



SURGE-2009

Annual Report

**SUMMER UNDERGRADUATE RESEARCH GRANT
for EXCELLENCE**

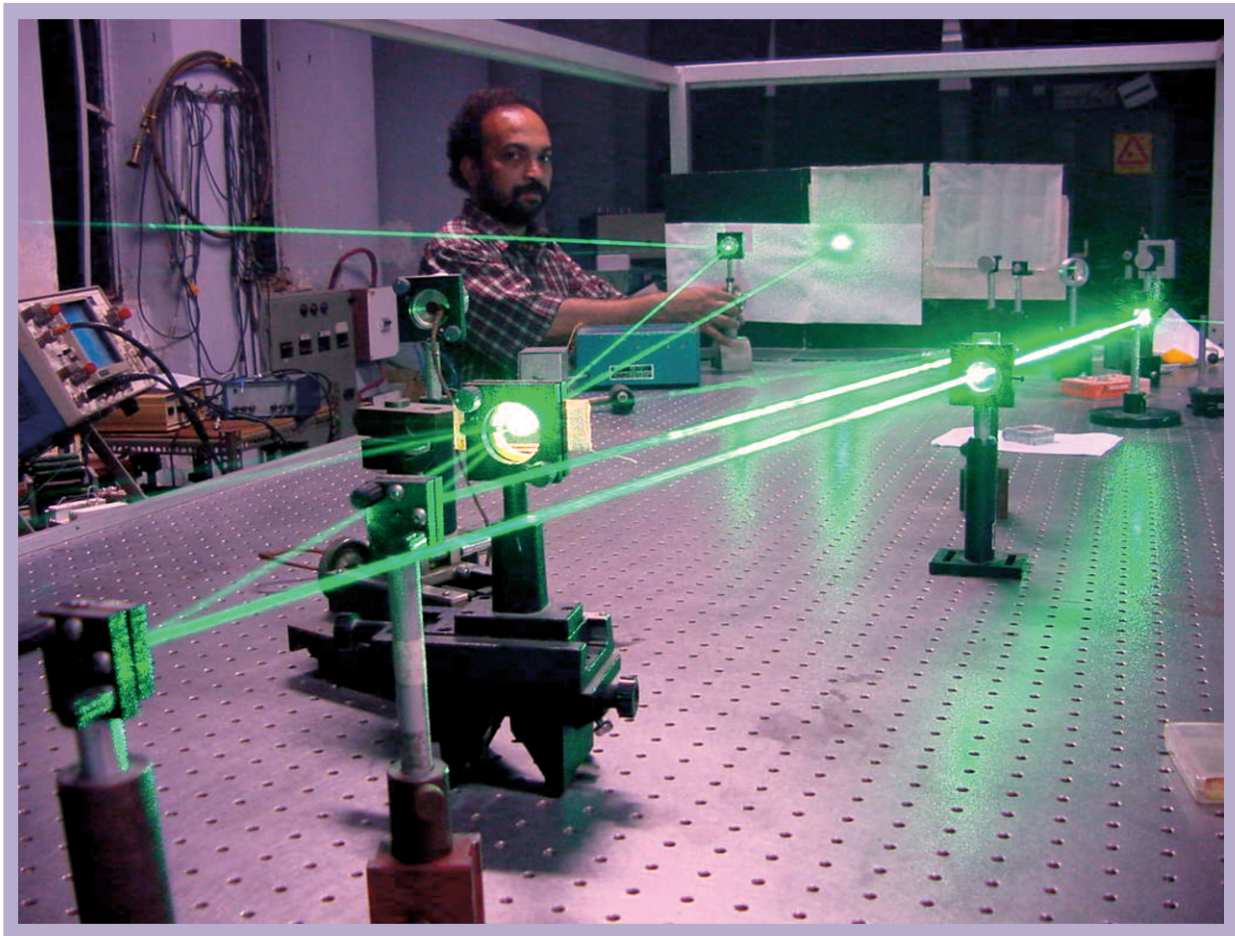
Office of Dean Resource Planning & Generation
Indian Institute of Technology Kanpur
Kanpur 208016

Executive Compendious

Surge 2009 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.

Vision Plan for Tomorrow:

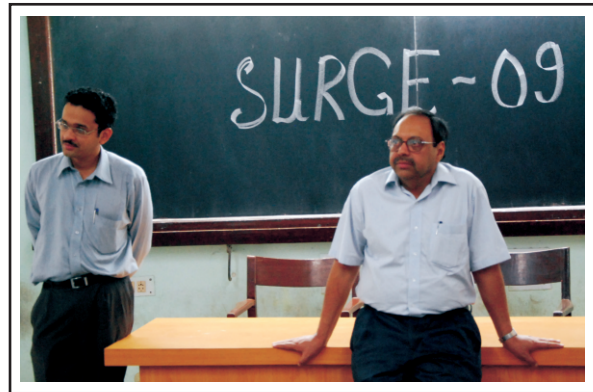
Undergraduate research fosters collegiality and welcomes students into the community of researchers and scholars. It promotes self-discovery, helps to bridge the gap between the class-room and the real world, and leads to the social, professional and educational development of the student. Undergraduate 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 SURGE Programme selects students from within the Institute and from different National Institutes of Technology (NITs) for a 10-week research experience at IIT Kanpur during the summer. In addition, under exchange arrangements with some overseas universities, students from these universities work at IITK and vice versa. The opportunities for research experience are invaluable and of great benefits to the students. Guidelines and markers are laid down well before the start of the programme and students (under the guidance of their faculty mentors) develop a research proposal well before they start work in the summer so as to have an effective lead time. The Office of the Dean, Resource Planning and Generation at IIT Kanpur coordinates this activity and provides infrastructure support.

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. The mentors from IIT Kanpur are impressed by the enthusiasm displayed and the rigor adopted by the young researchers. By the end of the programme, a surprising number of these young minds show an inclination towards seeking research and development as their career, and almost all students experience enhanced and holistic learning as opposed to the “chalk and talk method”. Fifty nine students have participated in the programme in the summer of 2009. Also, in addition to the ongoing exchange with Caltech, Ecole Centrale Paris and Ecole Polytechnique Paris, Rice University too has joined the programme this year. This report summarizes the work carried out by the students and gives an overall assessment of the programme.





Acknowledgements

The support and participation of the following is gratefully acknowledged:

- The faculty mentors at IIT Kanpur and the SURGE students for their enthusiastic participation
- The generous donors who made contributions to support the programme.
- Members of the Advisory Committee, Implementation Committee, Departmental Representatives and numerous other faculty members who helped in the programme.
- Dr. Siddharth Dasgupta (MSc5/CHM/1980), Associate Director for Industrial Relations & Tech Transfer, NSE Center for Science and Engineering of Materials, Caltech for relationship building between IIT Kanpur and Caltech.
- Professor Pierre Becker of Ecole Centrale Paris for his enthusiasm and participation and help improvise the relationship with Ecole Centrale Paris.
- Dr. Sharad Tripathi (BT/AE/1969) and Mr. Anoop Tandon (both based in Paris) for their support towards building a relationship with Ecole Centrale Paris.
- Mr. Sylvain Ferrari, International Development Coordinator for developing the relationship with Ecole Polytechnique, Paris.
- Dr. Ratna Sarkar, Associate Dean of engineering for global initiatives in the George R. Brown School of Engineering made efforts to build relationship between IIT Kanpur and Rice University.
- Dr. Yogesh M Joshi, Faculty Incharge SURGE; Dr. Sameer Khandekar (committee member) and Dr. Madhav Ranganathan (committee member) for the continuous support and involvement.
- Ms. Aparna Mitra who coordinated the program on behalf of DRPG office and the entire staff of the Office, Resource Planning and Generation for their support and assistance.

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1. SURGE programme – An overview

Objective, scope and Progress

IIT Kanpur launched a 10-week Summer Undergraduate Research Grant for Excellence (SURGE) program in the summer of 2006. The programme aimed to promote a culture of research amongst undergraduate students of IIT Kanpur and some other selected academic institutes in the country. This programme was developed in collaboration with the California Institute of Technology (USA), which has been running the highly acclaimed Summer Undergraduate Research Fellowship (SURF) programme for over 25 years (www.surf.caltech.edu). Later, SURGE was expanded to cover a much larger number of students, and it now includes an exchange arrangement with Caltech, Ecole Centrale Paris, Ecole Polytechnique Paris as well as Rice University, US.

As an undergraduate student, you won't only benefit personally and academically from doing your internship at IITK; you'll enhance the process of self-discovery of their dreams and capabilities, and appreciate education in its true spirit, as well. Undergraduate research is a pedagogical tool that helps channelise the energy and enthusiasm of students into conceptual-based education, thereby igniting their minds to explore with curiosity the world around them. It can help students to bridge the gap between classroom education and real world challenges, and learning the relevance of the curriculum that they undergo at the Institute, and internalize and take ownership of the process of learning and education.

Thus, undergraduate research is seen as a vehicle to bring about a change in the approach of addressing the holistic development of undergraduate students at this Institute. It offers valuable experiences and benefits to all sections of the academic environment - students, mentors as well as the Institute.

An Exposition

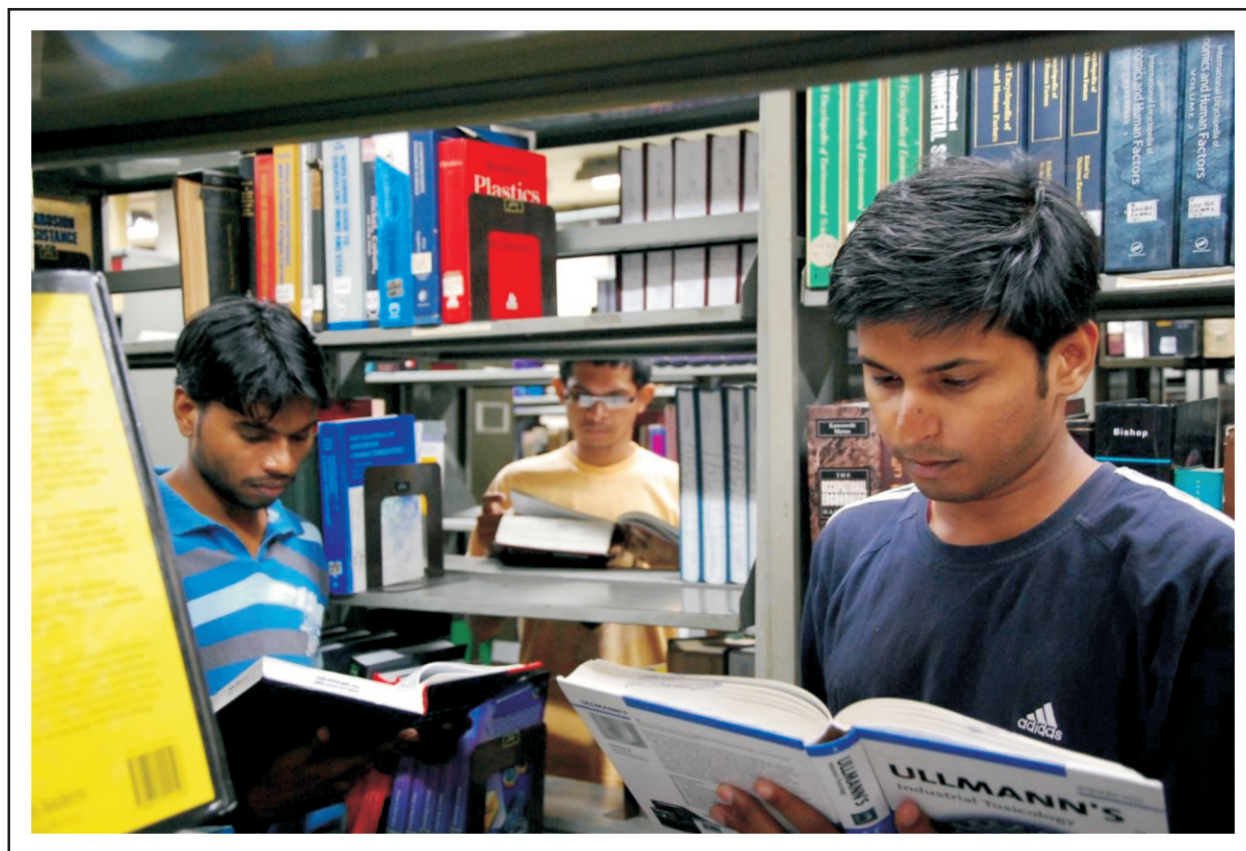
The students benefited greatly from the experience and learned not only science but also interpersonal skills (please see the SURGE Annual Report at <http://www.iitk.ac.in/surge/SurgeReport.pdf>). Excellent feedback was received from students and faculty members and it was decided to further expand the programme.

Under the SURGE programme, second and third year undergraduate students (including those in the Dual Degree programmes) undertake short duration, but focused research projects and push their intellectual abilities beyond those driven by the classroom. Selected students receive a stipend plus a commendation certificate is also given to those SURGE students who produce exceptional quality research during the 10 weeks.

The candidates are selected on the basis of their academic record, involvement in extra-curricular technical activities, recognition at the national student level competitions, and their technical proposal for the research to be undertaken. Two faculty members from the concerned departments and the Implementation Committee scrutinize the applications. Details of the information sought from the aspiring students in their applications are given on the SURGE website (www.iitk.ac.in/surge).

