SURGE 2010

Summer Undergraduate Research Grant for Excellence

Annual Report

Office of Dean Resource Planning & Generation
Indian Institute of Technology Kanpur

From the desk of DRPG

Dear SURGE Friends

I am very pleased to report that SURGE program is continuously gaining recognition amongst the student and the faculty members.

SURGE 2010 had 122 student participants from 115 institutes, and 80 IIT Kanpur faculty mentors which are nearly double compared to SURGE 2009. The team worked very hard to ensure that the core of our academic and research endeavors would remain strong in spite of the higher numbers.

We received about 1500 applications this year. Most of the applications were of very good quality, and had excellent research proposals. The committee had a tough time in selecting the proposals and had to turn down many good proposals. After careful consideration committee selected 122 excellent proposals.

At the end of the program every participant was asked to make a poster presentation. Each presentation was evaluated by at least three faculty mentors. We present to you abstracts of all the research projects done during SURGE 2010.

The success of this program has been possible due to hard work of student participants, enthusiastic and dedicated mentoring by faculty members, excellent infrastructure support provided by staff members, and generous financial support by our illustrious alumni.

I thank all of you for making this program a grand success and I am confident that the institute will continue to receive your support in the future too. This hard work, participation, ideas and support are what make IIT Kanpur such a special place.

Thank you!

Sanjeev K Aggarwal
Dean Resource Planning and Generation

SURGE program- An overview

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

Speakers during SURGE 2010 Happy Hour:

Dr. Anandh Subramaniam
Department of Material Science and Engineering
Title:Universe to Nanocrystals

Dr. Tapan K Sengupta
Department of Aerospace Engineering
Title: Computing: Are we there yet?

Dr. Rajat Moona
Department of Computer Science and Engineering
Title: Software Development: Is it Science or Art?

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Funding SURGE

The participating students receive a stipend of Rs 10,000 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 2010 and beyond! Endowments help to ensure the future of the SURGE program and provide students with unparalleled research opportunities.

Special Thanks to:

- Batch of 1977
- Batch of 1980
- Microsoft Research, Bangalore
- Sukriti Vidyut Udyog Pvt. Ltd., Ghaziabad (Sudhir Mohan Mittal, BT/CHE/1970)
- Manasvi Srivastava (BT/CHE/1989)

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 2010 at IITK from IITK			
S. No.	**Name of the participant**	**Project**	**Mentor**
1	Abhinav Prateek Mechanical Engineering	Simulation of Convection in a Cavity Using Lattice Boltzmann Method	Dr.Subrata Sarkar Mechanical Engineering
2	Agrim Gupta Civil Engineering	Rational determination of cover thickness in RC structures for fire loading	Dr. Sudhir Misra Civil Engineering
3	Akshara Rai Electrical Engineering	Polychromatic Near-Infrared Video Capture and Analysis	Dr. K.S.Venkatesh Electrical Engineering
4	Akshay Mittal Computer Science & Engineering	Infrequent and Frequent Itemset Mining using Pattern Growth Method	Dr. Arnab Bhattacharya Computer Science & Engineering
5	Anjani Varshney Mechanical Engineering	Thermal Performance Characterization of Embedded Pulsating Heat Pipe Radiator Plate by Infrared Thermography	Dr. Sameer Khandekar Mechanical Engineering
6	Ankit Kumar Computer Science & Engineering	Query Adaptive Reference-Based Indexing In Databases with Metric Distance Measures	Dr.Arnab Bhattacharya Computer Science & Engineering
7	Ankit Sharma Electrical Engineering	Determining the Number of Speech Sources in Meeting Rooms	Dr. Rajesh M. Hegde Electrical Engineering
8	Ankur Jhavery Chemistry	Biotin and Transferrin interaction with chicken erythrocytes: contact on membrane surface and formation of self-assembled fibrous structures	Dr. Sandeep Verma Chemistry
9	Anshul Sirohiya Electrical Engineering	Development of algorithm for microwave imaging	Dr.Md. Jaleel Akhtar Electrical Engineering
10	Anup Rana Chemistry	Dynamic kinetic resolution in small ring aza-heterocycles	Dr.M.K.Ghorai Chemistry
11	Ardhendu Shekhar Tripathy Electrical Engineering	Estimation of azimuth and elevation angles of arrival of speech signals using phase of MUSIC spectrum for a circular array	Dr. Rajesh M. Hegde Electrical Engineering
12	Aseem Kushwah Electrical Engineering	Construction of Bayesian Networks using Decomposition learning algorithm	Dr.Nishchal Verma Electrical Engineering
13	Atanu Chakraborty Chemistry	Effect of Molecular Structure on the Thermal Lens Spectroscopy	Dr.Debabrata Goswami Chemistry
14	Kartikey Asthana Aerospace Engineering	Infinite Images System as a model for determining inviscid, irrotational flow for circular geometries	Dr. T K Sengupta Aerospace Engineering
15	Keerti Choudhary Mathematics & Statistics	Algorithm to find a Minimum Vertex Cover of a graph if its size is equal to the size of Maximum Matching	Dr.S K Mehta Mathematics & Statistics
16	Mani Chandra Physics	Study of velocity field reversals in Rayleigh-B´enard convection	Dr.. M. K. Verma Physics
17	Parnika Agrawal Material Science and Engineering	Effect Of Electrical Stimulation On Cell-material Interactions On Stainless Steel	Dr. Bikramjit Basu Material Science & Engineering
18	Parul Agarwal Computer Science & Engineering	Tissue-specific metabolic network prediction: Interpreting a genome-wide expression screen	Dr.Arnab Bhattacharya Computer Science & Engineering
19	Pranay Sharma Electrical Engineering	Estimation of Minimal Cut Sets in a Network	Dr. Saikat Chakrabarti Electrical Engineering
20	Puneet Chugh Civil Engineering	Improvement of punching shear resistance in RC slabs using GFRC (Glass Fiber Reinforced Concrete): An Experimental Study	Dr. K.K. Bajpai Civil Engineering

21	Puneet Singh Aerospace Engineering	Modelling and Analysis of Yaw Dynamics of a Mini Helicopter on a Test Rig	Dr. C. Venkatesan Aerospace Engineering
22	Punyashloka Debashis Electrical Engineering	Photonic Band Gap Material for Grating Assisted Directional Coupler	Dr.Utpal Das Electrical Engineering
23	Richa Srivastava Humanities & Social Sciences	Trade and Competitiveness of Environmental Goods and Services. A Developed and developing countries Analysis.	Dr.Somesh K. Mathur Humanities & Social Sciences
24	Rik Dey Electrical Engineering	Realisation of Dual Band Wilkinson Power Divider using Metamaterial	Dr.Kumar Vaibhav Srivastava Electrical Engineering
25	Rohit Arora Mechanical Engineering	Simulating autonomous MAV Navigation in Uncertain Environment	Dr.Amitabh Mukherjee & Dr. Nachiketa Tiwari Computer Science & Engineering
26	Rohit Ranjan Civil Engineering	Evaluation of Liquefaction Potential of Soil	Dr.Prishati Ray Chowdhury Civil Engineering
27	Sandhya Kumari Chemical Engineering	Flexible Temperature Sensor Based On Conducting Polymer	Dr. Siddhartha Panda Chemical Engineering
28	Saswati Roy Chemical Engineering	Hysteresis in Doped Oxide Catalysts	Dr. Raj Ganesh S. Pala Chemical Engineering
29	Shah Harsh Laxmikant Civil Engineering	Quantitative Analysis of the Microstructure of Thermo-Mechanically Treated Reinforcing Steel bars under Application of Heat	Dr. Sudhir Misra & Dr. Sandeep Sangal Civil Engineering
30	Shakti Saurabh Aerospace Engineering	Flow past two side by side cylinders at low Reynolds number	Dr.T.K.Sengupta Aerospace Engineering
31	Shourya Sonkar Roy Burman Biological Sciences & Bioengineering	Identification of Genes Essential for Attachment of Tendons	Dr. A. Bandyopadhyay Biological Sciences & Bioengineering
32	Shyamashis Das Chemistry	Protein-Fluorescent Dyes Interaction	Dr. Pratik Sen Chemistry
33	Siddharth GS Aerospace Engineering	Flow Study and Optimization of Corrugated Plates/Airfoil	Dr. Sanjay Mittal Aerospace Engineering
34	Siddharth Jain Electrical Engineering	Application of Genetic Algorithms for the Design of Metamaterial Resonator and Filter	Dr. Animesh Biswas Electrical Engineering
35	Somil Bansal Electrical Engineering	Application Of Genetic Algorithm For Design Of Metamaterial Resonator And Band-Pass Filter	Dr. Animesh Biswas Electrical Engineering
36	Subhali Subhechha Electrical Engineering	Conformal antenna for Small Satellites	Dr. A R Harish Electrical Engineering
37	Tushar Agarwal Chemical Engineering	Piezoresistive polymeric pressure sensors	Dr. Siddhartha Panda Chemical Engineering
38	Vibhav Agarwal Biological Sciences & Bioengineering	Role of Deiodinase3 in migration of trunk neural crest cells	Dr Amitabha Bandyopadhyay Biological Sciences & Bioengineering
39	Vidur Kumar Biological Sciences & Bioengineering	Search for Topographic Guidance Molecules in RetinoTectal Mapping Comparison of Transcription Profile (along the two Tectal axes)	Dr.Jonaki Sen Biological Sciences & Bioengineering
40	Vishwas Sharma Civil Engineering	Anaerobic Wastewater Treatment as Microbial Fuel Cell	Dr. Soumyen Guha Civil Engineering

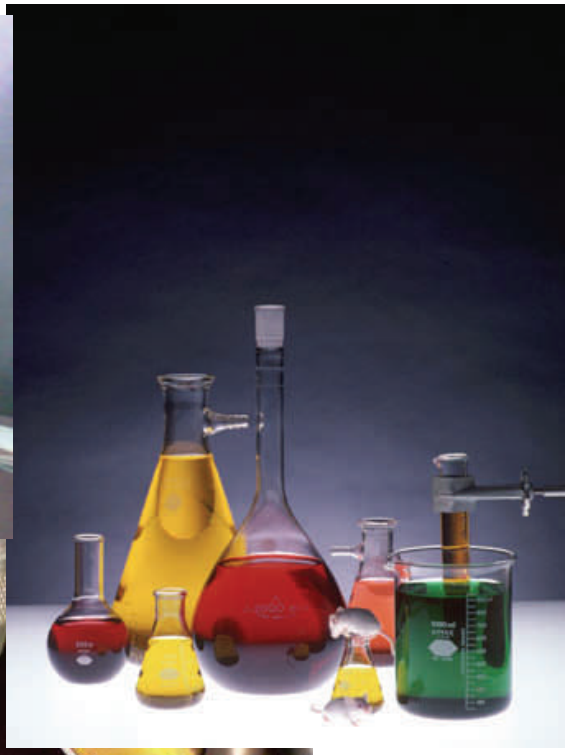
Participants of SURGE 2010 at IITK from other universities				
S. No.	**Name of the participant**	**Name of the Institute**	**Project**	**Mentor**
1	Adithya V. Computer Science and Engineering	Amritha School of Engineering	A deterministic algorithm for solving AΞB2 mod(P)	Dr. Manindra Agrawal Computer Science & Engineering
2	Akruti Khare Applied Physics	NIT Surat	Modelling Critical Thickness in Core-Shell Semiconductor Nanowires	Dr.S Ingole Material Science & Engineering
3	Amrith Thandra Mechanical Engineering	MNNIT, Allahabad	Optimum material decoupling point in an information enriched legile supply chain	Dr. Subhas Misra Industrial & Management Engineering
4	Ankit Naik Mechanical Engineering	NIT	Closed Loop RPM Control of Autonomous Mini-Helicopter	Dr. C. Venkatesan Aerospace Engineering
5	Ankita Agarwal Computer and Communication Engineering	LNMIIT	Multimedia Transmission over OFDM based Cognitive Radio	Dr. A Jagannatham Electrical Engineering
6	Ankur Kumar Electronics & Communication Engineering	NIT Hamirpur	Design and Implementation of 1-D Solar Tracker	Dr. R S. Anand Electrical Engineering
7	Ankur Verma Electrical & Electronics Engineering	NIT Surathkal	Improving the Lifetime of OLEDs	Dr. R S Anand Electrical Engineering
8	Aravind Muthiah Chemical Engineering	NIT Trichy	Development of GIS based National Emission Inventory for Black Carbon	Dr. Mukesh Sharma Environmental & Management Engineering
9	Arka Mondal Production and Industrial Engineering	MNNIT, Allahabad	Personal Information Management for Engineering Students	Dr. Jayanta Chatterjee Industrial & Management Engineering
10	Arnab Ghosh Production and Industrial Engineering	MANIT Bhopal	Improving the Quality of Customer Information	Dr. Subhas Misra Industrial & Management Engineering
11	Bipasha Mallick Electrical Engineering	NIT Durgapur	Optimal Placement of Phasor Measurement Units for Multi-Area Observability	Dr. S. Chakrabarti Electrical Engineering
12	C.Pavan Kumar Chandanam Chemistry	University of Hyderabad	Cyclophosphazene-Supported Pd(0) Nanoparticles: Synthesis, Characterization and Reactivity	Dr. V Chandrasekhar Chemistry
13	Debdeep Sarkar Electronics and Telecommunication Engineering	Jadavpur University	Metamaterial-inspired design of Efficient Electrically Small Antennas	Dr. K V Srivastava Electrical Engineering
14	Debtosh Mukhopadhyay Metallurgy and Materials Engineering	VNIT Nagpur	Simulation of Growth of Heteroepitaxial 2-D Island and Determination of Critical Dimensions Using Finite Element Methods	Dr. Anandh Subramaniam Material Science & Engineering

15	Deepika PV Chemical Engineering	NIT Surathkal	Steady State Optimization of the GTL process	Dr. Nitin Kaistha Chemical Engineering
16	Disha Shrivastava Electronics & Communi-cation Engineering	BIT Mesra	Effects of Chromatic Dispersion in single and mul-tichannel fiber-optic communication systems	Dr. Pradeep Kumar Electrical Engineering
17	Gaurav Singh Ceramic Engineering	IT-BHU	Mechanical Characterisation of HAp Based Ferro-electric Composites for Bone Applications	Dr. Bikramjit Basu Material Science & Engineering
18	Gitanjali Sachdeva Computer Engineering	SVNIT Surat	Design of Direct Memory Access Device for Parrallel Multiprocessor System Dedicated to Natural Lan-guage Procesing Applications	Dr. Ajai Jain Computer Science & Engineering
19	Harsh Shukla Information Technology	Sikkim Manipal Institute of Tech-nology	Computational Aspects of Determining Chaos in Dynamical Systems	Dr. Brahm Deo Material Science & Engineering
20	Himanshu Aggrawal Electrical Engineering	IIT-Rajasthan	Location Tracking Using Passive RFID	Dr. A R Harish Electrical Engineering
21	Himanshu Singh Computer Science and Engineering	IT-BHU	Effects of MAC Protocols on Energy Efficiency In Wireless Sensor Networks	Dr. R K Ghosh Computer Science & Engineering
22	Indu Bhrit Srivastava Chemical Engineering	NIT Trichy	Steady State Optimization of the GTL process	Dr. Nitin Kaistha Chemi-cal Engineering
23	Jagannath Prasad Mishra Electrical Engineering	NIT.Rourkela	Object Grasping using Barrett Hand: A Self Organiz-ing Map Based Approach	Dr. L. Behera Electrical Engineering
24	Jagnyashini Debadarshini Computer Science and Engineering	NIT.Rourkela	Load balancing in Multi processor Natural Language processing (N.L.P.) System	Dr. Ajai Jain Computer Science & Engineering
25	Joy Mitra Electronics and Telecommunication Engineering	KIIT University, Bhubaneswar	Multimedia Transmission over OFDM based Cogni-tive Radio	Dr. A Jagannatham Electrical Engineering
26	Karuna Phuyal Electronics Engineering	SVNIT Surat	Visual Traffic Monitoring & Statistics generation	Dr. K S Venkatesh Electrical Engineering
27	Kavitha K.G. CELOS	CELOS	Critical thickness of heteroepitaxial thin films using finite element method	Dr. Anandh Subramaniam Material Science & Engi-neering
28	Leroy Mathew Mechanical Engineering	NIT Warangal	Magnetic levitation of Steel Sphere with Flexible Cantilever Strips	Dr. Bishakh Bhattacharya Mechanical Engineering
29	Mahesh Shukla Mechanical Engineering	NIT Surathkal	Convecting aperiodic vortex induced perturbation effects on a wall boundary layer	Dr. T K Sengupta Aerospace Engineering
30	Manisha Pandey Biotechnology	NIT Durgapur	Removal of Arsenite (As III) and Arsenate (As V) from aqueous solution by adsorption onto modified sand.	Dr. Mukesh Sharma Environmental & Management Engineering
31	Meenakshi Singh Bio technology and Medical Engineering	NIT.Rourkela	Resorbable micro-/nano-fiber based scaffolding sys-tem for sub-chondral bone regeneration	Dr. Dhirendra S. Katti Biological Sciences & Bioengineering

32	Nitin Saurabh Jha CELOS	CELOS	Fabrication and Testing of a Hand Held Fibre Probe for Fluorescence Imaging of Cervical Tissue	Dr. Asima Pradhan Laser Technology
33	Nitisha Gupta Mechanical Engineering	MANIT Bhopal	Damage Monitoring of a Composite Plate Using a Laser doppler Vibrometer	Dr. Bishakh Bhattacharya Mechanical Engineering
34	Pallavi Kesarwani Metallurgical & Materials Engineering	VNIT	Bactericidal effect of Silver addition on Hydroxyapatite and Carbon Nanotubes	Dr. Kantesh Balani Material Science & Engineering
35	Pankaj Agarwal Communication and Computer Engineering	LNMIT Jaipur	Smart Card Operating System and PKI	Dr. Rajat Moona Computer Science & Engineering
36	Prachi Chautiwale Electronics and Communication Engineering	VNIT Nagpur	An Application-oriented Model for Wireless Sensor Networks integrated with External Networks	Dr. Priya Ranjan Electrical Engineering
37	Pragya Maheshwari Electronics and Communication Engineering	NIT Calicut	Secure Spectrum Sensing in Cognitive Radio Networks	Dr. A. Banerjee Electrical Engineering
38	Radhika M.V. Computer Science	Pondicherry University	An Epidemiological Approach to Opiate Drug Users	Dr. Peeyush Chandra Mathematics & Statistics
39	Rajesh Kumar Industrial & Production Engineering	NIT Jalandhar	The Impact of ERP on SMEs and Implementation Problems	Dr. Subhas Misra Industrial & Management Engineering
40	Ravi Sundaria Electrical Engineering	MNIT Jaipur	Efficiency Improvement of Wireless Power Transfer	Dr. K V Srivastava Electrical Engineering
41	Ravishekhar Kumar Mechanical Engineering	Vellore Institute of Technology	Hydrodyanamics of Oscillating Slug Flow Inside Square Capillary/ Mini Channels	Dr. Sameer Khandekar Mechanical Engineering
42	Roshan Sam Mechanical Engineering	NIT Trichy	Study of flow over Inverted Aerofoil in Ground Effect using Overset Grid Method	Dr. T K Sengupta Aerospace Engineering
43	Rutayan Patro Electronics Engineering	SVNIT Surat	Design of Bus Controlling Units for Parallel Multiprocessor System Dedicated to N.L.P (Natural Language Processing) Applications	Dr. Ajai Jain Computer Science & Engineering
44	Sandeep Kumar Mechanical Engineering	NIT Surathkal	Flow Study and Optimization of Corrugated Plates/ Airfoils	Dr. Sanjay Mittal Aerospace Engineering
45	Sanjay Kishore Prabhakaran Production Engineering	NIT Trichy	Role of 3PL services in the context of Special Economic Zones	Dr. Peeyush Mehta & Dr. A K Mittal Industrial & Management Engineering
46	Santosh Devarajan Production Engineering	NIT Trichy	Modelling of μ-ED Milling Responses Using CAD	Dr. J Ram Kumar Mechanical Engineering
47	Sapna Devi Chemistry	NIT Jalandhar	Filling of Carbon Nanotube with Different Metal Nanoparticles	Dr. Sabyasachi Sarkar Chemistry
48	Savya Sachi Pandey Metallurgical and Materials Engineering	VNIT Nagpur	Study and Simulation of Biomaterials for Dental Implants	Dr. Kantesh Balani Material Science & Engineering
49	Seema Choudhary Mechanical Engineering	MNIT Jaipur	Design and Computation of Flow through a Supersonic Wind Tunnel	Dr. B Eshpuniyani Aerospace Engineering

