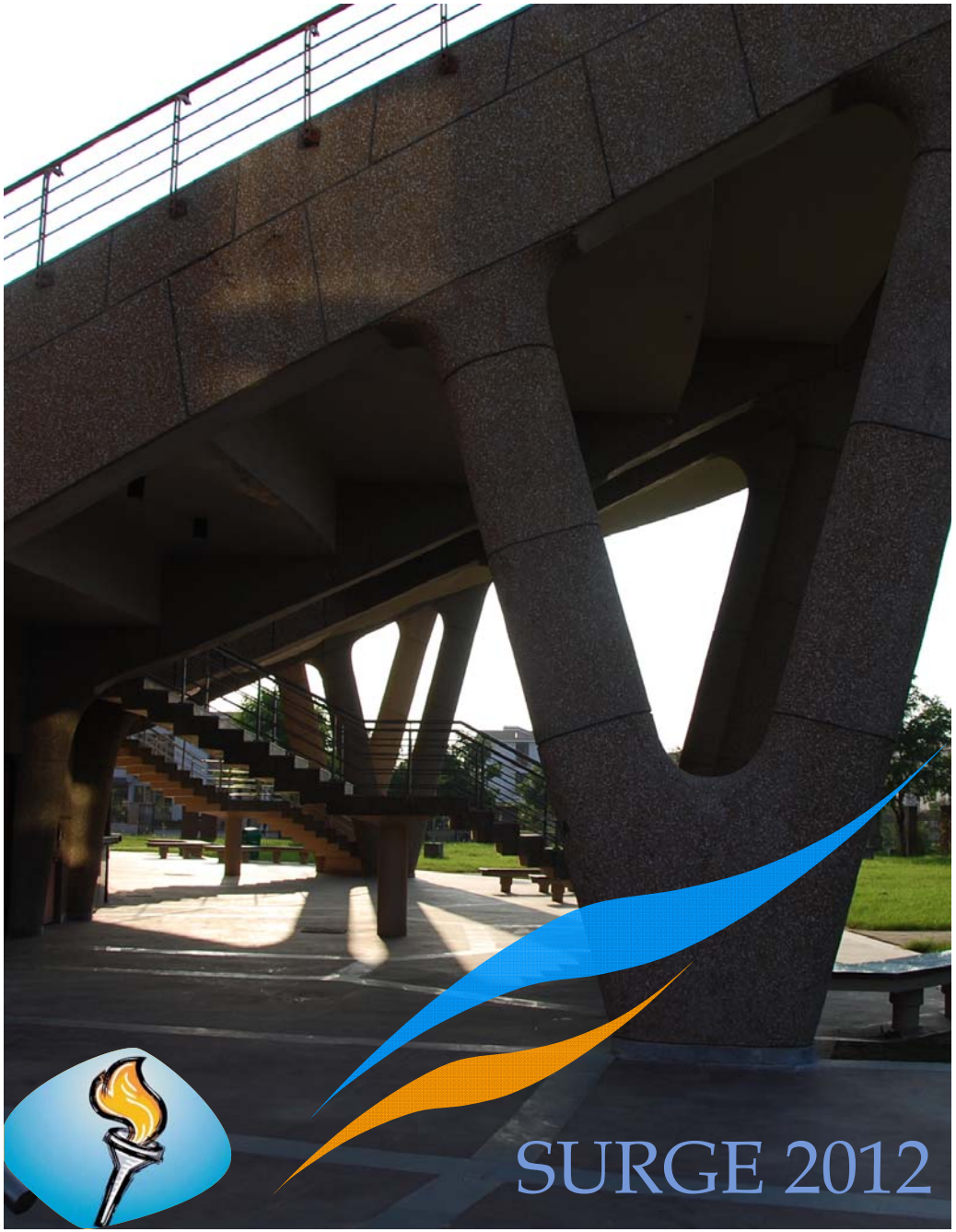


From the desk of DRPG

Congratulations to all the 2012 SURGE fellows and their mentors on another successful summer!

Every year since 2006 the SURGE program has grown, providing more and more research opportunities to eager young scholars than the year before. This year was no different.

SURGE gives undergraduate students two unparalleled opportunities, first, the real access to many of the finest research facilities in the world and second, the personal mentoring from best professors at IIT Kanpur in their respective fields.

The research engaged in by SURGE participants might also spark a new investigative passion, motivate students down an exciting career path, or make a positive impact on society.

A record number of approximate 2700 applications were received from 147 colleges and 63 excellent students were welcomed from different institutions to the IITK campus for SURGE.

I would like to congratulate all the members of SURGE family who made this summer so successful. Thanks to the SURGE Core Committee, for their invaluable leadership. Thanks to the 53 mentors who took time out of their busy summers to direct the boundless energy of SURGEians down the most illuminating path.

Finally, thanks to all of the friends and alumni whose donations help make SURGE financially possible. I applaud all of your tremendous generosity and look forward to your continued support.

Helping support the next generation of innovators is truly an investment in the future!
Thank you!

Manindra Agrawal
Dean Resource Planning and Generation

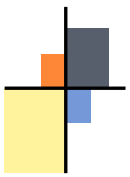
SURGE program- An overview

SURGE program introduces students to research under the guidance of seasoned research mentors at IIT Kanpur. Students experience the process of research as a creative intellectual activity. It is an 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. It promotes self-discovery, helps to bridge the gap between the class-room and the real world, and leads to the social, professional and educational development of the student. Undergraduate research at IIT Kanpur presents opportunities for students to do research under the mentorship of senior researchers at the frontiers of engineering and science.

The programme is being very well received both by students and mentors. The students experience a noble non-competitive, challenging and exciting method of learning, which encompasses multiple levels of educational experience.

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



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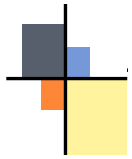


Funding SURGE

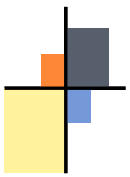
The participating students receive a stipend of Rs 12,500 for the ten-week summer program from the funds raised from external sources. The Dean Resource Planning and Generation Office raises funds to support SURGE students from a variety of sources including gifts from individuals, foundations, and corporations. 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 2012 and beyond! Endowments help to ensure the future of the SURGE program and provide students with unparalleled research opportunities.

Special Thanks to:

- Batch 77
- Batch 80
- NRM Fund
- AGP

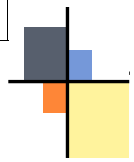
Opportunities Still Available for New Endowments

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 2012 from IITK

S. No.	Name of the participant	Project	Mentor
1	Anchal Goyal Aerospace Engineering	Experimental Characterization Of Transverse Cracks In Sandwiched Composites	Dr. C. S. Upadhyay & Dr. Rajesh Kitey Aerospace Engineering
2	Anubhav Dwivedi Aerospace Engineering	Auto Take Off And Landing Of Coaxial MAV	Dr. Abhishek Aerospace Engineering
3	Jatin Mitruka Aerospace Engineering	Role Of Lagging Motion In performance of Flapping Wing Ornithopter	Dr. Debopam Das Aerospace Engineering
4	Prasoon Suchandra Aerospace Engineering	Motion Control In Hummingbird Like Flapping Mav Using Piezoelectric Applications	Dr. Sudhir Kamle Aerospace Engineering
5	Rachita Biological Sciences & Bioengineering	Identifying Unusual ATP And GTP Binding Sites	Dr. Balaji Prakash Biological Sciences & Bioengineering
6	Gaganpreet Singh Kalra Chemical Engineering	Heat And Mass Transfer Through Porous Catalyst Pellets	Dr. V Shankar Chemical Engineering
7	Shashwat Mishra Chemical Engineering	Simulation Of The PUREX Process	Dr. Ashok Khanna Chemical Engineering
8	Sindhukush Chemical Engineering	Designing A Novel Carbon-Based Battery Separator Using Molecular Dynamics	Dr. Nishith Verma Chemical Engineering
9	Naiwrit Karmodak Chemistry	Understanding The Fluorescence Behaviour Of GFP Analogue	Dr.Pratik Sen Chemistry
10	Sambo Paul Chemistry	New Methodologies For The Synthesis Of Chiral Amino Alcohol Derivatives of Ferrocene	Dr. Ramesh Ramapanicker Chemistry
11	Abhinav Mishra Civil Engineering	To Understand The Property Of FRP bars after exposing them to Elevated Temperature	Dr Sudhir Misra & Dr. K. K. Bajpai Civil Engineering
12	Ankit Chaudhary Civil Engineering	Behavior Of RC Bridge Girders Repaired/ Strengthened externally bonded with FRP Composite Materials: An experimental study	Dr. Samit Ray Chaudhari Dr. K. K. Bajpai Civil Engineering
13	Rocky Kasana Civil Engineering	Behavior Of reinforced Brick Slab	Dr. D C Rai Civil Engineering
14	Saumya Kapoor Civil Engineering	Laboratory Indoor Air Quality For CO_2 And Inhalable-Respirable Particles: Assessment And Plausible Remediation Through Epipremnum Aureum (Money Plant)	Dr. Mukesh Sharma Civil Engineering
15	Shikhar Gupta Civil Engineering	Accuracy Analysis Of modern surveying based As- built mapping of High rise chimneys	Dr. Bharat Lohani Civil Engineering
16	Ashudeep Singh Computer Science & Engineering	Automatically Generating Problems In Propostional Logic	Dr. Amey Karkare & Dr. Subhajit Roy Computer Science & Engineering
17	Deepak Pathak Computer Science & Engineering	Goal Directed Navigation In Dynamic Obstacle Space and its extension to 2-stage search	Dr. Arnab Bhattacharya Computer Science & Engineering
18	Divyanshu Bhartiya Computer Science & Engineering	Scientific Computing With Map-Reduce	Dr. Sanjeev K. Agarwal Computer Science & Engineering
19	Kaustubh Tapi Computer Science & Engineering	Transport Protocol For Wireless Sensor Networks	Dr. R.K. Ghosh Computer Science & Engineering
20	Pulkit Jain Computer Science & Engineering	Automatic Problem Generation In Logic	Dr. Amey Karkare & Dr. Subhajit Roy Computer Science & Engineering



21	Mridul Agarwal Electrical Engineering	Robotic Grasping Of Novel Objects using Kinect	Dr. Laxmidhar Behera Electrical Engineering
22	Nitish Kumar Srivastava Electrical Engineering	Flexible Algorithm For Dynamic Power Allocation In Broadband Multibeam Satellite Network	Dr. A.K. Chaturvedi Electrical Engineering
23	Rahul Kataria Electrical Engineering	Disturbance Observer as load Torque Ripple Estimation	Dr. Ramprasad Potluri Electrical Engineering
24	Utsav Electrical Engineering	Reconfiguration Of Meshed Distribution Systems Considering Reliability And Power Loss	Dr. Saikat Chakrabarti Electrical Engineering
25	Vatsal Sharan Electrical Engineering	Blind Beamforming Using Randomly Distributed Wireless Sensor Nodes	Dr. Rajesh M. Hegde Electrical Engineering
26	Swapnika Reddy R Humanities & Social Sciences	Evolutionary Stale Conjectures in Oligipolies and social optimality	Dr. Praveen Kulshreshtha Humanities And Social Sciences
27	Deepti Verma Materials Science And Engineering	Dual Phase Structural Steel And Its Mechanical Properties	Dr. Kallol Mondal & Dr. Sandeep Sangal Materials Science And Engineering
28	Pratik Agarwal Materials Science And Engineering	Algorithm For Dynamic Scheduling Based On Optimal Deoxidation And Alloying Practices In a Steel Melt Shop Of An Integrated Steel Plant	Dr. Brahma Deo Materials Science And Engineering
29	Rishabh Jindal Materials Science And Engineering	Biodegradable Polymer Composites	Dr. Vivek Verma Materials Science And Engineering
30	Priya Goyal Mathematics & Statistics	An Algorithm For Fast And Automatic High Order Representation Of Complex 3-D Surfaces Via Fourier Continuation Analysis	Dr. Akash Anand Mathematics And Statistics
31	Amber Srivastava Mechanical Engineering	Machine Fault detection using image moment and ridge matrix & Integrated Vehicle Health Monitoring(IVHM)	Dr. Nalinaksh S. Vyas Mechanical Engineering
32	Nijit Sharma Mechanical Engineering	Non destructive testing: Reconstruction And Detection of cracks Using ultrasonic Phased Array Probe	Dr. N. N. Kishore Mechanical Engineering
33	Prabhanshu Pavecha Mechanical Engineering	Numerical Simulation Of Mixed Convection Over Protruded Heated Surfaces In A Vertical Channel	Dr. P.S.Ghoshdastidar Mechanical Engineering
34	Ravi Shankar Mishra Mechanical Engineering	Feasibility Analysis Of Image To Sound Signal Inter-Conversion	Dr. Nachiketa Tiwari Mechanical Engineering
35	Rishav Garg Mechanical Engineering	Numerical Studies Of Micro Combustion Through A Micro-Channel	Dr. D.P. Mishra Aerospace Engineering
36	Niraj Kumar Physics	Classic Genetic Algorithm to Solve A Maze	Dr. D. Goswami Chemistry