The SURGE participants are required to give a mid-term presentation after four weeks, to a review committee consisting of a group of academic staff members. The review committee gives feedback and suggests possible improvements in the work. The candidates prepare a final technical report at the end of 10 weeks. The culmination of the summer research is the poster presentation of the work and the feedback of student experiences.

Care is taken to ensure that SURGE focuses not only on “research” but also on a multifaceted personality development of the student. Thus, weekly social and cultural activities are interlaced with the research programme. While these meetings allow the students to socialize and share their enthusiasm with each other, they also help SURGE coordinator to group mentor the students and get regular feedback. As a bonus, these activities win strong loyalty from the students for the programme.



2. SURGE 2009 Programme- *The Glory continues and goes global*

In the SURGE 2009 Programme, as many as 52 undergraduate students (20 from IIT Kanpur, 27 from National Institutes of Technology across India, 3 from Ecole Centrale Paris and 2 from Rice University). These young researchers spent 10 weeks of their summer vacation at IIT Kanpur doing research at the frontiers of engineering and science under the mentorship of IIT Kanpur faculty members. Moreover, in the SURGE 2009 Programme, 3 IIT Kanpur students participated in a 10 weeks research program at Caltech, 3 at Ecole Centrale Paris and 1 student did likewise at Ecole Polytechnique Paris.

In order to maintain the non-academic facets of this programme, there were extra-curricular activities during every Wednesday evening for a “happy hour”. An idea of “Wednesday-Talks” by faculty members for SURGE students and educational documentary was a success to get together both students and faculty

members. This enhanced the interaction between students and as well with their mentors. Abstracts of the research undertaken by students during the 2009 SURGE Programme and an analysis of the surveys undertaken by the SURGE office is given in following pages.



Participants of SURGE 2009 at IIT Kanpur

Sl. No.	Name of the Institute	Name	Project	Mentor's Name
1	From IIT Kanpur	Ankit Gupta <i>B.Tech/EE/II Yr</i>	Speaker Separation by Sinusoidal Modelling of Speech	Dr. Rajesh M Hegde <i>Electrical Engineering</i>
2		Ankit Jain <i>B.Tech/ME/II Yr</i>	CFD Prediction of Carbon Nanotube Production Rate in a CVD reactor	Dr. M K Das & Dr. A K Saha <i>Mechanical Engineering</i>
3		Anurodh Tripathi <i>B.Tech/Che.E/II Yr</i>	Generation of White light from Lanthanide doped Nanoparticles by down-conversion of Ultra violet Light	Dr. Sri Sivakumar <i>Chemical Engineering</i>
4		Ashish Kumar Bajpai <i>B.Tech -M.Tech Dual/ME/II Yr</i>	Simulation of Fluid Flow Past Square Cylinder using Lattice Boltzmann Method	Dr. Gautam Biswas & Dr. Malay Kumar Das <i>Mechanical Engineering</i>
5		Ashutosh Kumar <i>B.Tech/EE/II Yr</i>	Shapes, Descriptors and Skeletons	Dr. K S Venkatesh <i>Electrical Engineering</i>
6		Avirishu Verma <i>B.Tech/CSE/II Yr</i>	Image Search Engine for PDF Files	Dr. Arnab Bhattacharya <i>Computer Science & Engineering</i>
7		Biplab Dutta <i>M.Sc. Int./Chemistry/II Yr</i>	A Study of Fibre Optic Refractive Index Sensor	Dr. Pinaki Gupta Bhaya <i>Chemistry</i>
8		Brajesh Kushwaha <i>B.Tech/EE/II Yr</i>	Automatic Singer-Identification of Popular Music Recordings	Dr. Pradip Sircar <i>Electrical Engineering</i>
9		Himanshu Jain <i>B.Tech -M.Tech Dual/ME/II Yr</i>	Microfabrication Using Electric Discharge Route	Dr. V K Jain <i>Mechanical Engineering</i>
10		Mahim Misra <i>B.Tech/Che.E/II Yr</i>	Study of Rise of Fluids in Nanotubes using Molecular Dynamics Simulation	Dr. Jayant Kumar Singh <i>Chemical Engineering</i>
11		Mainak Chowdhury <i>B.Tech/EE/II Yr</i>	Sampling and Reconstruction of Finite Rate of Innovation Signals	Dr. Ajit K. Chaturvedi <i>Electrical Engineering</i>
12		Mansi Agarwal <i>B.Tech/MME/II Yr</i>	Studies on Co-deposited Nanocrystalline Copper- Nickel alloys	Dr. R. Balasubramaniam & Dr. K Balani <i>Materials and Metallurgical Engineering</i>
13		Mohit Mittal <i>B.Tech/Che.E/II Yr</i>	Magnetic Cell Sorting	Dr. P K Panigrahi <i>Mechanical Engineering</i>
14		Pranav Agrawal <i>B.Tech/Che.E/II Yr</i>	The Study of Wetting on Functional Surfaces using Molecular Dynamics Simulation	Dr. Jayant Kumar Singh <i>Chemical Engineering</i>
15		Prateek Mishra <i>B.Tech/BSBE/II Yr</i>	Role of Retinoic Acid Signaling in Cell Proliferation and Survival of Developing Hippocampus	Dr. Jonaki Sen <i>Biological Sciences and Bioengineering</i>
16		Raghav Khanna <i>B.Tech/ME/II Yr</i>	Design of an Experiment to Study Creepage in Rolling	Dr. Ishan Sharma <i>Mechanical Engineering</i>
17		Runit Jhanwar <i>B.Tech/CE/III Yr</i>	Generalised Methods for Interpretation of CRS Testing	Dr. Amit Prashan <i>Civil Engineering</i>
18		Sankalp Agarwal <i>B.Tech/Che.E/III Yr</i>	Comparative Study of Design & Plant - Wide Control for Two Alternate Process of Cumene Manufacture	Dr. Nitin Kaistha <i>Chemical Engineering</i>
19		Siddharth Chatterjee <i>B.Tech/EE/III Yr</i>	Performance analysis of a Transmit Beamforming Scheme for the downlink MoSO Channel with Delay	Dr. Ajit K Chaturvedi <i>Electrical Engineering</i>
20		Sonam Goenka <i>B.Tech/Che.E/II Yr</i>	Plant Wide Control for Maximum Profit	Dr. Nitin Kaistha <i>Chemical Engineering</i>
21	From Different NITs	Abhilash Kumar Sethi <i>B.Tech./ME/IIIIYr/NIT, Warangal</i>	Hydrodynamics of a Single Oscillating Meniscus in Square Capillary	Dr. Sameer Khandekar <i>Mechanical Engineering</i>
22		Abhishek Mishra <i>B.Tech./CE/IIIIYr/NIT, Warangal</i>	Quantification of Positional Errors in Maps Derived from Remote Sensing Data	Dr. Onkar Dixit <i>Civil Engineering</i>
23		Amarendra <i>B.Tech./CE/IIIIYr/NIT, Allahbad</i>	Strengthening of Partially Damaged Moment Resisting RC Frame Using FRP	Dr. D C Rai & Dr. K K Bajpai <i>Civil Engineering</i>

24	Arka Mondal <i>B.Tech./PIE/IIYr/MNIT, Allahbad</i>	Study of a Company's Suitability For the Adoption of Cloud Computing and its Corresponding Return on Investment (ROI)	Dr. Subhas Misra <i>Industrial & Management Engineering</i>
25	R. Ateeth Datt <i>B.Tech./IPE/IIYr/NIT, Jalandhar</i>	Return of Investment (ROI) of Agile Software Development	Dr. Subhas Misra <i>Industrial & Management Engineering</i>
26	Bikash Kumar Aggarwal <i>B.Tech./ME/IIYr/NIT, Surathkal</i>	Study of Bubble Growth in Aqueous Laponite Suspension	Dr. Sameer Khandekar <i>Mechanical Engineering</i> & Dr. Y M Joshi <i>Chemical Engineering</i>
27	Daya Shankar Choudhary <i>B.Tech./CE/IIYr/NIT, Silchar</i>	Seismic Analysis of Nailed Slope	Dr. Amit Prashan <i>Civil Engineering</i>
28	Dheer Vora <i>B.Tech./PE/IIYr/NIT, Tiruchirappalli</i>	Return of Investment (ROI) Model for Grid Computing	Dr. Subhas Misra <i>Industrial & Management Engineering</i>
29	G. Vengatesan <i>B.Tech./ME/IIYr/NIT, Tiruchirappalli</i>	Optimization of Magnetic Abrasive Finishing Process for Nanofinish	Dr. J Ramkumar <i>Mechanical Engineering</i>
30	Gopalakrishnan R <i>B.Tech./MME/IIYr/NIT, Nagpur</i>	Simulation of Growth of Heteroepitaxial Thin Films using Finite Element Method (FEM)	Dr. Anandh Subramaniam <i>Materials and Metallurgical Engineering</i>
31	Harminder Singh <i>MSc./Chemistry/IIYr/NIT, Jalandhar</i>	Synthesis of Silver Nanoparticle and its Deposition on Water Soluble Carbon Nanotube	Dr. Sabyasachi Sarkar <i>Chemistry</i>
32	Jasjeet Kaur <i>MSc./Chemistry/IIYr/NIT, Jalandhar</i>	Purification of N,N-Dimethylformamidase from <i>Paracoccus</i> sp. DMF	Dr. R. Gurunath <i>Chemistry</i>
33	Karuna Phuyal <i>B.Tech./ECE/IIYr/SVNIT, Surat</i>	Intrusion Detection in Presence of Continuous and Highly Varying Projector Illumination	Dr. K S Venkatesh <i>Electrical Engineering</i>
34	Nandani Rai <i>B.Tech./MSM E/IIYr/MANIT, Bhopal</i>	Simulation of Coherent and Semicohereant Precipitate using Finite Element Method	Dr. Anandh Subramaniam <i>Materials and Metallurgical Engineering</i>
35	Niladri Bhusan Jena <i>B.Tech./ME/IIYr/NIT, Hamirpur</i>	Fluid Flow and Heat Transfer analysis of Gas Flowing through a Micro-channel using Computational Fluid dynamics	Dr. A K Saha & Dr. P K Panigrahi <i>Mechanical Engineering</i>
36	Pallavi Kesarwani <i>B.Tech./MMSE/IIYr/VNIT, Nagpur</i>	Spark Plasma Sintering of Functionally Graded Hap-Al ₂ O ₃ -3YSZ	Dr. Kantesh Balani <i>Materials and Metallurgical Engineering</i>
37	Pooja Sharma <i>MSc./Chemistry/IIYr/NIT, Jalandhar</i>	Purification of N,N-Dimethylformamidase from <i>Paracoccus</i> sp. DMF	Dr. R. Gurunath <i>Chemistry</i>
38	Pradeepta Kumar Panda <i>B.Tech./ME/IIYr/NIT, Tiruchirappalli</i>	Numerical Simulation of 3D Synthetic Jet	Dr. A K Saha & Dr. P K Panigrahi <i>Mechanical Engineering</i>
39	Prayakarao Sukanya <i>B.Tech./CE/IIYr/NIT, Warangal</i>	Evaluation of Liquefaction Potential of Ganga and Ennore sand using Vibration Table test and Fly Ash using Dynamic Triaxial Test	Dr. Nihar Ranjan Patra <i>Civil Engineering</i>
40	Ram Krishna Mishra <i>B.Tech./MME/IIYr/NIT, Warangal</i>	Electrostatic Spraying of Biocompatible low Density Polythene (LDPE)- Ultra High Molecular Weight Polythene(UHMWPE)- Al ₂ O ₃ - Hydroxyapatite (HA)- Carbon Nanotube(CNT) Nanocomposites	Dr. Kantesh Balani <i>Materials and Metallurgical Engineering</i>
41	Girish Krishna. S <i>B.Tech./ME/IIYr/NIT, Tiruchirappalli</i>	Theoretical Modelling of Magnetic Abrasive Finishing Process	Dr. Ram Kumar . J <i>Mechanical Engineering</i>
42	Shiva Nigam <i>B.Tech./ECE/IIYr/MNIT, Allahbad</i>	Development of Computer- Vision Techniques to Recognize Finger Gestures	Dr. Venkatesh K Subramaniam <i>Electrical Engineering</i>