50	Shashank Gupta Chemistry	IIT Roorkee	Modified Method for Extraction of Chlorophyll A, Its Charecterization and Synthesis of Some Metallporphyrins	Dr. Sabyasachi Sarkar Chemistry
51	Shiwani Berry Chemistry	NIT Jalandhar	Evaluation of Recyclable Supported Ru-catalyst for the Oxidation of 1,5-dienes	Dr. F A Khan Chemistry
52	Smriti Agarwal Computers and Communication Technology	LMNIT Jaipur	Generating Vocabulary for Software Architecture Documents and Using Drupal Content Management System at the Front End	Dr. T V Prabhakar Computer Science & Engineering
53	Sohun Choudhury Ceramic Engineering	NIT Rourkela	Study of the mechanical properties of HAp-Ti bioceramic composite	Dr. Bikramjit Basu Material Science & Engineering
54	Somya Singh Metallurgy and Materials Engineering	NIT Trichy	Synthesis and Characterzation of High Entropy Alloys	Dr. Anandh Subramaniam Material Science & Engineering
55	Sonal Katware Biotechnology	NIT Durgapur	Cloning, Purification and Crystallization of SAS proteins	Dr. Balaji Prakash Biological Sciences & Bioengineering
56	Souvik Roy Mechanical & Industrial Engineering	IIT Roorkee	Dynamic Wavelet Fingerprinting using Laser Based Ultrasonics	Dr. P Munshi & Dr. N. N. Kishore Mechanical Engineering
57	Sreeprasad A CELOS	CUSAT	Metallic Nanostructures for Magnetic Metamaterials	Dr. S. Ananth Ramakrishnan Physics
58	Srishiti Rijhwani Electrical & Electronic Engineering	NIT Warangal	Visual Speed Monitoring of Wind Energy Farms	Dr. K S Venkatesh Electrical Engineering
59	Subarna Kar Mathematics	BITS Pilani	Local Search Approach for Completion Time Variance In Shop Scheduling Problems	Dr. Prabha Sharma Mathematics & Statistics
60	Tariq Zyad Civil Engineering	NIT Surathkal	Shear strengthening of Unreinforced Masonry Wall using GFRP (Glass Fiber Reinforcement Polymer): Experimental and Analytical Study	Dr. K K Bajpai Civil Engineering
61	Tejas Agarwal Mechanical Engineering	MNNIT Allahabd	Study of Auction theory and analysis of India's 3G Auction	Dr. R. K. Amit + Dr. P. Mehta Industrial & Management Engineering
62	Udita Awasthi Biomedical Engineering	Vellore Institute of Technology	Application of Microwave in Biomedical Engineering	Dr. Md. Jaleel Akhtar Electrical Engineering
63	Umair Khan Bioinformatics and Biotechnology	Institute of Bioinformatics and Biotechnology, University of Pune	Studies towards Structure Determination of a set of Drosophila MADF- BESS domain proteins	Dr. Balaji Prakash Biological Sciences & Bioengineering
64	Upkar Kumar Photonics	CUSAT	Synthesis and Charecterization of ZnO:Eu2O3 Composite Thin Films via Pulsed Laser Deposition	Dr. Asima Pradhan Laser Technology
65	Vaibhav Mehta Computer and Communication Engineering	LNMIT Jaipur	An Application-oriented Model for Wireless Sensor Networks integrated with External Networks	Dr. Priya Ranjan Electrical Engineering

66	Varsha Anand Computer Science and Engineering	HBTI Kanpur	Conversion of Concept maps from CMap format to VUE format	Dr. T V Prabhakar Computer Science & Engineering
67	Vivek Singh Civil Engineering	IT-BHU	Application of PMF and UNMIX for Source Apportionment of the PM1 at IIT Kanpur	Dr. Tarun Gupta Civil Engineering
68	Aline Lueckgen Biology	Rice University	Designing an RNA interference-based Strategy for functional Characterization of Genes involved in Hippocampus Development	Dr. Jonaki Sen + Dr. Amitabha Bandyopadhyay Biological Sciences & Bioengineering
69	Autumn Allen Mechanical Engineering	Rice University	Design of the Mechanical Dragonfly	Dr.Anupam Saxena Mechanical Engineering
70	Adrian Chapman Physics	Caltech	The Effect of Sub-Dominant Foreground Components on Observed CMB Anisotropy	Dr. Pankaj Jain Physics
71	Manon Pelletier Mechanical Engineering	Ecole Centrale Paris	Hydro-dynamics of slug flows inside square capillaries	Dr. Sameer Khandekar Mechanical Engineering



Participants of SURGE 2010 from IITK to Overseas Universities				
S. No.	**Name of the participant**	**Name of the Institute**	**Project**	**Mentor**
1	Aditya Huddedar Computer Science & Engineering	Ecole Centrale Paris	Non-linear properties of Barium Titanate from First principles	Dr. Igor Kornev Physical Properties of Materials and Modelling Laboratory (SPMS)
2	Anugrah Jain Electrical Engineering	Ecole Centrale Paris	Mesh Partitioning Techniques.	Dr.Frederic Magoules Applied Mathematics and Systems
3	Bhuwan Dhingra Electrical Engineering	University Of Melbourne	Distributed Learning in Wireless Sensor Networks	Dr. Subhrakanti Dey Electrical & Electronic Engineering
4	Gaurav Bhatele Aerospace Engineering	Ecole Polytechnique	Investigation of impact of meteorites on Mars	Dr. Cristophe Clanet Hydrodynamics Laboratory
5	Himanshu Jain Mechanical Engineering	Ecole Centrale Paris	Study of seismic wave propagation over a hilly terrain using Fast Multipole accelerated Boundary Element Method	Dr. Régis Cottereau Mechanics, Structures and Materials Laboratory (MSSMat)
6	Mainak Chowdhury Electrical Engineering	Caltech	Robustness bounds for Coppersmith Sudan decoding over the real field	Dr. Babak Hassibi Electrical Engineering
7	Raghav Khanna Mechanical Engineering	Caltech	Design Principles for Functionally Graded Thermoelectric Cooling Systems	Dr. G.J. Snyder Material Science
8	Raziman TV Physics	Caltech	Evolution of Circumbinary Black Hole Disks	Dr. Sterl Phinney Department of Astronomy
9	Shubhayu Chatterjee Physics	Ecole Polytechnique	Analysis of Simulated Data of Proton-Proton Collisions in the CMS at LHC	Dr. Ludwik Dobrzynski & Dr. Raphael Granier de Cassagnac CMS group,Particle Physics and Astrophysics Laboratory
10	Vinamra Agarwal Mechanical Engineering	University Of Melbourne	Study of Cochlear Implants and 3D Finite Element Modeling of Human Cochlea	Dr. Saman Halgamuge Mechanical Engineering
11	Vineet Gupta Computer Science & Engineering	Ecole Polytechnique	Algorithms for Reasoning with Temporal Relations	Dr.Manuel Bodirsky Computer Science

Abstracts: 2010 SURGE Research Projects Done at IIT Kanpur

Simulation of Convection in a Cavity Using Lattice Boltzmann Method
Abhinav Prateek, Mentor: Dr. Subrata Sarkar

The objective of the work is to perform a detailed study of The Lattice Boltzmann Method, to understand its advantages, disadvantages over other existing methods, to develop an understanding of the working of the method. After developing an understanding of the method, it is to be applied to obtain the streamlines for the lid driven cavity problem. These results need to be compared with the results existing in literature. Further it involves studying the convection process and applying Lattice Boltzmann Method to simulate convection flow in a cavity. Again the results obtained are to be compared with the results existing in literature. The Lattice Boltzmann Method is a very new method and has a lot of scope for development. It is currently a hot topic of discussion in the field of Computational Fluid Dynamics.

Rational determination of cover thickness in RC structures for fire loading
Agrim Gupta, Mentor: Dr. Sudhir Misra

Reinforcing bars within reinforced concrete need to be protected from high temperatures (which may occur when any of the surfaces is exposed to fire) to avoid strength loss and structural collapse. Most of the time, it is only the concrete cover that protects the reinforcement from this thermal damage. Concrete cover in reinforced concrete is the least distance between the surface of embedded reinforcement and the outer surface of the concrete. The cover thickness values in codes are prescriptive and not always satisfactory. This study tries to find by simulation, the temperature variations within concrete that might occur in the event of a fire and as an end result arrive at rational values of cover thickness for a required fire resistance. Fire temperature and temperature profile of wall at all times were calculated numerically usingcompartment fire theory and 1-D heat equation (finite difference method) respectively. Thermal properties of concrete (thermal conductivity and heat capacity) were taken to be varying with both temperature and position. The program scales effortlessly to changes in simulation conditions. It can also generate a live preview of the temperature profile. The results (gas temperature, temperature profile and cover thickness values) obtained from the analysis were validated using published values in the available literature. Further provisions for nominal cover thickness given in Indian and other country codes have been examined in light of the findings and a proposal has been made for its rational determination by defining the idea of a ‘critical temperature’ at the reinforcement location.

Polychromatic Near-Infrared Video Capture and Analysis
Akshara Rai, Mentor: Dr. K.S.Venkatesh

The human eye needs three wavelengths of light to create different colours. The three colours the eye is most sensitive to are: violet, green and red. Infrared images are conventionally taken using only one wavelength, which gives a monochromatic image, devoid of the details of the object. We aimed at producing polychromatic images in the dark, followed by video capture. We captured gray scale images in two Near Infrared (NIr) wavelengths – 850nm and 950nm and put them into the red and green channels of a RGB image, after elementary image enhancement. The blue channel was taken to be an algebraic combination of these two images. Thus we obtained a pseudo-colour image, which preserved most of the details of the object concerned. It was modified so that human skin could be identified as pink. We produced a pseudo-coloured video of 15 frames per second in dark surroundings.

Infrequent and Frequent Itemset Mining using Pattern Growth Method
Akshay Mittal, Mentor: Dr. Arnab Bhattacharya

Association rules are used to identify relationships among a set of items in a database. These relationships are not based on inherent properties of the data themselves (as with functional dependencies), but rather based on co-occurrence of the data items. Discovery of frequent and infrequent itemsets is important for the mining of positive and negative association rules respectively. Market Basket Analysis is quite a good example where association rules are widely used. Frequent itemset mining is not limited to the single threshold model but has been extended to Multiple Level Minimum Supports (MLMS) model. The MLMS model uses multiple level minimum support thresholds to discover frequent itemsets. In the MLMS model, in order to constrain the number of frequent itemsets, different minimum supports are assigned to itemsets with different lengths. Pattern-growth based algorithms for frequent itemset mining have been experimentally found to be better than candidate generation-and-test based algorithms in earlier studies. We design a new algorithm, IFP, to mine minimally infrequent itemsets by employing a pattern-growth based approach. We further extend this algorithm to discover frequent itemsets in a MLMS model. We compare the extended algorithm with the existing algorithms and analyze the efficiency of the MLMS model. The experimental results and comparisons show the validity of the algorithm.

Thermal Performance Characterization of Embedded Pulsating Heat Pipe Radiator Plate by Infrared Thermography
Anjani Kumar Varshney, Mentor:Dr. Sameer Khandekar

Miniaturization of Electronic Components is leading to higher heat flux levels. There is a need of better cooling strategies to manage them thermally. Pulsating Heat Pipes provide an optimal solution due to their simple and passive construction design. Radiator plates are used to dissipate heat out of the electronic components in spacecrafts. Here we have embedded a Pulsating Heat Pipe into the plate. We have shown that such a plate indeed performs better in terms of increased effective thermal conductivity, more degree of isothermalization and lower maximum temperature. Infrared Images of the plate were taken for different combinations of heaters to determine the spatial temperature profile which showed oscillations of ethanol filled in the pulsating heat pipe. Simulation was carried out for one capillary tube by effective thermal conductivity approach to determine spatial temperature distribution over the length of capillary.

Query Adaptive Reference-Based Indexing In Databases with Metric Distance Measures
Ankit Kumar, Mentor: Dr. Arnab Bhattacharya

We consider the problem of maintaining a memory resident reference-based index for a database with an expensive distance metric under a varying query distribution. The objective is to select and update a set of reference objects from the database online as new queries arrive in order to improve query performance. In this work, we propose an algorithm that considers a window of the most recent queries and replaces the existing pivot objects with database objects that are likely to be better pruning pivots for the changing query distribution. With such a query adaptive approach, fewer distance computations are required to answer a similarity search query, resulting in much faster query response times for applications requiring database of objects with computationally expensive metric distance measures. We present experimental results that substantiate these claims.

Determining the Number of Speech Sources in Meeting Rooms
Ankit Sharma, Mentor: Dr. Rajesh M Hegde

An attempt to determine the number of speech sources in meeting rooms using subspace-based methods and Information Theoretic Criteria has been made in this project. The processing of signals received by sensor arrays can be separated into two problems (1) detection of the number of sources and (2) isolating and analyzing the signal produced by each source. We make this distinction because many of the algorithms for separating and processing array signals make the assumption that the number of sources is known a priori and may give misleading results if the wrong number of sources is used. A good example is the errors produced by estimation algorithms like MUSIC when the wrong number of sources is used. Three approaches, the classical subspace-based approach, Akaike Information Criterion (AIC) and Minimum Description Length (MDL) have been discussed and used to determine the number of signal sources in the presence of noise. The Information Theoretic Criteria, AIC and MDL, work in the same direction and they include the subspace-based method. The simulation results show that the subspace-based method is not stable especially when the number of microphones is insufficient. MDL seems to perform better than AIC and the subspace-based approach.

Biotin and Transferrin interaction with chicken erythrocytes: contact on membrane surface and formation of self-assembled fibrous structures
Ankur Jhavery, Mentor: Dr. Sandeep Verma

The objective of this work is to study the interaction of Chicken RBCs with fibrous protein and vitamin like transferrin and biotin respectively when incubated over a time span. Transferrin and biotin have been reported to form fibrous structures in buffer solutions. Also people have reported these fibres to cause damage to human erythrocytes when incubated for a period of 3-4 days. Transferrin and biotin are solutions are incubated in appropriate buffer with chicken RBCs and the nature of their interaction is analyzed using various microscopy techniques (Optical microscope, Atomic Force Microscope and Scanning Electron Microscope). As certain biotin derivatives gain access to Plasmodium falciparum infected erythrocytes and block parasite-induced transport of other solutes, the microscopy observations reported in this communication will provide impetus to unravel the access mechanism of biotin and its derivatives to malaria infected erythrocytes. Inside the body erythrocytes have a much longer observed *in-vivo* lifetime, which is of the order of 120 *days*. Also, no transferrin or biotin fibres have been reported to be circulating in the body.

Study of the mechanism through which body prevents any damage to the erythrocytes by transferrin and biotin may yield important insight into preventing fibrilisation of proteins that are already conclusively known to be linked to diseases (e.g. Amyloid β-protein), thus resulting in new channels to combat diseases aggravated by fibrillar protein aggregates such as Alzheimer's disease, Parkinson's disease and Type II Diabetes.

Development of algorithm for microwave imaging
Anshul Sirohiya, Mentor: Dr. Md. Jaleel Akhtar

The idea of the project is to extract the permittivity profile and thus the microwave image of the material using microwaves. It uses the relationship between the scattering coefficients of the microwave and the permittivity profile of the material. Permittivity profile can be extracted by applying algorithms and transformation on the scattering coefficient data. We have considered the case of permittivity reconstruction when we have band-limited measurement in the frequency domain and developed an algorithm which can effectively extract the permittivity information from given information.

Dynamic kinetic resolution in small ring aza-heterocycles
Anup Rana, Mentor: Dr. M. K. Ghorai

Over the years, biologically active nitrogen-containing molecules including a wide variety of natural products have attracted the attention of organic chemists in order to develop novel, synthetically useful and elegant methodologies for the synthesis of such types of compound as targets or designs for new drugs and important intermediates in organic synthesis. Aziridine rings constitute a vital sub-structure of biologically active molecules. Most of the cases for the synthesis of optically pure biologically active compounds requires optically pure aziridine intermediate. This versatility use of aziridine comes from the S_N2 type ring opening ability in presence of Lewis acid. By applying the concept of dynamic kinetic resolution (DKR) on aziridine, we can synthesize such type of chiral molecules from racemic aziridine. This fantastic idea comes from the racemisation of optically pure aziridine and S_N2 type ring opening ability of aziridine in presence of Lewis acid.

Estimation of azimuth and elevation angles of arrival of speech signals using phase of MUSIC spectrum for a circular array
Ardhendu Shekhar Tripathy, Mentor: Dr. Rajesh M. Hegde

Direction of arrival (DOA) estimation of speech signals using a set of spatially separated microphones in an array has many practical applications in everyday life. DOA estimates from microphone arrays placed on a conference table can be used to automatically steer cameras to the speaker if the conference is a part of a video conferencing session or long distance T.V. based classroom. DOA estimates can also be used in speech enhancement for human-computer interfaces that depend on speech input from operators. Subspace-based methods of DOA estimation, while been sub-optimal in comparison to the maximum likelihood estimator method, involve much less computation and hence can be used in real-time applications. Much of the literature at present focuses on DOA-estimation using a uniform linear array(ULA). However, a ULA fundamentally suffers from front-back ambiguity, and thus cannot specify DOA within a cone of confusion. Circular arrays, on the other hand, suffer from no

such problem, and are successfully used to estimate both azimuth and elevation of sound source. The performance of MUSIC algorithm deteriorates drastically in the presence of noise. On the other hand, MUSIC group-delay, which takes into account the phase information of the MUSIC spectrum, has been shown to give better performance in DOA estimation in case of a ULA. Following its cue, an attempt was made to take into account the phase information in the case of a circular array and a new definition for a spectrum was formulated, henceforth called MUSIC*phase spectrum. The new spectrum is shown to give consistently better DOA estimates, with lesser number of spurious peaks and more distinction between the DOA peaks and the peaks due to noise.

Construction of Bayesian Networks using Decomposition learning algorithm
Aseem Kushwah, Mentor: Dr. Nischal Verma

Bayesian network are probabilistic model with various practical application where it is used in a decision model. Bayesian networks are constructed using two main type of algorithm-i)Conditional ii)Scoring function In the following report attempts have been made to construct a Bayesian network using Decomposition learning algorithm and attempts at improving it have been made. This algorithm is loosely based on divide and conquer strategy, where all variables are divided into clusters and structure are learned in each of these clusters and they are combined to give complete network. The major advantage of this algorithm is in cases when the variable size is large and dataset size is comparatively small.It has major advantages in run times complexity as instead of searching over the complete graph of variables it searches only in cluster created in the method itself which reduces complexity. In the later part of project some modifications were tried by altering structure learning method from conditional independency tests to scoring functions based search methods.