Participants of SURGE 2012 at IITK from other universities

S.No.	Name of the participant	Name of the Institute	Project	Mentor
1	Abhinav Kapoor Aerospace Engineering	PEC University of Technology	Eulerian PDF transport modeling of turbulent swirling flames.	Dr. Ashoke De Aerospace Engineering
2	U Umesh Aerospace Engineering	Indian Institute of Technology Kharagpur	Numerical Investigation of High Pressure Hydrogen released in air	Dr. Ashoke De Aerospace Engineering
3	Shradha Suman Rickey Ceramic Engineering	National Institute of Technology, Rourkela	Synthesis and characterization of polymeric nanoparticles as drug carriers in huntington's disease	Dr. Ashwini Thakur Biological Sciences And Bioengineering
4	Spandhana Gonuguntla Chemical Engineering	National Institute of Technology, Surathkal	Synthesis and characterization of Conducting polymer - Graphene oxide composite	Dr. Siddhartha Panda Chemical Engineering
5	Tatsat Banerjee Chemical Engineering	Jadavpur University, Kolkata	Imparting Periodicity in Assembly of Nanoparticles	Dr. Sri Siva Kumar Chemical Engineering
6	Soumya Radhakrishnan Chemistry	Indian Institute of Technology Hyderabad	Synthesis of chemoattractant analogues	Prof. R. Gurunath Chemistry
7	Michael Koch Civil Engineering	National Institute of Technology, Silchar	Geo-synthetic encased Stone Columns- A numerical Study	Dr. Rajesh Sathiyamoorthy Civil Engineering
8	Aditie Garg Electrical And Electronics Engineering	National Institute of Technology, Tiruchirappalli	Study on Power System Stability and design of low pass filter	Dr. Nishchal K. Verma Electrical Engineering
9	Kailash Neelakantan Electrical And Electronics Engineering	National Institute of Technology, Surathkal	A Study of Wireless Power Transmission via Inductive Coupling	Dr. A. R. Harish & Dr. K. Vaibhav Srivastava Electrical Engineering
10	Shruti Singh Electrical Engineering	Kalinga Institute of Industrial Technology University, Bhubaneswar	Linear Approximation for illumination	Dr. K. S. Venkatesh Electrical Engineering
11	Chandana Kandru Electronics And Communication Engineering	Visvesvaraya National Institute of Technology, Nagpur	Secure spectrum sensing inr cognitive radio	Dr. Adrish Banerjee Electrical Engineering
12	Vishal Agarwal Electronics And Tele-Communication Engineering	Jadavpur University, Kolkata	Investigating out-of-band emission and PAPR reduction techniques in OFDM based cognitive radio networks	Dr. Adrish Banerjee Electrical Engineering
13	Saumya Choudhary Electrical Engineering	Indian School of Mines, Dhanbad	Decoy State method for OFDM based FC-QKD(Frequency coded-Quantum Key Distribution) system	Dr. Pradeep Kumar Electrical Engineering
14	Suryakant Pal Economics	Madras School of Economics, Chennai	Evaluating benefits of being part of an economic agreement: A Case Study of India, US, China, EU & ASEAN	Dr. S. K. Mathur Humanities & Social Sciences
15	Shantanu Singh Mechanical Engineering	Indian Institute of Technology (BHU), Varanasi	Design Of an efficient Micromixer	Dr. Shantanu Bhattacharya Mechanical Engineering
16	Nidhish Raj Mechanical Engineering	National Institute of Technology, Warangal	Autonomous Hovering of Micro Coaxial Helicopter using Optic Flow Sensor	Dr. Abhishek Aerospace Engineering
17	Vinodhini C. Mechanical Engineering	Indian Institute of Technology Kharagpur	Inertial Measurement Unit Optimization of blade Platform for Coaxial Micro air vehicle in Position Estimation	Prof. C. Venkatesan Aerospace Engineering

18	Shamayita Mukherjee Mechanical Engineering	National Institute of Technology, Durgapur	Analysis of Hover Performance of rotors with Rectangular flat plate blades	Prof. C. S. Upadhyay Aerospace Engineering
19	Pratyasha Mohapatra Metallurgical And Materials Engineering	National Institute of Technology, Rourkela	Effect of Carbon-nanotube reinforcement on the phase transformation of zirconia.	Dr. Kantesh Balani Materials Science & Engineering
20	Sagnik Sarkar Metallurgical And Materials Engineering	National Institute of Technology, Durgapur	Transformation kinetics of Shape Memory Alloys	Dr. Kallol Mondal & Dr. S. Sangal Materials Science & Engineering
21	Aramanda Shanmukha Kiran Metallurgical Engineering	Andhra University, College of Engineering, Visakhapatnam	Extending the limit(Entropy of mixing) for formation of high entropy alloys	Dr. Anandh Subramaniam Materials Science & Engineering

Participants of SURGE 2012 from IITK to Overseas Universities

S. No.	Name of the participant	Name of the Institute	Project	Mentor
1	Soumyadyuti Samai Chemistry	Ecole Centrale Paris	Non Photochemical Laser Induced Nucleation (NPLIN) of a Pharmaceutical molecule: Application to Carbamazepine (CBZ)	Dr. Anne Spasojevic SPMS Laboratory
2	Sreyoshi Sur Chemistry	Ecole Centrale Paris	Gold nanoparticles and their use in cancer therapy	Dr. Bruno Palpant & Dr. Simona Laza Laboratoire de Photonique Quantique et Moleculaire
3	Sushant Mani Tripathi Civil Engineering	Melbourne School of Engineering, University of Melbourne	Modelling of a double skin façade as discrete masses damper system for tall buildings using analytical approach	Dr. Cuong Nguyen Department of Infrastructure Engineering
4	Subhojit Ghosh Mechanical Engineering	Melbourne School of Engineering, University of Melbourne	Design and Control of a Partial UAV Simulator in a Water Tunnel	Dr. Chris Manzie Department of Mechanical Engineering
5	Archak Purkayastha Physics	Ecole Polytechnique	A comparative ab-initio study of geometrical, electronic and optical properties of silicene and graphene	Dr Valerie Veniard Laboratoire des Solides Irradiés laboratory
6	Aritra Kundu Physics	Ecole Centrale Paris	Simulation of Non-Photochemical Light Induced Nucleation	Dr. Anne Spasojevic & Bertrand Clair

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

Abstracts: SURGE 2012 Research Projects Done at IIT Kanpur

Experimental Characterization of Transverse Cracks in Sandwiched Composites
Anchal Goyal
Dr. C. S. Upadhyay & Dr. Rajesh Kitey

Transverse crack growth along weak planes plays a very significant role in failure of many unidirectional as well as cross-ply sandwiched laminates. To study this phenomenon, we have manufactured composite specimens sandwiched between aluminium strips. We have adopted a different approach to make laminates with high volume fraction and uniform fibres. We have shown that the multiple cracking occurs before fracture when the specimen is subjected to tensile loading. We have also studied the dependence of crack spacing on inner-ply thickness and the applied stress. Average crack spacing decreases with increasing applied stress and decreasing inner-ply thickness.

Auto takeoff and landing of coaxial MAV
Anubhav Dwivedi
Dr. Abhishek

In this work the problem of automation of takeoff and landing system to be used onboard a mini coaxial helicopter using a bio-inspired approach used by honeybees is considered. The auto takeoff and landing is implemented by regulating the thrust to attain a constant optic flow. The sensor used is an ADNS 3080 optical mouse sensor pointing vertically downwards. The proof of concept is demonstrated using a circling arm with rotorcraft and the sensor assembly onboard. The Optic Flow Regulator or the OFR allows the rotorcraft to perform auto takeoff and landing. During the takeoff it causes the rotorcraft to attain a steady throttle value and fixed height, while during landing the vehicle descends down from a fixed height to rest. All the processing is done onboard the vehicle using an Arduino mini and ADNS 3080.The simple control law and compact sensing unit makes this a useful option for utilizing visual cues for attaining autonomy over risky maneuvers like takeoff and landing. It can be concluded that the displacement output from the optical mouse chip can be taken as a good measure of optic flow. A tethered helicopter with a fixed pitch and no roll or yaw can successfully perform auto takeoff and landing using a simple proportional controller. By using two or more such sensors and integrated with an inertial measurement unit, it is possible to perform auto takeoff and landing on a free flying vehicle.

Role of Lagging Motion in performance of Flapping Wing Ornithopters
Jatin Mitruka
Dr. Debopam Das

Research on flapping-wings is enticing the interest of many scientist and engineers around the world. Flapping –wing ornithopters have become increasingly attractive flying vehicle for various applications. These vehicles operate at low Reynolds numbers with superior efficiency compared to fixed wing and Rotary wing flying vehicles. The natural bird's wing motion can be divided as flapping, feathering, spanning and lagging.
The proposed research is on studying the role of lagging motion in such flight. The objectives are as follows:

- Making a test model with control over the lead lag.
- Testing the model for different flapping frequencies to obtain optimal parameters of lagging.
- This would be done using force measurements with different amplitude of lead-lag motion for an optimal flapping frequency of the model in terms of lift generation.
- Finally making an optimal model with single motor or minimum number of motors which will be the path towards developing an efficient flying model in future.

Motion control in Hummingbird like flapping MAV using piezoelectric applications
Prasoon Suchandra
Dr. Sudhir Kamle

MAVs (Micro Aerial Vehicles) is one of the most fascinating and upcoming areas of Aerospace Engineering. Agility of such vehicles is very crucial. Due to inefficiencies of fixed-wing aircrafts at low speed aerodynamics, flapping is one of the most promising lift generation mechanisms. Since Hummingbirds are one of the most agile creatures, developing MAVs resembling these creatures would be great. The most important aspect is to develop a bio-mimetic wing in order to achieve efficiencies of natural prototypes. Wing designs and wing skeletons have been developed for such a wing. Integration of wing with Hummingbird's forelimb like skeletal structure has resulted in increased strength, stiffness and higher natural frequency.
Piezoelectric sensors could be used to obtain dynamic data from such wings. [5], [10]. Piezoelectric actuators could be employed for shape control and actuating flapping for such light weight MAVs. [9].

Identifying Unusual ATP and GTP Binding Sites
Rachita
Dr. Balaji Prakash

The purpose of this study is to identify unusual ATP and GTP binding sites in the proteins using computational techniques and structural analysis of proteins. In this study, first canonical GTP binding sites were analysed in common GTP binding protein GTPase using the BLAST and ClustalW software for sequence comparison and analysis. It was analysed that this approach is not decisive for novel proteins as it can't depict the contribution of individual residues to the affinity of interactions between GTP and the binding protein. Also, the spacing between the glycine residues is not always same. Therefore, a better approach, based on the Structural analysis and SVM based regression models, is needed to take into account the interaction at the residual level. Anticipated findings of this study will be useful in explaining the functions of new proteins and for understanding them better

Heat and Mass Transfer through porous catalyst pellets
Gaganpreet Singh
Dr. V Shankar

Catalytic reactions are the base of many industrial processes. Accurately studying the transport process through catalyst pellets will help to enhance the effectiveness and selectiveness of the reactions and hence the process as a whole. We try to approach the above said problem in a stepwise manner-first studying just the flow characteristics, then trying to understand the heat and mass transport and finally introducing reaction too.
We have solved the flow characteristics past an isolated rigid sphere, an isolated bubble/droplet to be finally able to tackle flow past an isolated porous sphere .To start with; we have assumed steady, low Reynolds number, axisymmetric flow of a Newtonian fluid.

Simulation of the PUREX process
Shashwat Mishra
Dr. Ashok Khanna

The project focuses on the simulation of the Purex process in a Pulsed Column Extractor using the FORTRAN language. While a code named PULCO to simulate this process has already been created, but because of its limitations and some accuracy issues, a new code named PARC is being developed. The code effectively simulates all the reactions and the mixing that takes place inside the extraction column and provides the concentration profile of all the components throughout the column.
Our aim for this project is to modify the older PULCO code to diminish any limitations that it currently has. We started off with tweaking the input files to better the accuracy of the code followed by the introduction of more number of components that the code can handle. Another important aspect of the project is to increase the number of reactions the code can handle. The results with improved accuracy have been taken and 29 components as opposed to the earlier 11 components can now be handled by the code.