43		Shruthi D Prabhu <i>B.Tech./CE/IIYr/NIT, Surathkal</i>	Recovery of Fertilizers and Usable Water from the Flush Solution of Zero Discharge Toilet System Developed at IIT Kanpur	Dr. Vinod Tare <i>Civil Engineering</i>
44		Siddhartha Gupta <i>B.Tech./MME/IIYr/NIT, Tiruchirappalli</i>	Corrosion Study of Advanced Iron- Rare Earth based Magnetic Materials in Simulated Human Body Condition	Dr. R. Balasubramaniam & Dr. K Balani <i>Materials and Metallurgical Engineering</i>
45		Sriram P R <i>B.Tech./MME/IIYr/NIT, Tiruchirappalli</i>	Simulation of Growth of Niobium Film on Sapphire Substrate and Determination of its Critical Thickness using Finite Element Method	Dr. Anandh Subramaniam <i>Materials and Metallurgical Engineering</i>
46		Varinder Singh <i>MSc./Chemistry/IIYr/NIT, Jalandhar</i>	Synthesis of Gold Nanoparticle and its Deposition on Water soluble Carbon Nanotube	Dr. Sabyasachi Sarkar <i>Chemistry</i>
47		Vishwanath Karthik M <i>B.Tech./Che.E/IIYr/NIT, Warangal</i>	The Characterisation of a Relative Humidity Sensor	Dr. Siddhartha Panda <i>Chemical Engineering</i>
48	Rice University	Matthew Sorenson <i>B.S/ME</i>	A Study of Turbulent Flow Past the NACA0012 Airfoil	Dr. Sanjay Mittal <i>Aerospace Engineering</i>
49		Maxwell Grossman <i>B.S/CSE</i>	Automated Parallelization of the Blas Library	Dr. Sanjeev K. Aggarwal <i>Computer Science & Engineering</i>
50	Ecole Centrale Paris	Cedric Codet <i>BS/Fundamental Physics</i>	Prospects in Graphene Research	Dr. R C Budhani <i>Physics</i>
51		Marcos Grappegia <i>BS/EE</i>	Image Navigation System Based on Terrain Reconstruction for Moon Rover	Dr. Venkatesh K Subramaniam <i>Electrical Engineering</i>
52		Marek Mazur <i>BS/ME</i>	Experimental Studies On Bluff-Body Stabilized Diffusion Flames	Dr. D P Mishra <i>Aerospace Engineering</i>

IIT Kanpur Students who participated in SURGE 2009 at Overseas Universities

Sl. No.	Name of the Institute	Name	Project	Mentor's Name
1	At Caltech	Abhishek Bhowmick <i>B.Tech/CSE/III Yr</i>	Using sum of small-bias distributions to fool degree d polynomials over F_2	Prof. Cris Umans <i>Computer Science</i>
2		Debanjan Choudhary <i>M.Sc. Int./Physics/II Yr</i>	Synchronization of Oscillators with Power Law Long-range Interactions	Dr. Michael C. Cross <i>Physics</i>
3		Vikas Trivedi <i>B.Tech/BSBE/III Yr</i>	Molecular Characterization of the Development of Branchial Arches in Vertebrates	Dr. Marianne Bronner Fraser <i>Biology</i>
4	At Ecole Centrale Paris	Dipanshu Bansal <i>B.Tech/CE/III Yr</i>	Accounting of Dampin ^f Induced by Sediments in Seismic Arch Dam Reservoir Analysis	Dr. Didier Clouteau & Dr. Regis Cotteneau <i>Civil Engineering</i>
5		Nitish Srivastava <i>B.Tech/CSE/II Yr</i>	Parametric Identification of Individual Variability in Plant Population models	Dr. Paul Henry Cournede <i>Systems and Applied Mathematics</i>
6		Shakti Saurabh <i>B.Tech/AE/II Yr</i>	Development of new generation combustors for aerospace application	Dr. Sebastien Ducruix <i>Aerospace Engineering</i>
7	At Ecole Polytechnique	Sushobhan Nayak <i>B.Tech/EE/II Yr</i>	Silicon Nanowires	Dr. Pere Roca I Cabarrocas <i>LPICM</i>

2009/IITK/1

Speaker Separation by Sinusoidal Modeling of Speech

Ankit Gupta, Electrical Engineering, IIT Kanpur

Mentor: Dr. Rajesh M Hegde, Electrical Engineering

An attempt to separate a single channel or double channel mixed signal using McAulay-Quatieri sinusoidal modeling of speech sounds has been made in this project. This MQ representation of sound extracts frequency spectra as amplitude peaks with phase information. In the first algorithm, a new perceptual distance measure between sinusoids is used. The perceptual distance measure is suitable mainly for the separation of harmonic sounds. Initially sinusoidal modeling is used to analyze the mixed signal and to obtain the frequencies and amplitudes of sinusoidal spectral components. A procedure for classifying the sinusoids into separate sound sources is presented. However, in case of colloidal tracks this algorithm fails. Second algorithm for sound separation depends upon directionality of sound. In two speakers and two sensors case it finds the onset with direction information and synthesis is done by using these information with the assumption that one speaker dominates at a time. The last approach of sound source separation system operating in real-world acoustic environments is proposed. The separation is based on the spatial origin of sound sources. In the first part the direction-of-arrival of the strongest sound source is estimated and then it performs the separation of the sound source by sinusoidal representation which allows grouping of spectral components based on estimated direction-of-arrival. The operation of both parts is based on the time delay between the channels, which is related to the spatial origin of sound sources. For stationary speakers and stationary sensor case, experimental results show all the schemes to be very effective.



2009/IITK/2

CFD Prediction of Carbon Nanotube Production Rate in a CVD reactor

Ankit Jain, Mechanical Engineering, IIT Kanpur

Mentor: Dr. M K Das & A K Saha, Mechanical Engineering

Chemical vapour deposition (CVD) is known as one of the most efficient methods of synthesizing carbon- nanotubes. Present study presents a computational fluid dynamics (CFD) model to predict the production rate of nanotubes via catalytic decomposition of ethylene in a CVD reactor. In our model, surface decomposition of ethylene into CNTs and hydrogen is taken into account. The time dependent, xi-symmetric Navier-strokes equation, continuity equation and mass transfer equations are solved for different flow regimes for a range of Reynolds number. The spatial temperature variation in the reaction zone is expected to be small and has been neglected. Dependence of deposition rate on Reynolds number, substrate geometry and molar fraction of ethylene in feedstock has been studied.



2009/IITK/3

Generation of White light from Lanthanide doped Nanoparticles by down-conversation of Ultra violet Light

Anurodh Tripathi, Chemical Engineering, IIT Kanpur

Mentor: Dr. Sri Sivakumar, Chemical Engineering

The summer research report describes the incorporation of lanthanide doped nanoparticles into LaVO₄ matrix to improve the optical properties of lanthanide ions and these materials can potentially be used in white light devices, optical amplifiers, lasers, and biolabeling. The approach used is figuratively depicted in the **Scheme 1. Core matrix of LaVO₄** was doped in stoichiometric ratios with **Eu³⁺, Tb³⁺ and Tm³⁺** emitting red, blue and green light respectively upon



excitation with UV light source. **Scheme 1**-We prepared the nanoparticles using two approaches one involving oleic acid as the ligand and operated at low temperatures and other approach include heating at high temperatures upto 8000C. Though, the basic idea in both approaches remained the same as shown in scheme 1. Six samples were prepared using first approach in which the concentration of added lanthanide ions was changed to figure out best possible combination for white light generation and two samples were prepared using second approach.

2009/IITK/4

Simulation of Fluid Flow Past Square Cylinder using Lattice Boltzmann Method

Ashish Kumar Bajpai, Mechanical Engineering, IIT Kanpur

Mentor: Dr. Gautam Biswas & Dr. Malay Kumar Das, Mechanical Engineering

We want to study the behavior of fluid flow past a square cylinder. Though there are several methods available like FVM (Finite Volume Method) and FDM which are powerful tools of solving a typical CFD problem but we are trying to use a new, powerful and alternative tool of aforementioned methods, LBM (Lattice Boltzmann Method). For this purpose, a new code for this problem has been developed using LBM method. In the first stage, in the learning process, we simulate the flow between two parallel plates (fully developed flow) for which analytical solution exists in the literature and the results obtained are compared with those existing e.g. the skin drag coefficient at the wall and velocity profiles in the developed region which are found in agreement with the one already existing through analytical solution. Thus we assured the validity of LBM. So we started with no cylinder case in the channel flow. Then, we introduced single square cylinder to simulate the flow. Developed the code and results found are compared with various papers M. Breuer et al(1999) and S.R. Kumar et al (2008) which are found to be consistent with the already available results in the aforementioned papers. Next we introduced three cylinders in the path of fluid and simulate the flow. The results thus found are consistent with Cheng and Moretti (1998) and some results are also compared with that found by S.R. Kumar and A. Sharma. Thus we used a completely new method and simulate the flow around square cylinders. Next we plan to increase the number of cylinders to ten and simulate the flow around ten cylinders.



2009/IITK/5

Shapes, Descriptors and Skeletons

Ashutosh Kumar, Electrical Engineering, IIT Kanpur

Mentor: Dr. K S Venkatesh, Electrical Engineering

How does someone remember a shape? Human can remember shape because they have something, called brain, they can directly store the shape in their brain. But what about a machine? How would you make a machine remember a shape and recognize it later or reconstruct it later? We should generate a set of numbers that would represent this shape. This set of numbers is called descriptors. They are produced to describe a shape. We would also like to have a one-one relationship between shapes and descriptors so that reconstruction and recognition is possible. Here I would like to add that a shape might not be exactly re-constructable from its descriptor but descriptors of different shapes should be different so that shapes can be discriminated. By calculating various moments of any shape we can approximately reconstruct the shape. So the set of moments act like a descriptor of a shape. We will talk about this later in the report. I have developed a method to generate descriptor of any shape by breaking the shape and then storing each component separately. We generate descriptor for each component. Later we can reconstruct the shape by pasting all these components together. Now, something about shock graph and skeletons and reconstruction of shape from skeleton. Can we



draw any shape by union of disk? The answer is yes. We can represent any shape as a union of disk such that no disk lies completely inside any other disk (No disk lies completely inside any other disk implies that each shape will have a unique combination of disk). These disks touch the boundary of the shape at least at two points. All of these disk lie completely inside the shape. Every disk has two properties its centre and its radius, when we talk of disk we specify it by its centre and radius. The union of disk centre of disk is called skeleton. It is continuous and unique for a given shape. There are many other ways by which we define the skeletons which are discussed later. Shock Graphs are a bit more informative than skeletons in a way that they have the qualitative information about increasing radius of disk shown by arrows. We cannot reconstruct shape by just having the skeletons or shock graph. We need to have some more information other than shock graph to reconstruct the shape, which are called dynamic information. Different shapes might have same shock graph. We call these shapes having same shock graph as cousin shapes. Given a shape i have to find the cousin shapes. For example we can see in fig1 that the same straight line having radius increasing monotonically in one direction may have different shapes.

2009/IITK/6

Image Search Engine for PDF Files

Avirishu Verma, Computer Science & Engineering, IIT Kanpur

Mentor: Dr. Arnab Bhattacharya, Computer Science & Engineering

Portable document format, PDF, is today one of the most common and readily available format for storing and transferring information in electronic form. This file format for document exchange, created by Adobe in 1993, is independent of the system configuration and thus finds wide use in a variety of applications. Any PDF document may contain both text as well as images. The earlier versions of Adobe-Acrobat reader did not allow for the PDF document to be edited, but the newer ones have tools like text search. This project aims to enable image search in a PDF document.



2009/IITK/7

A Study of Fibre Optic Refractive Index Sensor

Biplab Dutta, Chemistry, IIT Kanpur

Mentor: Dr. Pinaki Gupta Bhaya, Chemistry

An optical fiber, partially stripped of cladding is shown to sense refractive index of a liquid in which the uncladded sensing region is immersed, to a high degree of precision and over a wide range of refractive index. The transmitted light signal through a completely unclad and partially cladded fiber and its sensitivity to refractive index (RI) change has been measured as a function of the length of the unclad region. The data show a maximum at an intermediate length of unclad fiber and also for partially cladded fiber. The slope of sensor response is found to be non linear, can change sign with respect to the refractive index of liquid and length of the sensor region. The plots of light intensity as a function of refractive index of liquid for a given length shows a small maximum just before the core RI and a minimum slightly above the core RI. The maximum gradually disappears at large length of the unclad region, but the minimum persists. Measurements have been done with 10 different media, 4 different lengths at a core diameter of 400 micron. In the work described here, the fiber optic functions as an all fiber sensor system by exploiting the evanescent field of interaction at the cladding liquid interface.



2009/IITK/8

Automatic Singer-Identification of Popular Music Recordings

Brajesh Kushwaha, Electrical Engineering, IITK

Mentor: Dr. Pradip Sircar, Electrical Engineering

In most popular music, the vocals sung by the lead singer are the focal point of the song. The unique qualities of a singer's voice make it relatively easy for us to identify a song as belonging to that particular artist. With little training, if one is familiar with a particular singer's voice one can usually recognize that voice in other pieces, even when hearing a song for the first time. In the case of rock and pop music, even the music can help us identify the singer as a music (or band) is generally unique for a singer. The scheme developed attempts to automatically establish the identity of a singer using acoustic features extracted from .As a first step, the song sample (training or testing)is divided into overlapping frames(of 20ms width and 50% overlap).These frames are then, converted into mel-Frequency Cepstral Coefficient(MFCC) vector known as the feature vector (signature vector of a song).This step is followed by preparing a model (GMM,SVM or ANN). We employ the Gaussian Mixture Models (GMMs). As we need training to identify the singer, the model too needs to be trained. This training is done using the feature vectors extracted from the training set. One model is trained for each singer. During testing phase, the feature vectors from the test set songs are fed into each model and likelihood ratios are calculated. A song is assigned to the model with max- likelihood. This scheme gave promising accuracies of 65.27%(8 artists,242 training songs,216 test songs), 54.00%(9 artists,308 training songs, 100 test songs) and 67.53%(5 artists,194 training songs,154 test songs) for the three song databases and 84.06%(5 instruments, 97 training samples, 69 testing samples) for the classification of instrumentalsounds. This identification can be improved by carefully identifying the vocal and non-vocal sections of the song. As a step in this direction, the separation of singing voice from the song was attempted using band-stop filter. It gave good results but the filter was not robust rather a lot song dependent.