Effects of Molecular Structure on the Thermal Lens Spectroscopy
Atanu Chakraborty, Mentor: Dr. Debabrata Goswami

In this report we will show how the thermal lens spectroscopy will change with the change of the molecular structure. We have used three samples n-butanol, sec-butanol and tert-butanol mixed with methanol with different volume fraction. These are the three isomer differ only by their structure. We have got three different types of pattern of thermal lens vs vol. fraction of methanol plot. We compare this with the ethanol-methanol mixture and find that only the tert-butanol-methanol have almost the same plot with the methanol-ethanol mixture. We have concluded that this type of plot is coming for the nonideality which is attributed due difference of interaction between solvent and solute interaction.

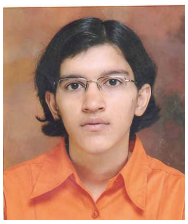
Infinite Images System as a model for determining inviscid, irrotational flow for circular geometries
Kartikey Asthana, Mentor: Dr. T. K. Sengupta

During computational investigation of high Reynolds number flows, the results produced through the solution of the Navier Stokes equation have significant dependence on the initial conditions chosen. Ordinarily, the simulation is started by assuming uniform flow over the entire domain and then the physical surfaces are introduced impulsively along with viscosity. A more efficient impulsive start to the simulation is to use potential flow around the system of physical surfaces to supply the initial conditions. In this case, the physical surfaces are already present at the start and only viscosity is introduced impulsively. In this project, a mathematical model composed of infinite singularities has been used to determine potential flow around two cylinders. The model is based on the requirement of an 'image' doublet in order to cancel the effect of its 'source' doublet which is necessary for satisfying the boundary condition on cylinder surfaces.

This requirement becomes recursive since every 'image' in turn starts behaving like a 'source'. Owing to the decay in strength of the singularities, a sufficiently large number of pairs of singularities can be selected to limit the error in the boundary condition below a desired threshold. By utilizing the same, computational solutions have been generated for (i) side-by-side and (ii) tandem configurations of the two cylinders. Differences in mathematical relations among singularities for these two cases have been illustrated and proven.Even though, this project proves the applicability of the model for two cylinder arrangements, the domain of application of this model naturally extends to all such systems that include one or more circular geometries.

Algorithm to find a Minimum Vertex Cover of a graph if its size is equal to the size of Maximum Matching

Keerti Choudhary, Mentor: Dr. Shashank K. Mehta



The size of a minimum vertex cover is at least as large as the size of a maximum matching in a graph. The problem of finding a minimum vertex cover for any general graph is known to be NP-hard, whereas maximum matching can be computed in polynomial time. Let G = (V, E) be any graph, we present an algorithm that (i) Verifies whether the given graph satisfies the property – "The size of the minimum vertex cover of the graph is equal to the size of its maximum matching." (ii) Compute a minimum vertex cover Vc of the graph, if it does. The time complexity of algorithm is O (n^2), where n denotes the number of vertices in graph G.

Study of velocity field reversals in Rayleigh-B´enard convection

Mani Chandra, Mentor: Dr. M. K. Verma

We perform high accuracy direct numerical simulations of Rayleigh-B´enard convection in a 2D box for Prandtl number of one and Rayleigh numbers from 106 to 109. No-slip boundary conditions are imposed on the velocity field on all the walls. The top and the bottom walls are at a constant temperature, whereas the side walls are insulating. We find that for specific Prandtl numbers, there are global reversals in the velocity field, which are also observed in experiments. It is seen that during the reversal, the dominant large scale structure is destroyed and small scale structures come into play. We study the interplay between structures that exist at different scales by projecting the velocity and temperature fields onto a basis spanned by Chebyshev polynomials. The time series of various large scale modes are studied to understand how the reversals take place.

Effect Of Electrical Stimulation On Cell-material Interactions On Stainless Steel

Parnika Agrawal, Mentor: Dr. Bikramjit Basu

Electric field affects the cell-material interaction in a number of ways depending on its intensity and duration. This study aims to observe the effect of parallel electric field on cell adhesion and proliferation on the surface of stainless steel. L929 mouse fibroblast cells were used for this study. Cell culture samples were qualitatively analyzed through the use of optical and fluorescence imaging. It is shown that due to the application of electric field during the cell culture experiment, the cell proliferation as well as the cell spreading on the surface of the biomaterial was enhanced in the voltage range 1V-5 V and in the electric field range 0.33 V/cm-1.67 V/cm . The maximum cell density was observed at 1V. Significant differences in cell density within the same sample were also seen. This could be attributed to cathode-directed motility of fibroblast cells on application of electric field.

Tissue-specific metabolic network prediction: Interpreting a genome-wide expression screen
Parul Agarwal, Mentor: Dr. Arnab Bhattacharya

The objective of this project is to build tissue-specific metabolic networks for chicken. Tissue specific metabolic network means to build an inter-linkage map of pathways that are functional in a specific tissue during organogenesis in chicken. This is carried out by mapping biologically validated genome-wide metabolic enzyme expression data on KEGG pathway maps. KEGG (Kyoto Encyclopedia of Genes and Genomes) is an online databases dealing with genomes, enzymatic pathways, and biological chemicals. We have built an inter-linkage map of all the pathways functional in chicken and an inter-linkage map of pathways functional in kidney tissues of chicken during organogenesis. The results of this project can be further used to build the tissue restricted gene networks for chicken i.e., the hierarchical order of signaling molecules, transcription factors and metabolic enzymes operative in a particular tissue. This will test the hypothesis that metabolic enzymes are responsible for conferring the unique physico-chemical property to a tissue during organogenesis.

Estimation of Minimal Cuts Sets in a Network
Pranay Sharma, Mentor: Dr. Saikat Chakrabarti

This project consisted of two main parts. In the first part of the project, I implemented an already existing algorithm (ref. 1) for calculating the minimal cut sets of any general network in the form of a MATLAB code. This algorithm is based on Boolean algebra and set theory and has many advantages over other algorithms meant to do the same task. It is more efficient computationally, can have any number of input and output nodes, etc. But, this algorithm is very time consuming and the system under consideration cannot be scaled up easily using it. Therefore, we needed another algorithm which could predict the effect of adding more components to a pre-existing system. This was the second part of the problem statement of this project. The algorithm for the second part developed yet works only for a single-input-single-output node system. This algorithm is iterative and at each step calculates the minimal cut sets of the system and uses these for the successive system.

Improvement of punching shear resistance in RC slabs using GFRC (Glass Fiber Reinforced Concrete): An Experimental Study
Puneet Chugh, Mentor: Dr. K.K. Bajpai

The report presents the results and conclusions derived from an experimental program to investigate the improvement of punching shear resistance in RC (Reinforced Concrete) slabs (manhole covers) using GFRC (Glass Fiber Reinforced Concrete) for both steel and FRP (Fiber Reinforced Polymers) used as reinforcement. The initial part of the program was designing of a manhole cover for typical vehicular loads on the Indian National Highways. Once designed, the manhole covers were tested for punching shear strength up to failure. The experiments mainly aimed to achieve the ultimate punching shear strength, deflection at the peak load and the strain in the reinforcement at the peak load for both steel and FRP reinforcement used in RC as well as GRC slabs. The experimental values are then analyzed to draw some visible conclusions and compared with the some of the predictions made using analytical models for the punching shear strength. It is observed that when designed for the same load, the punching shear strength of FRP reinforced slabs is found to be lesser than those of the steel reinforced ones.

Also improvement in mechanical properties of the slabs is seen for both types of reinforcement on adding glass fiber to the mix. For the steel reinforced slabs, it can be made out from strain data that the punching failure occurs before the yielding of reinforcement begins. Also it is seen that none of the analytical models used gave a very accurate prediction of the punching shear strength of the specimen. However in all of the specimen tested, the punching shear strength was found to be greater than the predicted values. The experimental phase of the study, the key results and the most important conclusions derived are presented in the report.

Modelling and Analysis of Yaw Dynamics of a Mini Helicopter on a Test Rig
Puneet Singh, Mentor: Dr. C. Venkatesan

The Helicopter is a vehicle of considerable interest to practical air transport because of its versatility in motion along any direction. Although the idea of the Helicopter had been around for centuries, it was only after an understanding of its controls that the first powered manned helicopter could become a reality. A helicopter obtains its lift from its rotating horizontal rotor blades. However due to a reaction torque from the shaft, the body tends to rotate in the opposite direction of the blades. To counter this movement, a tail rotor provides a counter moment to balance the helicopter. This motion of the Helicopter about the vertical axis is known as yawing or heading. The heading is controlled by changing the pitch angle of the blades of the tail rotor. This increases or decreases the force created by it and hence the helicopter yaws clockwise or anti clockwise.Under Dr. C. Venkatesan, an experimental research activity on the design & development of an Autonomous Mini Helicopter is currently under progress in the Department of Aerospace Engineering at IIT Kanpur. In the Mini Helicopter, the pitch of tail rotor blades is changed by a mechanism controlled by a digital servo. In the experiments of heading control done in the laboratory, the vehicle was mounted on a test rig. On this setup, an Inertial Measurement Unit was placed in the Avionics Box of the Helicopter, which sent data about angles, angle rates and accelerations to the Computational End. Different servo inputs were given and the Helicopter yaw movement was observed. These open loop tests concluded that the response of the vehicle was inconsistent at smaller step inputs, a higher main rotor RPM allowed smoother response, and for same inputs the vehicle behaved differently in different runs. On the basis of these characteristics, mathematical modelling of the transfer function was done and a closed loop control system was designed and implemented. An inner loop controlled the yaw rate and the outer loop controlled the yaw angle. However the vehicle response was not well behaved. In this research, the yaw characteristics in the two opposite yaw directions were proposed to be different and modelled in its dynamics. The control logic was simulated for this system. The servo and tail rotor characteristics were used to compare experiment with theory. An experimental setup was designed for more precise tests.

Photonic Band Gap Material for Grating Assisted Directional Coupler
Punyashlok Debashish, Mentor: Dr. Utpal das

Under the project, the response of a Grating Assisted Directional Coupler (GADC) [1] that can be used as a Coarse Wavelength Division Multiplexing (CWDM) channel drop filter is proposed to be optimized to an acceptable degree by the use of photonic band gap crystals. A Grating Assisted Directional Coupler (GADC) consists of two asymmetric wave guides of different width and refractive index. The purpose of a GADC is to selectively pass a certain band of wavelength and to block others. This is achieved by having gratings on the spacing region between the two waveguides. But the response is not yet satisfactory. The aim is to achieve the coupled power as close as possible to the CWDM requirements.However, with only gratings, we find the curve has side lobes having considerable magnitude at wavelengths other than the required band.

Also in the required pass band, the curve is not sufficiently flat. The aim is to make circular air incisions in the unperturbed Multi Quantum Well (MQW) region of the grating, which would effectively create a 2-dimentional photonic crystal thereby selectively modifying the refractive index to make it more wavelength selective. Photonic Band Gap materials (also known as photonic crystals) are materials, which have a band gap due to an energy range where wave behaving photons cannot be transmitted through the material. The lattice can prohibit the propagation of certain wavelengths in certain directions. We would like to use this property in the spacing region of the coupler to achieve a more selective coupling response. In order to analyze the device, we need to calculate the refractive index of the photonic crystal at particular wavelength. This can be derived from the band structure of the crystal. In this project, the band structure is calculated by analytic method and then numerically by using MATLAB. From the band structure, the effective refractive index of this region would be calculated, which can be used to predict the response of the coupler using the previously established software.

Trade and Competitiveness of Environmental Goods and Services A Developed and developing countries Analysis.

Richa Srivastava, Mentor: Dr. Somesh K. Mathur

The growing importance of Environmental issues and sustainable development strategies has created a parallel interest in trade in Environmental Goods and Services (EGS). The global environmental market is currently estimated to be over USD 700 billion while the trade is just about one tenth of that amount. Liberalizing trade in EGS may assist the developing countries build their economies on more environmentally sustainable lines, but the economic benefits that it has, for the trading partners (developed and developing countries) depends not only on the existence of policy conditions that allow freer trade, but also on the existence of a viable consumer market for the environmental goods and services. This work analyzes the competitiveness of regional groups of developing countries like ESCAP (57), SAARC (8), ASEAN (10) and APTA (6) in trade in Environmental goods and services. This is done by calculating the various competitiveness indices like Revealed comparative Advantage, Michelaye Index, Competitiveness Index and Export Share for the commodities like Climate Smart Goods(64), Clean Coal Technologies(5), Energy Efficient Lightening(1),Solar Photovoltaic Systems (3), Wind Energy(2) etc. The study of the variables affecting the trade in the EGS is done using Gravity Equation Analysis. The gravity model uses econometric techniques to evaluate thousands of individual observations on trade and investment between countries over time against the "gravitational mass" of explanatory variables that describe the characteristics of bilateral trade and investment partners. Two such explanatory variables can be real GDPs of partners and the distance between them. In this analysis- Tariff (simple and weighted), Distance, GDP (reporting and partner) and PCGDP (reporting and partner) are used as explanatory variables and their effect on the trade (gross export) of Climate Smart Goods , is studied using Regression analysis (Software: STATA).

Realisation of Dual Band Wilkinson Power Divider Using Metamaterial
Rik Dey, Mentor: Dr. Kumar Vaibhav Srivastava

Power dividers and combiners are very important for microwave and millimeter-wave systems, because they can be widely used in balanced power amplifier, antenna feed networks, measurement systems etc. Recently, due to the requirement of dual-band microwave or wireless communication systems (such as GSM, TD-SCDMA), the researches on dual-band impedances matching and dual-band Wilkinson power dividers become very popular. In this article, we design a dual-band modified Wilkinson power divider using balanced composite right and left handed (CRLH) metamaterial. The structure has been simulated for lumped element and distributed microstrip implementation. The design equations are obtained by using CRLH TL property. A simulated dual band example with frequency ratio 3.1 has been presented to achieve theoretical verification. The results indicate that it can operate at desired dual band with good performances in return loss, insertion loss, equal power dividing and isolation.

Stimulating Autonomous MAV Navigation in an Uncertain Environment
Rohit Arora, Mentor: Dr. Nachiketa Tiwari & Dr. Amitabh Mukherjee

The obstacle avoidance algorithm for a Micro Air Vehicle (MAV) [<15cm and <100g flying object] is considered in a medium dense environment (e.g. warehouses and offices). **Due to payload limitation –** already available high performance algorithms for obstacle avoidance and navigation are not useful as they are computational intensive requiring lot of onboard battery power. In general, there are two types of obstacle avoidance methods; offline and online. The first method, calculates the complete trajectory before motion execution, I have investigated Virtual Potential Field method for this type. Online methods recalculate the motion alternation during motion execution, based on all available information including current sensory data. A new algorithm based on kinematic constraints has been proposed. This paper aims at finding an algorithm for autonomous navigation of MAV in an uncertain environment using a single **laser rangefinder**[a low power(<200mW) , low weight(<20g) device] and to simulate the flight in a random environment using MATLAB-SIMULINK software to test the effectiveness and robustness of the proposed algorithm.

Evaluation of Liquefaction Potential of Soil
Rohit Ranjan, Mentor:Dr. Prishati Ray Chowdhury

The phenomenon of soil liquefaction is common for saturated sand deposits during strong earthquake motions. Soil liquefaction is defined as the complete or partial loss of strength of saturated soil deposit due to increase in pore water pressure and reduction in effective stress under cyclic loading condition. Ever since the 1964 Niigata Earthquake which displayed great damage to structures resulting from liquefaction of soil, this phenomenon has gained significant attention in Geotechnical & Earthquake Engineering Research. Numerous efforts have been made in order to understand the phenomenon of liquefaction, predict liquefaction potential and adopt proper remediation techniques. This study focuses on a comparative analysis of three methods; one deterministic and two probabilistic for predicting liquefaction potential of a seismic region of Southern California. The models used in this study are: (i) deterministic method proposed by Youd et al. (2001), (ii) probabilistic method proposed by Liao et al. (1988) and (iii) probabilistic method proposed by Toprak et al. (1999). Using the standard penetration test data collected from the Port of Los Angeles, California, USA, the results from the three models are compared.

Flexible Temperature Sensor Based On Conducting Polymer
Sandhya Kumari, Mentor: Dr. Siddhartha Panda

Conducting polymer possesses electrical, electronic, magnetic properties of a metal with mechanical properties, processibility, etc. The great advantage of using organic based devices is because of them being very cheap, easy processibilty and ease of synthesis. Moreover the organic polymer adds an advantage to the device for being flexible in nature. In this work, study has been done on to use films of polyaniline (a conducting polymer) doped by camphor sulphonic acid (**CSA**) as the temperature sensing element. Polyaniline (**PANI**) is synthesized from monomer aniline and doped with CSA in the solution form. The films of doped PANI are made on glass substrate by using spin coating technique. Different characterizations of film have been done. From electrical characterization, it is observed that temperature sensitivity of these films is very high as compare to metal based resistive temperature devices (RTDs). The thickness of the films played a great role in the temperature sensitivity. Thickness can be varied by varying rpm during spin coating or varying viscosity of the polymer solution. It is observed that sensitivity of thin films (**<** 80 nm) is much higher than thick films (**>** 120 nm). Temperature sensitivity of encapsulated and non-encapsulated films has been compared. Aging effect on films has been also observed.

Hysteresis in Doped Oxide Catalysts
Saswati Roy, Mentor: Dr. Raj Ganesh S. Pala

A given system can exhibit two different activities under the same operating conditions. This phenomenon is termed as **hysteresis.** Mars–van Krevelen (MVK) mechanism (proposed in 1954) has been used traditionally to explain catalysis with the help of doped oxide catalysts. However that mechanism is not able to rationalize the phenomenon of hysteresis observed in a Ti-doped ZnO catalyst. The oxidation of CO on a Ti-doped ZnO catalyst proceeds through several parallel reaction pathways that differ from the traditional MVK mechanism. The aim of this work is to develop a mathematical model incorporating these parallel pathways and explain the phenomenon of hysteresis.

Quantitative Analysis of the Microstructure of Thermo-Mechanically Treated Reinforcing Steel bars under Application of Heat
Shah Harsh Laxmikant, Mentors: Dr. Sudhir Misra & Dr. Sandeep Sangal

When a reinforced concrete structure is exposed to fire, the concrete and the reinforcing bar are also exposed to higher temperatures. Steel when exposed to high temperature is known not to maintain its microstructure distribution pattern. So the quantitative change in the various phases of steel in a TMT bar on account of high temperature exposure is an important matter to study. The present study is done using Fe500, nominal diameter 25mm High Strength Deformed (HSD) Thermo-Mechanically Treated (TMT) steel bar conforming to IS 1786:2008. The fire conditions were simulated in lab by heating the sample to the peak temperature for the soaking time in a furnace and cooling in air. Different samples from reinforcing bar were exposed to peak temperature 250°C, 500°C, 750°C and 950°C in an electric furnace for time ranging from 10-120 minutes and cooled down to room temperature in air. Each sample was grinded, polished and etched to obtain the micrograph. Micrographs were taken at the outer surface and at 2.5mm, 5mm, 7.5mm, 10mm and 12.5mm from the surface assuming radial symmetry. Quantification of all the phases is done using the point count method. The original sample was found to have mainly ferrite, pearlite, bainite and tempered martensite. The different heating treatments led to the redistribution of these phases.

It was found that there was not significant change in the distribution pattern of the phases for the samples exposed up to 500°C except for the increment of grain size of the phases. The sample exposed to 750°C and 950°C show a significant change in the distribution of phases irrespective of the soaking period.

