuel injection strategies and timing, supercharging boost pressure, varying compression ratio etc. For Combustion visualization, it has transparent quartz liner and quartz window in the piston crown. Engine also has provision for installation of endoscope for combustion visualization at higher engine operating load. This facility can be used for various fundamental studies related to combustion visualization, spray formation, ECU mapping for wide range of fuels.

Biodiesel pilot plant

Biodiesel has been identified as a suitable alternative for the traditional diesel fuel for rural applications in India because of its biodegradable nature and localized abundant availability of the feedstock materials. Biodiesel pilot plant is designed and developed in Engine Research lab. The pilot plant is 25 Kg batch size and works on transesterification process. This plant has a steam generator for meeting process heat requirements. The transesterified biodiesel is then washed using warm water, in order to remove the catalyst and the final product is later stored for distribution. Field trial of 100 percent biodiesel fuelled SCORPIO vehicle was done.

Diesel oxidation catalyst

Diesel particulate mainly composed of elemental carbon, organic carbon, inorganic ions and ash. Diesel oxidation catalyst is an effective way to control the particulate emission from diesel vehicles. It is very effective in removing the soluble organic fraction (SOF) of the particulates, which is mainly responsible for carcinogenic and mutagenic effects on human beings. The reduction of different particulate components, PAHs emission and regulated gaseous emissions is being done using DOC.

Visit to mini-helicopter laboratory

On the visit to Helicopter lab, students not only got an opportunity to see the Autonomous Mini-Helicopter being developed at IIT Kanpur, with funding from Department of Science and Technology, but also got to interact with researchers involved in development of autonomous Mini and Micro helicopter technology. The students visiting the lab were divided in to groups of 6 to facilitate better understanding and allow them time to interact and discuss with laboratory experts. Each group spent time discussing the details of the helicopter model, followed by a trip to manufacturing section, where they got to observe the details of design and manufacturing of various structural and mechanical components of the helicopter. After this they also spent time at the engine test facility discussing the challenges associated with characterization of the engine used on mini helicopter. In addition to the graduate students and other lab personnel's, the students got their queries solved from the   Professors. The trip concluded with outdoor demo flights of autonomous micro coaxial helicopters developed at the Helicopter Lab.

Visit to the pseudo dynamic tests facility (PDTF)

The SURGE2013 students visited PDTF along with the Professor Adrish Banerjee on 05 July 2013 . The students were first shown a short video on activities in the area of experimental earthquake/structural engineering being done at IIT Kanpur which included the various facilities available for performing such experiments like Uniaxial Shake Table (Figure 1), Servo-Controlled Hydraulic Actuators (Figure 2), Vibration measuring equipment (Figure 3) etc. They were then physically shown around the various equipment available in the laboratory and explained about the capabilities of the PDTF e.g. performing tests for research on earthquake performance evaluation on prototype civil infrastructures models e.g. up to the size of a 03 storey building inside the laboratory which is a unique feature of the PDTF and is only one of its kind in India. The photograph showing details like reaction walls and strong floor of PDTF is given in Figure 4 along with its specifications.

Characteristics:

Table Size	:	1.2 m x 1.8 m
Weight of Table	:	8 kN
Maximum Payload	:	40 kN
Maximum Displ.	:	75 mm
Maximum Velocity	:	1.5 m/s
Maximum Accel^n	:	5 g
Frequency Range	:	upto 50 Hz