2009/IITK/9

Microfabrication Using Electric Discharge Route

Himanshu Jain, Mechanical Engineering, IITK

Mentor: Dr. V K Jain , Mechanical Engineering

The need for miniaturization of mechanical, optical and electric products and devices has led to the development of various microfabrication technologies and one of the emerging technologies in this field is the Electric Discharge Deposition Process. This process is carried out on an Electric Discharge Machine (EDM).A voltage is applied across tool electrode (which is in form of a very thin wire) and workpiece, conditions are set such that the tool wear is high and as a result when electrical spark occurs between tool and workpiece, tool material gets deposited on to the workpiece. Experiments were carried out to study the effect of EDM parameters (voltage, current, pulse on time and duty cycle) on width and height of deposition. In order to make complex profiles the width of deposition had to be reduced so a way was found so as to reduce the width and increase the height of deposition. Various micro structures were deposited on the substrate and finally a method was devised so as to detach the deposited structures from the base metal. As a real life application, microproducts such as micro gears, micro stamps etc were made.



2009/IITK/10

Study of Rise of Fluids in Nanotubes using Molecular Dynamics Simulation

Mahim Misra, Chemical Engineering, IITK

Mentor: Dr. Jayant Kumar Singh, Chemical Engineering

Molecular Dynamic is used to understand the ultra fast flow of water and oil (n-decane) in carbon nanotubes and boron nitride nanotubes of size (13,13) at 300 K. Our observations is in agreement with recent observation of simulation and experimental observation (Majumder M et, Nature, 438, 44 (2005)). Our results suggest that Washburn equation does not hold at nanoscale. Further, we observed imbibition rater is substantially faster in boron nitride nanotube compared to that seen in carbon nanotube.



2009/IITK/11

Sampling and Reconstruction of Finite Rate of Innovation Signals

Mainak Chowdhury, Electrical Engineering, IITK

Mentor: Dr. Ajit K. Chaturvedi, Electrical Engineering

We have considered the problem of sampling and reconstructing signals with finite rate of innovation (FRI). Many members of this class of signals do not admit sampling and exact reconstruction according to classical Shannon sampling theorem. However, there exists particular filters which allow the same. We have considered a multichannel scheme of reconstruction of a special subclass of these signals, namely a periodic train of delta functions. We have shown that the scheme leads to more efficient reconstruction. Also, a stochastic algorithm for estimation of the signals from noisy samples was investigated and a statistic was proposed to estimate its error performance.



2009/IITK/12

Studies on Co-deposited Nanocrystalline Copper- Nickel alloys

Mansi Agarwal, Materials and Metallurgical Engineering, IITK

Mentor: Dr. R. Balasubramaniam & Dr. K Balani, Materials and Metallurgical Engineering

Nanocrystalline Ni-Cu alloy films were synthesized by pulsed electro deposition from a citrate bath. Cathodic polarization experiments were carried out to decide the bath composition and the range of current density to codeposit Ni-Cu alloys. Depositions were carried out at current densities of 0.05 Acm⁻², 0.1 Acm⁻², 0.15 Acm⁻², 0.2 Acm⁻² and 0.25 Acm⁻² respectively and these deposits were characterized by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). Transmission electron microscopy revealed that the grain size was in nanometer range. Vickers Hardness Testing was then carried out on to study the effect of variation of composition and grain refinement on the hardness of these samples.



2009/IITK/13

Magnetic Cell Sorting

Mohit Mittal, Mechanical Engineering, IITK

Mentor: Dr. P K Panigrahi, Mechanical Engineering

This work presents the design and characterization of a Poly carbonate made lab-on-a-chip based on the magnetic force. It is designed to facilitate the mixing of magnetic beads and biomolecules and sorting of the above magnetic beads/biomolecules conjugate in a single micro-channel. It is demonstrated that a pair of integrated micro conductors (or permanent magnets) provides a local magnetic field sufficient enough to attract nearby magnetic beads. Mixing of magnetic beads is accomplished by applying a time-dependent control signal to a row of conductors whereas the sorting is achieved by permanent magnets placed externally on both the sides of lab-on-a-chip. The mixing and sorting of magnetic beads were observed by the CCD camera on an inverted microscope. As expected the mixing and sorting of magnetic beads were dependent on the strength of magnetic field generated and concentrations of magnetic beads in the solution. A numerical model for particle capture in case of sorting was also developed which shows that the particle capture efficiency depends on the strength of the magnet and the size of the magnetic particles. This lab-on-a-chip can be useful for the development of future bead-based assays.



2009/IITK/14

The Study of Wetting on Functional Surfaces using Molecular Dynamics Simulation

Pranav Agrawal, Chemical Engineering, IITK

Mentor: Dr. Jayant Kumar Singh, Chemical Engineering

The wetting is the tendency for a liquid to spread on a solid substrate. The wetting of solid surfaces by liquids is of fundamental importance in area of everyday life ranging from biology to industrial applications. A striking example is the remarkable non-wetting property of the lotus plant leaf. How a surface behave towards a particular liquid, hydrophobic or hydrophilic, determines their applications. Manipulating the hydrophobic or hydrophilic character of a surface require understanding of the microscopic principles that control the macroscopic scale wetting behavior. Wetting behavior of a surface can be turned to derisive purpose by altering it chemically or geometrically. In this work, we have done extensive molecular dynamics simulation and obtained contact angle to understand the wettability of graphite, a hydrophobic surface, in the presence of functional groups. We present results for the case of $-OH$, $-COOH$ and $-CO$ groups. We found hydrophilicity increase in the following order: $-COOH < -OH < -CO$.



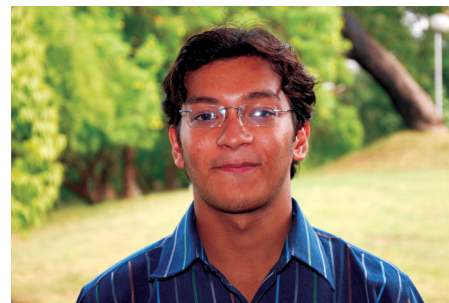
2009/IITK/15

Role of Retinoic Acid Signaling in Cell Proliferation and Survival of Developing Hippocampus

Prateek Mishra, Biological Sciences and Bioengineering, IITK

Mentor: Dr. Jonaki Sen, Biological Sciences and Bioengineering

We standardized the procedure for BrDU staining using the chicken retina. It is known that the proliferative zone in the embryonic retina at embryonic day 6-7 is in the central layer. Applying our protocol on retina of embryonic day 7.5 showed that the BrDU labeled cells are present in the appropriate location. We used the same protocol on the brain sections of embryonic day 7.5. The right figure shows the BrDU-labeled cells in the region of the neuroepithelium which is expected since neuroepithelium is considered as the birth place of neurons.



2009/IITK/16

Design of an Experiment to Study Creepage in Rolling

Raghav Khanna, Mechanical Engineering, IITK

Mentor: Dr. Ishan Sharma, Mechanical Engineering

Wheels and other bodies undergoing rolling undergo elastic deformation, due to tensile and compressive forces, in the longitudinal as well as the lateral directions. The deformation affects the effective radius and the area of contact between the wheel and the ground due to which the motion cannot be accurately modeled as pure rolling. The difference in displacement caused by this creepage can be large for more elastic materials such as rubber, of which tires are made. An experiment is designed to measure the difference in distance traversed compared to pure rolling for different materials and quantify the additional slip caused due to creepage. The experiment can be used to determine the micro slip caused in different applications by varying the cylinder radius, material, normal force and average velocity. Measurements were taken for steel and rubber cylinders on a steel plate. The creep ratio vs. normal force curve was found to be approximately linear indicating a direct relationship between creep ratio and elastic deformation. The results obtained can be used for accurately measuring distance traversed by only measuring rotations of the wheel for use in Automatically Guided Vehicles and Robotic rover applications.



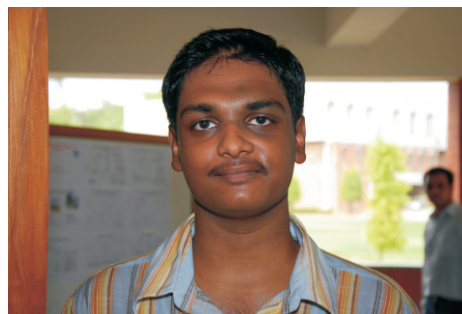
2009/IITK/17

Generalised Methods for Interpretation of CRS Testing

Runit Jhanwar, Civil Engineering, IITK

Mentor: Dr. Amit Prashan, Civil Engineering

This work presents a generalised methodology to correctly interpret various consolidation parameters such as permeability (k) and coefficient of volume compressibility (mv). Existing theories could not correctly interpret these parameters over the entire range of data. Thus, a generalised differential equation has been formulated for consolidation which takes into account the spatial and temporal variation of k and mv . This differential equation has been discretized using finite difference schemes. The inputs to this equation are the seed curves of e vs k and e vs mv obtained from the linear theory and the outputs are U_b and settlement (δ). The error between the experimental U_b and δ and the calculated ones have been optimized with respect to the input curves and thus finally modified plots of e vs k and e vs mv are obtained. These have been further used for the correct interpretation of the consolidation parameters.



2009/IITK/18

Comparative Study of Design & Plant - Wide Control for Two Alternate Process of Cumene manufacture

Sankalp Agarwal, Chemical Engineering, IITK

Mentor: Dr. Nitin Kaistha, Chemical Engineering

Comparative analysis of design operability and control of two alternative processes for cumene synthesis via irreversible gasphase alkylation of benzene with propylene ($A+B \rightarrow C$) is done. The first process is a Reactive Distillation column followed by separation column, second consists of a conventional Plug Flow Reactor (PFR) followed by a three separation. Initially, cost optimum process flow sheet is obtained by experimenting with various parameters of the module for the same input conditions. This design has been subject to exhaustive operability of plant wide control evaluation of their ability to handle a through put change, variations in the fresh feed composition and tightness of product quality control achieved. The former process combines reaction and separation into a single unit leading to process intensification. The comparative analysis shows the incentives of the reactive distillation process in terms of capital cost, operational cost and energy exchange incurred.



2009/IITK/19

Performance analysis of a Transmit Beamforming Scheme for the downlink MoSO Channel with Delay

Siddharth Chatterjee, Electrical Engineering, IITK

Mentor: Dr. Ajit K Chaturvedi, Electrical Engineering

Feedback delay can severely affect the performance of transmit beam forming (TB) and the analytical quantification of the performance degradation has attracted much research interest recently. In this project attempt has been made to study the effect of delayed feedback on the error rate performance of a new TB scheme over Rayleigh fading channels. Attempt has been made to derive the closed form expressions for the moment generating functions (MGF) and the probability density function (PDF) of the receiver output signal-to-noise ratio (SNR) including the effects of outdated feedback and further provide accurate analytical error rate expressions. The results are expected to provide new analytical insight into the loss caused by feedback delay for different system parameters and modulation formats.



2009/IITK/20

Plant Wide Control for Maximum Profit

Sonam Goenka, Chemical Engineering, IITK

Mentor: Dr. Nitin Kaistha, Chemical Engineering

For continuous chemical processes manufacturing bulk chemicals, maximizing the operating profit typically boils down to maximizing the process through-put. This requires operating the process as close as, or if possible, at the bottleneck constraint(s) that limits production. In this work the optimum operating condition for maximizing the profit of the plant is decided by varying the various parameters subject to constraints on various materials and energy streams using genetic algorithm. The module consists of the reaction $A + B \rightarrow C$, $B + C \rightarrow D$ occurring in a CSTR followed by two distillation column separating the product from the recycled unreacted reactants and undesired side product. The column vapor boil-up hitting a maximum and the liquid percent level of CSTR acts as the bottleneck constraint limiting the through-put. The application of Valve positioning Control (VPC) on top of a basic regulatory plant wide control structure for maximizing the process through-put to increase plant profitability is demonstrated. The input to the VPC controller is a measurement of the bottleneck constraint and the output is the through-put manipulator set-point in a cascade arrangement. Results shows that the automatic adjustment of the through-put manipulator allows process to operate close to bottleneck constraint. De-rating of the plant throughput due to possibility of disturbances is less resulting in enhanced throughputs and plant profits.



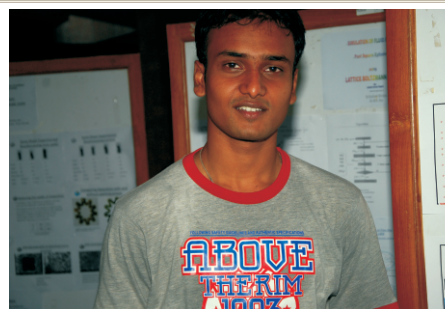
2009/NIT/IITK/21

Hydrodynamics of a Single Oscillating Meniscus in Square Capillary

Abhilash Kumar Sethi, Mechanical Engineering, NIT, Warangal

Mentor: Dr. Sameer Khandekar, Mechanical Engineering

Development in fabrication techniques has led to the miniaturization of the systems which has led to the development of mini and micro systems in heat and mass transfer. Reduction in size leads to higher species transfer due to increase in surface to volume ratio. Miniaturized systems involve single and multiple phase flow which has its applications in PHPs, lab on chip devices, fuels cells etc. Dominance of surface tension leads to the formation of Taylor bubbles in these systems. These flows are also subjected to oscillations and are not steady. Hence, understanding the hydrodynamics of these flows will help in increasing the efficiency of the systems. The present work aims at the study of interfacial contact line behavior of a single meniscus in a square mini channel of hydraulic diameter 2.0 mm. Water and silicon oil were used for experimentation. Eccentric cam follower



mechanism was used to provide sinusoidal oscillations to the fluid. A high speed CCD camera was used for taking pictures of the meniscus. Contact angle measurements were done for water at 0.25 Hz, 0.50 Hz, 0.75 Hz and 1.0 Hz and it was observed that the difference between the advancing and receding contact angle increases with increasing frequency. For silicon oil experiments were conducted at various frequencies and it is seen that the meniscus is pinned at the extreme end of the stroke and we get a film of silicon oil during oscillations. It is also observed that the thickness of the film formed increases with increase in oscillating frequency.