Flow past two side by side cylinders at low Reynolds number
Shakti Saurabh, Mentor: Dr.T.K.Sengupta

Fluid flow and vortex dynamics investigation through a simple configuration of two side by side cylinders help us to build our understanding of flows around more complex structures, like chimney stacks, chemical reaction towers, offshore structures, and skyscrapers in modern cities. Here, we solve the flow past two side by side cylinders using overset grids by computing Navier–Stokes equation in two-dimensions. The Reynolds number was fixed at 100. The difference between the centers of the two cylinders (s) determines to a large extent the level of wake interference and subsequent wake structure. Williamson, has reported vortex shedding in anti-phase as well as in in-phase for different values of 's'. We observe through computation similar vortex shedding patterns and have a good qualitative assessment of the obtained results. To deal with the numerical parameters ascribing the flow past two side by side cylinders, such as lift coefficients, strouhal number etc, and comparisons were made with the available numerical as well as experimental results. We find very close matching of our calculated parameters with those already present in literature, and thus justify the validity of using overset grid for solving flow past complex systems (two side by side cylinders, in our case). This is followed with Proper Orthogonal Decomposition of the data obtained to represent the flow using finite number of relevant coherent modes that contribute to the entire dynamical system.

Identification of Genes Essential for Attachment of Tendons
Shourya Sonkar Roy Burman, Mentor: Dr. A. Bandyopadhyay

Tendons and ligaments (addressed by the generic name, tendons) are the connective tissues which join the muscles to the bones and the bones to each other, respectively. In any organism, they make very specific and precise connections with bones and muscles to enable body movement characteristic to its species. Focussing on the limbs, we have tried to elucidate a probable mechanism by which tendons attach to the bones with such spatial accuracy. The problem was divided into three parts– where the tendon progenitors of the limb originate, how they are localised to their final location besides the developing skeleton and how they make their characteristic attachment to the bone in a site specific manner. The preliminary data source was a screen performed by Bandyopadhyay et al [i], which identified certain genes which had a distinct expression in the most superficial layer of the developing skeleton (perichondrium or periosteum). Using a candidate gene approach, the expression profiles of these genes were compared to that of a known marker for tendon progenitors and tendons, *Scleraxis*. Also, some genes associated with a few of these genes were studied to check for expression in the required domains. Time course experiments were conducted on day 4 to day 6.5 chick embryos. An unexplained domain was observed for some of the genes which had the required expression patterns. Through lineage tracing experiments, it was identified as a candidate for the origin of limb tendon progenitor cells. Based on the preliminary positive data, some transcription factors were identified using bioinformatics tools, which could regulate the genes of interest and hence, control the processes of homing and attachment.

Protein-Fluorescent Dyes Interaction
Shyamashis Das, Mentor: Dr. Pratik Sen

Interaction of two organic dye molecules coumarin 153 (C153) and fluorescein sodium salt (Fl) with bovine serum albumin (BSA) has been studied by steady state absorption and emission spectroscopy. Changes in the absorption and emission property of these dye molecules upon binding to BSA were used to determine the binding characteristics between the dye and the protein. Binding stoichiometry has been determined by Job's plot method for the respective complex. The binding constant also has been calculated by monitoring the protein concentration dependent absorption and emission signal of the dye molecule after fitting the raw data with our derived equation. Site marker competitive experiment has been done with the help of two drugs namely warfarin and ibuprofen which bind to specific binding site of BSA. This indicates that C153 binds in the domain IIIA of BSA where as fluorescein bind non-specifically. Urea induced denaturation of the C153 and fluorescein binding location of BSA was studied and compared to the global denaturation of the protein. Furthermore, kinetics of binding has been studied by measuring the change of the absorption and emission intensity during the time of complex formation using the stop-flow technique.

Flow Study and Optimization of Corrugated Plates/Airfoil
Siddharth G. S, Mentor: Dr. Sanjay Mittal

Experimental studies on static, non-flapping dragonfly wings have shown favorable aerodynamic performance at low Reynolds number (Re ≤ 10,000).The objective here is to study the effect of corrugation on plates and to obtain an optimal shape for corrugated plate of small thickness for high Aerodynamic efficiency at Reynolds number 1000 using 2D flow simulations. A continous adjoint approach was used for shape optimization.A stabilized finite element method based on Streamline Upwind Petrov/Galerkin (SUPG) and Pressure Stabilized Petrov/Galerkin (PSPG) stabilization technique is employed to solve both the flow equations and the adjoint equations L-BFGS algorithm, a quasi-Newton optimisation technique was used to minimize the objective function.Non-Uniform Rational B-Splines (NURBS) were used in the parametrization of the airfoil. The current investigation was carried out to determine the primary flow features and mechanisms that are responsible for the enhanced performance of these biological wing sections at these relatively low Reynolds numbers.Different shapes were subjected to inverse optimisation for high aerodynamic efficiency. The obtained optimal shapes have significant improvement in aerodynamic performance.

Application of Genetic Algorithms for the Design of Metamaterial Resonator and Filter
Siddharth Jain, Mentor: Dr. Animesh Biswas

The objective of this research is to understand the application of Genetic Algorithm in the optimisation of design of CRLH Transmission Line (TL) Metamaterials. Metamaterials are a class of materials which exhibit properties not found in naturally occurring materials. Left Handed Metamaterials have negative ε (permittivity) and μ(permeability). The basic unit of a metamaterial is known as a unit cell. LHMs can be realised by a CRLH TL. For a metamaterial to be used for a specific application, its unit cell has to be designed and then that design has to be optimised to get the desired performance. It has been found that using metamaterial zeroth order resonators (ZORs) one can realise narrow microwave band pass filters with size reduction of about 60% as compared to conventional RH filters. Genetic Algorithms are used for optimisation purpose. These algorithms work their principle from natural genetics.

The advantage of using GAis that a GA search converges to a global maxima rather than other gradient based classical optimisation which converge to local maxima. In this work, we have used GAs for two applications, (i) to optimise the design of unit cell to make it balanced and (ii) to optimise the design of metamaterial band pass filter to minimise the insertion loss.

Application Of Genetic Algorithm For Design Of Metamaterial Resonator And Band-Pass Filter

Somil Bansal, Mentor: Dr. Animesh Biswas

A way of excitation of Composite Right /Left Handed (CRLH) unit cells as resonators was analysed, which lead to improved insertion loss and hence Band Pass filter realisation with CRLH unit cell meta-material structures with via as resonators with improved response presents complete theme of this Project work. In this project Band Pass Filter (BPF) was designed using CRLH metamaterial unit cells of traditional Left Handed Transmission Line (LHTL) with via as resonators. The BPF topology is based on CRLH structure with Inter Digital Capacitance (IDC) and stubs with via. The BPF is made of three capacitively coupled CRLH resonators. The BPF's performance has been simulated and optimized by Finite Element Method (FEM) based commercial software(HFSS) and the results show the BPF's insertion loss is less than 0.7dB, the return loss is less than -18db, the 3dB bandwidth is larger than 800MHz at the center frequency of 4.8GHz. The good performance, small size and relatively simple fabrication process make this topology of CRLH structure unit cell based BPF a good candidate as an integrated filter for MIC environment.

Conformal Antenna for Small Satellites

Subhali Subhechha, Mentor: Dr. A. R. Harish

This project aims at parametric study of conformal antennas, their return loss and radiation characteristics, and developing an efficient radiator. Starting with an Inverted F-antenna, parameters (length, height, feed loop length, ground plane) were varied and their effect was studied and the contribution of each part was analysed. We understood the effect of introducing a plate between the antenna and ground plane, kept it floating, grounded it, made with slots, cut out as squares. In order to keep the same inductance, and reduce the height, we made the loop have its maximum part under the surface which showed very good results. Simulations were carried out with an approximate model of JUGNU with the looped antenna mounted on it, keeping all sides open and for another set with three sides covered. Its return loss and radiation pattern were explained. Using the simulation results, we tested them on the practical model. After many modifications in it, we now have a working model with a very good match at the required frequency.

Piezoresistive polymeric pressure sensors

Tushar Agarwal, Mentor:Dr. Siddhartha Panda

A new type of pressure sensor has been developed based on piezoresistive behavior of the Carbon black and Polyvinyl butyral polymer screened and cured on the epoxy glass substrate consisting of interdigitated copper electrodes . The sensor satisfies all the requirements for a good pressure sensor: cost efficient, flexibility, high repeatability and applicability over a large temperature range. The developed pressure sensor can be fabricated by homemade ink-jet printing technology and dip coating process. The developed process will widely reduce the cost of the pressure sensor implementation even in large scale area manufacturing. The flexibility of the sensor will allow it to be used on curved surfaces, footwear, seats of automobiles, etc. In this work we have tried to find the optimum concentration of carbon black required to fabricate the sensor for maximum sensitivity. Also by studying different theories we have tried to propose a mechanism in such composites.

Role of Deiodinase3 in migration of trunk neural crest cells
Vibhav Agarwal, Mentor: Dr.Amitabha Bandyopadhyay

The objective of this work is to found out the role of deiodinase3 in migration of trunk neural crest cells. Neural crest cells are population of migratory and ectodermally derived cell. Deiodinase3 is an enzyme that inhibits thyroid hormone signaling. My work is to functionally characterize deiodinase3 using chick as a model organism. The approached used here was loss of function. I used the enzyme inhibition technique. Iopanoic acid is a known inhibitor of dio3. The embryos were allowed to grow on a petri-plate in both conditions i.e. with and without Iopanoic acid. Then I did in-situ hybridization on them and checked for probes of dio3 and slug (a marker gene expressed in neural crest cells). On the basis of data collected in in-situ hybridization I was able to conclude that Iopanoic acid inhibits migration of trunk neural crest cells. But for further analysis of the role of dio3 in it one need to perform RNAi for dio3 and then do in-situ hybridization for dio3 and check for viral infected area.

Search for Topographic Guidance Molecules in RetinoTectal Mapping Comparison of Transcription Profile (along the two Tectal axes)
Vidur Kumar, Mentor: Dr. Jonaki Sen

The nervous system essentially functions on the basis of neural connections, and their specificity. How these connections develop, is not well understood till date. In the pathways pertaining to sensory information, the "wiring" needs to be highly accurate to interpret the sensory stimulus. For example – in the visual system, the point-to-point connections made by the retinal ganglion cells with the tectum (retino-recipient region in the mid-brain), gives rise to a topographic map that is an accurate spatial representation of the visual field. Thus, this is a good model to work on, to understand how these connections take place in the brain and nervous system in general. The chick (*Gallus gallus)*, is the ideal model organism for such a study - since its tectum is significantly larger (as compared to other model organisms) in the developmental stages we're interested in. One fundamental mechanism that has been found to give rise to a topographic map is the graded expression of guidance molecules in the tectum (where the axons terminate) , and on the growing axonal processes. The expression is asymmetric along the dorsal-ventral and the anterior-posterior axes of the retina and tectum. Some guidance molecules were already known, eg – the Eph family and their ligands, the ephrins, but with the discovery of Wnt3 and Engrailed-2 it is believed that there are other retino-tectal guidance molecules as well. The purpose of the proposed project, is to further identify and characterize other molecules that are involved in the formation of the topographic map. Using a broad scale search for asymmetric expression (along the anterior-posterior and medial-lateral axes) via Microarray, have to be shortlisted, which might be involved in forming the topographic map. Using in-situ hybridization, the hypothesis needs to tested for each of the genes and then further verified by mis-expression and over-expression. Further information can be gathered about connections beyond the retino-tectal junction by dying the neurons, and checking the connections upstream, in a topographic manner. Hence, with the above mentioned (and other molecular/genetic) techniques, we hope to characterize and map-out the expression of molecules responsible for the specificity of neural connections. The future applications from such information would be along the lines of regeneration of neurons, with artificially guided connections – to return function to damaged or under-developed parts of the nervous system in humans and animals.

Anaerobic Wastewater Treatment as Microbial Fuel Cell
Vishwas Sharma, Mentor: Dr. Saumyen Guha

The human population in this world is increasing at an alarming rate. The rapid economic growth and urbanization will need sustainable sources of energy but at the same time accumulation of waste and pollution of soil, water and air have emerged as one of the biggest threats to the quality of life. If some part of the chemical energy stored in the wastewater can be harnessed and converted into electricity, the treatment and management of wastewater can become self-sustainable. A Microbial Fuel Cell (MFC) is basically a device that converts the chemical energy of the organic waste matter into electrical energy by the catalytic reaction of the microorganisms and generates electrons by the oxidation of the organic matter. After the startup of a Semi-Batch Microbial Fuel Cell, the steady state was reached which is characterized by a uniform and stable amount of bacterial and other microbial growth in the reactor. With the objective of increasing current density and power generated from the reactor, the density of electrodes in the anode chamber was increased and the Cathode Surface Area was optimized. Simply putting in multiple electrodes in the anode chamber did not help in increasing the current and power output from the MFC. In order to increase the current and power output from the same total volume of the reactor in this configuration, the anode chamber needs to be segregated. The analysis and trends show that the performance of the MFCs is limited by their internal resistance derived from the proton mass transfer and poor oxygen kinetics at the cathode. While the full-scale, highly effective MFCs are not yet within our grasp, the technology holds considerable promise for a successful implementation in the future.

A deterministic algorithm for solving $A \Xi B^2$ mod(P)
V.Adithya, Mentor: Dr. Manindra Agrawal

In our project we attempt to solve the equation, $A \Xi B^2 \bmod p$, deterministically. Till date, there has been no deterministic algorithm in literature that could solve such an equation, deterministically (in polynomial time). This project may not have a great practical application. In fact, the algorithm is deterministic under a famous, age old hypothesis called the Extended Riemann Hypothesis. According to this hypothesis, with in a $\ln^2 p$ distance from a quadratic residue, we are sure to find a non-residue. Unfortunately, this hypothesis has neither been proved or disproved till date. This problem has a lot of academic interest. A solution to this problem could give us an insight to the distribution of quadratic residues and non-residues between 0 and p. Finding a quadratic non-residue has always been a major problem in computational number theory. The solution to this problem revolves around finding a non-residue. Thus, it would be a major development in Computational Number theory. Also, many existing randomized algorithms could become deterministic.

Modelling Critical Thickness in Core-Shell Semiconductor Nanowires
Akruti Khare, Mentor: Dr. S. Ingole

An Indium Gallium Arsenide (In0.6Ga0.4As) shell when grown on an Indium Arsenide (InAs) core is coherent initially, but becomes semi-coherent by the nucleation of dislocation (at critical thickness) in the nanowire. The stress states of shell growth are simulated using Finite Element Method by feeding stress-free strains (Eshelby strains). ABAQUS/STANDARD software is used for the simulation. The total energy of the system is plotted for different shell thickness. Two sets of values are obtained, one without dislocation and other with dislocation. In both cases, thermal stress corresponding to interfacial misfit is fed and simulations are performed.

The total energy plot gives us the critical thickness of the InAs/In0.6Ga0.4As system (as shown in fig.). The critical thickness was determined to be 47.2 Å which is in close accordance with the mathematical value of 52 Å as found in research paper of S. Raychaudhuri.

Optimum material decoupling point in an information enriched legile supply chain
Amrith Thandra, Mentor:Dr. Subhas Misra

A legile supply chain is a kind of hybrid supply chain which incorporates both lean and agile strategies. In this work, the concept of Optimum Material Decoupling Point has been introduced in similar lines with Material Decoupling Point which is also called Order Penetration Point. In order to aid agility, the material decoupling point is ideally positioned as close to the customers as possible. In an information enriched legile supply chain, the effect of positioning the material decoupling point at various positions within the supply chain, on the overall manufacturing cost and on agility have been plotted. These plots called the optimization charts, have been proposed and would serve as major decision aids in deciding the Optimum Material Decoupling Point. The Optimum Material decoupling Point is the Material Decoupling Point such that there is considerable economic advantage and acceptable effect on agility.

Closed Loop RPM Control of Autonomous Mini-Helicopter
Ankit Anurag Naik, Mentor: Dr. C. Venkatesan

Closed loop RPM control is one of the integral parts of an autonomous mini-helicopter. It helps in maintaining the rpm of the main rotor around a given set point irrespective of external disturbances. In our system we implemented a PID control to match the actual response with the desired response. In my report, a closed loop RPM control scheme has been designed and a closed loop transfer function for it was obtained, using the open loop response of the system for 0.02% change in duty cycle of the throttle servo. The values of the PID gains were tuned using MATLAB and implemented in the helicopter where they were further optimized for better results in the practical system. Codes for RPM measurement and PID control were written in LabVIEW and implemented in the PXI, through which all the servo controls are regulated. Lastly, a hardware using pic microcontroller was designed, to calculate the rpm of the main rotor, which could be used where usage of PXI is not economical.

Multimedia Transmission over OFDM based Cognitive Radio
Ankita Agarwal, Mentor:Dr. A. Jagannatham

According to survey of FCC in 2002, it has been found that spectrum access is more significant problem than physical scarcity of spectrum. Cognitive radio offers an intelligent way to utilize the underutilized spectrum. With many technological advances in the field of wireless communication and 3G and 3.75G technology already being employed and 4G being developed, Multimedia Broadcast and Multicast Services (MBMS) demand has tremendously increased and with the standardization of MBMS it has gained significant interest in the market. Multimedia content requires more bandwidth, storage capacity and few applications pose tight delay constraints. We propose a model to use cognitive radio over OFDM and transmit multimedia traffic using priority queue with Luby Transform (LT) codes. Our model focuses on dynamically adaptation of frequency selection strategies of secondary users in order to maximize the utility function in an informationally decentralized system.

Design and Implementation of 1-D Solar Tracker
Ankur Verma, Mentor: Dr R.S.Anand

The objective of this project work is to design and implement a 1-Dimensional solar tracker system, with emphasis on designing an easily modifiable system, which can be used for any kind of load requirement. For this, the sun's movement has been studied in detail, along with a case study. Various possible designs have been discussed and the best one is chosen for the experiment with the designed control circuit. The circuit is designed such that only one controller can control more than one panel.

Improving the Lifetime of OLEDs
Ankur Kumar, Mentor: Dr. R. S. Anand

The objective of this work is to suggest a technique to improve the lifetime of OLEDs (organic light emitting diodes) and to optimize luminance efficiency of these devices. Due to their high power efficiency, low cost of manufacture, durability, and the fact that they are lightweight, OLEDs represent the future of visual displays for portable electronic devices but these also have some problems like expensive manufacturing process, very sensitive to water etc but major problem is their lifetime. This report describes the various degradation mechanisms in OLED which limit its lifetime. Out of those many, one is heat dissipation influences. The work describes a top-emission OLED manufactured using copper substrate. Copper has very high thermal conductivity compared to glass hence it can effectively dissipate the joule heat to the environment thereby reducing the junction temperature and hence heat dissipation influences. For the comparison another top-emission OLED is made on glass substrate.

Development of GIS based National Emission Inventory for Black Carbon
Aravind Muthiah, Mentor: Dr. Mukesh Sharma

As much as 40% of current net warming is attributable to Black Carbon (BC) aerosols which are released from incomplete combustion. Compared to CO2, a greenhouse gas which has a life of up to about 40 years, BC remains in the atmosphere for as little as several weeks. Because of its large effect on radiative forcing and relatively short residence time in the atmosphere, reducing BC emissions can have an immediate impact on slowing down the rate of atmospheric warming. Furthermore, deposition of BC aerosols, on snow over the Himalayas (often referred to as the third polar region) is thought to increase the thinning rate of glaciers and has raised concern on future water supplies to large river systems that support millions of people inhabiting the surrounding areas, especially India. In India, these BC emissions from biofuel combustion are highly prevalent and compared to other regions, BC aerosol amounts are high. Thus, the objective of this work is to develop an emission inventory of Black Carbon for the entire country using Geographic Information Survey (GIS) as a platform so as to establish which regions emit the largest amounts of BC. The inventory will be able to provide accurate data up to a resolution of 40km x 40km. The robust data thus obtained can be used for modeling purposes and one can then determine the process of and magnitude of deposition of BC over the Himalayas and enable policy makers to effectively curb these emissions.