Figure 1: Uni-axial Shake Table

Figure 2: Servo-Hydraulic Actuator

Figure 3: Vibration Measurement System

Figure 4: Pseudo-Dynamic Test Facility

The PDTF facility is meant for simulation of earthquake loading for prototypical structures as large as full-scale three-storey building or 15m long bridge. This 500 sq. m new lab space is served by a 200 kN EOT crane with its ceiling height at 15 m. The integrated strong floor and wall (10x15x4.0 m three cell box girder floor and 10.5 m high, 2 m thick post-tensioned walls) provide a rigid three-axis reaction system for application of vertical and lateral loads. Anchorages on walls at 0.6 m grid are capable of 2 MN for axial load and 1.5 MN for shear loads.
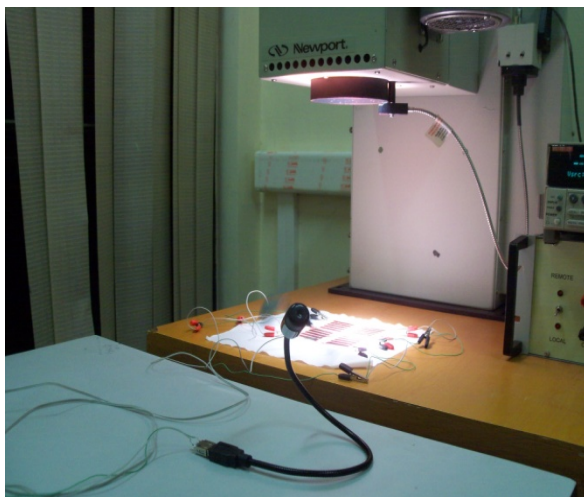
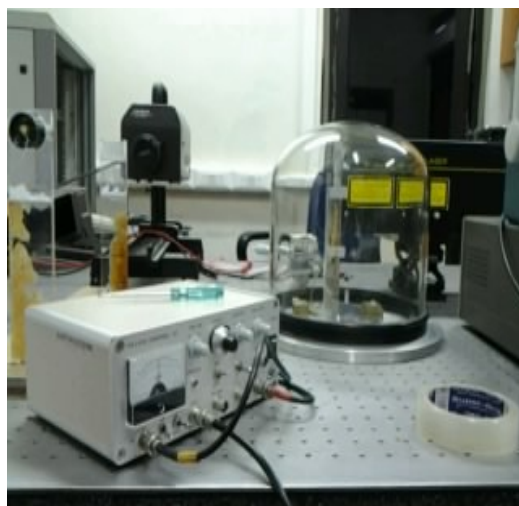# Visit to the samtel centre (SCDT)

Glove box (Nitrogen ambient)

Ellipsometry

Fan running from an organic solar cell

Kelvin Probe Set-up

SURGE students visited SAMTEL Centre for Display Technologies (SCDT) on 05 July 2013 . The visit was organized along with visits to other labs in the institute. The students arrived at SCDT at 16.15 P.M. They were received by SCDT Co-ordinator Prof. B. Mazhari along with Dr. Vandana, two Ph.D. students (Mr. Sandeep Kumar and Ms. Devika Kataria) and SCDT staff. Prof. B. Mazhari presented an introduction about SCDT, its working, the kind of equipments and facilities it has and about associated faculty. A brief introduction about organic electronics and its application was delivered. A video of the SCDT class 1000 ISO 6) clean room was shown to students. After this brief presentation, the students were divided into two groups. The batches were in turn shown scanning electron microscope (SEM), atomic force microscope (AFM) and were then taken to the optical and electrical characterization labs. In the latter two labs, the students were shown optical characterization (Optical microscope, Photoluminescences (PL), Time resolved photoluminescence (TRPL) set ups and ellipsometry), Kelvin probe, Aglient Semiconductor characterization system (SCS), probe station, glove box and solar simulator. The students were given demo of working organic LED display and were shown how to characterize thin film transistor and organic solar cells.

Achievements of students-"accepted papers in journals "

"Evolutionarily stable conjectures and social optimality in oligopolies "the earlier version of the paper was presented at the "International Conference on Game Theory and Operations Research Applications ,Hyderabad, December 21-22, 2012.

Swapnika Reddy Rachapalli (SURGE 2012 participant) & Dr. Praveen Kulshreshtha

Abstract: Following the evolutionary game-theoretic approach to analyze Conjectural Variations (CV) in oligopolies, a model is developed to derive the Evolutionarily Stable Strategies (ESS) for quantity-setting and price-setting oligopolies with CV, producing heterogeneous goods. It is shown that ESS coincides with the Consistent CV in the oligopoly model. Earlier studies have demonstrated the above result only for duopolies. It is also shown that the market outcome induced by ESS is socially suboptimal if firms produce heterogeneous products, but can be socially optimal if firms produce homogeneous goods. In general, the market outcome approaches the socially optimal outcome, as the number of firms increases to infinity.

Keywords: Conjectural Variations (CV), Consistent Conjectural Variations (CCV), Evolutionarily Stable Strategies (ESS), Quantity Competition, Price Competition, Social Optimality.