2009/NIT/IITK/22

Quantification of Positional Errors in Maps Derived from Remote Sensing Data

Abhishek Mishra, Civil Engineering, NIT, Warangal

Mentor: Dr. Onkar Dixit, Civil Engineering

Thematic maps are one of the most common entities of representing the spatial data. These maps are produced from remote sensing images through the process of digital image classification. There are two components of accuracy in context of thematic maps: positional accuracy and thematic accuracy. Traditionally, a parameter called RMSE is used to represent the positional accuracy of the remote sensing data but this does not give any idea about the distribution of positional errors over the image. The aim of this work is to develop a methodology to model the positional accuracy at the pixel level and also develop an application using MATLAB as a platform which will act as a tool for the quantification and easy understanding of these errors. The application uses kriging for interpolation of the residuals in X and Y coordinates and then these errors are simulated using Monte-Carlo simulations to produce multiple realizations. With the help of visualization tools, these multiple realizations are presented in various forms which help in easy understanding and realization of these errors. One can also plot the errorellipses at the control points to analyze the statistical uncertainty in the position of these Ground Control Points.



2009/NIT/IITK/23

Strengthening of Partially Damaged Moment Resisting RC Frame Using FRP

Amarendra, Civil Engineering, NIT, Allahabad

Mentor: Dr. D C Rai & Dr. K K Bajpai, Civil Engineering

RC concrete buildings are the most common type of construction all over the world. These buildings are subjected to damage during an earthquake especially near the end of the columns due to formation of plastic hinges attributed to high bending moments at these regions. Such columns of non-ductile gravity load designed RC buildings generally fail to provide the required seismic demand and suffer extensive damage leading to partial or complete collapse of the buildings. Hence, there arises a need to develop a simple and efficient retrofitting technique to enhance lateral strength, stiffness and ductility of these buildings. Fiber Reinforced polymers are very effective retrofitting materials owing to their superior properties such as low weight and high strength and easy applicability. In the present study, the effectiveness of a strengthening technique using epoxy mortar and GFRP fabric had been studied by means of various tests viz. measurement of stiffness by forced vibration test, load controlled slow cyclic test. Further the displacement controlled reverse cyclic tests were performed up to 4.5% drift level as per ACI recommendations. The test frame used in the present study was a partially damaged RC frame with a stiffness of 0.6 kN/mm. The stiffness after the strengthening was substantially high at 3.43 kN/mm and the hysteresis response of the strengthened RC frame under reverse cyclic loading up to 4.5% drift level was also compared with original frame.



2009/NIT/IITK/24

Study of a Company's Suitability For the Adoption of Cloud Computing and its Corresponding Return on Investment (ROI)

Arka Mondal, Production & Industrial Engineering, MNIT, Allahabad
Mentor: Dr. Subhas Misra, Industrial & Management Engineering

Internet has become all pervasive in our everyday lives and the newest offering as service over the ubiquitous web is cloud computing. Cloud computing has become a much hyped phenomenon in the IT and business world promising to deliver a host of benefits. There is no doubt about the infinite potential of Cloud Computing but it is still very much in its infancy with few takers owing to some of the challenges of its widespread adoption such as security, cost, etc. Companies need to look beyond the hype and think hard about the real value of incorporating the Cloud in their own businesses. This paper helps a company analyze several characteristics of its own business and pre-existing IT resources and identify their favorability in the migration to the Cloud Architecture. A general ROI model has also been developed taking into consideration various intangible impacts of cloud computing also away from the narrow cost factor only. Together they help give a much broader perspective and insight of Cloud Computing to its would-be adopters.



2009/NIT/IITK/25

Return of Investment (ROI) of Agile Software Development

R. Ateeth Datt, Industrial & Production Engineering, NIT, Jalandhar
Mentor: Dr. Subhas Misra, Industrial & Management Engineering

The importance of calculating the Return on Investment (ROI) is very well known and well-established. Agile software development is growing popular due to its many advantages over the traditional methods but calculation of ROI of Agile software development has always been a challenging task because the computation exact costs of benefits are difficult to compute. Calculation of ROI of Agile involves calculating the costs incurred, cash inflow and cost savings due to adoption of Agile. Moreover, the metrics used in traditional methods cannot be used to measure Agile. Exhaustive literature review and analysis of ROI models in diverse applications has lent a few ideas. The various factors in Agile that contribute to ROI are normally not known to many organizations. Also many benefits of Agile are intangible and hence to derive and quantify them is tough. This paper presents an easy-to-understand approach for organizations to calculate the ROI of Agile over any time period being sure that all factors that influence ROI computation have been taken into consideration.



2009/NIT/IITK/26

Study of Bubble Growth in Aqueous Laponite Suspension

Bikash Kumar Aggarwal, Mechanical Engineering, NIT, Surathkal
Mentor: Dr. Sameer Khandekar, Mechanical Engineering & Dr. Y M Joshi, Chemical Engineering

Laponite is a synthetic disc-shaped crystalline colloid that is widely used to modify rheological properties of liquids in applications such as cosmetics, paints, and inks so that understanding its flow properties and aging behavior is of considerable practical as well as fundamental importance. Chemical processes are often involved with air-liquid operations and particularly to understand heat transfer and mass transfer characteristic, understanding bubble dynamics is very important. The motion of single bubble rising in aqueous laponite suspension which is rheologically complex is a



pragmatically important topic but unfortunately has received little study. The bubble dynamics in aqueous laponite suspension is investigated experimentally with its aging behavior at different flow rates. The growth of four consecutive bubbles with time till its departure has been studied at different aging time of the suspension. Bubble merging at different flow rates and variation of eccentricities of bubbles were also studied at different flow rates. The significant results obtained from the study provide new insights in understanding bubble dynamics in aqueous laponite suspension.

2009/NIT/IITK/27

Seismic Analysis of Nailed Slope

Daya Shankar Choudhary, Civil Engineering, NIT, Silchar

Mentor: Dr. Amit Prashan, Civil Engineering

In this proposed method seismic analysis of reinforced slope is analyzed within the frame work of the pseudo-static approach, using kinematic theorem of limit analysis under seismic loading. Homogeneous cohesive soil deposit is considered, assuming circular failure plane with rotational failure mechanism. Based on this proposed method, by changing various soil parameters such as nail length, slope angle etc. factor has been calculated which yielded excellent results. A comparative analysis between different formulations is made. The result is compared using the proposed approach and factor of safety calculated by Geo5 shows good agreement.



2009/NIT/IITK/28

Return of Investment (ROI) Model for Grid Computing

Dheer Vora, Production Engineering, NIT, Tiruchirappalli

Mentor: Dr. Subhas Misra, Industrial & Management Engineering

Grid computing not only possesses tremendous ability to do complex tasks faster and more reliably but it is also known to cut down costs dramatically as well as increase profits. In academic and research areas, it has been successfully adopted but its adoption in the commercial sector has been hindered due to lack of knowledge and problems associated with the analysis of costs and benefits, resource allocation and pricing mechanisms. This work aims at helping various types of companies calculate their initial, recurring costs and benefits and hence return on investment (ROI) for grid computing by customizing the model it suggests according to their respective individual cases. This customization is needed because the initial and recurring costs of grid computing would be different for different types of companies, especially those which are already using HPC (high performance computing). It is concluded that because of the model's easy and satisfactory customization, companies would trust it. They would do it without a need to develop a deep insight into grid computing, which has not only proved time-consuming but also detrimental to its adoption.



2009/NIT/IITK/29

Optimization of Magnetic Abrasive Finishing Process for Nanofinish

G. Vengatesan, Mechanical Engineering, NIT, Tiruchirappalli

Mentor: Dr. J Ramkumar, Mechanical Engineering

Ultra High Speed Gas Bearings are used to support shafts rotating at ultra high speeds, sometimes in excess of 100,000 RPM. Ultra high speed gas bearing-shaft combinations are used in turboexpanders having industrial significance. The turbo expanders are used for cooling and obtaining cryogenic temperatures usually in a Helium environment. Fatigue strength and corrosion resistance should be very high for these shafts and the bearings are expected to have good durability. To avoid fatigue



failure, it is necessary that the shafts should have minimum or no micro-cracks on their surfaces. Conventional methods of machining cannot finish shafts to an extremely high level of surface finish and development of micro-cracks is inevitable. The bearings are subject to considerable amount of wear due to friction. In order to reduce the friction at the shaft-bearing interface, the shaft and bearing surfaces should be extremely smooth. Magnetic Abrasive Finishing (MAF) is one of the finishing techniques that can be successfully employed to obtain a fine surface finish in the order of nanometers. The parameters in the MAF process which highly influence the resulting surface finish are studied using one factor at one time (OFAT) experimentation. The current, machining time and to an extent the rotational speed of the workpiece, significantly influence the final surface finish. Also the working range of each parameter is found out from OFAT. The response surface model for improvement in surface finish generated by ANOVA from the experimentation results using the central composite rotatable design of experiments. For optimizing the model, different types of population based meta-heuristic optimization techniques such as genetic algorithm (GA), particle swarm optimization (PSO) and the recently developed breeding swarm optimization (BSO) techniques are studied and the best combination of controlling parameters of the algorithms is chosen from literatures and experimentation. These functions are also tested with several benchmark test problems. Finally optimization of the response surface model for improvement in surface finish is done. Optimization of MAF process leads to high standards of surface finish. The optimized value of parameters the model will help the MAF process to finish surfaces with roughness in the order of nanometers.

2009/NIT/IITK/30

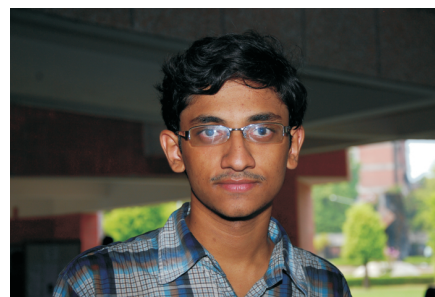
Simulation of Growth of Heteroepitaxial Thin Films using Finite Element Method (FEM)

Gopalakrishnan R, Materials and Metallurgical Engineering, NIT, Nagpur

Mentor: Dr. Anandh Subramaniam, Materials and Metallurgical Engineering

An interfacial dislocation is nucleated in strained layer thin film systems (at critical thickness), 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 GeSi_{1-x} film 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 nucleation of an array of dislocations was found to be favorable at film thickness greater than critical thickness. Simulations are performed and the stress state is studied. The results are compared with published experimental and theoretical data.



2009/NIT/IITK/31

Synthesis of Silver Nanoparticle and its Deposition on Water Soluble Carbon Nanotube

Harinder Singh, Chemistry, NIT, Jalandhar

Mentor: Dr. Sabyasachi Sarkar, Chemistry

This report contains the synthesis of Silver Nanoparticle from Silver Nitrate which is a precursor for Silver nanoparticle. There are many methods to synthesize silver nano which involved the use of surfactant, organic moiety, and use of higher (~300 oC) as well as lower temperature (-20 oC) and need at least 20 hours. First time, we have synthesized the Silver nanoparticle with simple reduction by an amine which gives a uniform Silver nano of size (~2 to 4 nm). In this process no chemical is used except



amine and distilled water so it is eco-friendly and nanoparticle can be synthesized within 30 minutes. We have also decorated the water soluble carbon nanotubes with silver nanoparticles.

2009/NIT/IITK/32

Purification of N,N-Dimethylformamidase from *Paracoccus* sp. DMF

Jasjeet Kaur, Chemistry, NIT, Jalandhar

Mentor: Dr. R. Gurunath, Chemistry

N,N-dimethylformamide is a synthetic organic solvent produced in large quantities throughout the world. It is extensively used in the chemical industries as a solvent, intermediate and as an additive in the manufacture of wide variety of chemicals due to which it is present in the industrial effluents. Because of its toxic effects on humans and other organisms, there is a need to remove it from the source of contamination. Biodegradation is one of the methods to remove it from the environment. The degradation pathway of DMF includes several enzymes. DMFase is the first enzyme of the pathway. In the present study, an attempt has been made to purify DMFase enzyme from the *Paracoccus* strain DMF which was isolated earlier and could use DMF as the source of carbon and nitrogen.