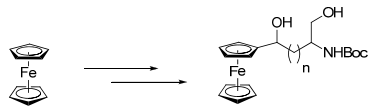
Designing a Novel Carbon-Based Battery Separator using Molecular Dynamics
Sindhukush
Dr. Nishith Verma

The objective of the proposed project through **SURGE** is to design a simulation model of carbon nanofibres (CNFs) dispersed poly-vinyl alcohol (PVA) nanocomposite material for Li-ion electrolyte battery separator and predict its chemical and electrochemical properties via molecular dynamics (MD). The process conditions involved in synthesizing the prepared materials must be optimized to impart desired properties. Experimental investigation may be cost inhibitive, so MD is used to simulate the physical movements of atoms and molecules. Accelrys Materials Studio 6.0 engineering software is used for this purpose.
The work describes the complete method of simulating first pure PVA and then CNF dispersed PVA using the software. The simulation starts with construction of an amorphous cell at a particular density and temperature, which represents the basic unit of a bulk of material. The amorphous cell is made to undergo geometry optimization, equilibration, relaxation and short simulation runs to make it as realistic as possible. The properties can be predicted thereafter. In this work, glass transition temperature (T_g) is predicted and validated with literature and experimental values. The T_g of pure PVA is predicted to be 370 K (experimental: 358 K). Following similar procedure gives T_g of CNF dispersed PVA to be around 400 K. So it can be concluded that incorporation of CNF gives superiority to the properties of PVA.

Understanding the fluorescence behavior of the GFP analog
Naiwrit Karmodak
Dr. Pratik Sen

The green fluorescence protein is used for cellular imaging and is well known for its highly fluorescent nature. However in the isolated form, its quantum yield reduces to a greater extent. To study the fluorescence behavior of the green fluorescent protein analog, **Z-4-(4-dimethylamino)-1-(4-nitrophenyl)-2-phenyl-1H-imidazol-5(4H)-one (DMNPI)** was synthesized and its steady state measurements were done. To understand its behavior the ground and excited state dipole moment were calculated, the solvent dependence and the viscosity dependence of the quantum yield were investigated. Theoretical calculations were done to find out the molecular orbitals in which charge transfer takes place in the chromophore on absorption of photon. The quantum mechanical calculations also suggest the occurrence of exo-methylene double bond rotation in the excited state. Such observations may help us to understand the highly fluorescent behavior of the wild type GFP as compared to this isolated chromophore.

A New Methodology for the Synthesis of Chiral Amino Alcohol Derivatives of Ferrocene
Sambo Paul
Dr. Ramesh Ramapanicker



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Amino alcohol derivatives of ferrocene find a number of applications in asymmetric catalysis, materials science and biological chemistry. A very simple and extremely efficient synthesis of chiral amino alcohol derivatives of ferrocene is achieved from readily available starting materials. The strategy is based on coupling the dithiane derivative of ferrocene carbaldehyde with chiral iodo derivatives synthesized from L-amino acids. The current method provides a very useful alternative to existing methods for the synthesis of the title compounds.

To understand the properties of FRP bars after exposing them to elevated temperature
Abhinav Mishra
Dr. Sudhir Misra & Dr. K.K. Bajpai

Fiber Reinforced Plastics [FRP] have evolved as a useful construction material in the ongoing struggle against infrastructure deterioration all over the world as a better alternative to steel for retrofitting and repair of Reinforced concrete structures. In mid twentieth century when the roads and highway system was expanding the corrosion menace forced the material scientists to search for some newer material. Witnessed and impressed by the large use of composites in electronic and aerospace industry engineers decided to use FRP as a concrete reinforcement however, it was only in late eighties that FRP was considered a suitable solution. More than two decades of research, worldwide, have established some codes and guidelines for using FRP as a construction material. But still FRP reinforcement has been restricted for use in bridges and open structures despite having a humongous scope in high rise buildings, apartments, garages and commercial structures. The fundamental reason being their behavior under high temperature. FRP materials are combustible and highly sensitive to fire and their use in buildings makes these structures particularly vulnerable to fire. At present there is very little information available on FRP reinforced structural members under elevated temperature. Moreover as FRPs are very new to the Indian construction scenario, unlike many other countries, design codes on FRPs do not exist in India. In this study I have tried to characterize the basic tensile properties of glass fiber reinforced polymer [GFRP] bars (with unidirectional glass fiber as reinforcement), discussing the gripping methods of GFRP bars in tensile testing. Moreover, this study investigates the residual tensile properties of GFRP bars after exposing them to elevated temperature for different periods. The specimens were subjected to three different controlled temperatures [100, 200 and 300 ^{0}C] for three different time periods [1, 2 and 3 hr.]. Tensile behavior of each type of specimen was established by plotting the stress strain curve and values of fracture stress and tensile modulus were recorded. Values of tensile modulus using Non Destructive Methods such as UPV and surface velocity method was also obtained and was compared with the former values. Losses in tensile strength, tensile modulus and fracture strain proportional to exposure to environment and exposure period were recorded. Moreover an experimental study on determining a minimum concrete cover required to preserve the integrity of an internal reinforcement was undertaken. Concrete cylinders with FRP bar as an internal reinforcement were casted and then subjected to elevated temperature. After extracting the bar from the cylinder it is to be tested with basic tensile properties mentioned before. Thus the variation of percent loss in tensile strength with the concrete cover was to be accomplished.

Behavior of RC bridge girders repaired/strengthened with externally bonded FRP composite materials: An experimental study
Ankit Chaudhary
Dr. Samit Ray Chaudhari & Dr. K.K. Bajpai

Fibre Reinforced Polymer (FRP) composites have been widely used in construction purposes in recent days. Their high strength to weight ratio is a good advantage. The low cost of FRPs is also one of their advantages.
The initial part of the program was based on understanding the behaviour of FRP and their advantages. Then beams were taken as the representative models of girders and so a design which was used in CE 623 was used to cast beams and after the beams were casted, they were tested with and without FRP sheet. Only one layer of FRP sheet was applied so as to check the effect of the sheet. The main aim of the program was to look at the load bearing capacity of the beams reinforced with FRP sheets and then they were compared with those beams which were not externally bonded with FRP sheets. Also there is an issue of bonding FRP to the concrete surface. So, adhesive epoxy and epoxy with partial anchorage were used as bonding agent. Adhesive epoxy with partial anchorage was used to prevent the debonding of FRP sheet on the concrete surface.
But in the later part, it was realised that there was no debonding of the sheet before failure of the beam. The debonding only occurred when the beam was completely failed. So, the beams in which FRP sheets were applied using bonding and partial anchorage were not tested.

Behavior of reinforced brick slabs
Rocky Kasana
Dr. D. C. Rai

Reinforced masonry slab are widely used in India for construction since 1920 due to low cost, aesthetics, solidity, durability, low maintenance, versatility, sound absorption, fire protection, availability of material at ease and manpower skilled in its construction. Although this is widely used less research have been done on masonry.
Reinforced slab are often subjected to in-plane and out-of-plane loads. In the present study, an attempt has been made to model reinforced brick slab in **ABAQUS** using macroscopic approach for out of plane loading. Brick and mortar have been modeled as combined unit as masonry and property for steel have been defined separately. Also analytical study has been carried out for full scaled brick slabs using limit state, working stress and SAP section designer approach.
The results obtained from analysis have been validated using the results published in literature (Behavior of centrally loaded half scaled reinforced brick slabs, Nishit Shandilya 2012, IIT Kanpur).

Laboratory Indoor air quality for CO_2 and inhalable-respirable particles: Assessment and plausible remediation through Epipremnum Aureum (money plant)
Saumya Kapoor
Dr. Mukesh Sharma

Poor indoor air quality can lead to fatigue, headache, loss of concentration and has given rise to various Sick Building Syndromes(SBS). This makes it necessary to monitor the quality of air present in indoor areas. The air quality parameters which are being studied include mass and size concentrations of particulate matter, distribution of particulate matter, temperature of the surroundings and CO_2 levels. Also, the objective of this study is to determine the impact of air conditioning operation on air quality and attempts have been made to improve air quality with the help of Epipremnum Aureum (money plant).

Accuracy analysis of modern surveying based as-built mapping of high rise chimneys
Shikhar Gupta
Dr. Bharat Lohani

This project is about chimneys - the importance they have in our lives, and the problem that exists with them today. In recent times, many chimneys have collapsed due to poor workmanship and inability to carry out the construction the way it is planned. The size and complexities of the chimneys make it difficult to monitor the construction at every stage. Again for the same reasons, it is almost impossible to fully diagnose the chimney after it has been built. The geometry of the chimney is one of the important parameters that controls its quality and performance, which is the prime concern of this project.

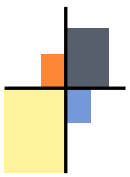
The objective of this project is to come up with a methodology for developing error propagation model in the as-built geometry measurement techniques of a chimney. Modern surveying techniques are able to generate a large number of data points on the chimney surfaces through a complex workflow in field. These data points are then employed to extract various as-built geometries e.g. coordinate of centre , wall thickness, and radii at different levels. This information can be compared with the CAD drawing of the chimney in order to assess the quality of construction and taking appropriate measures. This project specifically looks into these as -built measurement techniques and generates error propagation model for these. The proposed method is based on Least Squares technique for computation and error propagation at different stages of these as-built measurement techniques. The project has successfully developed these techniques and shown the results for error propagated through a simulated data set. The results include the quantum of error propagated at different levels of the chimney.

Automatically Generating Problems in Propositional Logic
Ashudeep Singh, Pulkit Jain
Dr. Amey Karkare & Dr. Subhajit Roy

Intelligent Tutoring Systems are automated systems, which aim at tutoring learners. The intelligence of these systems lies in being able to guide the learner by providing a rich set of problems, which are attempted by the learner until he/she has grasped the concept. These systems are supposed to be capable of providing multiple solutions or approaches to a same problem. Generating hints when a user gets stuck, or guiding the user towards an alternate solution are some aspects that such systems should possess. Verifying the validity of responses and grading user responses are also parts of such systems. We, in this project have made an attempt at automatic problem generation and solution generation for the domain of Propositional Logic.

Goal directed navigation in dynamic obstacle space and its extension to 2-stage search
Deepak Pathak
Dr. Arnab Bhattacharya

Our objective is to design and implement optimal path-cost and time enceinte heuristic algorithm for target oriented navigation in completely dynamic space, then solving popular snake game. The game contains finite length agent which has to reach the target in obstacle containing maze. We implemented different existing dynamic space algorithms for this game and demonstrated experimentally that our proposed algorithm runs faster giving optimal answer. Then further we discuss the extension of this algorithm to 2-stage search i.e. searching in a space if future target is known and then analyze the deviation of the proposed solution from optimal answer.



Scientific computing with map-reduce
Divyanshu Bhartiya
Dr. Sanjeev K. Aggarwal

Cloud computing is a new technology in the field of science. We are focussing on implementing some operations of BLAS (Basic Linear Algebra Subprograms) library in a distributed fashion, paralleling on a cluster using map-reduce. Since data-dependencies become very intricate on complex operations, it becomes difficult to devise a parallel way to compute the oprations. We focus on how to map and input, and reduce the output using the data dependencies for different operations. We wanted to show that a distributed parallel way to handle such operations and data is consistent with idea of cloud and is motivating to try these operations on a commercial cloud and ease the computation time.

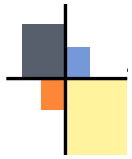
Transport Protocol for Wireless Sensor Networks
Kaustubh Tapi
Dr. R. K. Ghosh

Wireless Sensor Networks consists of spatially distributed sensor nodes which record environmental conditions like humidity, temperature, luminosity,etc. Modern Wire-less Sensor Networks (WSNs) allow two way communication between sensor nodes and basestation . Energy e ciency plays an important role in working of sensor nodes as they are required to last long duration of time without any physical supervision. Many e cient protocols have been developed for upstream communication but the main approaches used for downstream communication rely on source routing and dissemination . These approaches are unable to handle large networks and result in ooding of network.

We have implemented a Transport Protocol which uses Collection Tree Protocol (CTP) for upstream communication and post order numbering based (PON) routing protocol for downstream communication. Post Order Numbering based protocol for downstream communication incorporates the advantage of both source routing and dissemination and is capable of handling large networks. We tested the Transport Protocol on a real wireless sensor network comprising of iris motes and we were able to send random numbers to any desired node e ciently . We can control the rate at which data is recorded at sensor nodes from basestation. This Transport Protocol allows us to e ciently communicate in both upstream and downstream direction.