Personal Information Management for Engineering Students
Arka Mondal, Mentor: Dr. Jayanta Chatterjee

Personal Information Management has been a subject of intensive study in the last decade or more. It has become an essential part of not only corporate managers and their likes but also for students especially those involved in the field of sciences and engineering. Engineering is such a discipline which requires the application of knowledge of science, mathematics and other technical concepts for finding suitable solutions to problems. This knowledge is mostly gained during the years of study as an engineering student. Personal Information Management is thus very important for engineers as they may have to retrieve or re-find the information which they have accumulated during their time as an engineering student. Retrieving and re-finding would be easier only if they have organized their information properly using proper schemes. This paper explores various strategies which students may use in order to manage their information in a better and efficient manner.

Improving the Quality of Customer Information
Arnab Ghosh, Mentor: Dr. Subhas Misra

"Information quality" is a measure of the value which the information provides to the user of that information. "Quality" is often perceived as subjective and the quality of information can then vary among users and among uses of the information. This article presents a methodology and tests its efficacy through a survey based study. It aims to measure service quality and product quality performance and identify critical service quality and product quality characteristics as perceived by the customers. This began by conducting a survey through a designed questionnaire in likert type to the identified group of customers to get their feedback. This is followed by constructing a 2-by-2 matrix of product quality and service quality, establishing the customer's requirements and technical specifications, design the questionnaire, and identifying other parameters for the Quality. This likert survey is made to undergo pilot test for the purpose of verifying feasibility and correctness. The questionnaire is surveyed for customer response and based on that the importance and necessity of each of the factor is calculated. This will enable us to understand which IQ variable is lagging in the system and which ones are adequate. Also, as a whole, whether the company is lagging in service quality and product quality can be understood.The frequency description shows an overview of which factors lag and which factors show adequate customer satisfaction. The regression analysis shows in each of the quadrant which factor/factors are the most influencial based on the value of R^2. Thus, these two analyses enable us to understand which IQ variable is lagging in the each quadrant and which ones are adequate.

Optimal Placement of Phasor Measurement Units for Multi-Area Observability
Bipasha Mallick, Mentor: Dr.S. Chakrabarti

Very often a power system is decomposed into smaller interconnected areas. The state estimators play an important role in collecting the informations regarding the state of the individual areas in order to observe the entire network. Often a two level estimation is used and it is proposed that Phasor Measurement Units(PMUs) be used for the coordination of the information from the individual areas to perform the estimation for the entire network at the second level. This work proposes a method for optimal placement of Phasor Measurement Units (PMUs) for complete observability of power systems consisting of multiple areas. Binary integer programming is used to minimize the total number of PMUs and maximize the measurement redundancy at the boundary busses. The proposed method is applied to the IEEE 14-bus and IEEE 118-bus test system.

Cyclophosphazene-Supported Pd(0) Nanoparticles: Synthesis, Characterization and Reactivity
C.Pavan Kumar, Mentor: Dr. V. Chandrasekhar

This report contains synthesis of cyclophosphazene-based starburst moleculestabilized palladium nanoparticles (Pd NPs) and study of their catalytic properties. We synthesized Pd NPs by a simple method that does not need any external reducing agent. Further, the synthesis was carried out at room temperature under ambient conditions. Reasonably small-sized Pd NPs (~3-4 nm) were formed within one hour. The Pd NPs thus formed were found to be air stable. These hybrid systems were examined for their reactivity in Suzukicoupling reactions. They were found to promote homo-coupling reactions at room temperature in preference to heterocoupling.

Metamaterial-inspired design of Efficient Electrically Small Antennas
Debdeep Sarkar, Mentor: Dr. K. V. Srivastava

Design of efficient miniaturized antennas is a problem of utmost importance for its stringent needs in the field of communication technology and sensor networks. Such electrically small antennas (ESAs) are inherently inefficient narrowband radiators. Several classical techniques have been proposed in the past for improvement in their radiated power, bandwidth and directivity, for obtaining an optimised antenna system suitable for practical fabrication. But these techniques mostly fail to keep the system electrically small. After the practical realization of artificially engineered metamaterials in the 21st century, researchers have resorted to some novel techniques for efficiently addressing the issue of trade-off between miniaturization and improvement in antenna performance, by using metamaterial-paradigm in antennas.In this work, some metamaterial-inspired design methodology of electrically small antenna systems have been theoretically studied and simulated. Some improvised structures have also been proposed. The simulated results clearly show that use of metamaterial-inspired structures increase the radiated power of dipole and monopole antennas in some cases, whereas the system still remains narrowband. On the other hand, the antenna bandwidth becomes significantly large for some designs, along with considerable minimization of overall antenna systems.

Simulation of Growth of Heteroepitaxial 2-D Island and Determination of Critical Dimensions Using Finite Element Methods
Debtosh Mukhopadhyay, Mentor:Dr. Anandh Subramaniam

An interfacial dislocation is nucleated in strained layer thin film systems (at critical dimensions) which destroys the coherency at the interface. This is a serious impediment to the performance of the strained layer system. In this analysis, the growth of $In_{0.6}Ga_{0.4}As$ film on GaAs substrate which takes place through 'Stranski–Krastanov' growth mode, is simulated using Finite Element Method (FEM) by feeding the appropriate stress-free strain (Eshelby strains) corresponding to the lattice mismatch between the film and the substrate. The strains are imposed as thermal strains in the numerical model using standard commercially available software. Interfacial dislocation is simulated in a similar manner by feeding thermal strains to account for the extra half plane of atoms. The total energy of the system with dislocation at the centre and at a distance of 2b ('b' is the burgers vector of GaAs) from the edge of the island and without dislocation is plotted as a function of dimensions of 2-D island keeping the aspect ratio constant. Critical dimension of the island is determined from the two plots by the energy minimization criterion. The nucleation of an array of dislocations was found to be favorable at dimensions greater than critical dimensions and also the nucleation of dislocation is favourable at the centre of the interface.

Steady State Optimization of the GTL process
Deepika PV, Mentor: Dr.Nitin Kaistha

A simulation study on Gas to Liquid (GTL) process using AspenHYSYS 2006 was carried on. During simulation, the process was assumed at the steady state. It was also assumed that the physical properties of reaction medium were governed using Redlich-Kwong- Soave (RKS) equation. In this work, Auto Thermal Reformer (ATR) was used for synthetic gas production and CSTR for the Fischer Tropsch (FT) conversion to liquid fuels. The well-known Satterfield kinetics were used for the FT reactor, the remaining reactions were simulated assuming thermodynamic equilibrium. The process also includes low-pressure CO2 removal. The effect of temperature on CO conversion and the C5-C12 (gasoline) hydrocarbons in the FT reactor were observed. The study showed that the product distribution followed Anderson- Schulz-Flory (ASF) distribution. The optimum temperature in CSTR was observed as 3100 C.

Effects of Chromatic Dispersion in single and multichannel fiber-optic communication systems
Disha Shrivastava, Mentor: Dr. Pradeep Kumar

The recent years have witnessed resurgent interest in coherent optical communications. Advanced digital modulation formats such as DPSK, DQPSK, and MSK have been demonstrated at 40Gbps over long distances. However, various channel induced signal impairments due to chromatic and polarization mode dispersion and nonlinearity limit the achievable bit rate and distance. Such effects have been studied mostly on single channel communication systems. This work uses MATLAB Simulink modeling to incorporate chromatic dispersion (CD) in single channel and multichannel 10Gbps RZ – DPSK optical transmission systems. A random sequence of bits (generated by Bernoulli Binary Generator) was used to differentially phase modulate the RZ pulse carrier (1.93×10^{14} Hz) with the help of Mach Zehnder Intensity Modulator. The modulated pulse was then applied to CD block (channel) which broadened each spectral component present in the pulse by different amounts causing Inter- Symbol Interference. BER vs SNR plots were obtained using BERTool (Monte Carlo Simulation) and compared with the theoretical results. Investigation of BER vs Delay plots for different values of group delay and attenuation was also carried out both for single channel and four channel systems with the addition of Gaussian White Noise. Finally the frequency domain analysis of the whole system was made and results were recorded.

Mechanical Characterisation of HAp Based Ferroelectric Composites for Bone Applications
Gaurav Singh, Mentor: Dr. Bikramjit Basu

Hydroxyapatite (HAp) is main mineral composition of bone. HAp based toughened and electrically active ceramics are of interest as a bone substitute material. In the present study, HAp and barium titanate (BT) powders were mixed with different ratios by planetary ball milling and sintered via multi-stage {670°C(5min)-850°C (5min)-900°C(0min)} spark plasma sintering technique. Densification, hardness and biological response of these composites were investigated. XRD and FT-IR analysis confirm the presence of HAp and BT phases in the developed composites. The results show that densification decreases with increase in amount of BT. However, hardness increases upto 40wt% addition of BT in HAp. Further addition of BT in HAp decreases the hardness value. The maximum hardness value for HAp 40wt%BT composite was 8.1±0.2 GPa, which was better than that of pure HAp having hardness 5.5±0.1 GPa. Cell density on samples was comparable to that of pure HAp. No indication of cytotoxicity was detected. Based on experimental results, HAp-BT composites can be considered to be biocompatible.

Design of Direct Memory Access Device for Parrallel Multiprocessor System Dedicated to Natural Language Procesing Applications

Gitanjali Sachdeva, Mentor: Dr. Ajai Jain

In a parallel multiprocessor system, all the processors work together in a synchronized manner. This requires proper communication between processors. One mode of this communication is memory to memory data transfers. These data transfers occur between shared and local memories present in a Multiprocessor System. To handle such data transfers, Direct Memory Access (DMA) Device is used within each processor. A parallel multiprocessor system has been considered for supporting Natural Language Processing Applications (Machine Translation, Information Retrieval and Text Summarization). This project focuses on designing a DMA device for each processor within the multiprocessor system.The designed DMA device is a dedicated hardware to manage memory-to-memory data transfers. Data transfers can occur between Shared Memory and Cluster Master's Memory, Cluster Master's Memory and Slave Processor's Memory or between two Cluster Master's Memories. Proper control signals are required to manage the data transfer. The DMA device can be efficiently designed with the usage of basic digital circuits such as counters, multiplexers, registers, and buffers. After designing the device, proper simulation of this hardware unit has to be done in VHDL using XILINX iSim

Computational Aspects of Determining Chaos in Dynamical Systems

Harsh Shukla, Mentor: Dr. Brahm Deo

Intensive efforts to study of chaos in non-linear dynamical systems started around 1988-89 and now the literature is replete with research papers and books on chaos modeling in physics and economics. The applications of chaos modeling in computer science and engineering are still in fancy. It is usual to consider the system to be deterministic and treat randomness and chaos as being similar. It has now been realized that a precise control of a dynamical system can be rendered quite difficult due to the existence of chaos. This is also true for some applications in data mining, quantum computing, and chaos computing. Recently, some good applications of chaos in cryptography have been reported. In the present work, the applications of chaos in computer science, though relatively recent, are reviewed. As an example of the control of a dynamical system, the basic oxygen process (BOP) is considered in which the supersonic jets with a velocity of approximately Mach 2.5 are used to refine molten iron containing impurities such as carbon, silicon, phosphorus, manganese etc. In this process the control of refining is severely affected due to high a degree of turbulence introduced by the action of the supersonic jets impinging directly on the surface of metal. The gases CO and CO_2 coming out at a temperature of approximately 1600 °C also affect the reaction dynamics. In all processes wherein chaos is suspected, including the applications in computer science, the first requirement is to establish the presence chaos. The sensitivity to initial conditions is the defining factor in the theory of chaos. In this study, the existence of chaos is investigated by calculating the Lyapunov Exponents which uses the degree of separation in the exponentially diverging trajectories as an input for analysis. On-line data on BOP has been collected from industry for this purpose and used to the study the existence of chaos.

Location Tracking Using Passive RFID
Himanshu Aggrawal, Mentor: Dr. A.R. Harish

We describe a navigation and position estimation system for mobile robots, which is based on RFID technology. This system avoids deficiencies of existing solutions (solutions which typically rely on the use of data-rich sensors, like GPS, laser range scanners or cameras, and on algorithms which are often very demanding both in terms of memory and computation) and offers high flexibility and accuracy at moderate cost. The core idea of the system is to structure the workspace by means of a Smart Floor in a manner, which enables and supports reliable navigation and positioning with absolute accuracy over large distances. The "intelligence" of the floor is in a dense, area-wide network of thousands of RFID transponder, which are mounted underneath the regular floor covering and quasi serve as radio beacons. Finally this navigation system senses the identifiers of RFID transponders in its proximity and computes an estimate of the absolute position and orientation of the vehicle and uses these data to guide the vehicles locomotion along a planned path, Thus user's position can be identified by referring to the ID of received RFID tags.

Effects of MAC Protocols on Energy Efficiency In Wireless Sensor Networks
Himanshu Singh, Mentor: Dr. R K Ghosh

In Wireless Sensor Networks (WSN), sensor nodes are often inaccessible for battery replacement. To increase the network lifetime, energy consumption by sensor nodes should be minimum. Recent researches have presented many Medim Access Control (MAC) protocols with an aim to minimize energy consumption. However, the MAC protocols behave differently under different network scenarios. In this project, we aim to evaluate MAC protocols based on energy consumption, by simulating them under same simulation scenarios and platform. Implementation of MAC protocols is done in TOSSIM, a simulator for WSN applications, which directly simulates code to be run on real hardware, thus reducing the gap between simulation and real hardware. Current implementation includes CSMA/CA, Sensor-MAC, Timeout-MAC, Berkley-MAC and Berkley+ MAC protocols. Each MAC protocols is then integrated with PowerTOSSIM-Z, a power modelling tool, to measure the energy consumption. Implementation of MAC protocols is done as low level components and high level abstraction is provided to enable users to switch between different MAC protocols. During simulating their WSN applicaions, users can switch between different MAC protocols and evaluate that which MAC protocols is best suited to their specific application.

Steady State Optimization of the GTL process
Indu Bhrit Srivastava, Mentor: Dr.Nitin Kaistha

A simulation study on Gas to Liquid (GTL) process using AspenHYSYS 2006 was carried on. During simulation, the process was assumed at the steady state. It was also assumed that the physical properties of reaction medium were governed using Redlich-Kwong-Soave (RKS) equation. In this work, Auto Thermal Reformer (ATR) was used for synthetic gas production and CSTR for the Fischer Tropsch (FT) conversion to liquid fuels. The well-known Satterfield kinetics were used for the FT reactor, the remaining reactions were simulated assuming thermodynamic equilibrium. The process also includes low-pressure CO2 removal. The effect of temperature on CO conversion and the C5-C12 (gasoline) hydrocarbons in the FT reactor were observed. The study showed that the product distribution followed Anderson-Schulz-Flory (ASF) distribution. The optimum temperature in CSTR was observed as 3100 C.

Object Grasping using Barrett Hand: A Self Organizing Map Based Approach
Jagannath Prasad Mishra, Mentor: Dr. L. Behera

Vision based control is preferred in the real-world deployment of robots due to the dynamic nature of the environment and it gives a comprehensive knowledge about the environment and the location of the objects. This work proposes Kohonen's self organizing map based inverse kinematic controller for vision based grasping with Barrett Hand™. The inverse kinematic relationship of individual fingers of the Barrett Hand is learned with separate self organizing maps. The experimental setup comprises a 3-fingered Barrett Hand gripper mounted on a 7-DOF PowerCube™ Manipulator and the workspace is seen with a wall-mounted stereo vision. This visual feedback is used to estimate the position of the object and the finger tip using triangulation method. With simple knowledge about the geometry of the given object, the grasping point is estimated from the vision. The estimated position is given as input to the self-organizing maps and then the joint angle configurations of individual fingers are computed. Self organizing map learns the inverse relationship with a cluster of local linear models which results in a computationally efficient algorithm for kinematic control of the grasper. The simulation results show that self organizing map learns the inverse relationship with an accuracy of 1mm. The learned maps are tested to grasp a ball within the workspace of Barrett Hand.

Load balancing in Multi processor Natural Language processing (N.L.P.) System
Jagnyashini Debadarshini, Mentor: Dr. Ajai Jain

The parallel multi processor system for NLP application under consideration is having clusters. This cluster is a group of processors, performing similar tasks, connected to a master processor in star topology. Parallelism requires load on the processors to be balanced. As the processors have a master to control them, the master processor is provided with a mechanism for load balancing. Whenever the master finds that a particular processor is overloaded, the load is transferred from the overloaded processor to under loaded processors. The proposed load balancing mechanism provides fault tolerance also. We have designed a hardware unit, load balancer, which performs load balancing between the processors. The simulation of this hardware unit was done in VHDL using XILINX.

Multimedia Transmission over OFDM based Cognitive Radio
Joy Mitra, Mentor: Dr. A. Jagannatham

According to survey of FCC in 2002, it has been found that spectrum access is more significant problem than physical scarcity of spectrum. Cognitive radio offers an intelligent way to utilize the underutilized spectrum. With many technological advances in the field of wireless communication and 3G and 3.75G technology already being employed and 4G being developed, Multimedia Broadcast and Multicast Services(MBMS) demand has tremendously increased and with the standardization of MBMS it has gained significant interest in the market. Multimedia content requires more bandwidth, storage capacity and few applications pose tight delay constraints. We propose a model to use cognitive radio over OFDM and transmit multimedia traffic using priority queue with Luby Transform (LT) codes. Our model focuses on dynamically adaptation of frequency selection strategies of secondary users in order to maximize the utility function in an informationally decentralized system.

Visual Traffic Monitoring & Statistics generation
Karuna Phuyal, Mentor: Dr. K. S. Venkatesh

Traffic control and monitoring using video sensors has drawn increasing attention recently due to the significant advances in the field of computer vision. Congestion problems and incompetence of existing detectors creates a broader area of research. The occlusion and uncontrollable motions of the vehicles require a lot of real time traffic data updates and data on traffic patterns. This work aims to present a system for visual traffic monitoring and their statistics generation by processing images from one or more visual sensors which are not pre calibrated. The proposed system which has been developed is flexible, scalable and can be applied in a broad field of applications. Also a robust and accurate detection and tracking of moving objects has always been a complex problem especially in the case of outdoor video surveillance systems, where the visual tracking is particularly challenging due to illumination or background changes, occlusions problems etc. Since the recent available techniques have been superannuated due to various flaws, the aim was to find a robust effective technique for doing the same by usage of efficient detection algorithms. Various computer vision techniques were used during development of the project. Vehicle classification, the need of understanding the intensity of traffic at different times of the day, statistical generation that is led by pragmatic significance of vehicular classification, finding spatial occupancy etc all has motivated to the aim of the project. The system calculates the position, velocity and direction of the targets and it classifies them according to their type (car, man, long vehicle etc). Alerts can be displayed for dangerous situations, such as speeding. The focus of this application is on the collection of traffic statistics, such as speed and traffic loads per lane. It can also identify dangerous situations, such as objects falling, animals or traffic jams. The advantages of computer vision would be in minimizing the user interaction, less amount of prohibitive bandwidth and most importantly minimizing the cost and time.