2009/NIT/IITK/33

Intrusion Detection in Presence of Continuous and Highly Varying Projector Illumination

Karuna Phuyal, Electronic & Communication Engineering, SVNIT, Surat

Mentor: Dr. K S Venkatesh, Electrical Engineering

Due to the extensive proliferation of low cost cameras in the market over the last few years, the automation of many tasks that require visual sensing or intervention has received a big boost. Recent research in projector-camera systems overcame many obstacles to deploying and using intelligent displays for a wide range of applications. Significant progress has been made in projected displays that utilize a camera to monitor projected imagery as well as the surface into which it is being projected. In parallel with these developments, projector costs continue to decline with corresponding increase in resolution, brightness and contrast ratio. Blending of projected imagery with underlying surface characteristics has offered unique and profound capabilities. The detection of events that differ from what is considered normal is, arguably, the most important task for camera-based surveillance. In the case of intrusion monitoring, simple motion detection may be sufficient, such as based on color modeling. Variations in lighting conditions and camera hardware settings complicate the intrusion detection problem. It is often necessary to cope with the phenomenon of illumination variations as it can falsely trigger the change detection module that detects intrusions. The information of each band of the RGB color space of the video sequences produces a pixel wise change detection algorithm in the observed input frame with response to a recursively updating background.



2009/NIT/IITK/34

Simulation of Coherent and Semicoherent Precipitate using Finite Element Method

Nandani Rai, Material Science and Metallurgical Engineering, MANIT, Bhopal

Mentor: Dr. Anandh Subramaniam, Materials and Metallurgical Engineering

A coherent precipitate may change to semi coherent by nucleation of dislocation (at critical thickness). In this analysis the stress state of precipitate is simulated using Finite Element Method (FEM) by feeding-in the appropriate stress-free strain (Eshel by strains) corresponding to the mismatch between the precipitate phase and parent phase. The strains are imposed in the numerical model using standard



commercially available software. A plate shape for θ' precipitate in Al-4%Cu is taken and energy is determined for different size values. The total energy (adding interfacial energy) is plotted as a function of the size of the precipitate. Similar plot is taken for the precipitate with dislocation and critical thickness is determined. Critical thickness for precipitate of size 810Å in diameter is 35.4Å.

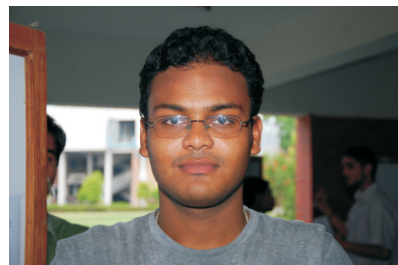
2009/NIT/IITK/35

Fluid Flow and Heat Transfer analysis of Gas Flowing through a Micro-channel using Computational Fluid dynamics

Niladri Bhusan Jena, Mechanical Engineering, NIT, Hamirpur

Mentor: Dr. A K Saha & Dr. P K Panigrahi, Mechanical Engineering

Here in this report I investigate numerically the constant wall temperature convective heat transfer characteristics of a model gaseous flow in a micro-channel under hydro dynamically and thermally fully developed situation. The channel is considered to be 2 dimensional horizontal and infinitely long. The time-dependent, Navier-stokes, energy and continuity equations are solved for slip flow regimes ($0 \leq Kn \leq 0.1$) for a range of Knudsen numbers. Finite Volume Method on uniform grid is used for computation of the flow. The flow regime, the flow characteristics and heat transfer characteristics for the configurations considered is presented. The flow is considered to be incompressible and laminar. The effects of Knudsen number on fully developed velocity profiles, streamlines and transverse velocity contours, temperature and pressure contours have been studied. I also show that the Nusselt number decreases monotonically with increase of Knudsen number in fully accommodating case. Poiseuille number, the product of friction factor and Reynolds number (fRe) is also obtained numerically.



2009/NIT/IITK/36

Spark Plasma Sintering of Functionally Graded Hap-Al₂O₃-3YSZ

Pallavi Kesarwani, Materials and Metallurgical Engineering, VNIT, Nagpur

Mentor: Dr. Kantesh Balani, Materials and Metallurgical Engineering

Functionally Gradient Material (FGM) is a novel concept to implement functions that cannot be achieved by conventional homogeneous materials. The present work aims at the synthesis of a HAp-Al₂O₃-3YSZ functionally graded material for enhanced fracture toughness of bio-composite via Spark Plasma Sintering (SPS). The Al₂O₃ layer is incorporated to reduce the gradation in the properties between HAp and 3YSZ and hence improve its overall performance. SPS enables sintering at lower temperatures and time which is a necessity in cases where different materials are to be sintered together. A HAp-Al₂O₃-3YSZ FGM with 96% theoretical density was prepared by the SPS technique. The fracture toughness of the FGM is calculated by Vicker Indentation Technique and compared with the individual constituents. The sintered pellets are characterized using various characterization tools such as SEM, XRD, EDX and TEM. A dense outer layer of HAp was obtained in contrast to the porous HAp layer which is required to facilitate tissue ingrowth.



2009/NIT/IITK/37

Purification of N,N-Dimethylformamidase from Paracoccus sp. DMF

Pooja Sharma, Chemistry, NIT, Jalandhar

Mentor: Dr. R. Gurunath, Chemistry

N,N-dimethylformamide is a synthetic organic solvent produced in large quantities throughout the world. It is extensively used in the chemical industries as a solvent, intermediate and as an additive in the manufacture of



wide variety of chemicals due to which it is present in the industrial effluents. Because of its toxic effects on humans and other organisms, there is a need to remove it from the source of contamination. Biodegradation is one of the methods to remove it from the environment. The degradation pathway of DMF includes several enzymes. DMFase is the first enzyme of the pathway. In the present study, an attempt has been made to purify DMFase enzyme from the *Paracoccus* strain DMF which was isolated earlier and could use DMF as the source of carbon and nitrogen.

2009/NIT/IITK/38

Numerical Simulation of 3D Synthetic Jet

Pradeepta Kumar Panda, Mechanical Engineering, NIT, Tiruchirappalli

Mentor: Dr. A K Saha & Dr. P K Panigrahi, Mechanical Engineering

In this work, a 3D numerical simulation of circular synthetic jets issued into a quiescent external medium is under taken in a complementary manner with the aim of achieving an improved visualization of the flow field within the actuator cavity as well as exterior to it. The simulation is carried out in Fluent with three different orifice diameters, by giving unsteady sinusoidal velocity profile at the inlet of cavity actuator. Large Eddy Simulation has been implemented as the turbulence modeling for flow analysis on the unstructured grid developed by using ICEM. The details of computational procedure are summarized and the accuracy of numerical results is assessed through the comparison with experimental results. For the three cases three distinct flow patterns are obtained with different size and shape of vortex. For flow visualization, the contours of vorticity magnitude are clearly presented. The variation of jet velocity and pressure along the centerline of synthetic jet are graphically reported both in axial and radial direction. From the following study it can be observed that, by increasing the orifice diameter both the stroke length (L) and Reynolds number decreases. Simultaneously the flow inside the actuator tends to become laminar from turbulent.



2009/NIT/IITK/39

Evaluation of Liquefaction Potential of Ganga and Ennore sand using Vibration Table test and Fly Ash using Dynamic Triaxial Test

Prayakarrao Sukanya, Civil Engineering, NIT, Warangal

Mentor: Dr. Nihar Ranjan Patra, Civil Engineering

It is widely recognized that earthquakes are among the most severe natural disasters causing significant damages such as failure of earth structure, settlement or tipping of buildings, lateral spreading of loosing ground and densification causing vertical settlements. The reasons for these failures can be attributed either due to the compaction of loose deposits of soils or by a phenomenon called liquefaction. The phenomenon of liquefaction is associated with a condition of zero effective stress due to progressive increase in pore water pressure resulting from the tendency to densification of the sand structure subjected to cyclic loading. The generation of excess pore pressure under undrained loading condition is a hallmark of all liquefaction phenomena. Sand is very economical and workable material to use in the earth structures. But also, it has the defect to be liquefiable under the loading. Liquefaction damage triggered by earthquakes caught the sight of scientific community and several criteria were devised to ascertain the liquefaction potential of cohesion less soil beds. Soil liquefaction describes the behavior of soil that when loaded, suddenly go from a solid to liquefied state or having the consistency of heavy liquid with effective stress reduced to zero. During this project work, evaluation of liquefaction resistance of Ennore and Ganga sands with different saturation conditions is studied. In this paper, the impact of presence of nonplastic silt in a granular mix soil its liquefaction potential is presented. This paper also presents the results of the laboratory tests conducted on the sample of fly ash for the purpose of defining the characteristics of the Cyclic Shear Stress Ratio. Change in pore water pressure for different CSR values is observed. Simultaneously, the process of occurrence and development of liquefaction was investigated.



2009/NIT/IITK/40

Electrostatic Spraying of Biocompatible low Density Polythene (LDPE) - Ultra High Molecular Weight Polythene(UHMWPE)- Al₂O₃- Hydroxypatite (HA)- Carbon Nanotube(CNT) Nanocomposites

Ram Krishna Mishra, Materials and Metallurgical Engineering, NIT, Warangal

Mentor: Dr. Kantesh Balani, Materials and Metallurgical Engineering

In these days, practically all powder coatings are applied using an electrostatic spraying process. Our area of interest is to do polymer coating on the Ti alloy substrate which is going to be used as an implant for the bones and hip joints. For this, we have chosen LDPE and UHMWPE as the matrix polymers and added biocompatible HA and alumina to increase the strength and stiffness of the coating. Later on we reinforced the matrix with CNT which further increased the strength and wear resistance of the coating. Despite being corrosion resistive and hard Ti needs a coating because it produces toxic ions in the body which prove to be harmful. Our purpose is to produce strong corrosion and wear resistive coatings that allow cell culture growth. Bioactive coating on composite implants facilitates biological fixation between the prosthesis and the hard tissue, and increase the long-term stability and integrity of the implants. It produces an intermediate region between bone and implant, and enhances the transition of stress between them. The coated materials were characterized by X-ray diffraction, Scanning electron microscopy, wear test, Vickers hardness test. Bacterial culture study of the coatings showed excellent cell growth properties.



2009/NIT/IITK/41

Theoretical Modelling of Magnetic Abrasive Finishing Process

Girish Krishna. S, Mechanical Engineering, NIT, Tiruchirappalli

Mentor: Dr. Ram Kumar. J, Mechanical Engineering

Magnetic Abrasive Finishing (MAF) is a finishing process which can be employed to obtain high surface finish on work piece of complex shape. MAF also minimizes the formation of micro-cracks on the work piece surface which is essential for practical applications of the work piece where fatigue failure is minimized. In this process, a magnetic field is applied across the machining gap (between magnet and the work piece) filled with unbounded magnetic abrasive powder (UMAP), i.e. a homogeneous mixture of abrasives and ferromagnetic iron particles. The ferromagnetic particles get aligned along the magnetic lines of force and form a flexible magnetic abrasive brush (FMAB). This FMAB originate micro indentations into the work piece surface. The brush is flexible in nature and it is able to access the surface where the conventional tools are hardly applicable in practical use. In order to evaluate the forces involved in the MAF process, for better understanding of the process mechanics, it is necessary to model the brush formation and model the structure using unit cell concept. From the unit cell model, the magnetic forces and the depth of indentation of the abrasive particle was obtained. Further, using this data, the surface profile of the work piece was simulated postfinishing. The simulated model was in agreement with the experimental value with a minor error.



2009/NIT/IITK/42

Development of Computer- Vision Techniques to Recognize Finger Gestures

Shiva Nigam, Electronic & Communication Engineering, MNIT, Allahabad

Mentor: Dr. Venkatesh K Subramaniam, Electrical Engineering

The sign language recognition has emerged as one of the best areas of research in the field of human computer interaction. The aim of sign language recognition is to transcribe the sign language into text or speech. The aim of this project is to propose a video based approach to recognize gestures in which we rely on the skin segmentation to obtain the skeletal images for every frame of the video. Firstly, we detect skin and non-skin regions in every frame. We use the



concept of adaptive thresholding where we define an optimum threshold value of the intensity above which the pixels are declared as to constitute skin. From binary images obtained, we remove Salt and Pepper noise to prepare blob of the fingers. Then, we do finger tip detection and tracking. We determine the finger tips by detecting edges in the images using the contour detecting techniques as proposed by Canny. Then we track the finger tips to detect their motion that is the movement of finger tips by determining the curvature of the detected skin region in every frame. Next, we plot the graph of curvature versus of number of pixels for every frame of the video and by plotting the trajectory of highest curvature tip in every consecutive plot, we declare the type of movement and classify the gesture accordingly. Presently, we are working on the development of vision techniques for 19 elementary gestures.

2009/NIT/IITK/43

Recovery of Fertilizers and Usable Water from the Flush Solution of Zero Discharge Toilet System Developed at IIT Kanpur

Shruthi D Prabhu, Civil Engineering, NIT, Surathkal

Mentor: Dr. Vinod Tare, Civil Engineering

Zero discharge toilets are eco friendly toilet systems which do not convey any waste to the water bodies and the nutrients present in the human waste are recovered. Recycled water is used for flushing thus contributing to the conservation of water. Flush solution is the liquid used for flushing the waste. This contains urine, fresh water, dye, microbial culture and liquid filtered by the Membrane during Solid Liquid separation through Special type of Separator. The excess flush solution is sent to the solar evaporation tank for concentration. This project aimed at recovering the fertilizer nutrient from the flush solution which is mainly due to the presence of urine and also to obtain usable water as by product. A pilot scale evaporator was developed at EEM lab, IITK for the evaporation of flush solution and it was possible to get water and fertilizer. Various tests were performed on the water and it is shown that acceptable quality of water can be obtained by activated charcoal filtration of the condensate obtained by the evaporation of flush solution. The evaporator was run under different operational conditions and optimum working condition was observed. Due to the by-products namely usable water and fertilizer, this type of evaporator is economical and since no waste water is let into sewers, it solves the problem of water body pollution. In Indian Railways where Zero Discharge Toilet system has been introduced, such evaporator can be set up at suitable plant to produce usable water and fertilizer on a large scale.