Automatic Problem Generation in Logic
Pulkit Jain
Dr. Amey Karkare and Dr. Subhajit Roy

Intelligent Tutoring Systems are automated systems, which aim at tutoring learners. The intelligence of these systems lies in being able to guide the learner by providing a rich set of problems that are attempted by the learner until he/she has grasped the concept. These systems are supposed to be capable of providing multiple solutions or approaches to a same problem. Generating hints when a user gets stuck, or guiding the user towards an alternate solution are some aspects that such systems should possess. Verifying the validity of responses and grading user responses are also parts of such systems. We, in this project have made an attempt at automatic problem generation and solution generation for the domain of Propositional Logic.



Robotic Grasping of Novel Objects using Kinect
Mridul Agarwal
Dr. Laxmidhar Behera

The objective of this work was to build an algorithm to identify grasping points in front of a robot and grasp an object in real time.
A new approach to the problem of identifying the grasping point in an image is presented. Principles of computer vision, machine learning has been applied and implemented using Microsoft Kinect.
Using image features, we applied a probabilistic neural network trained using supervised learning. It identifies to grasping regions in 2D images and generalises to new objects in satisfactorily.
The algorithm is demonstrated on RBG images, taken by kinect, of real life objects. The 3D real world coordinates are obtained utilising the IR camera of kinect. A robot manipulator is used to grasp the objects at those grasping points.
The manipulators used were PowerCube and Barrett WAM. The algorithm was successfully implemented on Windows (XP) platform as well as Linux (Ubuntu 10.04) platform.

Flexible Algorithm for Dynamic Power Allocation in Broadband Multibeam Satellite Network
Nitish Kumar Srivastava
Dr. A. K. Chaturvedi

Nowadays, use of broadband satellite communication is increasing. The broadband satellite communication uses frequency bands such as Ka and Q/V bands. These are high frequency bands and at such high frequencies atmospheric attenuation is caused by many factors such as rain, clouds, gases etc. The rain is the most dominant im-pairment factor. Dynamic reconfiguration of multi-beam satellite antennas has been proposed as a fade mitigation technique. A system model and an algorithm for dy-namic power allocation has been proposed in [1]. The algorithm gives better results as compared to the static power allocation used earlier. We propose an algorithm which gives better results than the existing algorithm [1].

Disturbance observer as load torque ripple estimator
Rahul Katari
Dr. Ramprasad Potluri

A disturbance observer (DOB) is an emerging tool with motors primarily for estimating and rejecting disturbances acting on the motor. We show in this work that the ripples in the load torque acting on the motor can also be estimated using a DOB, provided these ripples lie within the bandwidth of the DOB-based load torque ripple estimator. We have theoretically discussed the feasibility of this ripple estimator in the presence of non-linearities like dead zone and saturation. In practical experiments, we compensate the dead zone present in the H-bridge powering the motor using an existing idea of using a DOB, and sense the amplitude and frequency of the ripples present in the load torque by another disturbance observer. One promising practical use of this DOB-based load torque ripple estimator is in the problem of terrain classification for planetary rovers, for which a recent solution was to use an accelerometer-based vibration sensor. The proposed load torque ripple estimator could replace this sensor.

Reconfiguration of meshed distribution system considering reliability and power loss
Utsav
Dr. Saikat Chakrabarti

Meshed power distribution system is reconfigured considering reliability and power loss. Reliability at load point is calculated using probabilistic reliability model. Optimal paths and alternate paths in case of the failure of the optimal path can be found out using the methodology described in the report. An algorithm for finding the minimal cut sets is used to find the minimal set of components appearing between feeder and any particular load point. Binary Particle Swarm Optimization (BPSO) is used to find the optimum configuration of switches. Reliability under N-2 contingencies is found out. This process is also extended to Ring-main systems. The effectiveness of the proposed methodology is demonstrated on 33 bus and 123 bus distribution system.

Blind beamforming using randomly distributed wireless sensor nodes
Vatsal Sharan
Dr. Rajesh Hegde

The aim of this work is to do blind beamforming using wireless sensor nodes with the spatial location of the nodes being unknown and random. First, the maximum power collecting array algorithm is extended to do blind beamforming of two source signals. Then, an algorithm is proposed for blind source separation of any number of source signals. For this, it is demonstrated that the eigenvector corresponding to the k^{th} largest eigenvalue of the correlation matrix can null the 1^{st} *(k-1)* strongest sources. The algorithm then iteratively separates the source signals. For obtaining the strongest power source, the proposed algorithm performs better than maximum power collecting array and it also successfully does blind source separation. A practical multimodal Wireless Sensor Network is also investigated using various sensors.

Evolutionarily stale conjectures in oligopolies and social optimality.
Swapnika Reddy R
Dr.Praveen Kulshreshtha

The evolutionary approach to analyse Conjectural Variations has revived the idea of the long forgotten Consistent Conjectural Variations (CCV), showing us that CCV can be viewed as a short cut to a much elaborate 2-player evolutionary games. We have attempted to generalise this result for oligopolies and also to analyse the welfare consequences of these equilibria in a framework of both quantity and price competitions. We found that the coincidence of CCV and Evolutionarily Stable Strategies (ESS) holds for general n-firm markets. We have also derived conditions under which we can expect the stable equilibrium to be equal to the social optimal, in which the shape of the cost of production functions of firms play an important role.

Dual phase structural steel and its mechanical properties
Deepti Verma
Dr. K. Mondal & Dr. S. Sangal

We need material of high strength and ductility to be used as structural steel. In addition, we need the material to be cost efficient. Pearlite is the most common phase present in the steels used in construction industry, which has high elongation of about 25% and Yield Strength (YS) of about 240 MPa. Tempered Martensite used has YS around 1000 MPa but the percentage elongation is only 10%. Pearlite has high ductility but not much strength and tempered martensite has high strength but not much plastic deformation before break point.
A new heat treatment design was invented to combine the pearlitic and tempered martensitic phases. The dual phase steels combining the pearlitic and tempered martensitic phases were developed and were studied on its improved mechanical properties with YS of 850 MPa and %elongation of 15% at break point. With high strength to weight ratio and large toughness the developed steel is more suitable for its use in construction industry,

Algorithm for dynamic scheduling based on optimal de-oxidation and alloying practices in a steel melt shop of an integrated steel plant

Pratik Agarwal
Dr.Brahma Deo

The temperature of liquid steel is predicted at various stages of operations during secondary steelmaking. Heat loss from the liquid steel depends on several parameters like emissivity, tapping duration, amount of alloys added, ladle track time etc. The error in predictionis minimized by fine tuning the models actual against plant data. The scheduling of ladles can be done on the basis of predicted temperatures. The temperatures at argon rinsing station can be predicted with an accuracy of ± 20^{0}C. This accuracy can be increased further if the thermal history of ladle between the caster and basic oxygen furnace is known.

Biodegradable polymer composites

Rishabh Jindal
Dr. Vivek Verma

The focus of this work was to study the mechanical and thermal properties of biodegradable polymer composites. Composites based on Poly(vinyl alcohol) and kaolinite clay were synthesized, in the form of thin films, using solvent casting method. Kaolinite clay reinforced in the polymer matrix was in two forms; one with dispersant (Sodium Hexametaphosphate) and the other without dispersant. The films were characterized for their biodegradability, structural, mechanical and thermal properties by scanning electron microscopy (SEM), X-Ray diffraction (XRD), dynamic mechanical analysis (DMA), differential scanning calorimetry (DSC) and soil burial test. SEM images showed agglomeration of clay when used without dispersant and moderate dispersion after addition of dispersant. XRD results indicated that crystallinity decreased with clay loading and this effect was more in case of composites of clay without dispersant. The storage modulus increased to 4.5×10^{9} Pa (5% (wt/wt) clay loading) and 5.3×10^{9} Pa (10% (wt/wt) clay loading) as compared to 4.1×10^{9} Pa (PVA) at 25^{o}C. The biodegradability increased with clay loading, reaching a weight loss of 38% in 5% (wt/wt) clay loading with dispersant.

An Algorithm for Fast and Automatic High Order Representation of Complex 3-D surfaces via Fourier Continuation Analysis

Priya Goyal
Dr. Akash Anand

Given a set of data points, creating the parameterizations of the full surface that represents this point cloud, is a problem of great importance to engineers and scientists. Though there is software available for this purpose, the process requires a lot of human intervention particularly in the selection of intermediate projection surfaces. This makes the overall process of surface generation slow. This report presents an algorithm to automatically find the good projection surface and an efficient method of projecting the points orthogonally on it. This will make the process fast many times. The proposed algorithm can be applied to non-smooth surface (having some geometric singularities) also, provided the necessary pre-processing of given data is done. For generating the projections surfaces automatically, we interpolate the given point cloud by quadratic curves and proper surface of revolution. We use Fourier Continuation method to find a smooth function for a discrete set of data points representing a smooth function. We demonstrate our approach by randomly generating a point cloud for a known surface and then show our implementation results on the fuselage and engines of Falcon aircraft for which the point cloud was given or generated using softwares like computer aided design (CAD).

Machine fault detection using Image Moment and Ridge Matrix & Integrated Vehicle Health Monitoring (IVHM)

Amber Srivastava
Dr. Nalinaksh. S. Vyas

The present work focuses on detecting the faults in a machine working under transient operating conditions. Transient operating condition means that the frequency using the vibration signals. Wavelets are used as a signal processing tool which convert the time domain vibration signals into frequency-time domain. Image processing technique is an au current technique to extract the fault determining features. It helps to convert the spectrogram obtained from wavelet transform into an equivalent ellipse. The ridge diagrams and matrices are used to extract fault features by training of an expert based system. Experiments were carried out on two test rigs Gearbox Fault Simulator and Machine Fault Simulator.

Non-Destructive Testing: reconstruction and detection of cracks using Ultrasonic Phased Array Probe

Nijit Sharma
Dr. N. N. Kishore

The aim of this project was the Reconstruction of defects and cracks in different specimens using the Omniscan MX machine along with the omniscan 1-D linear phased array probe. This probe is lined with a 1-d linear array of ultrasonic transducers arranged side by side. The NDT is a frontline process in modern industries for material testing without harming the specimen. In this project ,several specimen with defects of various shapes intentionally inserted inside them were analyzed and these defects were accurately reconstructed on a PC. This process can be further extended to practically important components like rail tracks ,aerodynamic components etc. Finally we tried to find out the dimensional limit of defect for this machine for accurate reconstruction

Numerical Simulation of Mixed Convection over Protruded Heated Surfaces in a Vertical Channel

Prabhanshu Pavecha
Dr. P. S. Ghoshdastidar

A numerical study of steady, laminar, 2D mixed convection cooling of two identical rectangular protruding heat sources located in a vertical channel is presented in this report. Air as a coolant is used for electronics coolant applications and for non-electronics coolant applications Al_2O_3-Water and TiO_2-Water nanofluids have been used. Effects of Reynolds number (Re), Richardson number (Gr/Re^2), separation distance between the blocks (d/H), chip height (h/H) and width of the chips (w/H) on the average Nusselt number and Pumping Power are investigated. For non-electronics cooling applications the volume fraction of nanoparticles (ϕ) is an additional parameter. A composite correlation for the pumping power for air based on a regression analysis is also presented. Finally, a comparison between the aforesaid nanofluids has been

based on the heat transfer coefficient enhancement factor and the ratio of heat transfer coefficient to pumping power. The present work is an extension of Dhingra and Ghoshdastidar.

Feasibility analysis of image to sound signal inter-conversion

Ravi Shankar Mishra
Dr. Nachiketa Tiwari

Feasibility on image transfer via sound signal has been undertaken. The importance of such a mode of transfer becomes vital in scenarios where the electromagnetic signal transmission, which is a common mode of transmission mechanism, becomes obscure. Several methods of transfer has been experimented and tabulated according to their pros and cons. Theoretical study was done in the field of Signals and Systems and Discrete Fourier transforms to aid better understanding and design algorithms used in analyzing the data during experiments. At the end, gray scale images of different standard sizes such as 32X32, 64X64, and 256X256 has been successfully converted to sound signal, transferred using a loudspeaker, recorded using microphone and from the recorded data the image has been re-mapped using suitable algorithms to retrieve the images with satisfactory accuracy.