Critical thickness of heteroepitaxial thin films using finite element method.
Kavitha K.G., Mentor: Dr. Anandh Subramaniam

On growth beyond critical thickness, interfacial misfit dislocations nucleate, and this partially relaxes the strain due to lattice mismatch in epitaxially grown thin films. In this analysis, the growth of GexSi1-x thin film and thin film stripe on Si substrate is simulated using Finite Element Method (FEM) by feeding the appropriate stress-free strain (Eshelby strains) corresponding to the lattice mismatch between the film and the substrate. The strains are imposed as thermal strains in the numerical model using standard commercially available software. Interfacial dislocation is simulated in a similar manner by feeding thermal strains to account for the extra half plane of atoms. The total energy of the system with and without dislocation is plotted as a function of film thickness. Critical thickness is determined from the two plots by the energy minimization criterion. The variation of critical thickness with dislocation displaced from the centre is studied for the thin film case. The variation of critical thickness with varying width of the thin film stripe is also studied. The results are analyzed comparing them with the published results available.

Magnetic levitation of Steel Sphere with Flexible Cantilever Strips
Leroy Mathew, Mentor: Dr. Bishakh Bhattacharya

Our probe into magnetic levitation consists of varying the profile of the body by virtue of adding flexible wings on the sphere's periphery and then observing their characteristics by varying the controller parameters which govern levitation. We check for the instabilities existing in the process, most notably rotation, inclination and vertical oscillation. Then an analytical expression based on electrical and mechanical concepts is formulated for the vertical displacement of the body whose consistency is checked later by testing the setup.

Convecting aperiodic vortex induced perturbation effects on a wall boundary layer
Mahesh Kant Shukla, Mentor: Prof. T. K. Sengupta

The present work investigates the perturbation effects induced on a wall boundary layer by a Convecting aperiodic Vortex along a thin flat plate in a low viscosity fluid media. The flow of a low viscosity fluid sets up thin shear layer close to the surface of the plate with the no slip boundary conditions at the surface of the plate. As the vortex convects downstream there is a variation in the pressure gradient. The Convecting Vortex interacts with this boundary layer affecting the nature of velocities in the wall-normal & streamwise directions and consequently affecting the vorticity field. The similarity solution for the Falkner-Skan equation is found after incorporating the effects of the non-diffusing convecting vortex on the edge velocity of the boundary layer. Numerical solution of the equation is used to generate results for the following cases: (i) the vortex convects along the plate while the velocity profiles are generated at a reference section for a given distance from the leading edge, (ii) for the non-diffusing vortex at a given position along the plate and the solution of the Falkner-Skan equation is generated for sections located at varying distances from the leading edge. The data generated is used to generate plots for velocity profile in the wall-normal and the streamwise direction, and plot the variations in the vorticity field. In next stage, a Convecting Lamb-Oseen vortex is introduced in place of the non-diffusing convecting vortex. The plots for velocity profiles and the vorticity field are generated. The results obtained for the non-diffusing vortex and the Lamb-Oseen vortex are compared.

Removal of Arsenite (As III) and Arsenate (As V) from aqueous solution by adsorption onto modified sand.
Manisha Pandey, Mentor: Dr. Mukesh Sharma

Arsenic is known by its notoriety as poisonous and carcinogenic substance in homicides. It is treated as synonym to toxic. Many countries like India, China, Bangladesh, Taiwan, Mexico, Argentina, USA have reported high arsenic concentrations but the largest population at risk is in Bangladesh followed by West Bengal and other north-east states of India. The occurrence of arsenic in natural ground water is due to geological composition of soil, anthropogenic causes like mining and smelting process, using pesticides etc. Several methods for removal of arsenic from water have been reported such as coagulation, followed by filtration, membrane processes, ion exchange and adsorption. Adsorption methods proved to be effective, economic, easy to perform and construct. The objective of this study was to investigate the removal of arsenic from aqueous solution using biodegradable adsorbents prepared by coating sand with biopolymer, chitosan. The method used for the analysis was SDDC (standard method by APHA). The maximum removal of arsenic was observed at pH 6.5 and within 2 hours with 80% removal efficiency,20% more than reported with iron coated sand as an adsorbent.

Anions including sulphate, phosphate and silicate at the levels present in groundwater did not cause serious interference in the adsorption behaviour showed by the material (Chitosan Coated Sand). Material do have reusability potential so less waste discharge would be less keeping the environment pollution free.

Resorbable micro-/nano-fiber based scaffolding system for sub-chondral bone regeneration
Ms. Meenakshi Singh, Mentor: Dr. Dhirendra S. Katti

Osteoarthritis is a debilitating disease of the joints. It results in the degradation of the articular cartilage (covering the ends of bones forming the joints) followed by the damage of the underlying sub-chondral bone. The current advances in medicine and treatment strategies have improved the treatment of joint disabilities. However, these treatment modalities have a number of shortcomings in terms of improved tissue repair and regeneration. Tissue engineering has emerged as a potential alternative for the repair and regeneration of the sub-chondral bone. Structurally, bone is a composite of hydroxyapatite (HAp) crystals embedded in collagen fibers. One of the approaches for bone repair is biomimetic approach, wherein the biomaterials are used to mimic the structural, mechanical and biological behavior of the bone. Inspired by nature, a hydroxyapatite /fibrous composite scaffold have been fabricated using electrospinning. The three dimensional scaffolds generated by electrospinning are fibrous and porous. These scaffolds resemble the extracellular matrix (ECM) of the tissues. One of the approaches for bone repair is biomimetic approach, wherein the biomaterials are used to mimic the structural, mechanical and biological behavior of the bone. Inspired by nature, a hydroxyapatite /fibrous composite scaffold have been fabricated using electrospinning. The three dimensional scaffolds generated by electrospinning are fibrous and porous. These scaffolds resemble the extracellular matrix (ECM) of the tissues. In this current study, HAp was uniformly dispersed in the poly(lactide- co- glycolide) [PLGA] solution and electrospun with PLGA nanofibers. Further these nanocomposite scaffolds were characterized for their morphology, porosity and mechanical strength. The fibrous nanocomposites demonstrated an enhanced mechanical strength without compromising on the morphology and porosity of the pristine polymer scaffolds. These nanocomposites closely mimicked the organic/inorganic component of the ECM of natural bone. Further, it is expected that these scaffolds can be potentially used in bone tissue engineering applications.

Fabrication and Testing of a Hand Held Fibre Probe for Fluorescence Imaging of Cervical Tissue
Nitin Saurabh Jha, Mentor: Dr. Asima Pradhan

The current project aims at fabricating a hand held fiber probe for the Fluorescence Imaging of Cervical Tissues. A hand held probe was fabricated in the first stage of the project along with the designing of a Circular Fiber Jig. Attempts were made to give the probe a compact and easy look. In the later phase, tissue samples were studied with the probe using a linear jig. Typical fluorescence spectra were obtained for normal and abnormal tissues using the probe. The differences in the spectra for normal and abnormal tissue samples were observed in which consistent results were obtained with NADH fluorophore.

Damage Monitoring of a Composite Plate Using a Laser doppler Vibrometer
Nitisha Gupta, Mentor: Dr. Bishakh Bhattacharya

To study and verify the modal strain pattern in healthy and damaged laminated composite plate using vibration response and velocity data from the Laser Doppler Vibrometer (steady state excitation). Composite materials and structures are susceptible to defects, which can significantly reduce the strength and may even lead to failure. Early detection of damages and development of a reliable method for structural health monitoring is important in maintaining the integrity and safety of the composite structures.

Non-contact measurement techniques are gaining importance for the purpose of damage detection since they avoid the effect of mass loading due to sensors/actuators and ensure repeatability of the measurements. In recent years optical measurement systems like Laser Doppler Vibrometer (LDV) is used to study the dynamic response of structures. In this study, experimental analysis of dynamic response-based delamination detection in Glass-Epoxy Composite plates is presented. LDV captures the vibration characteristics of dynamically excited composite plates. Few additional local modes are present in case of delaminated specimens. In the high frequency region coalescence of different modes is observed.

Bactericidal effect of Silver addition on Hydroxyapatite and Carbon Nanotubes
Pallavi Kesarwani, Mentor: Dr. Kantesh Balani

Bacterial infection remains an important risk factor in orthopedic surgery. Since millions of people receive orthopedic implants every year, even a low percentage of infection reported can cause serious complications in tens of thousands of patients. Recent studies have proved that silver shows antibacterial property. Present work aims at the synthesis of hydroxyapatite-silver (HAp-Ag) and carbon nanotube-silver (CNT-Ag) via Spark Plasma Sintering (SPS) processing route. Phase analysis from x-ray diffraction and Raman spectroscopy confirmed that the initial phases were retained after spark plasma sintering. EDX results showed that Ag was distributed uniformly. *Escherichia coli* were utilized to test the antibacterial effect and it was found that the no of bacterial colonies decreased significantly in HA-Ag and CNT-Ag w.r.t. HA and CNT.

Smart Card Operating System and PKI
Pankaj Agarwal, Mentor: Dr. Rajat Moona

Public Key Infrastructure(PKI) systems have gained popularity over the last few years because of their scalability, security and ease of maintainence. They are slowly turning into a necessity from being a luxury particularly in smart card industry. Smart cards fit seamlessly into Public Key Infrastructures. They are very natural key storage units. Today's extensive use of smart cards in variety of applications in conjuntion with the advent of advanced cryptographic smart cards that can do complex cryptographic calculations on board demand robust operating systems with PKIs built into them. Although some operating systems with these features exist, few implement open standards. In addition, many PKIs designed by other parties, very often outside India, do not address the native problems in appropriate ways. Since I understand the kind of applications that are going to be deployed in India and limitations of existing resources better, i felt the need of an efficient PKI system developed in-house. In this report, i present the Architecture of SCOSTA file system and test scenario for testing PKI operations details in SCOSTA - a Smart Card Operating system that is already widely used by some Government agencies in India. I look at what different components or modules should constitute a PKI architecture and how we approached and implemented each of them. I shall also present details about how we tested our system to make it robust enough.

An Application-oriented Model for Wireless Sensor Networks integrated with External Networks
Prachi Chauthaiwale, Mentor: Dr. Priya Ranjan

The objective is to provide an application layer interface for integrating WSN with external networks (IP, TELECOM). Tremendous growth in both sensor network technology and anticipated applications is driving the need for new techniques and tools for analyzing and visualizing sensor network data streams. We have implemented different Network Topologies for wireless sensor networks which can be selected on the basis of area covered, data redundancy issues and energy efficiency.

We have implemented an application interface for data acquisition and processing on MATLAB and Java platforms.

Secure Spectrum Sensing in Cognitive Radio Networks
Pragya Maheshwari, Mentor: Dr. Adrish Banerjee

Cognitive Radio (CR) is an emerging wireless technology based on Software Defined Radio (SDR) that is aware of its environment and location and can make decisions on reusing the available frequency band dynamically. The efficiency of CR totally depends on its sensing ability so that it does not create interference to the primary or licensed user of that frequency. Various techniques have been proposed for spectrum sensing. Cooperation among various cognitive users can improve spectrum sensing. However, the performance of cooperative sensing is severely degraded due to the presence of malicious secondary users (SUs). In this report we study the detection of the untrustworthy secondary users who send false information to the fusion center to mislead the system. We introduce a weighing method which has two phases, training phase, in which decision is made according to the majority rule and weighing phase, in which weights are assigned to each node ac-cording to each node decisions deviation from the global decision. We show that this weighted scheme outperforms majority logic combining at the fusion center in presence of malicious users.

An Epidemiological Approach to Opiate Drug Users
Radhika M.V., Mentor: Dr. Peeyush Chandra

The main objective of this work was to study about the opiate drug addiction. The main motivation behind this work was the recent report on drugs and crimes by United Nations. It said that India is the highest consumer of Heroin in South Asia. This project report studied about the human population and the progression of drugs in the society. Epidemiological approach was used to study this. The drug addiction was treated as an epidemic where humans act as the carriers. Mathematical models were formulated and the analyses were done for the same. Mainly the study was done to find out the factors which contribute in accelerating the rate of drug users. The study was conducted on various models. A detailed model on the epidemic was proposed and the study was carried out for this model. It gave an idea about the drug progression and the ways in which the rate can be decreased. As a further step, some more assumptions and theory was incorporated. The model actually gives idea about the physiological and sociological factors involved in the epidemic. Investigations were done again and with much more clear portrayal an advanced model was proposed.This model and the work conducted will pave as a road map for a detailed study on this epidemic.

The Impact of ERP on SMEs and Implementation Problems
Rajesh Kumar, Mentor: Dr. Subhas C. Misra

The purpose of this research project is to consolidate and formalize as ontology, on the basis of an extensive literature review, the key processes and skills required for successful implementation of ERP in an SME. Using the Protégé software program, the research identified and formalized 395 terms, each of which has its own definition. Exploitation of this ontology could take multiple and varied forms, including creation of a learning system, an on-line cooperation platform, or a project management process mapping tool contributing to successful use of ERP in SMEs.

Efficiency Improvement of Wireless Power Transfer
Ravi Sundaria, Mentor: Dr. Kumar Vaibhav Srivastava

The project aims to efficiency improvement of the Wireless Power Transfer (WPT).For WPT we are using coupled magnetic resonance principle. This principle states that maximum power transfer can take place if the two objects are in resonance and coupled through the tails of their non radiative fields, while dissipating relatively little energy in off resonant objects. For maximizing the efficiency and power transfer the ratio of coupling to loss called 'Figure of Merit' need to be optimized. This ratio depends on the physical parameters of the system and frequency of operation. To improve the efficiency of WPT we analyze the effects of lumped capacitor and inductor and get positive results. With the help of lumped capacitance we are able to decrease the resonant frequency of system. The effect of loop-coil distance on efficiency is also analyzed.

Hydrodyanamics of Oscillating Slug Flow Inside Square Capillary/ Mini Channels
Ravishekhar Kumar, Mentor: Dr.Sameer Khandekar

Improvements in the fabrication capability have given rise to micro systems for heat and mass transfer Operations. The flow of uniform/oscillating menisci or air-plug inside such systems is a hydrodynamics Problem with interesting practical applications like Pulsating heat pipes, Fuel cells, Lab-on-chip devices, Electro-wetting, Micro fluidics etc. Understanding the hydrodynamics of such flows inside channels will help us in manipulating the performance parameters, which will further improve the efficiency of multiphase Microsystems. Mass transfer characteristics are affected by the hydrodynamic properties of the flow such as bubble Velocity, bubble and slug lengths, bubble shapes and profiles, thickness of the liquid film that surrounds the bubbles, mixing, and flow circulation within the liquid slugs and pressure drop along the flow. Experimental, Theoretical/analytical, and modeling attempts to predict these properties are reviewed and suitable correlations are mentioned. Most of these refer to capillaries, but there are number of studies on channels especially Circular cross sectioned. In general, flow properties are well understood and predicted for fully formed Unidirectional Taylor bubbles in a developed flow and in clean systems, in circular as well as rectangular Channels. However, the presence of impurities and their effect on interfacial tension cannot be fully accounted For. In addition, there is still uncertainty on the size of bubbles and slugs that form under certain operating and Inlet conditions, while there is little literature available for oscillating slug flows/meniscus.

Study of flow over Inverted Aerofoil in Ground Effect using Overset Grid Method
Roshan J Sam, Mentor: Dr. Tapan K. Sengupta

The work aims to solve the flow past an inverted aerofoil placed close to the ground using structured overset grids and by solving the Navier Stokes equations in two dimensions. Of the two grids used in the Overset Grid method, the grid surrounding the aerofoil is a body-conforming grid, allowing surface boundary conditions on the wing to be set easily. The grid used to study the wake further downstream is a planar grid which spaces out according to the tan-hyperbolic function. The data is transferred from one grid to the other by fourth order Lagrangian Interpolation, where a stencil of 25 grid points surrounding a point in one grid is used to determine the value of stream function at the corresponding node on the other grid. The Poisson equation is used to find the constant streamline over the surface of the aerofoil. A second order filter is used to stabilize the oscillating values of flow variables.

Design of Bus Controlling Units for Parallel Multiprocessor System Dedicated to N.L.P (Natural Language Processing) Applications.
Rutayan Patro, Mentor: Dr Ajai Jain

The proposed architecture for the Natural Language Processing Applications is a multi -processor design involving parallel processing. There are many parts in the system where more than one module may ask for the same bus. To resolve such conflicts bus controllers are used. The function of a bus controller is to arbitrate the control of the bus between different modules according to a priority which can be either static or dynamic. Using basic digital circuits such as counters, multiplexers, registers, and buffers, the controller can be efficiently designed. We have designed hardware units, bus controllers, which perform arbitration of the channel access between the processors/clusters. The simulation of this hardware unit was done in VHDL using XILINX ISE, XILINX IMPACT.

Flow Study and Optimization of Corrugated Plates/Airfoils
Sandeep Kumar, Mentor: Dr. Sanjay Mittal

Efficient aerodynamic performance at low Reynolds number flight regimes (Re < 10,000) has lately gained scientific and technological interest. Natural insect flight inspires bio-mimetic MAVs (Micro Aerial Vehicles). Experimental studies on bio-inspired fixed wings (characterized by corrugated airfoils) have shown favourable results. The objective in the current study is to analyse the effect of sharp corrugations on thin plates and to obtain optimally shapedcorrugated plates for high lift to drag ratiosat Reynolds number 1000 using two dimensionalnumerical flow computations.A continuousadjoint approach has been used for shape optimization with the airfoil being parameterized by Non-Uniform Rational B-Splines (NURBS). L-BFGS algorithm, a quasi-Newton optimisation techniquehas been employed to optimize the objective function. The primary flow mechanisms responsible for enhanced performance of pleated wing sections at low Reynolds numbers have been examined. The bio-inspired and modified geometries subjected to inverse optimization yielded shapes with significantly high aerodynamic efficiencies.

Role of 3PL services in the context of Special Economic Zones
Sanjay Kishore P, Mentors: Dr. Peeyush Mehta & Dr. Ashok K. Mittal

The first part of the project deals with the general study on the Special Economic Zones in India. The second part deals with the role of 3PL services in a two echelon supply chain consisting of a single supplier and multiple buyers. The 3PL brings about co-ordination among the buyers. The objective of this work is to model a two echelon supply chain with 3PL which offers more flexibility in case of changes in demand forecast to the 3PL by the buyers so that supply chain surplus is maximised. The work also deals with analysing the new model with an already existing model which does not offer flexibility.

Modelling of μ-ED Milling Responses Using CAD
Santhosh D., Mentor: Dr. J. Ramkumar,

Micro electric discharge milling (μED-milling) is a process in which complex shapes are generated on conductive workpiece by moving the axi-symmetrical rotating tool in a defined path. It has been adopted as one of the most valuable techniques for micromachining because of its excellence in the fabrication of precise micro hole, micromechanical parts, and complex microstructures. Although the process eliminates tool shaping effort for complex profiles, the tool wear phenomenon causes dimensional inaccuracy in the final shape. Elimination of tool wear is impracticable and hence it is necessary to measure and compensate the tool wear. Different theories and techniques have been proposed by various authors among which the uniform wear theory is widely accepted. The researchers like Masuzawa *et al.*, Blyes *et al.*, Yu *et al*. etc. have used this theory to compensate tool wear in 1D only while the actual tool wears occurs along the entire cross-section of the tool. Hence it is essential to estimate the wear of the tool throughout the contact length as a function of the machining parameters and further compensate it by providing multiple passes to generate the desired profile. In this project, a technique of wear prediction is proposed where the uniform wear behavior is extended to tool side along with the tool face. A CAD tool using NURBS is considered in predicting the tool wear. The objective of the work is twofold: First, to find out the number of passes required to obtain the desired shape of the μ-channel for the given machining conditions, then to predict the shape.