2009/NIT/IITK/44

Corrosion Study of Advanced Iron- Rare Earth based Magnetic Materials in Simulated Human Body Condition

Siddhartha Gupta, Materials and Metallurgical Engineering, NIT, Tiruchirappalli

Mentor: Dr. R. Balasubramaniam & Dr. K Balani, Materials and Metallurgical Engineering

Rare earth magnetic materials find extensive use in several commercial and bioimplants like pacemaker. The rare earth based alloys and compounds are electrochemically very active in nature and so, inherently prone to corrosion. Terfenol-D ($\text{Tb}_{0.3} \text{Dy}_{0.7} \text{Fe}_{1.92}$) is a recently developed (Tb,Dy) Fe_2 magnetostrictive single crystalline compound. This work focuses on the corrosion aspects of Tb-Dy-Fe alloy systems in human body environment. The Structural characterization was conducted using X-ray diffraction, optical and electron microscopy based techniques. General corrosion behavior of $\text{Tb}_{0.3} \text{Dy}_{0.7} \text{Fe}_{1.92}$ (as cast) was studied in c-SBF in deaerated condition. The different electrochemical techniques used in this study include measurement of free corrosion potential, linear polarization and Tafel polarization. Analysis of the corrosion products revealed that the corrosion products were primarily rich in rare earth elements. A possible corrosion mechanism is also suggested by performing immersion test on the sample for different time durations and then studying structure of the corrosion products formed through Scanning Electron Microscopy (SEM) and performing Energy Dispersive analysis of X-Rays (EDX).



2009/NIT/IITK/45

Simulation of Growth of Niobium Film on Sapphire Substrate and Determination of its Critical Thickness using Finite Element Method

Sriram P R, Materials and Metallurgical Engineering, NIT, Tiruchirappalli

Mentor: Dr. Anandh Subramaniam, Materials and Metallurgical Engineering

A niobium (Nb) film when grown on a sapphire substrate is coherent initially, but becomes semi coherent by the nucleation of dislocation (at critical thickness). The stress states of film 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 film 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 Nb/sapphire system (as shown in fig.1). The critical thickness was determined to be 70.5Å which is in close accordance with the theoretical value of 72 Å as obtained from the Matthews and Blakeslee formula.



2009/NIT/IITK/46

Synthesis of Gold Nanoparticle and its Deposition on Water soluble Carbon Nanotube

Varinder Singh, Chemistry, NIT, Jalandhar

Mentor: Dr. Sabyasachi Sarkar, Chemistry

This report contains the synthesis of Gold Nanoparticle from Auric chloride trihydrate ($\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$) which is a precursor for gold nanoparticle. There are many methods to synthesize gold nano which involved the use of surfactant, organic moiety, and use of higher ($\sim 300^\circ\text{C}$) as well as lower temperature (-20°C) and need at least 24 hours. First time, we have synthesized the Gold nanoparticle with simple reduction by an amine which gives a uniform gold nano of size ($\sim 14\text{-}17\text{ nm}$). In this process no chemical is used except amine and distilled water so it is eco-friendly and nanoparticle can be synthesized within 45 minutes. We have also decorate the water soluble carbon nanotubes with gold nanoparticles.



2009/NIT/IITK/47

The Characterisation of a Relative Humidity Sensor

Vishwanath Karthik M, Chemical Engineering, NIT, Warangal

Mentor: Dr. Siddhartha Panda, Chemical Engineering

Humidity sensing is of paramount importance in many everyday applications. In recent days conducting polymers have been identified as suitable candidates of application as humidity sensing elements. The main advantages with polymers as sensing materials are their simple synthesis, flexibility, light weight, easy processibility and importantly that they can be used at room temperature wherein the inorganic sensors normally operate at elevated temperatures. The field of conducting polymers has been largely dominated by the search for higher conductivities, better stability and greater processibility. The different techniques to confine and measure humidity in a chamber have been studied and experimented initially. The most feasible and least erroneous method has been adopted to produce desired humidity and the humidity chamber was fabricated. Polyaniline sensor films have been taken, calibrated and characterized under various conditions for use as a practical humidity sensor.



2009/RU/IITK/48

A Study of Turbulent Flow Past the NACA0012 Airfoil

Matthew Sorenson, Mechanical Engineering, Rice University, Texas, US

Mentor: Dr. Sanjay Mittal, Aerospace Engineering



The present research is concerned with the 2-D simulations of turbulent flow using the Spalart-Allmaras turbulence model over the NACA0012 airfoil. The incompressible Reynolds-Averaged Navier-Stokes (RANS) equations are solved using stabilized finite element formulations. The finite element mesh consists of a fine structured mesh near to the surface of the airfoil, and an unstructured mesh, generated via Delaunay's triangulation, in the rest of the domain. The ability of this type of grid was assumed to handle fairly complex geometries while still providing the desired resolution close to the body, effectively capturing the boundary layer and shear layer especially in the context of unsteady flows. This assumption is studied following variant results from experimental data. The flow phenomenon over the NACA0012 airfoil at a Reynolds number of 2,000,000, and the calculated aerodynamic coefficients, are compared to experimental data collected from the Sandia National Laboratories, Albuquerque, New Mexico. Analysis of the flow field, specifically the velocity and pressure magnitudes, as well as the eddy viscosity, is conducted. These aspects of the flow field build a good model of the behavior of the flow past the airfoil, and allow for easy graphical representation.

2009/RU/IITK/49

Automated Parallelization of the Blas Library

Maxwell Grossman, Computer Science & Engineering, Rice University, Texas, US

Mentor: Dr. Sanjeev K. Aggarwal, Computer Science & Engineering



At the time of their invention, Graphics Processing Units (GPUs) were entirely dedicated to performing graphics operations in order to calculate the red, blue, and green values of each pixel on the screen of a computer monitor. However, as their processing power has developed, there has been increased interest in their suitability for general purpose calculations. Because of this, numerous companies have introduced graphical programming languages that facilitate the manipulation of General Purpose Graphics Processing Units (GPGPUs), such as NVIDIA's Compute Unified Device Architecture (CUDA) programming language. Despite the obvious performance advantages in scientific fields of parallel programming and ability to easily program GPUs using CUDA, there still remains a conceptual barrier to the switch from serial programming. The easiest way to facilitate this switch is the development of automated parallelization programs that can, without supervision, translate source code from serial languages to languages that support parallelization, while maintaining the function of the application. Therefore, it is the goal of this research to build a tool that will automatically translate serial Fortran files into C source files with calls to the CUDA API, producing potential performance increases due to the use of the GPGPU, using the BLAS library as an initial domain for testing. I will demonstrate the successful translation of a Fortran source file into a C source file with CUDA calls, as well as the performance advantages of CUDA over Fortran, but also demonstrate that much work remains to be done on program analysis if automatically generated CUDA code is to perform optimally.

2009/ECP/IITK/50

Prospects in Graphene Research

Cedric Codet, Fundamental Physics, Ecole Centrale Paris, France

Mentor: Dr. R C Budhani, Physics



The study of graphene, basically described as a plain sheet of Carbon atoms, is now a mainstream among solid state physicists but it exhibits so many amazing effects that few are those who can claim to know all of them. This is the result of a hectic pace of discoveries in this field which may be explained by the fact that this material had been widely explored theoretically before it was even proved to exist. This report should be

used as a roadmap of experiences to carry out on graphene in order to confront theory and available measures.

2009/ECP/IITK/51

Image Navigation System Based on Terrain Reconstruction for Moon Rover

Marcos Grappeggia, Electrical Engineering, Ecole Centrale Paris, France

Mentor: Dr. Venkatesh K Subramaniam, Electrical Engineering

The 3D object reconstruction is a tool very useful for the image navigation system of mobile robots. In this work, we developed the 3D object reconstruction process using laser based techniques for the Moon Rover project. These techniques allows us to realize real-world measurements and also to create an internal 3-dimensional map of the nearby surroundings of the robot in its memory, allowing so an easy navigation even in unstructured terrains. All the steps involved were developed thinking in the evident need of a capacity of real-time processing of the visual data received in order to enable a realtime reaction of the Moon Rover, for a better interaction with its environment. The reconstruction method adopted here utilized the concept of a rotatory platform with a camera which would sweep all the area surrounding in regular steps, and for each different angle step the terrain reconstruction is based in the deformations of a single line coming from a laser beam directed to the ground, such that the composition of all the lines in different angle gives to our robot an approximate reconstruction of the terrain. For the camera calibration we've used chess-like patterns in horizontal and laser plane orientations, such that a transformation matrix would be obtained from the point in the images taken to the real coordinates of these points. The use of a transformation matrix reduces our processing time during the analysis of multiple points, and so is the best adapted for real-time systems, like the Lunar Rover.



2009/ECP/IITK/52

Experimental Studies On Bluff-Body Stabilized Diffusion Flames

Marek Mazur, Mechanical Engineering, Ecole Centrale Paris, France

Mentor: Dr. D P Mishra, Aerospace Engineering

An experimental investigation on the lift-off and flame length of coaxial LPG diffusion flame is carried out to understand the effect of bluff body on flame stabilization. It is observed that the lift-off height gets reduced with the use of bluff body. However, the flame height with and without bluff body remained the same for the range of fuel and air velocity examined. In addition, a flow visualization system is developed to observe the recirculation zone formed by the bluff body. This visualization clearly indicates the presence of counter rotating vortices formed at the wake of the bluff body, which helps in stabilizing the flame particularly for bluff body case.



Abstracts: 2009 SURGE Research Projects Done in Overseas Universities

2009/IITK/Caltech/1

Using sum of small-bias distributions to fool degree d polynomials over F_2

Abhishek Bhowmick, Computer Science & Engineering, IIT Kanpur

Mentor: Prof. Cris Umans, Computer Science

We introduce a new formal complexity measure called the rank- degree for polynomials over F_2 . We show that it is rank-degree that denotes the power of a polynomial rather than the degree as far as distinguishing pseudorandom distributions is concerned. We construct a pseudorandom generator against rank r and degree d polynomials with seed length $O(\log n + rd \log rd)$ which gives far better results for constant degree and constant rank as well as logarithmic degree and constant rank than current pseudorandom constructions.



2009/IITK/Caltech/2

Synchronization of Oscillators with Power Law Long-range Interactions

Debanjan Choudhary, Physics, IIT Kanpur

Mentor: Dr. Michael C. Cross, Physics

In this project, we carried out analytical calculations for the synchronization of oscillators interacting via long range power law interaction on a one dimensional lattice. We identified the value of the power law exponent, α_c , across which a transition from a synchronized to an unsynchronized state takes place for a sufficiently strong but finite coupling strength. We found $\alpha_c = 3/2$ for a thermodynamically large system. In the infinitely large one dimensional system, there are three main regions of interest: $\alpha \leq 1$ corresponds to the regime of complete phase and frequency locking even for a finite coupling strength. $1 < \alpha < 3/2$ is the region of partial synchronization, where the system starts breaking up into frequency clusters. Finally, for $\alpha = 3/2$, it is impossible to synchronize a macroscopic fraction of the oscillators unless the coupling strength is infinitely large. The calculations are performed using the spin-wave approximation and are supported using other scaling and coarse graining approaches. The analytical results are in good agreement with the numerical results that have been performed for large system sizes. Finally, we have generalized the spin-wave results to the d -dimensional problem.



2009/IITK/Caltech/3

Molecular Characterization of the Development of Branchial Arches in Vertebrates

Vikas Trivedi, Biological Sciences and Bio Engineering, IITK

Mentor: Dr. Marianne Bronner Fraser, Biology

Co-Mentor: Dr. Ankur Saxena

The development of vertebrate embryo involves multiple signalling cascades that participate in a series of orchestrated gene regulatory networks to help in its formation. The detection of novel participants benefits from an unbiased screen for new proteins. A large-scale flip trap screen in zebrafish (*Danio rerio*) has been designed to find new, developmentally-relevant proteins of interest using a Cre/loxP-based fluorescent reporter system. This allows monitoring of spatiotemporal expression and subcellular protein localization in vivo and non-invasively. Using this approach several lines have been produced which show expression in the branchial arches and are currently being studied. Branchial (pharyngeal) arches are outpocketings of the head and neck region into which the cranial neural crest cells migrate. The pharyngeal pouches form between these arches and become the thyroid, parathyroid and thymus. The work discussed here focuses on the preliminary characterization of two isolated flip trap fusion proteins termed FT 59a and FT 74a which show expression in the branchial arches and the hind brain region. 3'



RACE revealed them to be a novel transcript mapping to the HoxB genomic region. Protein expression, including the time of first detection, was tracked temporally using time-lapse imaging and dissected in further detail by comparing Flip-Trap RNA and protein expression. Thus Flip Traps prove to be efficient means for creating functional fusion proteins to study various aspects of development in the organism.