Numerical Studies of Micro-Combustion in a Micro-channel

Rishav Garg
Dr. D.P. Mishra

Microcombustion is a potential energy source for small devices like unmanned vehicles and micro satellites .It is to be carried out in a miniature device called micro-combustor which is typical of 1mm diameter. There are a lot of methods that converts chemical energy to thermal energy like fuel cells. But combustion is the most important one to obtain thermal energy from various fuels including hydrogen, natural gas, fuel oils because of its more energy output. Flame extinction is the biggest disadvantage of micro-combustion as heat losses become more important at smaller scales. So in order to maintain the balance between heat generated and heat lost through a micro-combustor, properly designed micro-combustor with suitable fuel has to be used. In the prescribed research work, two dimensional mathematical models for momentum, heat, and mass transport are used to simulate the combustion processes. Equations are solved numerically using the commercial software FLUENT. An annular micro-combustor found suitable for hydrogen fuel combustion in the presence for heat losses has been used. Its suitability has been investigated for a commonly available fuel methane gas and further it has been investigated for methane-hydrogen blends with different conditions of heat losses at wall boundaries. If such a small and reliable combustor is developed then it could be used in many devices such as turbines, compressors, pumps and several other electrical devices etc. This would help in operational flexibility and cutting costs.

Classical Genetic Algorithm To Solve A Maze

Niraj Kumar
Dr. Debabrata Goswami

Maze solving is an NP problem i.e. those whose none of the solutions are solvable in polynomial time but if an answer is reached, then the verification of the answer can be done in polynomial time. This is a very interesting optimizational problem and a lot of algorithm have been developed over the past years which look into this phenomenon. This paper would discuss upon the Classical Genetic Algorithm (CGA) technique to solve the problem. Inspired by Darwin Genetic theory, this paper discusses on how to create the chromosomes, evaluate their fitness values and generate new generation via crossover and mutation technique to look for the optimal solution.

Eulerian pdf transport modeling of turbulent swirling flame

Abhinav Kapoor
Dr. Ashoke De

In recent time, probability density function (PDF) transport modeling has gained lot of attention in combustion community since PDF approach in a turbulent reacting flow directly takes care of the probability distribution of all the scalars. Also this method can be modeled easily to different kinds of flames.

Positives - Very complex reaction mechanism can be easily solved
Negatives - High dimensionality

Thus, these models are constrained to numerical techniques because it requires huge memory. To cope up with the issue of high memory Monte-Carlo technique is implemented. But for the statistical error reduction, in each grid cell a good number of particles must be present. With huge particles the whole process to simulate takes a lot of time. So far, the method used till now is the "Langrangian PDF".

In particular, this study uses an alternative methodology which exploits the advantages of the PDF transport equation and is also computationally viable known as Multi environmental Eulerian PDF (EPDF). The study proposes to perform a stochastic modeling of a Sydney-Swirl-Burner (SM1 & SM2) using the EPDF method. The EPDF combines with the interaction-by-exchange-with-the-mean (IEM) mixing model, the direct quadrature method of moments (DQMOM) and realistic combustion chemistry. The EPDF treats the chemical equation exactly like in PDF method and has multiple reactive scalars. In this the joint composition PDF has a decided shape and is represented by collection of finite number of delta functions over number of environments. The PDF shape is resolved by solving the governing transport equations of probability of occurrence, weighted species mass fractions and weighted enthalpy in environment. They are then solved using the Finite Volume Method (FVM).

The final results are achieved by simulating the Sydney Swirl burner (SM1 & SM2), and are compared with the experimental data achieved by the experiments in University of Sydney. The swirling provides an interesting part in the flame investigation as it provides local tangential velocity to the particles in the flame. The results of the EPDF method will be validated against the measurements of these flames. The aim of the study is to create a computational tool for studying the swirl burner so as to bring more accuracy, save time and help in further study.

Numerical investigation of high pressure hydrogen released in air

U. Umesh
Dr. Ashoke De

The continuously growing energy needs of the world accompanied with 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, whose phenomena are not yet completely understood. 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.

The present work 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. As the shock propagates through the air, vortices are also formed which aid in the mixing of the hydrogen and shock-heated air, thereby forming a combustible mixture. The analysis of the physical mechanism of shock propagation and a quantification of the associated temperature profiles of the flow field is done. Parametric studies are carried out based on the numerical results of temperature profiles obtained for the various initial conditions of release pressure and tube length to study their effects on this high-pressure hydrogen jet behavior and how they would favor occurrence of spontaneous ignition.

Synthesis and characterization of polymeric nanoparticles as drug carriers in Huntington's disease
Shradha Suman Rickey
Dr. Ashwani Kumar Thakur

Aggregation phenomenon causing Huntington's disease, which is a neurodegenerative disorder, can be controlled by delivery of protein inhibitors to the polyQ domains. As the delivery involves crossing the blood brain barrier (BBB), polymeric nanoparticles with size less then 200nm have been used frequently as drug delivery systems because of their less toxicity, better encapsulation, adaptable surface for efficient targeting, controlled release and restorability. The project involves synthesis of polymeric (PLGA) nanoparticles using nanoprecipitation method and afterwards its characterization study using Dynamic Light Scattering (DLS) and Scanning Electron Microscopy (SEM). Nanoparticles were subjected to degradation studies followed by DLS experiments. Results obtained indicate that, at 37°C three weeks are enough to bring about an abnormal change in the particle environment ensuring its instability. Also a temperature of 80°C can ensue the degradation in less than 4 days.

Synthesis and characterisation of conducting polymer – graphene oxide composites
Spandhana Gonuguntla
Dr. Siddhartha Panda

Conducting polymers have several advantages for utilization as sensors. The sensitivity of these processes can be enhanced by use of composites of these conducting polymers. One such filler material is Graphene oxide (GO) or exfoliated graphite oxide which has been studied here owing to its high conductivity and high specific surface area. Composites of conducting polymers and graphene oxide were synthesized via an in-situ chemical polymerization of the corresponding monomers in aqueous dispersion of graphene oxide. Materials characterization of these composites was conducted using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR) and electrical characterization was done using I-V measurements.

Imparting periodicity in assembly of nanoparticles
Tatsat Banerjee
Dr. Sri Sivakumar

This project report describes a simple and versatile approach to impart periodicity in assembly of nanoparticles using "Click" Chemistry for the photonic crystal applications. Copper(I)–catalyzed–Azide–Alkyne Cycloaddition has been used to form a directed assembly of silica nanoparticles on to a silicon wafer. We have attempted to fabricate tailored multilayer with good packing density by varying the parameters of the "Click" reaction such as concentration of nanoparticles, solvent and the method of nanoparticle deposition (horizontal sedimentation & vertical deposition) on the silicon wafer.

Synthesis of chemoattractant analogues
Soumya Radhakrishnan
Dr. R.Gurunath

Peptides and proteins are highly crucial compounds in our body that take part in many functions performed by the body, chemotaxicity being one of them. Chemotaxis, is the response of a cell to a stimuli as a result it migrates towards the source. The agents that promote chemotaxicity in cells are called chemoattractants. Chemotaxicity is induced in the neutrophils by chemoattractants like formylated peptides. Formyl-Met-Leu-Phe(f-MLF) is the parent formylated peptide for chemoattractant activity.

Here we report the synthesis of the Boc protected parent peptide (f-MLF) which is Boc-Met-Leu-Phe-OMe and its analogues by replacing the leucine component with β-alanine (β-Ala), γ-aminobutyric acid (GABA) and ε-amino caproic acid (ε-Aca). Synthesis of the analog with anthranilic acid was tried and successful upto dipeptide stage. All these peptides are characterized by ^{1}H NMR and mass spectroscopy.

Geosynthetic Encased Stone Columns-A Numerical Study
Michael Koch
Dr. Rajesh Sathiyamoorthy

The use of geosynthetic encased stone columns GESC for reinforcing soft soils is becoming increasingly popular. The additional confinement provided by the geosynthetics enables GESCs to be used in soft soils where lateral confinement is negligible due to their low shear strength. Although the research in this field is extensive most of the analysis has been done focusing on the improvement in capacity of GESC reinforced soil due to encasement with very few studies focusing on consolidation analysis, which is time dependent. In the present study, time dependent behavior of GESC under various conditions has been analyzed through parametric study. Equivalency factors were developed for comparing the performance of GESC with ordinary stone column (OSC) under identical test conditions. Parametric study was performed using a validated finite element (FE) model considering factors like stiffness of the geosynthetics encasement, loading and penetration depth of GESC. For a given loading condition and encasement stiffness (EA) the results indicate a superior performance of GESC over OSC in terms of ultimate settlement. A slight improvement in the time taken for dissipation of excess pore pressure is also seen. A 21% and 3.5% reduction in the ultimate settlement was observed for geosynthetic encasement of stiffness 5000 kN/m and 500 kN/m respectively. Another interesting observation made is that the performance of partially penetrating GESC (h = 0.75H) at an EA value of 500kN/m was equivalent to that of full depth OSC in terms of ultimate settlement. The results suggest that a saving in terms of cost and material can be made by reducing the penetration depth to 0.75H, for geosynthetic mentioned above. Similar relationships were observed for other encasement stiffness also. For an encasement stiffness of 500 kN/m and 2500 kN/m, the performance of 0.95H and 0.8H GESC was equivalent to that of OSC of full depth.

Study on Power System Stability and Design of Low Pass Filter
AditieGarg
Dr. Nishchal K. Verma

Power system is defined as a grid which consists of generation, transmission, load units over an area. Loss of any generation unit due to some fault will lead to reduction in the generation output and hence the system can collapse. So, to keep the system as stable, load shedding needs to be done. To see how the system is responding we implemented Seethalaxmiet. al. "A Synchrophasor Assisted Frequency and Voltage Stability Based Load Shedding Scheme for Self-Healing of Power System ". This paper dealt with curtailment of load shedding after a disturbance has occurred in a system. This load shedding was based on both voltage and frequency instability.

We plan to predict the system frequency and voltage graph for the case when load shedding would have happened at a certain bus. Since, there are 17 load buses so, we would create 17 models where each model will be an independent model learning on how the system would react if load is shed on that bus. Once the models are learnt, we would predict the 17 systems. Thus we can measure which system is best and hence, predict where to shed the load in the system. Accordingly we will perform load shedding on that bus from which we expect best future for the system.

A low-pass filter is that which suppresses high frequency signal and permits low-frequency signals [1]. The frequency response as in response of how the frequencies are suppressed varies from one filter type to another filter type. Designing of a filter means finding of appropriate filter coefficients so that we get a filter with good frequency response. There are various methods to calculate the coefficients such as Window design method, Frequency Sampling method, weighted least squares design, Parks-McClellan method. Our study includes designing of butter worth filter in android platform and convolution of the coffecients with the input signal for generation of the required signal.

A Study of Wireless Power Transmission via Inductive Coupling
Kailash Neelakantan
Dr. Kumar Vaibhav Srivastava and Dr. A.R. Harish
A mid-range wireless power transmission system was designed with a coil diameter of 40 cm and resonant frequency of around 500 kHz. The system was analyzed using Ansoft HFSS (**H**igh **F**requency **S**tructure **S**imulator). Analysis of the circuit model was carried out in MATLAB and the results obtained were compared to the results arrived at by HFSS. In order to protect the nearby objects from the magnetic field of the system, metallic shields were introduced. Studies on shielding effectiveness and the effect of shielding on the efficiency of power transmission were carried out using Ansoft HFSS. An approximate model was also developed on MATLAB for the case of a single plane metallic shield placed on the receiver side.

Linear approximation for illumination
Shruti Singh
Dr. K S Venkatesh
The objective of this work is to create a certain approximation to reach a minimum illuminant basis and to generate an approximation using the given sources as a basis that has a minimum squared error. The advantage of this work is its reliance on linear methods to find the solution when sources are fixed.
In this work, we have considered a certain set of illuminants with specified radiation patterns. Here the illuminated surface geometry is pre specified and hence the desired illumination pattern may be pre-computed. We have found out the best approximations of the desired patterns on the given surface by linearly combining the individual patterns on the same surface cast by each illuminant at its given surface. Freedom available for our solution confess only on the N weights with which the given N sources are combined.

Secure spectrum sensing in cognitive radio
Chandana Kandru
Dr. Adrish Banerjee
Cognitive Radio is an emerging wireless technology which employs opportunistic utilization of the spectrum. One of the most important aspects of cognitive radio is spectrum sensing which includes detecting the presence of licensed user over a wide range of spectrum. The detection performance is improved through Cooperative spectrum sensing but is also drastically degraded by the presence of malicious users in the system. Though, there exists various malicious user detection techniques in literature, not all of them work efficiently in all conditions. In this report we have studied various malicious user detection techniques with an aim to finding the efficient technique under a considered set of system conditions.