Filling of Carbon Nanotube with Different Metal Nanoparticles
Sapna Devi, Mentor: Dr. Sabyasachi Sarkar

The objective of this project is to find an eco-friendly, innovative method to synthesize metal nanoparticles and the encapsulation of such synthesized nanoparticles to the inner diameter of water soluble carbon nanotube. The mechanism of encapsulation of metal nanoparticles into the inner diameter of carbon nanotube is not clearly understood. In this project we have synthesized silver nanoparticles with eco-friendly method, the encapsulation was done and mechanism of filling of metal nanoparticles into the inner diameter of carbon nanotube via fracture present on the surface due to surface oxidation is clearly understood. The techniques like infrared, scanning electron microscopy, transmission electron microscopy, 3D imaging through ImageJ software was done to characterize the work

Study and Simulation of Biomaterials for Dental Implants
Savya Sachi, Mentor: Dr. Kantesh Balani

Biocompatible material with the best properties is the need of the hour. Hydroxyapatite(HAp) is the most biocompatible material know to man without any cytotoxic effect, but it being brittle,cannot be used alone. The project aims at synthesizing, simulating and studying and optimizing the properties of HAp-YSZ-CNT composite for dental implants without affecting its biocompatibility.YSZ is used to improve mechanical properties whereas CNT is used as reinforcing agents to further enhance the properties. Particle Size Analysis was done to find the particle size distribution of the powders used for making the samples. While SPS and conventional sintering were used to prepare the samples, mechanical properties such as hardness and density were measured. Characterization was done using tools such as SEM, XRD, FTIR while EDX showed that phases were distributed uniformly throughout the sample. To see the biocompatibility of sample, l929 mouse fibroblast cells were cultured on the samples. Simulation to find fracture toughness of the composite was done using ABAQUS 6.8.

Design and Computation of Flow through a Supersonic Wind Tunnel
Seema Choudhary, Mentor: Dr. B. Eshpuniyani

The aim of this study is to design a supersonic wind tunnel and computation of flow through it using Fluent which uses finite volume method. Contour of the diverging part of the De laval nozzle is obtained through a code which uses themethod of characteristics to design it. Diffuser profile used in the present study is straight walled, designed such that it creates a series of reflected shocks to slow down the flow with as small a total pressure loss as possible. The effect of various geometric parameters like length of test section, diffuser angle, throat height and length of the diffuser are investigated. After designing the tunnel, studies are conducted to analyze the effect of blockage area on the designed flow conditions in the test section and the behaviour of flow over a surface protrusion of various heights.

Modified Method for Extraction of Chlorophyll A, Its Charecterization and Synthesis of Some Metallporphyrins
Shashank Gupta, Mentor: Dr. Sabyasachi Sarkar

The objective of this project is to find a better method for extraction of chlorophyll a, its characterization, synthesis of some metalloporphyrins and their characterization as well. Different methods were tried for its extraction. The yields of chlorophyll a for all the methods have been mentioned. The compound was characterized by taking its UV and IR spectrum. Cyclic Voltammetry of chlorophyll a was also done to measure its oxidation potential. The metalloporphyrins that were synthesized are mesotetraphenylporphyrin magnesium(II), meso-tetrakis(3,4,5- trimethoxyphenyl) porphyrin magnesium(II), meso-tetrakis(4-methoxy)phenyl porphyrin iron(III) chloride, meso-tetrakis (3,4,5- trimethoxyphenyl) porphyrin iron(III) chloride, tetraphenylporphyrin cadmium(II). The synthesized metalloporphyrins were characterized by UV-Visible and IR spectroscopy.

Evaluation of Recyclable Supported Ru-catalyst for the Oxidation of 1,5-dienes
Shiwani Berry, Mentor: Dr. F. A. Khan

A number of methods for the oxidation have been reported like oxidative cyclizations with the use of stoichiometric amounts of permanganate, or with osmium tetraoxide or ruthenium tetraoxide. However, yields and selectivities are often low, due to unwanted overoxidation of processes and also due to isolation problems because of high water solubility of diol products. We have done the oxidation of 1,5-Cyclooctadiene with RuO_4 which gives cyclized products oxabicyclodiketone, ketoalcohol and diol because these products are helpful in the synthesis of □-lactones. These □-lactones can serve as starting materials for natural products synthesis. Initially RuO_4 had been used for the oxidation of alcohols, phenols, alkenes, alkanes etc., after that methods have been developed to replace stoichiometric amount of RuO_4 with a catalytic amount of $RuCl_3$ or RuO_2 along with a co-oxidant. During oxidation of 1,5- Cyclooctadiene, RuO_4 generated in situ from catalytic amount of $RuCl_3.xH_2O$ and $NaIO_4$ as co-oxidant. Use of $RuCl_3.xH_2O$, which is highly hygroscopic and staining in nature and cost of $NaIO_4$ made this methodology expensive. In order to make this reaction economic and environmental friendly we have used ruthenium-based supported catalysts as efficient and recyclable catalyst.

Generating Vocabulary for Software Architecture Documents and Using Drupal Content Management System at the Front End
Smriti Agarwal, Mentor: Dr. T.V. Prabhakar

Identification of Keyphrases from a document plays an important role in the light of growing number of digital documents. Keywords play an important role since the development of Web-2.0 where tagging of web pages with keywords is a good way to improve the metadata set. They are also an integral part of document systems where tasks like document classification, summarization, etc. play a crucial role. We intend to make a vocabulary that narrows down the set of keywords out of a bulk. We then use the Drupal Content Management System for using this vocabulary. For this purpose, we needed to carry out proper data processing. All the programming work is done in JAVA for vocabulary extraction, while the Drupal database is managed using PHP codes and the XAMPP server is used. The program is optimized to work within O (nm) time complexity. We found that the terms that occur at a frequency $1/8^{th}$ of maximum frequency of a keyword hold relevance in 150 documents while the list starts converging after 60 documents. The final vocabulary can then be uploaded into the CMS for use. The developed code can be well used for any particular field required that we have enough relevant material.

Study of the mechanical properties of HAp-Ti bioceramic composite"
Sohun Choudhury, Mentor: Dr. Bikramjit Basu

A biocompatible material is a synthetic or natural material used for the replacement of a part of a living system or to function in intimate contact with living tissue. Hydroxyapatite (HAp) is the main mineral constituent of bones. Its excellent bioactive property makes it an ideal choice for use in orthopedic applications and it does not show any cytotoxic effect. Due to some limitations, like brittleness and poor mechanical properties, HAp in pure cannot be used as a bulk load-bearing implant material. The basic aim of present research is to improve the mechanical properties (hardness, fracture toughness) of hydroxyapatite without considerably affecting its biocompatibility. For this reason, Titanium (Ti) upto 20wt% has been incorporated into the HAp matrix. HAp and Ti shows complementary properties (bioactivity and strength) to each other, making the possibility of an excellent composite biomaterial.The overall aim of this study is to perform the different mechanical tests to screen the optimum HAp-Ti composite for hard tissue replacement.

Synthesis and Characterzation of High Entropy Alloys
Somya Singh, Mentor: Dr. Anandh Subramaniam

The AlCoCrCuFe and AlCoCrCuFeNi alloy system was synthesized using an arc melting furnace. Their crystal structure, microstructure, hardness and chemical composition was investigated with X-ray diffraction, scanning electron microscopy and Vickers hardness testing. The alloys exhibit simple FCC and BCC phase and no intermediate phases are formed. Optical micrographs reveal the presence of dendritic and interdendritic regions which was further confirmed by SEM. The hardness of the AlCoCrCuFe decreases on the addition of Ni from 533Hv to 420Hv this is because Ni is a strong FCC phase former and hence tends to reduce the hardness.

Cloning, Purification and Crystallization of SAS proteins
Sonal Katware, Mentor: Dr. Balaji Prakash

In order to promote survival during stressful conditions, bacteria produce an unusual metabolite (p)ppGpp (guanosine 5`-diphosphate (or 5`-triphosphate) 3`-diphosphate) which modulates different processes according to the stress. RelA is the enzyme which maintains the levels of (p)ppGpp in the cell. Gram negative bacteria have two enzymes, RelA and SpoT to control the (p)ppGpp levels. RelA can synthesize (p)ppGpp from ATP and GTP and SpoT can both synthesize and hydrolyze it. Intuitively, it seemed that the gram positive bacteria also may possess more than one enzyme for controlling activities of (p) ppGpp. Recent reports suggest that there are atleast two other small enzymes called Small Alarmone Synthetases(SAS),YjbM and YwaC in *Bacillus subtilis* which are approx 200 aa in length. Additionally apart from synthesizing (p)ppGpp, YwaC also produces a novel triphosphate derivative of guanine (pGpp/ppGpp) and it is shown to be involved in alkaline stress response as well. The object of this project is to explore the characteristics of SAS proteins by analyzing their 3D atomic structure through crystallography.

Dynamic Wavelet Fingerprinting using Laser Based Ultrasonics
Souvik Roy, Mentors: Prof. P. Munshi & Prof. N.N. Kishore

The work aims to characterize ultrasonic signals in thick material sample using Laser Ultrasonics. The pulsed wave Nd-YAG laser is used to generate the ultrasonic signal in the material and continuous wave He-Ne laser heterodyne interferometer to record surface(out of plane) waves at the detection end. The ultrasonic signals thus obtained are quite complicated to analyse due to simultaneous presence of all kinds of waves such as bulk, surface, Rayleigh waves. Ultrasonic signals are generated in aluminium and brass specimens. A suitable stepped geometry is used to keep the length of travel same for all angles of laser incidence. The present work deals with a comparative study of some common wavelets and an analysis regarding their suitability in characterizing shear waves. The signals obtained are wavelet transformed using different wavelets and pattern recognition techniques are applied to identify the different wave arrivals in the signal. Zernike moment invariants are applied in the pattern recognition part to identify the Shear wave arrival. The arrivals of Shear and Pressure waves are correctly identified using continuous wavelet transform on different wavelets. The results so obtained confirm with the theoretical value of Shear and Pressure wave velocities.

Metallic Nanostructures for Magnetic Metamaterials
Sreeprasad.A, Mentor: Dr. S. Anantha Ramakrishna

Metamaterials is an arrangement of artificial structural elements, designed to achieve advantageous and unusual electromagnetic properties. Here we are trying to fabricate a magnetic metamaterials at higher frequencies. Magnetic metamaterials are the materials with magnetic permeability negative. For that we had designed a Silver Split Ring resonator with two slits and fabricated it using Focussed Ion Beam and its far field optical properties are studied.

Visual Speed Monitoring of Wind Energy Farms
Srishiti Rijhwani, Mentor: Dr. K. S. Venkatesh

The global market for wind energy has been expanding faster than any other source of renewable energy. The aerodynamic performance depends on the tip speed ratio of the wind turbine blade. It is thus obvious that in order to maximize efficiency we need to monitor the speed continually. Speed monitoring is hence an important area and routines have been developed but the existing SCADA (Supervisory Control And Data Acquisition) data require time and communication with individual turbine towers and local individual speed measurement are too expensive to provide. This is the motivation behind the development of Visual Speed Monitoring software. Here, a single camera is set up such that it can capture all the turbines of the farm at approximately the same viewing angle and scale. Analysis of this camera output will give all the turbine speeds on a continuous basis at one place. In effect the communication here is visual. Computer vision techniques are then applied to manually segment the regions corresponding to each windmill, detecting the rapid change in the background, getting the contour out of the connected components in the foreground, tracking the motion of each of the turbine blades to get the angular correlation in the successive frames and hence the speed of rotation. Usually in wind farms each turbine turns at a different speed. While Induction generators are capable of accepting varying shaft speeds even these systems operate effectively only within a specified range of shaft speeds. The excess speed can be addressed with speed governors without monitoring. Very low speeds will cause the respective generator in the farm to start motoring. Hence, turbines running at unacceptably low speeds needs to be isolated from the bus. This requires individual tachometry and instantaneous speed telemetry to a central server from each turbine.

Local Search Approach for Completion Time Variance In Shop Scheduling Problems
Subarna Kar, Mentor: Dr. Prabha Sharma

We have considered an algorithm "ADJACENT" to minimize the completion time variance in permutation flow shop problems. "ADJACENT" algorithm is a two phase local search algorithm that provides that dominates $2^{(n-3)}$ of total $2^{(n-2)}$ V-shaped feasible sequences. The coding for Phase-1 and Phase-2 has been done. By making use of the dominant relations inherent in CTV problem, it is possible to prune significant percentage of the search neighborhood in Phase-2 of the algorithm. All these have been included in the code for Phase-2 so as to reduce the computational time performance of the code. In Phase-2 coding, chances of backtracking to Phase-1 optimal solution have also been considered. The code has been tested for various cases and the cpu time too calculated.

Shear strengthening of Unreinforced Masonry Wall using GFRP (Glass Fiber Reinforcement Polymer): Experimental and Analytical Study
Tariq Zyad, Mentor: Dr. K. K. Bajpai

Unreinforced masonry (URM) walls exhibits poor seismic performance under moderate and high seismic demand. The present experimental and analytical study, performed on brick masonry panels strengthened by glass fiber reinforcement polymer (GFRP) bars, was aimed to investigate the effectiveness of alternate shear reinforcement technique to reduce seismic damage. A series of three unreinforced masonry (URM) panels and three strengthened panels were subjected to diagonal compression tests according to ASTM E519. Tests were also carried out to determine compressive strength of masonry prism, coefficient of friction and bond strength between masonry and mortar.

Different reinforcement configurations were evaluated based on analytical studies, to come up with the most effective design for strengthening. The study pointed out that the reinforcement in the diagonal direction increases the effective bond length of the bars intersecting the diagonal crack, thus making the reinforcement design, more effective and more economical.

Study of Auction theory and analysis of India's 3G Auction
Tejas Agarwal, Mentor: Dr. R.K. Amit & Dr Peeyush Mehta

The objective of this work was to study the "Auction theory" and applying it in the study of India's 3G spectrum auctions. The study was a three step process, going through the Game theory, Mechanism Design and Auction theory. Auction theory included enormous types and auctions with their characteristic behaviors to different circumstances. During the study, emphasis was laid upon designing of an auction that would yield desired objectives without falling prey to shortcomings such as collusion and entry predation. India's 3G spectrum auction was inspired by European Auctions and thus its study was mandatory. Study showed that careful and in-depth planning ensured that U.K. 3G auction was a big success. Unfortunately Netherland (different market structure) went with the exact same auction design, failed to achieve the set objectives. The above clearly restated that auction design is a matter of "horses for courses", not one size fits all; each economic environment requires an auction design that is tailored to its special circumstances. India's 3G auction which lasted for 183 rounds, was a big success generating revenue twice the expected amount. As a future work following work is intended to be done: -

- Comparison between the theoretical strategies and those adopted in India's 3G spectrum auction.
- Did Indian government "***rightly estimate"*** the prices of India's 3G spectrum.

Application of Microwave in Biomedical Engineering
Udita Awasthi, Mentor: Dr. Md. Jaleel Akhtar

A general technique is presented to measure the scattering coefficients of transmission and reflection of biological tissues using Microwave. Microwave which is used here of order of 1 to 10 GHz. It is based on various dielectric and mechanical properties of tissues. Permittivity is a dielectric property which is complex in nature. By this technique one can analyzes the overall inter action between the biological tissues. In this frame work two approaches are there and both give the same results. First is the Direct approach and second is Transmission matrix (TM) approach. TM approach is also employed to compute the scattering parameters of various biological tissues. The early detection the cancerous growth by comparing the scattering coefficients of the normal to cancerous breast tissue is possible.

Studies towards Structure Determination of a set of *Drosophila* MADF- BESS domain proteins
Umair Khan, Mentor: Dr. Balaji Prakash

The objective of this work is to initiate studies towards the expression, purification and crystallization of one interesting but yet unexplored family of transcription factors/co-activators in *Drosophila melanogaster*, the MADF-BESS domain family. The proteins of this family contain an N-terminal MADF DNA binding domain and a C-terminal BESS domain that is involved in protein: protein interactions. Based on the *Drosophila melanogaster* genome sequence, there are atleast 14 proteins that contain both the MADF and the BESS domain, indicating an important functional role for maintaining both domains in the same polypeptide sequences.

The structural and functional analysis of these transcription factors are important contents in elucidating the regulation mechanisms of gene expression. The work describes the cloning of the cDNA of the MADF-BESS domain proteins: CG12767/Dip3, CG3838, CG11723, CG6854, into the pRSETA plasmid and then optimizing the expression and purification conditions for these clones in a suitable *E. coli* host. In addition, homology modeling studies where undertaken to predict the structure of the MADF and BESS domains of these proteins.

Synthesis and Charecterization of ZnO:Eu2O3 Composite Thin Films via Pulsed Laser Deposition

Upkar Kumar, Mentor: Dr. Asima Pradhan

This report outlines the work done on the growth and characterization of ZnO: Eu_2O_3 composite thin films via the pulsed laser deposition (PLD) technique. In this technique, a solid state Nd:YAG laser operating at 355 nm and with a 5 ns pulse width was focused at a sintered pellet target to produce an expanding plume in a vacuum chamber (pressures in the $7.4*10^{-1}$ mbar range). The plume material condenses on the quartz substrates, to form a thin film. Oxygen was used as a background gas. The samples were characterized using XRD, PL and SEM techniques to study the effect of temperature variation on the growth of the thin films.

An Application-oriented Model for Wireless Sensor Networks integrated with External Networks

Vaibhav Mehta, Mentor: Dr. Priya Ranjan

The objective is to provide an application layer interface for integrating WSN with external networks (IP, TELECOM). Tremendous growth in both sensor network technology and anticipated applications is driving the need for new techniques and tools for analyzing and visualizing sensor network data streams. We have implemented different Network Topologies for wireless sensor networks which can be selected on the basis of area covered, data redundancy issues and energy efficiency. We have implemented an application interface for data acquisition and processing on MATLAB and Java platforms.

Conversion of Concept maps from CMap format to VUE format

Varsha Anand, Mentor: Prof. T.V. Prabhakar

The technique of Concept Mapping is not new to the field of Knowledge Representation. Concept maps are used for organizing and representing knowledge in form of graphs. These graphs have nodes that represent concepts and links that represent the relationships among the concepts. We have different tools to create Concept maps like: CMapTools, Compendium, XMIND and VUE. The objective of the research included the understanding of Concept mapping, the use of CMapTools and VUE to create the maps and creating a program for the conversion of concept maps in CMap format to VUE format. The program has been made successfully and it is running for large and sophisticated maps. This program will help to include the advantages of enhanced features of VUE in the existing Knowledge Models in CMap format.

Application of PMF and UNMIX for Source Apportionment of the PM1 at IIT Kanpur
Vivek Kumar Singh, Mentor: Dr. Tarun Gupta

This report is about source apportionment of PM1 sampling done at IIT Kanpur region to find out the sources for the abundant species using two receptor models, EPA UNMIX 6.0 and EPA PMF 3.0. Receptor models are mathematical or statistical procedures for identifying and quantifying the sources of air pollutants at a receptor location. A comparison of the two receptor models was carried out in order to do more robust characterization of the PM1 sources. Both the model predicted that the major source of PM1 in this region is secondary aerosol.