"Bactericidal effect of silver-reinforced carbon nanotube and hydroxyapatite composites "

Pallavi Kesarwani (SURGE 2010 participant) , Mohammad Atif Faiz Afzal , Sushma Kalmodia ,Bikramjit Basu , Kantesh Balani

Abstract: Bacterial infection remains an important risk factor after orthopedic surgery. The present paper reports the synthesis of hydroxyapatite-silver (HA-Ag) and carbon nanotube-silver (CNT-Ag) composites via spark plasma sintering (SPS) route. The retention of the initial phases after SPS was confirmed by phase analysis using X-ray diffraction and Raman spectroscopy. Energy dispersive spectrum analysis showed that Ag was distributed uniformly in the CNT/HA matrix. The breakage of CNTs into spheroid particles at higher temperatures (1700_C) is attributed to the Rayleigh instability criterion. Mechanical properties (hardness and elastic modulus) of the samples were evaluated using nano indentation testing. Ag reinforcement resulted in the enhancement of hardness (by _15%) and elastic modulus (_5%) of HA samples, whereas Ag reinforcement in CNT, Ag addition does not have much effect on hardness (0.3 GPa) and elastic modulus(5 GPa). The antibacterial tests performed using Escherichia coli and Staphylococcus epidermidis showed significant decrease(by _65–86%) in the number of adhered bacteria in HA/CNT composites reinforced with 5% Ag nanoparticles. Thus, Ag-reinforced HA/CNT can serve as potential antibacterial biocomposites.

Keywords: antibacterial, silver, carbon nanotubes, hydroxyapatite, nanoindentation, biocomposite

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"Functionally graded hydroxyapatite-alumina-zirconia biocomposite:Synergy of toughness and biocompatibility "
 Pallavi Kesarwani (SURGE 2010 participant) , Mohammad Atif Faiz Afzal, K. Madhav Reddy , Sushma Kalmodia ,Bikramjit Basu , Kantesh Balani

Abstract: Functionally Gradient Materials (FGM) are considered as a novel concept to implement graded functionality that otherwise cannot be achieved by conventional homogeneous materials. For biomedical applications, an ideal combination of bioactivity on the material surface as well as good physical property (strength/toughness/hardness) of the bulk is required in a designed FGM structure. In this perspective, the present work aims at providing a smooth gradation of functionality (enhanced toughening of the bulk, and retained biocompatibility of the surface) in a spark plasma processed hydroxyapatite-alumina-zirconia (HAp-Al2O3-YSZ) FGM bio-composite. In the current work HAp (fracture toughness ~1.5 MPa.m1/2) and YSZ (fracture toughness ~6.2 MPa.m1/2) are coupled with a transition layer of Al2O3 allowing minimum gradient of mechanical properties (especially the fracture toughness ~3.5 MPa.m1/2). The in vitro cyto-compatibilty ofHAp-Al2O3-YSZ FGM was evaluated using L929 fibroblast cells and Saos-2 Osteoblast cells for their adhesion and growth. From analysis of the cell viability data, it is evident that FGM supports good cell proliferation after 2, 3, 4 days culture. The measured variation in hardness, fracture toughness and cellular adhesion across the cross section confirmed the smooth transition achieved for the FGM (HAp-Al2O3-YSZ) nano composite, i.e. enhanced bulk toughness combined with unrestricted surface bioactivity. Therefore, such designed biomaterials can serve as potential bone implants.

"Flexible and dynamic power allocation in broadband multi-beam satellites" This paper accepted in IEEE communications letters
Nitish Kumar Srivastava (SURGE 2012 participant)and Ajit Kumar Chaturvedi

Abstract: For multi-beam broadband satellites operating at 10GHz and above frequencies, rain attenuation is the dominant impairment factor. Using a stochastic model for rain attenuation prediction and a greedy approach, dynamic power allocation has been recently shown to increase the number of users served than the static technique. Our paper proposes a new dynamic power allocation algorithm the novelty of which lies in treating users with similar power requirement as a group, instead of individuals. Thus, without resorting to exhaustive search we are able to serve more number of users than the existing technique.