Investigating out-of-band emission and PAPR reduction techniques in OFDM based cognitive radio networks
Vishal Agarwal
Dr. Adrish Banerjee
The electromagnetic spectrum is a highly valuable resource for wireless communication but it is underutilized most of the time. Cognitive Radio is an intelligent wireless technology which has come into existence for the efficient utilization of the spectrum. But the physical layer of the Cognitive Radio must be flexible in order to use the spectrum properly. Orthogonal Frequency Division Multiplexing (OFDM) has been found to be the best fit for CR networks because of its adaptive and flexible nature. OFDM is a modification of FDM (Frequency Division Multiplexing) technology, with better spectral efficiency due to overlapping of orthogonal subcarriers. Also high data rate applications can be supported by OFDM without any considerable fading or distortion. Although OFDM has many advantages it suffers from the problem of Out-of-Band (OOB) emission and high "Peak to Average Power Ratio" (PAPR). In this project pulse shaping has been considered to mitigate the OOB emission problem. Performance of five different pulses (Rectangular, Raise cosine, Better

than Raised cosine, Sinc Power and Improved sinc power) is considered and it is found that ISP (Improved Sinc power) pulse performs the best in reducing the ICI power. On the other hand the SLM and PTS techniques are compared for mitigating PAPR in OFDM systems. The CCDF of (PAPR>PAPR0) against PAPR0 plot for both these techniques show that PTS performs better than SLM technique under similar simulation parameters.

Decoy state protocol for OFDM based FC- QKD (Frequency Coded Quantum Key Distribution System)
Saumya Choudhary
Dr. Pradeep Kumar K
The objective of this study is to analyze the feasibility of OFDM or 'Orthogonal Frequency Division Multiplexing' as a subcarrier multiplexing technique for sub carrier multiplexed FC-QKD systems using B92 protocol and the inclusion of decoy pulse protocol. The entire QKD model was realized in Simulink using OFDM transmitter blocks. A proposition of suppression of intermodulation terms and sidelobe overflows by zero padding was also realized which showed very accurate results for the different cases analyzed for the systems considered. Zero padding also removed the intermodulation noise and significantly lowered the QBER or Quantum Bit Error Rate while increasing the maximum secure link length. It also yielded much higher keyrates and keylengths. For a link length of 50 km, keyrates $\approx 3.5\times10^{4}$ kbits/sec was obtained. Also, increasing the order of IFFT in the OFDM transmitter block i.e. no. of subcarriers increased the keyrates. In order to provide security to the system against PNS (Photon Number Splitting) attack by the adversary, decoy pulse protocol was included. The optimization of photon nos. for signal and decoy states was done by performing carrier ratio optimization. This was done to prevent the eavesdropper from distinguishing between signal and decoy pulses by measuring photon nos. in the pulses. Inclusion of decoy pulse protocol not only provided security against PNS attack but also it increased the keyrate and keylengths The maximum secure link length also increased to 135 km.

Evaluating benefits of being part of an economic agreement:
(A case study of India, U.S, China, European Union and ASEAN)
Suryakant Pal
Dr. Somesh K. Mathur
Trade is life line for each and every country. In this research paper -"Evaluating benefit of being part of an economic agreement" .I have chosen the countries India, US & China and regional group EU-27 & ASEAN. The study is able to identify some specialised product at the 2digit 4 digit and 6digit level of disaggregation for these countries and regional group by using RCA (Revealed comparative advantage) and market for India by using export specialization indices for the year 2007 to 2011, The study further identifies goods in which respective country has comparative advantage in production and its trade. The study then uses the simulation done through SMART analysis (within the WITS software) for evaluating the relative benefits of tariff liberalization of specialized goods by giving number to trade creation, trade diversion, revenue, welfare and consumer surplus effects of liberalizing trade for India in 2009.Thus finally research gives the conclusion by showing the best trading partner for India among these countries and regional group.
usage various parameters are changed and accordingly various manufacturing methodology are followed. In the present research different designs of micro-mixer are compared for their performance and detailed analyses for few of the most efficient designs are done.

Design of an efficient micro-mixer
Shantanu Singh
Dr. Shantanu Bhattacharya

Miniaturization of fluidic systems to carry out micro scale reactions and bio-analysis systems leading to "lab-on-chip" devices has been an interesting area of research. Some of the main applications are:-

Drug delivery
Sequencing or synthesis of nucleic acids
Polymerase Chain Reaction

These processes require chip mixing of reagents and delivery of mixed products. Depending upon the usage various parameters are changed and accordingly various manufacturing methodology are followed. In the present research different designs of micro-mixer are compared for their performance and detailed analyses for few of the most efficient designs are done.

Autonomous hovering of micro coaxial helicopter using optic flow sensor
Nidhish Raj
Dr. Abhishek

Helicopters have highly nonlinear dynamics and autonomous hovering of helicopter is a challenging problem. This paper describes a successful implementation of PID controller for autonomous hovering of a micro coaxial helicopter using optic flow sensor for velocity feedback. First, by performing an open loop excitation on a yaw test stand we were able to set the gains for a PI controller for yaw. Next, with the yaw gains set, an open loop flight was carried out to know the extent of control input needed for hovering. Next, two PID controllers were implemented with the optic flow sensor as velocity feedback to resist motion in the presence of disturbance and hover in the absence of disturbance. Finally, the resulting controller was successfully tested in a closed environment and the performance of the vehicle with and without the controller was compared. The controller was able to hover the helicopter with satisfactory performance.

IMU calibration and application in position estimation
Vinodhini C.
Dr. C. Venkatesan

The objective of this project is to calibrate an Inertial Measurement Unit (IMU) and use the device in position estimation of an autonomous mini helicopter. 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 like GPS as errors are quite significant. Hence, there is a need for a more reliable and more accurate method/ technology.

The errors and sensitivity associated with all the sensors in the IMU, namely Accelerometers, Rate Gyroscopes and Magnetometers, have to be investigated. The most important of all is the accelerometer as the data from this sensor will be integrated twice to obtain displacement and thereby, the position of the device can be determined. Since the IMU 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 the IMU has 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 the various errors and their sources in IMU data acquisition. Subsequently, it can be calibrated and experiments can be conducted to check the actual motion/displacement of the IMU with the data acquired by it. The final stage will include verification using flight test data.

Optimization of blade planform for coaxial micro air vehicle
Shamayita Mukherjee
Dr. C. S. Upadhyay

This project involved two phases. First, an analysis was developed using MATLAB, on the basis of the Blade Element Momentum Theory, to compute power and thrust distribution over the span of blade at a specific collective blade pitch angle and validate results obtained in the experiment. The expressions for thrust coefficient, power coefficient, figure of merit were formulated by solving the inflow equation iteratively. It was extended to optimize blade performance of single as well as coaxial rotors, in terms of thrust developed and power required, for a range of collective pitch angles, assuming ideal constant lift curve slope. An improvement in the above analysis was implemented, in which lift and drag coefficient were obtained from a table look up scheme by linear interpolation of angle of attack. Tables of lift coefficient versus angle of attack must be prepared, in future, to validate the code. In the second phase a hover test stand was built to characterize blade geometries by measuring rotor forces (thrust, drag and side force) and moments (roll, pitch and yaw), using a Nano17 6-Axis Force/Torque Transducer. This was connected to a PXI system for data acquisition. The transducer was calibrated in X, Y and Z directions. Single rotor tests were performed to compare performance of three rectangular flat plate Aluminium blades of constant solidity. Experimental results were further validated by comparing the same with results obtained from the BEMT predictions.

Effect of carbon nanotube reinforcement on the phase transformation of zirconia
Pratyasha Mohapatra
Dr. Kantesh Balani

The objective of the project work is to investigate the effect of carbon nanotubes on the stress induced phase transformation in cubic and tetragonal Zirconia. In this present work nanocomposite of Multi-walled Carbon nanotube with Zirconia(ZrO_2), 3 mol% Yttria Stabilised Zirconia(3YSZ) and 8 mol% Yttria Stabilised Zirconia (8YSZ) have been developed using Multistage Spark plasma sintering. Phase and microstructural analysis are performed on the sintered and crushed pellets in order to investigate the phase transformation on the application of stress. A comparison between the phase transformation in nYSZ and CNT nanocomposite and pure nYSZ, suggests the effect of Carbon nanotubes on the stress induced phase transformation in nYSZ. Tetragonal to monoclinic phase transformation decreases on carbon nanotube addition to 3YSZ by about 48.12%, as determined from the XRD phase analysis. Incorporation of CNT results in 2-3% decrease in densification. Hardness values also decrease but indentation fracture toughness increases by 25-30%, on the addition of CNT. The increase in the fracture toughness, on CNT incorporation, lies in the same range for 3YSZ, which undergoes phase transformation, and ZrO_2 and 8YSZ, which do not undergo any phase transformation on stress application. Thus the transformation (tetragonal to monoclinic) toughening provided by Zirconia is found to be much less significant as compared to the toughening provided by the CNTs.

Transformation kinetics of Shape Memory Alloys
Sagnik Sarkar
Dr. S. Sangal & Dr. K.Mondal

Transformation kinetics of Ni-Ti and Cu-Al-Ni shape memory alloys (SMAs) has been studied. The samples have been heated and cooled non-isothermally in differential scanning calorimeter (DSC) with different heating and cooling rates viz. 10, 20, 30, 40 and 50K.min^{-1}. The characteristic transformation temperatures for phase transitions are obtained from the DSC traces. Activation energies for phase transformations (martensitic and austenitic) have been calculated via three different routes using Kissinger, Augis-Benett and Takhor non-isothermal models. The primary goal of the present work is to find out the phase transformation energies during heating (austenitic) and cooling (martensitic) cycles and dependence of transformation temperatures on these cycles. Also the study aims at finding out changes in activation energies at different degrees of deformations of the alloys.

Interestingly, it is found that present method gives almost same activation energy calculated through the different techniques. It also explains the reason behind the higher activation energy required during martensite to austenite transformation than in the reverse process, in shape memory alloys.

Extending the limit (entropy of mixing) for formation of high entropy alloys
Aramanda Shanmukha Kiran
Dr. Anandh Subramaniam

The object of this work is to study about the lower limit for entropy of mixing for the formation of High Entropy Alloys. High Entropy Alloys are disordered solid solutions at room temperature. High Entropy alloys CoCuFeNi, AlCoFeNi, CoCrFeNi, AlCoCuFeNi were synthesized by using induction melting. The alloys are characterized by x-ray diffraction and scanning electron microscopy. Hardness of alloys were determine using Vicker hardness tester. Configurational entropy of mixing is determined using Boltzmaan's equation. We report the formation of high entropy alloys CoCuFeNi, AlCoFeNi, CoCrFeNi, AlCoCuFeNi which has entropy of mixing being lower than that of the entropy of mixing 13.4 J/(mol K) for five elements in equi-molar concentration. CoCuFeNi, CoCrFeNi alloys are FCC solid solutions with lattice parameters 3.58Å and 3.57Å respectively. AlCoFeNi has BCC phase solid solution with lattice parameter 2.88Å. AlCoCuFeNi has two phases BCC and FCC with lattice parameters 2.86Å and 3.60Å respectively. Hardness of prepared alloys is greater than any of the elemental component. Hardness CoCuFeNi alloy has smaller than AlCoFeNi and AlCoCuFeNi because of CoCuFeNi has FCC structure, AlCoFeNi has BCC structure and AlCoCuFeNi has two phases BCC and FCC.

Abstracts: SURGE 2012 Research Projects Done in Overseas Universities

Non Photochemical Laser Induced Nucleation (NPLIN) of a Pharmaceutical molecule: Application to Carbamazepine (CBZ)
Soumyadyuti Samai
Prof. Anne Spasojevic

The applications of the crystallization technique in the pharmaceutical industry are mainly purification and separation process for the isolation and synthesis of pure active pharmaceutical ingredients and to control the physicochemical properties of the solid obtained. The Non Photochemical Laser Induced Nucleation (NPLIN) is a phenomenon in which intense laser pulses induce supersaturated solutions to nucleate. The main objective of the work is to study the application of this recently discovered crystallization technique on a pharmaceutical molecule Carbamazepine to crystallize from its metastable state. Previously it was observed that on being exposed to the pulsed nanosecond laser (named NdYAG) with frequency 10Hz, of wavelength 532nm and max energy 300 mJ the CBZ solutions yield an orange coloration. The hypothesis behind the orange coloration is a photochemical reaction that produces iminostilbene from the CBZ which occurs by breaking the N-$CONH_2$ bond, the most Fragile bond of the molecule and adding hydrogen to the N atom from the surrounding water molecule, present as the solvent or in the moisture. Thus, this project is aimed to perform some experiments to verify the hypothesis proposed. Proper experimental conditions were imposed in order to avert the photochemical reaction resulting orange coloration and to produce the crystal of CBZ from its solution at the metastable state by NPLIN. Experiments were also performed to ascertain the metastable state for the solution and to obtain the best suitable conditions (temperature & dissolution method) for NPLIN. The effect of polarization of laser beam on the crystal morphology and impact of energy of the laser on the crystallization was also studied by using both the linearly and circularly polarized laser beam at different values of energy (200 mJ, 250 mJ and 300 mJ). The final results after the exposition of the solutions are yet to be obtained by the PhD student guide with whom I worked with. But it is quite evident from the results obtained till now that the hypothesis proposed behind the orange coloration during the NPLIN of CBZ is true. Moreover, we have been able to produce the CBZ crystals by NPLIN method, for the first time.