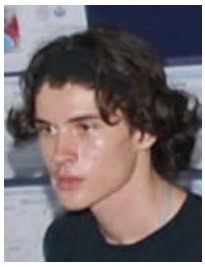
Designing an RNA interference-based Strategy for functional Characterization of Genes involved in Hippocampus Development
Aline Lueckgen, Mentor: Dr. Jonaki Sen & Dr. Amitabha Bandyopadhyay

The main goal of this research project is to determine the role of the neuroD1 gene in the formation of the hippocampus in the chick embryo. The approach used is RNA interference (RNAi) in which the gene of interest is essentially knocked down, its function is inhibited, and the resulting developmental changes are analyzed. RNAi necessitates the design of an oligonucleotide which exactly matches a nucleotide sequence of the gene of interest of about 64 base pairs. After this oligonucleotide has been annealed to its complementary strand, it can be incorporated into the shuttle vector pRmiR via ligation. A portion of this shuttle vector and the double-stranded oligo is then introduced into the Replication-Competent Avian virus with Splice acceptor (RCAS), which is injected into the forebrain of the chick embryo at stage 18. The development of the hippocampus is then tracked by observing the differentiation and migration of cells by days 7 and 8 post-injection, which are visualized through the use of green fluorescent protein (GFP). The hypothesis of this study is that the gene neuroD1 plays a crucial role in the formation process of the hippocampus in the developing chick embryo.

Design of the Mechanical Dragonfly
Autumn Allen, Mentor: Dr. Anupam Saxena

One of the most breathtaking yet complex species in nature is the dragonfly. Most concepts concerning this insect are very intricate, namely its wing construction, flight techniques, and body structure. They are able to fly forwards, backwards, hover for a long period of time, and maneuver with skill when under attack. Scientists and engineers are continually fascinated with the agile and hard to reproduce motion of the dragonfly's wings when exhibiting certain flight modes. Dragonflies possess two fore wings and two hind wings that are independently actuated due to direct musculature at the base of the wing and demonstrate a unique "figure 8" pattern. My research project entails three goals: to replicate the natural "figure 8" wing motion with a micro-mechanical version of the biological dragonfly, design this 1st generation model with the ability to hover with wings in counter stroking (180 degrees out of phase from one another) for at least 1-2 minutes, and to keep the weight at 30g or under. I have successfully achieved replicating the "figure 8" motion and keeping the weight under 30g. In the future the design will be more compact and efficient made of more sophisticated materials and will incorporate a camera lens and tiny microphone. This is a key field for governmental agencies such is the NSA or the CIA for surveillance and national security purposes.

The Effect of Sub-Dominant Foreground Components on Observed CMB Anisotropy
Adrian K. Chapman, Mentors: Dr. Pankaj Jain



We investigate the effect of unknown foreground components on the observed alignment of the CMB quadrupole and octopole. This alignment is studied using the principle eigenvector (PEV) of a power tensor defined for each multipole. We produce a set of simulated pure CMB maps injected with sub-dominant foreground components and cleaned using the Internal Power Spectrum Estimation (IPSE) procedure. The bias introduced by this procedure for a particular foreground is studied by comparing the multipole alignment in the pure CMB maps to that in the maps after cleaning. We then attempt to characterize those foreground distributions that tend to increase alignment. This study would help us in determining if the observed alignment may be caused by some unknown foregrounds. Given this characterization, subsequent work should attempt to explain the alignment in terms of real foreground sources in an effort to advance the current understanding of the astrophysics of foreground emission.

Hydro-dynamics of slug flows inside square capillaries
Manon Pelletier, Mentor:Dr. Sameer Khandekar

With the current emergence of energetic challenges comes the opportunity to make use of new and innovative devices, such as pulsating heat pipes. Since the latest improvements in micro-fabrication capabilities, Pulsating Heat Pipes, or PHPs, have come up as an interesting alternative to conventional heat transfer technologies. If it is now possible to m anufacture PHPs, no one yet knows how exactly to pin point its performance parameters and system characteristics, making it impossible to design and dimension a PHP from only its heat transfer capability. It is thus crucial to be able to understand the hydrodynamics of uniform air-plugs in liquid filled tubes. As the consequence, the purpose of this research project has been to study the meniscus shape and the behavior of the advancing interface of a fluid moving inside a square capillary. The ultimate goal was to get an overview of a flow's behavior through different capillaries sizes and a large range of velocities. Two different methods have been used: an imaging method, through the use of a video recorder and the micro-PIV method (Particle Image Velocimetry). Dynamic apparent contact angles inside square capillaries were measured by video recording for different Capillary Numbers and results demonstrate that Tanner's Law is valid in square capillaries but with a dependence on the Bond Number; more systematic data will be acquired to identify the exact relation. Micro- PIV was done to see the hydrodynamics behind moving menisci, and a thorough study showed that the flow behind the meniscus departs from parabolic profiles (Hagen-Poiseuille equation) as we move closer to the meniscus.

Abstracts:2010 SURGE Research Projects Done in Overseas Universities

Non-linear properties of Barium Titanate from first principles
Aditya Huddedar, Mentor: Dr. Igor Kornev

The basic idea of the paper is to study the nonlinear properties of barium titanate from first principles, in particular to find a temperature dependence for all the coefficients in the corresponding Landau potential. The later part of the paper is more concerned with making the computation more efficient.

Mesh PartitioningTechniques.
Anugrah Jain, Mentor: Dr. Frederic Magoules

The High Performance Computing (HPC) research group develops mathematical models and computational methods for the high-performance simulation of multidisciplinary scientific and engineering problems. Many solvers are written to run in parallel, using several processors. To distribute the work over n processors, the techniques, named "mesh partitionning", split the domain into n sub-domains. The domain is a set of elements: the vertices for graphs, the elements of meshes. The partitioning is by definition the distribution of initial domain elements into sub-domains elements. The first step of the internship will be to understand a Matlab code. This code applies a partitioning method on a image. Then the student will add to the Matlab code some post-processing functionalities. In addition, the student will change the code to run the partitioning on a 3D test case, including the post-processing functionalities. To run the codes on many test cases, the student will use script language as batch. Then, the student will create a C++ interface. This interface will be used to run several partitioning methods on the same test case in order to compare them with the Matlab code. Required knowledges/skills: Matlab, C++.

Distributed Learning in Wireless Sensor Networks
Bhuwan Dhingra , Mentor: Dr. Subhrakanti Dey

We study a Distributed Machine Learning framework for binary classification presented in [1], and look for possible extensions to it, with the main motivation of applying it to a Wireless Sensor Network. The approach used is that of Support Vector Machine (SVM) classification. We attempt to minimize the communication overhead between the various nodes by reducing the number of Support Vectors. Three schemes were tried- Learning Vector Quantization (LVQ) at each of the nodes, random selection at the nodes, and smart selection using SVM classification at the nodes. Their performance was studied on both real and simulated datasets.

Investigation of Meteorite Impact on Mars
Gaurav Bhatele, Dr. Cristophe Clanet

Meteorite impact on planets and the formation of craters and multi-ring basins have been studied earlier by using sand and low speed projectiles. Studies show that southern half of Mars is topographically high, heavily cratered and old while the northern half is lightly cratered and covered by smooth young volcanic plains. The Martian polar dichotomy is suggested by Melosh and others to have occurred due to a major asteroid impact on the lower hemisphere of the planet. This investigation aims at explaining the possibility of such an impact and its implications. In this study an impact is made on balloons filled with air and water and the characteristics of the waves formed are studied. The characterization of the frequency and modes of oscillations is done using a high speed camera. We observed three types of oscillations namely- surface wave oscillations, vertical oscillations, radial oscillations in the balloons. The results show a transition in wave nature with the variation in size of the balloon and also a transition between two regimes- lift-off and in-place oscillations which relate to the actual impact as to when the planet will remain in its trajectory and when it will be carried away. We have also been able to suggest a model for determining the critical energy required for the transition to take place.

Study of seismic wave propagation over a hilly terrain using Fast Multipole accelerated Boundary Element Method
Himanshu Jain, Mentor: Dr. Régis Cottereau

Nowadays earthquake engineering and seismology are very active research fields because of huge human and economical issues underlying them. As a result of which various numerical methods have been developed to model the 3-D elastic wave propagation and one such method is Boundary Element Method(BEM). The Boundary Element Method attempts to use the given boundary conditions to fit boundary values into the integral equation, rather than values throughout the space defined by a partial differential equation and hence it is well suited for unbounded media but in its traditional form BEM leads to high CPU costs and memory requirements so in order to increase the capabilities of standard BEM, Fast Multipole accelerated BEM (FM-BEM) are used. The first part of present work aimed at understanding the FM-BEM and its computer implementation code. The next part aimed at running the Fast Multipole -Boundary Element code for different configurations of hills, implementing the communications between the meshing device (COMSOL), the core FM-BE code (in Fortran 95), and the post-processor (MATLAB), and analyzing the results. From the present work it was concluded that the seismic ground motion is not only influenced by the source features but also by the site topography and Convex geometries like hills lead to more seismic amplification as compared to the concave geometries like canyons. Also from computation results it was observed that a clustering or trapping of seismic waves occurs in between the hills in case of a terrain with multiple hills.

Robustness Analysis of a List Decoding Algorithm for Compressed Sensing
Mainak Chowdhury, Mentor: Dr. Babak Hassibi

We analyse the noise robustness of recovery of sparse signals based on the compressive sensing equivalent of a list-decoding algorithm for Reed Solomon codes - the Coppersmith-Sudan algorithm. We use results from the perturbation analysis of singular subspaces of matrices to prove the existence of bounds for the noise levels (in the measurements) below which the error in the recovered signal (with respect to the original sparse signal) will be guaranteed to be bounded above.

Design Principles for Functionally Graded Thermoelectric Cooling Systems
Raghav Khanna, Mentor: Dr. G.J. Snyder

The concept of functionally graded materials provides design pathways to significantly improve performance characteristics of thermoelectric cooling systems. In contrast to the conventional constant property model cooler, where cooling is only due to the Peltier effect, cooling in functionally graded elements is largely driven by the Thompson effect which leads to a temperature profile which is significantly different from that of the former. The matching of the reduced current (u) to the compatibility factor (s), which maximizes the coefficient of performance at every point in the cooler, is used as the fundamental basis for obtaining optimised property profiles for such functionally graded cooling elements. Analysis of the optimised cooling elements quantifies the significant enhancement in performance parameters including the Coefficient of Performance, which has been postulated earlier, and brings forth the new possibility of obtaining arbitrarily large temperature differences using such coolers .The proposed design principles establish a useful strategy for improving cooler technology and are promising for design of thermoelectric cooling systems for low temperature applications.

Evolution of Circumbinary Black Hole Disks
Raziman T V, Mentor: Dr. Sterl Phinney

Gravitational accretion is the source of energy for some of the most luminous astrophysical objects. Accretion disks around compact objects are used to explain energetic phenomena such as active galactic nuclei (AGNs), compact X-ray sources etc. In this project we specifically look at external accretion disks which are disks in which the central object has sufficient angular momentum to prevent accretion. External accretion disks are found around black hole binaries, a source of which is galactic merger. We derive the equations describing the structure and evolution of such disks. This is being followed by the development of numerical code that can simulate the evolution of the disks based on these equations.

Effciency of Z Reconstruction in Proton-Proton Collisions in CMS
Shubhayu Chatterjee, Mentor: Dr Ludwik Dobrzynski & Dr Raphael Granier de Cassagnac

Data simulated in accordance with the CMS experiment of the LHC are analysed both at generated and reconstructed level for Drell-Yan events in proton-proton collisions. The channel investigated is the decay of a Z boson into an electron-positron pair. The efficiency of electron reconstruction, and subsequently, of Z reconstruction are calculated as a function of various physically relevant quantities. The efficiency is shown to increase under proper rapidity cuts on electrons in proton-proton collisions. In heavy ion collisions, an effort is made to reconstruct the Z from the supercluster data only. Momentum cuts and rapidity cuts are suggested to isolate the Z peak from the large background.

Study of Cochlear Implants and 3D Finite Element Modeling of Human Cochlea
Vinamra Agarwal, Mentor: Dr. Saman Halgamuge

Damage to hair cells renders the cochlea unable to convert mechanical vibrations to neural excitations. Cochlear implants have proven to be an effective solution for such type of deafness. Over the years, studies have been conducted to optimize the cochlear implant electrode array, varying the electrode shape, type of pulse and location of the arrays in the cochlea to create effective and safe stimulation. The power requirements of the cochlear implant undergoes constant changes after implantation. These changes are attributed to biological changes such as fibrosis and ossification occurring in the inner ear. The project focuses on developing a detailed 3D finite element model from histological sections of human cochlea to develop a computational study of these changes in impedance of electrode tissue interface upon electrical stimulation. The results obtained will be verified against the experimental observations.

Algorithms for Reasoning with Temporal Relations
Vineet Gupta, Mentor: Dr. Manuel Bodirsky

A temporal constraint language is a set of relations that has a first-order definition in (Q;<), the dense linear order of the rational numbers. A constraint satisfaction problem is a computational problem where the task is, informally, to decide for a given set of variables and constraints on the variables whether there exists an assignment of values to the variables that satisfies all constraints. Such problems appear naturally and frequently in most areas of computer science, for example in Artificial Intelligence, Scheduling, Computational Linguistics, Computational Biology, Combinatorial Optimization, Operations Research, Computer Algebra, and Programming Languages. Here I study the computational complexity of a large class of constraint satisfaction problems where the variables denote time points. Formally, by a temporal constraint language (L) we mean a relational structure (Q;R1,R2, . . .) where each Ri has a first-order definition in (Q;<), the rational numbers with the dense linear order. A temporal constraint language is finite if it contains finitely many relations. The constraint satisfaction problem (CSP) for a finite temporal constraint language L is the computational problem to decide for a first-order sentence S of the form :- there exists x1, . . . , xn. f1 ^ · · · ^ f p , where f1, . . . , fp are atomic formulas of the form R(xi1 , . . . , xik), whether S is true or false in (L). after understanding the ins and outs of the basics of CSP, I am left with the task of designing and Algorithm which takes A main relation and several other secondary relations as an input, along with the number of dummy variables (variables other than those present in the main relation) required and outputs the Primitive Positive definition of the main relation in terms of the secondary relations. Here, the problem faced is “how to represent the relations in pure numbers so that calculations can be done over them in the algorithm?” The answer is : < , > ,= and != define each and every possible ordering between two variables in any relation , hence numerals could be used to represent each such equality/inequality.

Feedback of Mentors and Students of 2010 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 2010 Program

#	Question	Average score
Student		***2010***
3	Did the student measure up to your expectations? (1: Well below expectations; 5: Beyond expectations)	4.00
4	How much supervision did the student require? (1: A lot; 5: Not much)	3.45
5	Did the student work when you expected him/her to? (1: Never; 5: Always)	4.23
6	Did the student observe guidelines you set forth? (1: Never; 5: Always)	4.55
7	Did the student work well with your research group? (1: No; 5: Yes)	3.59
8	Did the student participate in department seminars or discussion groups? (1: No; 5: Yes)	3.40
9	How well suited was the student for the research in terms of: (1: Low; 3: Medium; 5: High)	
	(a) Enthusiasm for the work	4.25
	(b) Preparatory Coursework	3.45
	(c) Skills or abilities, etc.	3.88
	(d) Background knowledge	3.02
10	Would you recommend this student for the SURGE 2011 Program? (1: No; 5: Yes)	3.00
11	Would you like to work with this student again? (1: No; 5: Yes)	3.98
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)	4.57
13	Please give us your overall evaluation of the student. (1: Poor; 5: Excellent)	3.97

Research		
14	Did the research you expected from the SURGE research project get done in the 10 weeks? (1: No; 5: Yes)	3.27
15	Is the work worth publishing in a refereed Journal? (1: No; 5: Yes)	3.56
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)	4.50

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 2010 Program

#	**Question**	
Research		***2010***
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)	2.32
4	Did you get the required equipment & facilities needed to carry out your research? (1: No; 5: Yes)	4.45
5	Did you attend research group meetings or participate in discussions with your research group members? (1: No; 5: Yes)	2.19
6	Did you feel comfortable asking questions of your Mentors and Co-Mentors? (1: No; 5: Yes)	
	(a) Mentor	3.90
	(b) Co-Mentor	3.17

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	3.87
	(b) Skill in interpretation of results	3.55
	(c) Tolerance for obstacles faced in research process	4.00
	(d) Readiness for more demanding research	4.59
	(e) Understanding how knowledge is constructed	4.27
	(f) Understanding of the research process in your field	4.33
	(g) Ability to integrate theory and practice	4.19
	(h) Learning ethical conduct in your field	3.67
	(i) Learning laboratory techniques	3.79
	(j) Skill in how to give an effective oral presentation	4.88
	(k) Skill in science writing	4.20
	(l) Self-confidence	4.43
	(m) Learning to work independently	4.54
	(n) Others (please state):	4.00
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)	3.99
9	Evaluate the overall performance of your Mentor or Co-Mentor: (1: Poor; 5: Excellent)	
	(a) Mentor	4.00
	(b) Co-Mentor	4.19
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	3.48
	(b) Oral presentations	4.08
	(c) Writing your final technical paper	3.99

Reviews from Students-"Impact of SURGE"

- The work that I began as a part of my SURF project at Caltech and which was later continued after my return to IIT Kanpur has just been published in Physical Review E (a journal of the American Physical Society). The link of this paper (by Debanjan Chowdhury & M.C. Cross) is as follows: http://pre.aps.org/abstract/PRE/v82/i1/e016205

I thank the SURGE programme at IIT Kanpur and the Caltech-IITK MoU for providing me with this excellent opportunity to spend a summer at Caltech. I was a M.Sc. Integrated student of Physics at IITK from 2005-2010.

Debanjan Chowdhury.

- First of all, my hearty congratulations for the success of SURGE. I have been a part of SURGE 2008, under the guidance of Dr. Animangsu Ghatak, Department of Chemical Engineering.

I should sincerely admit that SURGE has been the turning point of my life. It fetched me a project at University of Hamburg, Germany, for the summer 2009. I am currently working for Michelin India Tamil Tyres Pvt. Ltd., Chennai and would be shortly going to France for a 2 year assignment.

I wish that SURGE would continue its role encouraging students to experience a professional research experience at the learning stage.

Sravya Vallabhaneni.

- I would like to share my experience during the 10 week stay at IITK.

  "It was a wonderful experience for me. The concept of promoting research interests among young undergrads is something that fascinates me. I really had a good opportunity to have a deep insight into my career plans. The lush green campus, multi-cultured environment, enchanting and competitive young students all kept me going.

Enthusiasm soared higher when it was work without missing fun. It really gave us an all new dimension of learning. No doubt, all this helped me to receive best poster award. Overall, it helped us a lot to have an edge over others and 'surgians' stand a good chance of getting recognized throughout their carrier. "

The way the entire program was conducted especially the midterm and final poster presentation to keep up the competitive spirit was well established and student friendly.
Personally, I would like to thank you whole-heartedly for conducting the entire program with great success and for ensuring the pleasant stay of each and every one of us.

Santhosh.D

- I feel that the Surge program served as an excellent platform in giving a first hand experience to the undergraduates in the patience-testing field of research. What better place for innovation than IIT-Kanpur where the ambience was most conducive for any and every academic pursuit in sight. I was actually in awe of the infrastructure and all the facilities that were provided, ranging from library, internet and sports; I felt it was simply world class and unmatched by any other institute I have come across. Students in the campus were very polite and interacted with us with utmost ease; I felt as if I knew them for long and they definitely made sure there was no problem for me to settle in the 'IIT- way of life'. The faculty with their unsurpassed dedication and guidance continually encouraged me into working endlessly and also much more efficiently. The staff in the campus were very amiable and ready to help with any trouble I faced-thankfully I faced very few. The freedom that we enjoyed throughout our training period was one of a kind and did more than ease any pressure from our project work. Also the responsibility endowed on us definitely added new dimensions to the realm of our morale. In the campus I always felt a sense of purpose and everyone around was goal oriented and their struggle for perfection did leave quite an impact on my outlook and approach. I thank IIT-Kanpur for giving me this wonderful opportunity and for making me feel part of something important and worthwhile.

  Harsh Shukla

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