"Quantum algorithm to solve a Maze: converting a maze problem into search problem''   This paper accepted in the prestigious AQIS-2013 presenting in Aug in IMSC Chennai

Niraj Kumar (SURGE 2012 participant), Debabrata Goswami

Abstract: We propose a quantum methodology to approach a Maze problem, which is otherwise a NP complete problem. The paper aims to convert the maze problem to a quantum search algorithm and apply iterative Grover search mechanism to move towards the solution. Our solution deals with two dimensional perfect mazes with no closed loops. We encode all possible individual paths from the starting point of the maze into a quantum register. A quantum fitness operator applied on the register encodes each individual with it's? Fitness value. We propose an oracle design which marks all the individuals above certain? Fitness value and use Grover search algorithm to? find one of the marked states. Iterating this method, we approach towards the optimum solution.

"Performance assessment of geosynthetic-encased Stone columns in soft clay ? A numerical study'' was presented in fourth international seminar on forensic geotechnical engineering, 10-12 January,Bengaluru

Micheal Koch (SURGE 2012 participant)and Rajesh Sathiyamoorthy

Abstract: In this study, 2D finite element analysis was used to understand the time dependent behavior of geo synthetic-encased stone columns (GESC)of varied length. The influence of loading pattern (i.e. flexible and rigid) on the time dependent behavior of GESC were also studied and the results were compared with the ordinary stone column (OSC) to arrive at the equivalency factor. The results indicate that the performance of GESC was found to be many times superior to soft clay and OSC in decreasing time for dissipation of excess pore water as well as reducing the magnitude of settlement. The degree of improvement was found to depend on the loading condition and the length of the GESC. For a medium stiffness geo synthetic encasement, the performance of 0.8H and 0.75H length of GESC were found to be equivalent to that of OSC of height H in terms of ultimate settlement for flexible and rigid loadings respectively. However, a drastic increase in time required for dissipation of excess pore pressure has been noticed with the reduction in the length of the GESC.

"Numerical investigation of high pressure hydrogen released in air" proceedings of ASME 2012 gas turbine India conference Dec 1, 2012, Mumbai

MalayK.Das, U.Umesh (SURGE 2012 participant), Ashoke De

Abstract: The constantly growing energy needs of the world accompanied by the emphasis on environmental pollution control have driven us to look at the possibility of hydrogen as a potential source of energy for the future. However, there are serious self-ignition hazards associated with its use, which are not yet fully understood phenomena. The issue of spontaneous ignition of highly pressurized hydrogen release is an important safety concern and it is necessary to understand its mechanism in order to adopt adequate safety measures.This paper describes a numerical investigation of the flow physics of a high-pressure hydrogen gas released through a tube into the atmosphere. The formation of a strong shock wave ahead of the high-pressure hydrogen jet causes an increase in temperature of the ambient atmospheric air, thereby leading to the possibility of ignition of the hydrogen-air mixture formed at the contact surface. The analysis of the physical mechanism of shock propagation and associated temperature profiles of the flow field are presented. Parametric studies based on the numerical results of temperature profiles obtained for the various initial conditions of release pressure and tube length have been carried out to study their effects on this high-pressure hydrogen gas behaviour and how they would favour occurrence of spontaneous ignition.

"Multi eulerial PDF transport modeling of turbulent swirling flames" proceedings of ASME 2012 gas turbine India conference Dec 1, 2012, Mumbai

Abhinav Kapoor (SURGE 2012 participant), Ashoke De, Rakesh Yadav

Abstract: The paper presents numerical investigation using Multi environmental Eulerian PDF (MEPDF) transport model for turbulence-chemistry interaction. A turbulent flame (SM1) from Sydney swirling burner database is simulated along with two isothermal cases (N29S054, N16S159) of different swirl numbers. MEPDF methodology, a probability density function (PDF) transport modeling, exploits the advantages of the PDF transport equation and is also computationally less expensive compared to popularly used Lagrangian solution approach of PDF transport equation. In the MEPDF approach, the PDF transport equation is represented by direct quadrature method of moments with presumed shape PDF and the closure of micro-mixing is achieved by interaction by exchange with mean (IEM) model. In the current work, the reacting flow results using MEPDF are reported for SM1 flame, which is a part of the database of turbulent reacting flows and widely considered as benchmark test cases for validating turbulent-chemistry interaction models. Initially, the non-reacting flows are simulated to properly choose the boundary conditions, turbulence models as well as the grid; followed by reacting flow calculations. SKE and RKE predictions show good agreement with each other while the other turbulence model exhibit substantially different behaviour, especially for non-reacting case. However, RKE model exhibits substantial improvement in the case of reacting flows.