2009/IITK/ECP/1

Accounting of Dampinf Induced by Sediments in Seismic Arch Dam Reservoir Analysis

Dipanshu Bansal, Civil Engineering, IITK

Mentor: Dr. Didier Clouteau & Dr. Regis Cottureau, Civil Engineer

The boundary element method has been successfully applied in the past to the analysis of hydrodynamic forces in two- and three-dimensional finite water reservoirs subjected to seismic ground motions. In extending the method to an infinite reservoir, the loss of energy due to pressure waves moving away towards infinity must be taken into account. The water is assumed to be incompressible. In this paper the seismic analysis of arch dam has been discussed using the boundary element method for fluid structure interaction. The modeling and analysis is done using Comsol and interaction is computed using MISS. The response of an arch dam to harmonic P- or S-waves propagating vertically and horizontally is studied for full-reservoir conditions. The results on mode of vibration of Dam are discussed along with discussion on how increasing the frequencies of Dam affect the eigenvalues of dam plus reservoir system.



2009/IITK/ECP/2

Parametric Identification of Individual Variability in Plant Population models

Nitish Srivastava, Computer Science & Engineering, IITK

Mentor: Dr. Paul Henry Cournede, Systems and Applied Mathematics

We studied propagation of uncertainty in parameters of the GreenLab plant growth model and applied various techniques of estimation of Discrete Dynamic Systems to estimate the growth parameters required to model a plant population. Modeling heterogeneity in field crops is a key issue for a better characterization of field production. We choose a biologically plausible parameterized growth model for plants. The model is extended to plant populations. Several sources of individual variability in plant populations are identified, namely, initial conditions (seed mass, emergence delay), genetic variability (including phyllochron) and environment (including spacing and competition). A mathematical framework is introduced to integrate the various sources of variability in plant growth models. It is based on the method of Taylor Series Expansion, which allows the propagation of uncertainty in the dynamic system of growth and the computation of the approximate means and standard deviations of the model outputs. Parameter Estimation in models of a dynamic system generally involves adopting a probabilistic framework for model equations by taking into account process and measurement errors. When system observations are regular, very efficient methods based on Kalman filtering have been devised, eg. extended Kalman filters in Ljung(1979) or recursive least squares in Ljung and Söderström(1983). However some systems, such as living systems, do not allow regular data acquisition as measurements are too complex. For functional growth models, the system output is multivariate and generally corresponds to the masses of some elementary units of the plant. Measurements are thus destructive and can be done only once for a given plant. We attempt to give a method that relies on less data by including potential sources of strong variability across a plant population such as phyllochron and then using multi-fitting to fit the model at different stages of plant growth.



2009/IITK/ECP/3

Development of new generation combustors for aerospace application

Shakti Saurabh, Aerospace Engineering, IITK

Mentor: Dr. Sebastien Ducruix, Aerospace Engineering



The ever-increasing concern for reduction of pollutant emissions of industrial heating device, power generation systems or aeronautical engines has prompted the engineers and researchers all over the world to work on the development of new generation combustors working with lean premixed swirl stabilized flame. Keeping all these into consideration the main task that has to be performed so as to comply to the demand of an efficient combustor-injector development is to simultaneously undertake experimental diagnostics and theoretical simulations of the combustor and finally compare the results from the two streams. This process can go on until we converge to a desired level of efficiency of the combustor-injector assembly we have. So this task can be broken into two main steps in the present study: First is the measurements and post-processing on the new facility dedicated to GT injector testing using two types of diagnostics: backlighting and Phase Doppler Particle Anemometry. Second is dedicated to CFD simulations of this injector, i.e. to create the burner geometry, using any CAD software, mesh it and run cold flow (and maybe reactive) simulations using a CFD software.

2009/IITK/EP/1

Silicon Nanowires

Sushobhan Nayak, Electrical Engineering, IITK

Mentor: Dr. Pere Roca I Cabarrocas, LPICM



We wanted to explore the effect of vertical PIN SiNW(Si nanowires) development on degradation of solar cell. And if possible, to exploit it to our advantage by creating more efficient solar cells enhanced by perfect vertical PIN nanowires. We used different conducting substrates in a typical PIN layered amorphous Si(a-Si) solar cells; but before deposition of a-Si, the substrate was treated with plasma to create catalyst droplets that would further the growth of SiNW during deposition or alternatively, during annealing afterwards. The idea was that by suitably changing the condition of various processes involved, we could either produce perfect vertical PIN SiNW, which will act as diodes parallel to the original PIN layered cell, or else, the imperfect wire will short the device thereby degrading it. Though there were substantial developments, we were not able to get vertical SiNW and research on the topic is still underway.

3. Feedback of Mentors and Students of 2009 SURGE Programme

3.1 Mentor Feedback

The statistics of the responses to the quantitative questions of the Mentor Feedback form are given in Table 3.

Table 3: Quantitative Responses in Mentor Feedback for SURGE 2009 Programme

#	Question	Average score
Student		2009
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)	3.25
5	Did the student work when you expected him/her to? (1: Never; 5: Always)	4.33
6	Did the student observe guidelines you set forth? (1: Never; 5: Always)	4.54
7	Did the student work well with your research group? (1: No; 5: Yes)	3.89
8	Did the student participate in department seminars or discussion groups? (1: No; 5: Yes)	3.22
9	How well suited was the student for the research in terms of: (1: Low; 3: Medium; 5: High)	
	(a) Enthusiasm for the work	4.23
	(b) Preparatory Coursework	3.36
	(c) Skills or abilities, etc.	3.68
	(d) Background knowledge	3.15
10	Would you recommend this student for the SURGE 2008 Program? (1: No; 5: Yes)	4.01
11	Would you like to work with this student again? (1: No; 5: Yes)	4.20
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)	4.12
13	Please give us your overall evaluation of the student. (1: Poor; 5: Excellent)	3.99
Research		
14	Did the research you expected from the SURGE research project get done in the 10 weeks? (1: No; 5: Yes)	3.31
15	Is the work worth publishing in a refereed Journal? (1: No; 5: Yes)	3.78

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)	4.46

3.2 Student Feedback

The statistics of the responses to the quantitative questions of the Student Feedback form are given in Table 4.

Table 4: Quantitative Responses in Student Feedback for SURGE 2009 Programme

#	Question	
Research		2009
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)	2.50
4	Did you get the required equipment & facilities needed to carry out your research? (1: No; 5: Yes)	4.30
5	Did you attend research group meetings or participate in discussions with your research group members? (1: No; 5: Yes)	3.90
6	Did you feel comfortable asking questions of your Mentors and Co -Mentors? (1: No; 5: Yes)	
	(a) Mentor	4.50
	(b) Co-Mentor	4.67
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	3.88
	(b) Skill in interpretation of results	3.96
	(c) Tolerance for obstacles faced in research process	4.04
	(d) Readiness for more demanding research	3.99
	(e) Understanding how knowledge is constructed	4.25
	(f) Understanding of the research process in your field	4.25
	(g) Ability to integrate theory and practice	3.89
	(h) Learning ethical conduct in your field	3.87
	(i) Learning laboratory techniques	3.65
	(j) Skill in how to give an effective oral presentation	4.08
	(k) Skill in science writing	4.01
	(l) Self-confidence	4.28
	(m) Learning to work independently	4.11
	(n) Others (please state):	4.13

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)	3.79
9	Evaluate the overall performance of your Mentor or Co-Mentor: (1: Poor; 5: Excellent)	
	(a) Mentor	4.50
	(b) Co-Mentor	4.69
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	3.39
	(b) Oral presentations	3.98
	(c) Writing your final technical paper	3.89



Achievements of past SURGE Programs

The SURGE Programme has proved to be a highly interesting and stimulating event for all participants. It has given a platform to students for their innovative ideas and has also given space for the implementation of the same. It has thus given them a direction towards a possible career in research. By the time this report went to press, we got these emails from students reporting their work and experience based on SURGE. The details sent to us are given below. This information is just a part of all achievements, conveyed to us by students and other resources.

- A Research Paper entitled “Effectiveness of FRP Composites for Flexural Strengthening Unreinforced Masonry Walls” by K. K. Bajpai (Mentor) and Amarendra, student from MNNIT Allahabad, was accepted for proceedings of the 8th International Seminar on Structural Masonry (ISSM-08), held at Istanbul in November 2008.
- The Abstract of a Project titled “Synthesis and Characterization of Carbon Nanotube formed from Leather Industrial Waste” by Sabyasachi Sarkar (Mentor) and Jagdeep Singh, student from NIT Jalandhar, was accepted for the international conference at IIT Madras.
- A Research Paper entitled “Synthesis and Characterization of Water Soluble Carbon Nanotube (CNTs) from Industrial Waste” by Sabyasachi Sarkar (Mentor) and Ajay Singh, student from NIT Jalandhar was selected for oral and poster presentation in two international conference.
 - 1) AsiaNANO 2008 in Singapore. (Oral presentation)
 - 2) FM 2008 in IIT Madras. (Poster presentation)
- SURGE 2008 participant from VNIT Nagpur, Ms. Sria Majumdar helped in an ongoing sponsored project. Ms. Sria had initiated the experiments under the mentorship of Dr Sameer Khandekar which were subsequently completed by a project assistant, Mr. Yajuvendra Singh (who joined the project for one year after his BTech from VNIT Surat, immediately after Sria left). The manuscript written for the project has been accepted for the international conference “Proceedings of MNHMT2009 - Micro/Nanoscale Heat and Mass Transfer” in December 18-21, 2009 at Shanghai, China, extended version is being submitted to an international journal too.

Twenty participants of SURGE 2009 were awarded with the 1980 Batch Fellowship for outstanding performance.

This year three of our students went to Caltech for internship. This is what the Caltech office reported about them!

“We at Caltech have been extremely happy with the quality of students you have been sending us. Every year they get better and they are so enthusiastic, and actually end up discovering something new during their stay. Vikas discovered 2 new gene expressions, which will be reported at a meeting in San Francisco next month, and written up in a paper. Debanjan has discovered a solution in a 1-D chain of oscillators which is the first time for this problem. And Abhishek has discovered one solution to a NP hard problem that has been open for several centuries. Today they were not the shy kids that first came, but smiling all around with new found confidence.”

IN TOUCH, CONNECTED AND INVOLVED



Binod Prasad Koirala, (SURGE-2007) student, B.Tech. Electrical Engineering from MNIT,Jaipur, wrote *“For me, SURGE has always been quite helpful to choose my career path. I was fortunate enough to get into this program after my second year of undergraduate course at MNIT, Jaipur. I am grateful to SURGE programme, my supervisor Dr. P.S. Sensarma and all the students at NAMPET lab for giving me early exposure to Solar Photovoltaics. I worked in a project ‘Modelling of Solar cell/Panel in MATLAB and Maximum Power Point Tracking’ and I am following the same path till date. I also wrote an article at institute newspaper ‘Scribbles’ describing my experience at SURGE-07. After SURGE, I participated in Green Award Competition organized by EWB India (December 2007- March 2008) for sustainable technology innovation and got the award for the project ‘Village Specific Energy Planning’. Exposure to SUGRE gifted me the opportunity to travel to Institute of Solar Energy Technology, Kassel, Germany for Summer Internship in 2008. My work within this internship is soon getting published in European Photovoltaic Conference, 2009. I have worked on the implementation of solar home lighting system using LED lights in the villages of remote Rajasthan for Mondialogo Engineering Award (2006/2007) winning project ‘Improving health conditions of rural people using renewable energy resources’. SURGE has always been driving force for the career path I have travelled so far. I feel the scholarship offered by SURGE-07; to participate in the programme was the right stepping stone for me to achieve my goal in life. I still miss those Happy Hours on Wednesdays.”*



Saurabh Chandra,SURGE participant for two consecutive years SURGE 2007 and SURGE 2008, worked under the guidance of Dr. S.S.K.Iyer.In SURGE 2008 ,and was awarded the first prize in poster presentation, shared his view and posted us this *“as a part of SURGE programme, I got the great opportunity to work in world class lab facility of SAMTEL centre. I was fortunate enough to interact with the people from various part of the world. To know about their country, culture and university was added benefit of SURGE programme. SURGE programme helped me a lot to increase my knowledge in various current research field during weekly happy hour. I want to express my gratitude to the whole SURGE team, I am sure that SURGE program will be a great success in every forthcoming year.”*

Sravya Vallabhaneni, from National Institute of Technology Warangal, was a part of SURGE 2008 programme. She quoted *“It was an excellent experience to stay for 10 weeks at IITK. My work was about “Membraneless Microfluidic Fuel Cells”. My mentor Dr. Animangsu Ghatak has helped me a lot throughout my stay and finally by the end of 10 weeks, I was able to generate voltage. This experience helped me in understanding the joy in research. SURGE also helped me in finding a lot of friends, both the students of IITK as well as students from other NITs.*



The most important thing is that SURGE helped me in getting a project during summer 2009 at University of Hamburg, Germany. Thus, I was able to get an international exposure, which I never expected. ”

Acknowledgement

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The entire DRPG team, under Mr. Mohammad Shakeel played a vital role in the implementation of this task.



Surge 2009

Indian Institute of Technology Kanpur



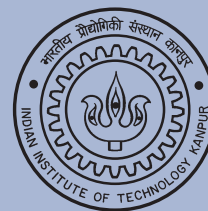


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