Gold nanoparticles and their use in cancer therapy
Sreyoshi Sur
Prof. Bruno Palpant & Dr. Simona Laza

In the modern world one of the most fast affecting potent threat to mankind is Cancer. There is no full proof medicine that can cure this disease completely and the oncologists today are looking for cures that can kill the cancerous cells leaving the healthy cells unharmed. This cannot be attained using the traditional method of chemotherapy that kills cancer cells but destroy a lot of healthy cells as well.

To kill cancer cells lasers has been extensively used to irradiate the effected tissue which is called photothermal therapy. This generally employs chemical photosensitizers that generate singlet oxygen which can destroy tumor cells. The use of nanoparticles instead of chemosensitizers would help in killing specific cancer cells as nanoparticles coated with polymers like PEG increases the temperature around itself on absorption of light from laser beam. They specifically accumulate heat near affected cells.

The aim of the project to which I was assigned is to irradiate cells in a cell culture medium containing nanorods and compare the cell mortality rate between only cells irradiated with laser beam and cells and nanorods irradiated with laser beam. This would help in understanding the relevance of nanorods presence and their effects on hyperthermia. This project was done at Laboratoire de Photonique Quantique et Moleculaire at Ecole Centrale Paris, under the guidance of Prof. Bruno Palpant and supervisor Dr. Simona Laza. The laboratory mainly conducts Spectral and Time-Resolved Pump Probe Spectroscopy and has

this project on hyperthermia along with the Laboratoire de Chimie Physique at Universite Paris Sud-IX and the MSS Mat laboratory at Ecole Central Paris. The project that I was part is an interdisciplinary project involving the physics laboratory (LPQM) where the cells were irradiated using the femtosecond laser, the part in which I was mainly associated with. The biology and chemistry labs synthesised the nanorods, cultured the cancerous cells and did the toxicity tests of the nanorods.

In the LPQM Laboratory I worked under Dr Simona Laza. I helped in preparing the optical set-up on the optical table so that the optical path of laser light is aligned properly. During the experiment the cells were required to be in their optimum temperature i.e. 37˚C. For this the temperature of the heating band has to be adjusted by doing temperature measurements with time. I was involved in measuring the temperature and characterising the heating set up suitable for my experiment. The laser beam has to be properly characterised so that the intensity remains homogenous and all the cells receive same amount of irradiation. Also the cells had to be exposed to different magnitudes of laser power which was one of the parameters that were changed during the hyperthermia experiment. I have worked with Anthony Aghedu in determing the beam profile at different power of the laser beam and the corresponding position of the lens in the beam expander. During the irradiation of cells with nanorods I have actively participated when the system was exposed to femtosecond laser beam at LPQM.

I had also visited the Physical chemistry Laboratory at University Paris Sud-IX where I was involved in the preparation of Nanobipyramids and their characterisation. I have also assisted to the preparation of PEG coated nanoparticles and their characterization using Zetasizer and UV-Vis Spectrophotometer.

Modelling of a double skin façade as discrete masses damper system for tall buildings using analytical approach
Sushant Mani Tripathi
Dr. Cuong Nguyen

In modern times, use of the double skin façade in high rise buildings has become quite prevalent because of its ventilation properties which can be either natural, fan supported or mechanical. However, the effect of the extra mass (in the form of outer skin) on the primary building mass and their combined response in case of dynamic load like wind and earthquake hasn't been pondered upon much by the practising engineers.

The report studies the structural effects of the façade mass on the dynamic behavior of the primary structure from the first principle and whether it can dampen vibrations of the building like a Tuned-mass damper.

As the first step the report presents the modelling of the building with double skin façade into a simplified analytical lumped mass model. The outer skin of the façade being a distributed mass, was modelled as discrete lumped masses connected to each of the primary floor lumped masses with a spring and a dashpot. The configuration is then solved to predict its behaviour under the dynamic loading circumstances. Governing equations are generated for motion of both the primary structures and DSF outer skins and solved to anticipate the dynamic responses of the system.

The second part of the report contains development of a MatLab code to solve the model in terms of its time history response to the dynamic loads like winds and earthquakes. The code developed solves any system having n number of degrees of freedom (where n is input by the user on the basis of the way in which the mass lumping is done as per the convenience), computes the response of the configuration and displays the plot for any lumped mass as per the request of the user. The input parameters (like the masses, stiffnesses and damping ratios) are sent to the code through a file. Another code developed for the same building without the outer skin has been presented in order to study the response generated by this configuration and compare how this response is getting reduced by the use of multiple lumped mass dampers.

Thirdly, the report presents use of the developed tool to perform a case study on a 20 x 20 x 50 m building with double skin façade, acted upon by dynamic wind loading and get the response of the configuration. The variation of the response was studied for different external wind forcing frequency and compared with the traditional building without the damper masses. The code has been further utilised to plot the maximum

displacement at the top by varying any one parameter, keeping all other parameters as constant.

Finally, the report presents various other prospects to which the developed tool can be put into use and study of special cases like varying mass density of the outer skin, or varying stiffness or varying damping ratio along the height of the building, and thus can be used to arrive at an optimised combination of these parameters from both structural and economic point of view.

Design and Control of a Partial UAV Simulator in a Water Tunnel
Subhojit Ghosh
Dr. Chris Manzie

This project explores in detail the development of a hardware-in-the-loop system modelling an underwater vehicle, with the real model being a fin mounted in a water tunnel. The main objective is to sense the hydrodynamic forces acting on the fin and feed this back to the HiL system to simulate the closed loop performance. This is a low-order model of the flight control system in which the aim is to force the model to achieve the steering commands developed by the guidance system. Since the flow-induced loads in a water tunnel are typically at least 2 to 3 orders of magnitude smaller than those acting on aircraft models in a wind tunnel, it is extremely difficult to obtain accurate force and moment data using typical load cells or strain-gauge balances. This project describes the major challenges faced in choosing the appropriate sensor and actuator used in the proposed design of the system which aims at maintaining the best trade-off between performance and cost. The steering of the model is achieved with the help of an actuator which accurately changes the angle of attack based on the feedback received from the sensor. Also discussed is a virtual Simulink model of the system and how a control scheme can be developed for the closed loop system.

A comparative ab-initio study of geometrical, electronic and optical properties of silicene and graphene
Archak Purkayastha
Dr Valerie Veniard

Silicene, a 2 dimensional sheet of Si analogous to graphene, has been the subject of recent research interest. In the present work, we investigate the geometrical, electronic and optical properties of silicene and graphene using ab-initio methods in the framework of Density Functional Theory (DFT) and Time Dependent Density Functional Theory (TDDFT) and compare the results. A supercell approximation is used to mimic a 2D surface. Local density approximation (LDA) has been used for DFT and independent particle and random phase approximations (IPA and RPA) have been used in finding the optical properties. The optimized structure of silicene in a plane resembles that of graphene. However, the stable structure of silicene is found to be low-buckled. Silicene shows similarities with graphene in that it is semi-metallic and has a linear dispersion about the Dirac point. On the other hand, electronic and optical properties of silicene are confined to a smaller energy scale compared to that of graphene. The optical properties are highly directional due to the 2D structure. The absorption properties of both silicene and graphene in the direction parallel to the plane show three peaks. One peak at zero energy is due to the metallic point in both cases. The relative strengths of the other two peaks are reversed in case of silicene as compared to that of graphene. Also, optical properties of planar and low-buckled silicene have been compared. The optical response for planar silicene has more discrete and sharper peaks than the low-buckled structure.

Simulation of Non-Photochemical Light Induced Nucleation

Aritra Kundu

Prof. Anne Spasojevic & Bertrand Clair, PhD

Non-photochemical light-induced nucleation (NPLIN) is the phenomenon that was a recently discovered in 1996 by Garetz and his co workers. Although the exact mechanism of this phenomenon is still not well understood, this process is of great importance industrially specially in pharmaceutical appliances for separating various organic polymorphs. In this work the NPLIN of aqueous supersaturated solutions of potassium chloride is studied using molecular dynamics simulation. Also the two step nucleation process is used to explain the theoretical background on the threshold electric power of Laser, characteristic of observed NPLIN data. An opensource Molecular dynamics software DLPOLY, developed by Daresbury University, UK is used to simulate the system with and without electric field. AMBER force field with LJ potentials is used for the KCl molecules.The TIP3P water model is found best suited for the problem. It is observed that KCl to certain degree shows the phenomena of clustering even without the electric field, this property is believed to help the formation of the initial nuclei. Simulation of the phenomena provided a better understanding of the nucleation process in NPLIN. This work laid the basic framework for future work on this subject, which will help in getting useful insight for the process of NPLIN for more complex molecules.

Feedback of Mentors and Students of 2012 SURGE Program

Mentor Feedback

The statistics of the responses to the quantitative questions of the Mentor Feedback form are given in Table below.

Table: Quantitative Responses in Mentor Feedback for SURGE 2012 Program

#	Question	Average score
Student		***2012***
3	Did the student measure up to your expectations? (1: Well below expectations; 5: Beyond expectations)	4.50
4	How much supervision did the student require? (1: A lot; 5: Not much)	4.00
5	Did the student work when you expected him/her to? (1: Never; 5: Always)	4.00
6	Did the student observe guidelines you set forth? (1: Never; 5: Always)	4.34
7	Did the student work well with your research group? (1: No; 5: Yes)	4.50
8	Did the student participate in department seminars or discussion groups? (1: No; 5: Yes)	3.00
9	How well suited was the student for the research in terms of: (1: Low; 3: Medium; 5: High)	
	(a) Enthusiasm for the work	4.46
	(b) Preparatory Coursework	3.00
	(c) Skills or abilities, etc.	4.00
	(d) Background knowledge	3.66
10	Would you recommend this student for the SURGE 2013 Program? (1: No; 5: Yes)	3.77
11	Would you like to work with this student again? (1: No; 5: Yes)	3.50
12	If your student was a non-IIT Kanpur student, would you consider taking him/her on as a graduate student? (1: No; 5: Yes)	4.50
13	Please give us your overall evaluation of the student. (1: Poor; 5: Excellent)	4.57

Research		
14	Did the research you expected from the SURGE research project get done in the 10 weeks? (1: No; 5: Yes)	4.15
15	Is the work worth publishing in a refereed Journal? (1: No; 5: Yes)	3.01
Overall		
16	Were you satisfied with the assistance and administrative support provided by the Office of the DRPG hosting the SURGE Program? (1: Poor; 5: Excellent)	4.53

Student Feedback

The statistics of the responses to the quantitative questions of the Student Feedback form are given in Table below.