"Group delay based methods for speech source localization over circular arrays," Hands-free speech communication and microphone arrays (HSCMA)

Ardhendu Tripathi (SURGE 2010 participant), Kumar L and Rajesh M Hegde

Abstract: Conventional sub space based approaches for source localization use the spectral magnitude of MUSIC. In this paper, a group delay based method for source localization of spatially close speech sources over circular arrays, with minimal number of sensors is proposed. This approach is based on the MUSIC-Group delay spectrum and can be used to accurately estimate both azimuth and elevation angles of spatially close sources. Both simulated and real speech signal measurements are acquired over a circular array and the DOA estimation is carried out for several trials. The accuracy of the pro-posed approach is illustrated by using two dimensional scatter plots for a single source, and average error distribution plots for multiple sources. The high resolution property of this method is explained using the additive property of the MUSIC-Group delay spectrum. The proposed method is also evaluated under sensor perturbation errors. Experiments on distant speech recognition are conducted using the proposed approach on sentences from the TIMIT database acquired over circular arrays. The MUSIC-Group delay method indicates reasonable reduction in word error rates when compared to the standard MUSIC-Magnitude method as noted from these experiments.

"Robust two dimensional source localization using the MUSIC-Group delay spectrum," Signal processing and communications (SPCOM)

Ardhendu Tripathi (SURGE 2010 participant), Kumar L and Rajesh M Hegde

Abstract: Subspace-based methods require a large number of sensors for localization of closely spaced sources since the spectral magnitude of Multiple Signal Classification (MUSIC) is used. However, the MUSIC-Group delay (MUSIC-GD) method has been used earlier to resolve closely spaced sources with a limited number of sensors. In this work, the MUSIC-GD method is used in high resolution azimuth and elevation estimation of spatially close sources under reverberant environments over a planar array. The efficiency of the MUSIC-GD method in effectively resolving closely spaced sources, even when the noise eigen-values change considerably under reverberation, is described and illustrated. Localization error analysis is performed on the proposed method and its performance is illustrated using two dimensional scatter plots. Cramer-Rao lower bound (CRB) analysis is also performed and the CRB is compared with the Root Mean Square Error (RMSE) of the proposed method. Large vocabulary speaker dependent speech recognition experiments are conducted on sentences from the TIMIT database acquired over a planar microphone array. The proposed MUSIC-GD method indicates reasonable improvements in terms of localization and the Cramer-Rao lower bound error analysis. A reasonable reduction is also observed in terms of word error rate (WER) from the experiments conducted on distant speech recognition.

"Localization of acoustic beacons using iterative null beam forming over ad-hoc wireless sensor networks"
Vatsal Sharan (SURGE 2012 participant), Sudhir Kumar, and Rajesh M Hegde

Abstract: In this paper an iterative method to localize and separate multiple audio beacon sources using the principles of null beam forming is proposed. In contrast to standard methods, the source separation is done optimally by putting a null on the other sources when obtaining an estimate for a particular source. Also, this method is not constrained by fixed sensor geometry as is the case with general beam forming methods. The wireless sensor nodes can therefore be deployed in any random geometry as required. Experiments are performed to estimate the location and also the power spectral density of the separated sources. The experimental results indicate that the method can be used in ad-hoc, flexible and low-cost wireless sensor network deployment.

"Multiple source localization using randomly distributed wireless sensor nodes," communication systems and networks (COMSNETS)
Vatsal Sharan (SURGE 2012 participant), Sudhir Kumar, and Rajesh M Hegde

Abstract: In this paper, we present a method to localize multiple sources using randomly distributed wireless sensor nodes. The principle of maximum power collection is used to obtain the beam forming weights which add the source signal constructively at the sensor outputs. The beam forming weights give the time difference of arrival (TDOA) for each of the sources from which the source location is subsequently computed using a hyperbolic estimator. Results show that the method successfully localizes multiple sources in noise.

Experimental performance evaluation of coaxial rotors for a micro aerial vehicle
Puneet Singh (SURGE 2010 participant), and Venkatesan C.

Abstract: Because of their potential for application in both civil and military sectors as well as the challenge in designing a tiny flying vehicle, micro aerial vehicles have attracted enormous attention. Several configurations of micro aerial vehicles are under development, namely fixed wing, rotary wing, and flapping wing. Under rotary-wing micro aerial vehicles, coaxial contra rotating configurations with a stabilizer bar seem to provide excellent stability behaviour in pitch and roll degrees of freedom. This paper presents the results of an experimental study performed on a coaxial-contra rotor helicopter model to evaluate the performance of the rotor system using different rotor blades. The thrust and power of the rotors in independent and coaxial configurations were observed. The percentage thrust loss in the coaxial configuration was seen to be dependent on the ratio of the upper- and lower-rotor revolutions per minute as well as the spacing between the rotors. A theoretical analysis using a non uniform inflow model was developed, which corroborated very well with the experimental data. Using low-Reynolds-number drag coefficients for the airfoil, the estimated power consumption of the rotors was found to match very well with the experimental data. A closed-form solution using a uniform inflow model to estimate the thrust performance of a coaxial rotor is proposed, which also matches with the experimental observations.

"Position estimation for autonomous hover of a mini-helicopter

Vinodhini C, Puneet Singh (SURGE 2012 participants), and C. Venkatesan

Abstract: Unmanned Air Vehicles (UAVs) are a promising research area due to their advanced capabilities and applications. The ability of an unmanned autonomous helicopter to hover enables one to operate in areas inaccessible or hazardous to other vehicles. This paper presents the research activity taken up at IIT Kanpur, India in the development of an autonomous mini-helicopter. In order to achieve stable hovering at a particular attitude, a study was conducted on the calibration of the onboard Inertial Measurement Unit (IMU) and its data was used to estimate position. The next step is aimed at integrating GPS with the IMU to obtain more accurate results. The focus of this paper is along the following lines:

1) Calibration of the IMU used in the mini-helicopter by experimentally correlating the output from the device with the output of a rotary potentiometer. The experimental setup, the procedure and the results of IMU 3DM-GX1 is discussed. Figure 1 shows the hardware setup built for this purpose as well as to check the accuracy of position calculated using the accelerometer data obtained from the IMU.

2) An analysis of the IMU output and corresponding displacement calculations at different orientations when it is subjected to rotational motion. Figure 2 shows the result for rotation of 120° provided to the servo connected to the IMU (about its Z axis with 0° about X and Y axes).

3) Simulation of position estimation at standstill condition considering data from both GPS and IMU, along with Kalman filtering. Figure 3 shows one such result.

"Aerodynamic performance of a coaxial rotor system for micro air vehicles

Puneet Singh (SURGE 2012 participant), and C. Venkatesan

Abstract: Recent advances in electric motors and lithium polymer batteries have led to development of several different types of micro air vehicles. The ability to hover is an important mission requirement for this class of vehicles. The coaxial contra rotating rotors with a stabilizer bar have been evaluated to be best in performance, stability and control in design analyses[1][2]. In this experimental study, a coaxial helicopter model was used to characterize its rotors (Fig. 1). The performance of the rotors was evaluated in independent and in the coaxial state. It was observed that there is a significant loss of total thrust for the coaxial configuration. The dependence of thrust loss with respect to RPM and other geometric parameters was studied. The thrust efficiency of the lower rotor is significantly influenced by the upper rotor. The single rotor configuration was found to perform better in terms of thrust per unit power consumed, than the coaxial configuration, (Fig. 2). The theoretical estimate of power, using low Reynold's number drag coefficient, was found to agree with measured input power. Additional experimental and correlation results will be presented in the final paper.

"OFDM for frequency coded quantum key distribution"
 Mukund A, S. Choudhary, and Kumar. P

Abstract: We propose OFDM to improve key generation rate of frequency 8208, coded QKD system. Simulation results show raw key length of 20 Kbit/s for link lengths up to 50 km. Frequency guard bands and the choice of orthogonal sub 8208,carrier spacing reduces noise power, leading to lower QBER and increased link length.

"Decoy state protocol for OFDM based frequency coded quantum key distribution"
 Mukund.A, S. Choudhary, and Kumar. P

Abstract: We propose and analyze decoy state method for OFDM& 8208,QKD systems. Carrier ratio optimization of individual subcarriers increases key generation rate and maximum transmission distance.

"Phase-change heat transfer of ethanol-water mixtures: towards development of a distributed hydrogen generator"
 Moharana M. K., Nemade R. M. and Khandekar S. Proc. ASME Summer Heat Transfer Conference, Minneapolis, Minnesota, USA, July 14-19, 2013. (Paper # HT-2013-17668).