Table: Quantitative Responses in Student Feedback for SURGE 2012 Program

#	**Question**	
Research		***2012***
3	On an average, how many hours per week did you interact with your Mentor and/or Co-Mentor? (1: 25 hours or more; 5: 5 hours or less)	4.01
4	Did you get the required equipment & facilities needed to carry out your research? (1: No; 5: Yes)	5.00
5	Did you attend research group meetings or participate in discussions with your research group members? (1: No; 5: Yes)	5.00
6	Did you feel comfortable asking questions of your Mentors and Co-Mentors? (1: No; 5: Yes)	
	(a) Mentor	5.00
	(b) Co-Mentor	5.00

7	What was the benefit you received from your summer research experience in terms of (1: Low; 3: Medium; 5: High)	
	(a) Clarification of career path	4.04
	(b) Skill in interpretation of results	4.51
	(c) Tolerance for obstacles faced in research process	4.00
	(d) Readiness for more demanding research	4.43
	(e) Understanding how knowledge is constructed	4.69
	(f) Understanding of the research process in your field	4.50
	(g) Ability to integrate theory and practice	4.78
	(h) Learning ethical conduct in your field	4.44
	(i) Learning laboratory techniques	3.99
	(j) Skill in how to give an effective oral presentation	4.90
	(k) Skill in science writing	4.78
	(l) Self-confidence	4.68
	(m) Learning to work independently	4.78
	(n) Others (please state):	3.50
8	How does your undergraduate research experience compare with the expectations you held before you began your project? (1: Well below expectations; 5: Well above expectations)	4.00
9	Evaluate the overall performance of your Mentor or Co-Mentor: (1: Poor; 5: Excellent)	
	(a) Mentor	4.78
	(b) Co-Mentor	3.67
Overview		
10	Please comment on the effectiveness of the following: (1: Low; 3: Medium; 5: High)	
	(a) Writing the research proposal or project plan before coming to IIT Kanpur	3.62
	(b) Oral presentations	3.50
	(c) Writing your final technical paper	3.48

Reviews from Students-"Impact of SURGE"

I, was the first student to come to SURGE from Andhra University, Visakhapatnam. I was lucky enough to get a chance to explore my dreams towards research through SURGE. The objective of my work was to synthesis new multi-component alloys. It was the first ever research experience in my life. By this research I got the feel of how research is done. A part from research I learned a lot of things during this program from my mentor, Dr. Anandh Subramaniam and co-mentor, Mr. Anil Kumar Singh without their motivation and guidance, this research work would not have materialized. I got the chance to listen classes of my mentor while he was giving NPTEL video lectures which helps me in understanding of many concepts. I still cherish the memories with new friends in IIT-Kanpur. I really made some great friends during the SURGE. I enjoyed Glider raiding with my friends provided by IIT-Kanpur. Finally I would like to thank SURGE, IIT-Kanpur for giving me a chance. **Aramanda Shanmukha Kiran, Andhra University, Visakhapatnam (SURGE 2012 participant)**

SURGE is a great platform for students at IIT Kanpur and outside to get indulged in the arena of research. SURGE showed me the way and gave the confidence to think of new ideas and implement them. The notion of mid-term and final evaluation makes SURGE program different from other undergraduate research programs as it always keeps you in quest of results. You never become loose. Sessions conducted by SURGE on scientific report and paper writing, avoiding plagiarism in your writings, etc were very helpful. After completion of my SURGE 2012, I am definite on taking research and academia as my career. Looking forward to participate in SURGE 2013. Cheers! **Prasoon Suchandra, AE, IITK (SURGE 2012 participant)**

SURGE has really helped me a lot to achieve my goals in life. When I first came to IITK I really did not had much experience but my term at IITK taught me a lot about lab work and research. Currently I am a graduate student pursuing MSc in Nanotechnology and Regenerative Medicine at University College London which is rated as 4th best university in world through fully funded Jubilee Scholarships by UK Government and British Council. I always wanted to do research in my life and after my term at the Biological Sciences and Bioengineering Department under Dr. Dhirendra S. Katti through SURGE programme I exactly knew how to proceed in life and take necessary steps. I would like to thank Dr. Dhirendra Katti and SURGE programme for providing me the opportunity to work at IITKanpur in the year 2011 which helped me a long way in my future endeavors. **Anjul Khadria, NIT Rourkela (SURGE 2011 participant)**

I actually don't know how to elaborate my feeling about SURGE program in words. But I want to say one thing - what I had learned there, the experience I had gathered there in ten weeks is something which will be, I do believe, a treasure for my future. From there only I had got an idea (may be of the basic level, still one is always greater than zero, no?)from how to pursue a research project to how to make a poster presentation. And yes, the most important part I had learned there failure is an indispensable part of the research - you have to accept it and you have to go forward. I think, this lesson will help me not only in research but in life also in future (Actually I can now feel the real meaning of Swami Vivekananda's famous quote - "In a day, when you don't come across any problem - you can be sure that you are travelling in a wrong path").
I had a lifetime experience during the two months of SURGE program. The experiments in the lab led me to rare sublime moments in my life. The guidance of my mentor Dr. Sri Sivakumar I would never forget. He is probably the best advisor that I can imagine in my dream. And the association of research scholars Arun Prakash Upadhyay and Gyan Prakash Sharma, who are like my elder brothers, will ever be cherished in my memory. Whatever little contributions I have made and achievements attained thereof (like best poster award) had been possible only for their kind co-operation and sagacious guidance. When I went there, first time in my life, I was estranged from my family but within a short period of time, I felt that I had been placed in a greater family headed by Dr. Sivakumar, as our friend, philosopher and guide.
And obviously at last, but not the least, I should thank Office of the Dean, Resource Planning and Generation, IIT Kanpur for conducting SURGE 2012 program. And it would be a lapse if I don't give special thanks to Dr. Anurag Gupta and Ms. Aparna Mitra who made my IIT Kanpur stay just a cakewalk. **Tatsat Banerjee, Jadavpur University (SURGE 2012 Participant)**

Regarding my experience at SURGE, it was my first and truly one of a kind. It gave me a very good exposure to research at IIT Kanpur and a brief idea about the expectations of research, namely passion, patience and perseverance. It has definitely inspired me to take up research as my career and I really look forward to work more in the field of Dynamics and Control.
Furthermore, SURGE also provided me with the opportunity of meeting new people, both friends and mentors alike. I managed to make new friends and the Happy Hours were instrumental in our bonding. We also managed to visit the malls in Kanpur as well as Bithoor Ghat. I would like to make a suggestion to increase the frequency of Happy Hours and perhaps include fun activities which would help in students getting to know each other better.
Also, the accommodation and food were to my liking and comfort. I would like to say a big thank you to the entire SURGE team of faculty and staff for the constant support and assistance.
To conclude, I would like to say that the entire SURGE experience was enriching and enjoyable. On a personal note, I would like to say thanks a lot Aparna ma'am for all your help and guidance. SURGE would have been incomplete without your presence :)
Vinodhini C., IIT Kharagpur (SURGE 2012 Participant)

Achievements of Students-"Accepted Papers in Journals "

Flight Control System for Gust Resistant Micro Air Vehicle, presented at 8th International Conference on Intelligent Unmanned Systems, Singapore, 22 – 24 October, 2012.
Verma, A., **Raj, N. (SURGE 2011 & 2012 participant)**, and Abhishek
Abstract: This paper discusses the preliminary development of flight control system for a gust resistant Micro Air Vehicle (MAV). Maintaining the state of autonomous hover for a MAV in presence of any disturbance is a challenging task which depends on the robustness of the control system as well as rotor control power for a rotor based vehicle. This paper compares two different approaches for achieving autonomous hover. In the first part, a PID controller is implemented for attitude stabilization of the vehicle using the states measured with an Inertial Measurement Unit (IMU). In the second part, PID controller is refined to incorporate velocity feedback by using an optic flow sensor for autonomous hovering of a micro coaxial. This is achieved in various steps. First, the PI controller for yaw stabilization is tuned by performing an open loop excitation on a yaw test stand. Next, with the yaw gains set, an open loop flight is carried out to identify the extent of control input needed for hovering flight. Next, two PID controllers are implemented with the optic flow sensor as velocity feedback to resist motion in the presence of disturbance and hover in the absence of disturbance. Finally, the resulting controller is successfully tested in a closed environment and the performance of the vehicle with and without the controller is compared. The controller is observed to be able to satisfactorily maintain the hover of the MAV.

Development of Auto Take off and Landing System for a Coaxial MAV, to be presented at 8th International Conference on Intelligent Unmanned Systems, Singapore, 22 – 24 October, 2012.
Dwivedi, A.(SURGE 2012 Participant), Srivastava, V., and Abhishek
Abstract: This paper discusses the preliminary development of an auto takeoff and landing system to be used onboard a mini coaxial helicopter using a bio-inspired approach used by honeybees. The auto takeoff and landing is implemented by regulating the thrust to attain a constant optic flow. The sensor used is an ADNS 3080 optical mouse sensor pointing vertically downwards. The proof of concept is demonstrated using a circling arm mechanism with rotorcraft and sensor assembly onboard. The Optic Flow Regulator (OFR) allows the vehicle to perform auto takeoff and landing. During the takeoff it directs the rotorcraft to attain a steady throttle value and a constant height. During landing, the vehicle descends down from a known height to rest. All the processing is done onboard using an Arduino mini and ADNS 3080. It can be concluded that the displacement output from the optical mouse chip can be taken as a good measure of optic flow. A tethered helicopter with a fixed pitch and no roll or yaw can successfully perform auto takeoff and landing using a simple proportional controller and a compact sensing unit. By using two or more such sensors and integrating them with an inertial measurement unit, it is possible to perform auto takeoff and landing on a free flying vehicle.

Autonomous Hover of a Coaxial MAV Using Velocity Feedback, Submitted to Defense Science Journal towards an invited paper for Special Issue on Micro Air Vehicles.
Raj, N.(SURGE 2011 & 2012 participant), and Abhishek
Abstract: This paper describes an implementation of PID controller for autonomous hovering of a micro coaxial helicopter using optic flow sensor for velocity feedback. First, an open loop excitation test was performed on a yaw test stand to set the gains for a PI controller for yaw. Next, with the yaw gains set, an open loop free flight test was carried out by a human pilot to know the extent of control input needed for hovering. Next, two PID controllers were implemented to use the combination of optic flow sensor and IR sensor for velocity feedback to resist unwanted motion in the presence of a disturbance and hover in the absence of disturbance. Finally, the resulting controller was successfully tested in a closed gust free environment and the performance of the vehicle with and without the controller was compared. The controller was observed to maintain hover by imparting zero mean velocity to the coaxial helicopter.

Pseudo-isothermal crystallization kinetics from non-isothermal experimental data
C. Chattopadhyay**, S. Sarkar (SURGE 2011 & 2012 participant),** S. Sangal and K. Mondal
Abstract:- Isothermal and non-isothermal techniques are used to determine kinetic parameters and understand phase transformation mechanism guided by nucleation and growth process like crystallization of glass. Many of the methods of analyzing non-isothermal kinetic data cannot give full insight of the phase transformation mechanism. Therefore, isothermal process or simulation of non-isothermal data is necessary for understanding the mechanism of a particular process. In the present work, a new approach, called pseudo-isothermal technique, is proposed for getting isothermal transformation behavior of any phase transformation such as crystallization of glassy alloys at different temperatures well above the normal crystallization temperatures as indicated by the from non-isothermal differential thermal analysis. This new technique is simple and robust since it uses non-isothermal data and it is associated with least amount of fitting error. It also enables to get complete understanding of the mechanism of crystallization behavior of glassy alloys.
Note: 25% work is done by Mr. Sagnik Sarkar in his SURGE project and rest is done by PhD student, Mr. Chinmoy Chattopadhyay. * Corresponding

CAD Based Modeling and Prediction of Tool Wear in μED-milling
Karthikeyan G., Sambhav K., **Santhosh D.(SURGE 2010 participant),** Ramkumar J.
Abstract:- Micro electric discharge milling (μED-milling) is a process wherein a simple cylindrical tool is made to move along a predefined path to generate complex shapes in difficult-to-machine materials. Although the process eliminates tool shaping effort for complex profiles, the tool wear phenomenon is a major issue which needs to be attested. Basically tool wear can be measured as bottom wear and/or side wear. In bulk machining were the complete material is removed with single depth of cut, both of these wears become important. In this research article, a technique of wear prediction is proposed where the uniform wear behavior is extended to tool side along with the tool bottom. A CAD tool using NURBS is employed in predicting the tool wear. The objective of the work is twofold: first to simulate the micro channel for varying conditions and then predict the shape of the μ-channel in successive passes for a given machining conditions.

Functionally Graded Hydroxyapatite-Alumina-Zirconia Biocomposite: Synergy of Toughness and Biocompatibility. Mater. Sci. Engg. C, Vol. 32 (2012), pp. 1164-1173.
Md. A.F. Afzal, **P. Kesarwani (SURGE 2010 participant),** K.M. Reddy, S. Kalmodia, B. Basu, K. 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 FGMstructure. In this perspective, the presentwork 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) FGMbio-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 FGMwas 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) nanocomposite, i.e. enhanced bulk toughness combined with unrestricted surface bioactivity. Therefore, such designed biomaterials can serve as potential bone implants.

Bactericidal effect of silver reinforced carbon-nanotube and hydroxyapatite composites.
Journal of Biomaterials Applications, doi:10.1177/0885328211431856 (2012).
Md A.F. Afzal, S. Kalmodia**, P. Kesarwani (SURGE 2010 participant),** B. Basu, K.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 nanoindentation 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

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