Abstract: Hydrogen fuel from renewable bio-ethanol is a potentially strong contender as an energy carrier. Its distributed production by steam reforming of ethanol on micro scale platforms is an efficient upcoming method. Such systems require (a) a pre-heater for liquid to vapor conversion of ethanol water mixtures (b) a gas-phase catalytic reactor. We focus on the fundamental experimental heat transfer studies (pool and flow boiling of ethanol-water mixtures) required for the primary pre-heater boiler design. Flow boiling results (in a 256 ?m square channel) clearly show the influence of mixture composition. Heat transfer coefficient remains almost constant in the single-phase region and rapidly increases as the two-phase region starts. On further increasing the wall superheat, heat transfer starts to decrease. At higher applied heat flux, the channel is subjected to axial back conduction from the single-phase vapor region to the two-phase liquid-vapor region, thus raising local wall temperatures. Simultaneously, to gain understanding of phase- change mechanisms in binary mixtures and to generate data for the modeling of flow boiling process, pool-boiling of ethanol-water mixtures has also been initiated. After benchmarking the setup against pure fluids, variation of heat transfer coefficient, bubble growth, contact angles, are compared at different operating conditions. Results show strong degradation in heat transfer in mixtures, which increases with operating temperature.

SURGE 2013 – Popular lectures

Dr. Ajit Chaturvedi
A recipient of distinguished Teacher's award from IIT Kanpur and Tan Chin Tuan fellowship from Nanyang technical university, Singapore. Serving in electrical engineering department having research interest lies in communications theory and systems, mobile communication spread spectrum systems.

Title: The exciting world of research
Abstract: This will be a light talk which will begin by trying to answer the question what is research or more specifically what kind of work qualifies as research. Then we will discuss the inspirational works of some eminent Indian researchers like CV Raman, JC Bose and Ramanujan. We will also discuss the current landscape in India in terms of laboratories/institutions which provide opportunities for taking up research as a career. This will be followed by what is expected from the interns of the SURGE program. We will conclude the talk by discussing some very important things that any student entering the field of research must know.

Dr. Y. N. Mohapatra
A recipient of MRS Medal of MRS Indian Chapter. A member of Board of Governors of Institute of Physics. He serves on the editorial board of Journal of Nanophotonics (SPIE), and Advanced Condensed Matter Physic & his research interest lies in physics of semiconductors, and electronic and photonic materials suitable for device applications.

Title: Laboratory life: Routine or revolution?
Abstract: A research laboratory is an exciting place! Or, is it merely a place to run a routine race of resolving some esoteric controversies? At what point does a routine become revolution? How does our attitude to research shape as we go along, and how has it changed over the last decades? I will illustrate this by highlighting the daily sources of joy, and occasional pits and falls in a typical life in the Laboratory. I will try to interweave snippets from my own discipline by telling the story of the tribe which is interested in the humble 'diode', and its journey from hard semiconductors to its soft organic avatar. The theme crisscrosses my own wanderings in a no-man's land somewhere between physics and chemistry, engineering and science.

Dr. Sohini Sahu
Serving in humanities and social sciences department and her interest lies in macroeconomics

Title: "Crossing over" in research
Abstract: Can a seemingly banal conversation with friends change the trajectory of one's academic path? Can a non-major course, which was credited almost grudgingly due to non-availability of other options, turn out to the chosen field of research later in life? Can a life-threatening accident prompt the victim to ponder over certain questions, that later lead him to pursue research in a field different from his subject of specialization ? Yes, yes and yes. The path to pursuing higher studies/research is often non-linear. It is not rare to come across scholars who have crossed over from one subject to another; sometimes out of one's own volition, or due to governing circumstances, or as an outcome of pure luck. Each such case of "crossing over" has a story and goes on to show that choice revisions are made before arriving at the desired subject for pursuing research .In this talk, we will hear why and how a history-major, another a budding lawyer and someone with a degree in psychology or engineering(and the list continues), all opted to embrace Economics as their subject of research. Anecdotes apart, we will see how these converts, including some Nobel laureates in Economics, brought in fresh and new perspectives/techniques to expand the scope of the subject and gave it anew direction.

Dr. Harish Chandra Verma
Having vast experience in diverse areas of physics & his interest lies in condensed matter and materials applications

Title: "Small experiments: big learning"
Abstract: Science education has various aspect but the most important is to develop a feel of the phenomena. The culture of developing such feel can be inculcated through very short experiments picked from the natural events occurring around us. We have developed hundreds of such experiments which look so simple in the first sight but they have amazing potential to ignite the minds and a detailed analysis can be very efficient way to understand the principles threadbare. In the present talk I will share my experiences with using such small experiments with big learning through some of the demonstrations.

Dr. Lilavati Krishnan

A member, Board of Governors, G.B. Pant Social Science passion for teaching in humanities and social sciences department and her interest lies in distributive justice; prosocial behaviour; cross-cultural issues; indigenous concepts in psychology; socialization and parenting.

Title: "Research - A way to discover oneself"

Abstract: Why do people carry out research? Is being a researcher a matter of personality? Is creativity a necessary feature of research? Answers to these and other questions bring out the human component of research. In the final analysis, every researcher ends up discovering something that is not already known. This includes some hidden features of the researcher as a person, that may also be unknown. These ideas will be illustrated through examples and some activities.

Dr. Manindra Agarwal

A recipient of Clay Research award, Shanti Swarup Bhatnagar award, and Padma Shri. prof. in computer science and engineering department having interest lies in computational complexity theory.

Title: "The P <> NP hypothesis"

Abstract: The classes P and NP were formally defined about 50 years ago although intuitively they have been understood for much longer. The class P aptures the set of all those problems that can be efficiently solved using some mechanized process (including computers). And the class NP captures all the problems whose solutions can be efficiently verified by a mechanized process. Note that it may be inefficient to compute the solution of a problem in NP; what is required is that once a possible solution is given, it is easy to verify its correctness. An example of such a problem is solving Sudoku puzzle on an n^2 x n^2 grid (in place of typical 9 x 9 grid). It can be very difficult to find a solution, but it is straightforward to verify the correctness of a given solution .It has been conjectured that P is not equal to NP; that is, there are problems whose solutions are easy to verify but hard to compute. Intuitively, this appears to be true; for example, in mathematics, finding a proof of a statement is generally much harder than verifying the correctness of the proof. However, there exists no formal proof of the hypothesis despite intense efforts to find one. The hypothesis is considered to be one of the most important unresolved questions in mathematics and computer science. In this talk, I will describe obstacles that have been encountered while attempting to find a proof of the hypothesis.

Dr. Elizabeth and Dr. Verkey Cherian award for SURGE 2013 best project

S.No.	Student Participant	Home Institute	Research Title	Department	Mentor
1	Rohit Gupta	BES University, Shibpur	Design of a Coaxial Mono Tilt rotor MAV	Aerospace Engineering	Dr. Abhishek
2	Tanvi Soni	IIT Kanpur	Construction of Normal Numbers In Polynomial Sized Circuit Classes	Computer Science & Engineering	Dr. Satyadev Nandakumar

SURGE 2013- outstanding poster award

S.No.	Student Participant	Home Institute	Research Title	Department	Mentor
1	Bibek Dutta	NIT Durgapur	Chromosomal Instability (CIN): A cause or consequence of epithelial tumor progression in *Drosophila*	Biological Sciences & Bioengineering	Dr. Pradip Sinha
2	Chaitanya Ahuja	IIT Kanpur	On-Line Modeling of the pinna for fast computation of HRTFs in rendering 3D Audio	Electrical Engineering	Dr. Rajesh M Hegde
3	Mohit Sharma	IIT Kanpur	C programs on MIPS processor and performance enhancements	Computer Science & Engineering	Dr. Mainak Chaudhuri
4	Unnat Jain	IIT Kanpur	Dynamic IP networks path selection	Electrical Engineering	Dr. Ketan Rajawat
5	Vinodhini C	IIT Kharagpur	Velocity and Position Estimation of Autonomous Helicopter using IMU and GPS data	Aerospace Engineering	Dr.C. Venkatesan

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The staff members of DORA office.

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Prabhat Munshi(Dean, Resources and Alumni)
Dheeraj Sanghi (Dean, Academic Affairs)
A.K. Ghosh (Dean, Students Affairs)

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Abhishek (Aerospace Engineering)
Anurag Gupta (Mechanical Engineering)
Kantesh Balani (Material Science & Engineering)
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Vinay K Gupta (Civil Engineering)

SURGE 2013 BATCH

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