

SURGE 2014 Annual Report

Office of Resources & Alumni Indian Institute of Technology Kanpur Kanpur 208016 Dear SURGE Friends,

Congratulations to all 2014 SURGE fellows and their mentors on another successful year !!!

The success of the program has been possible due to hard work of SURGE fellows, enthusiastic and dedicated faculty mentors, excellent support provided by staff members, and financial support by our illustrious alumni.

This year 2,591 applications were received from different institutions . As the number of seats were limited the committee selected 65 proposals after much careful consideration.

This program is getting good response from the students as well as from IIT Kanpur faculty. The SURGE program is receiving more number of applications over the years and is getting more competitive.

I thank and applaud all of your generosity and effort for making this program a grand success. I also take the opportunity to remind you to continue to give your support in the future too.

Thank you! Prabhat Munshi Dean of Resources and Alumni

SURGE program- An overview

Summer Undergraduate Research Grant for Excellence (SURGE) started in the year 2006 summer. In this program second & third year undergraduate students both from IITK and from different institutes of India participate with the objective of receiving technical learning in their area of research. The students get selected on the basis of their academic record ,their research proposal & their technical achievements.

During the 9 weeks program students do research work ,undertake lab visits and do technical tours .They make a mid-term presentation of abstracts of their work and at the end of the program make a poster presentation of the work carried out from IITK . The poster presentation was evaluated by faculty members.

SURGE overseas program welcomes overseas institutes as well. At present, IITK has a exchange program with Melbourne School of engineering, Australia.

All students working under SURGE program at IITK receive a stipend. The students experience a challenging and exciting method of learning which encompasses multiple levels of educational experience.

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Funding SURGE

The participating students receive a stipend of Rs 12,500 for the nine week summer program from the funds raised from external sources. The Dean of Resources and Alumni Office raises funds to support SURGE students from a variety of sources including gifts from individuals, foundations, and corporations. SURGE depends upon the generosity of its many friends for annual gifts or for contributions to the SURGE endowment to build a robust financial base. We thank the donors who have supported SURGE 2014 and beyond! Endowments help to ensure the future of the SURGE program and provide students with unparalleled research opportunities.

Special Thanks to: Batch 1977 and 1980 Shri N R Narayana Murthy

Opportunities still available for new endowments

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

Participants of SURGE 2014 from IITK						
S.No Name of the Participant Project Title Mentor						
1	Rishav Choudhary	Passive control of sonic orifice jets by	Dr. Rakesh Kumar Mathpal			
	Aerospace Engineering	altering the orifice geometry	Aerospace Engineering			
2	Vishal Srivastava	Estimation of the temperature profile of a	Dr. Abhijit Kushari			
	Aerospace Engineering	premixed LPG flame using an image intensifying digital camera	Aerospace Engineering			
3	Ayush Sekhari	Intelligent tutoring system to teach basic	Dr.Amey Karkare			
	Computer Science & Engineering	programming(ESC101)	Computer Science & Engineering			
4	Kundan Krishna	Normality of the Ehrenfeucht Mycielski sequence	Dr. Satyadev Nandakumar			
	Computer Science & Engineering		Computer Science & Engineering			
5	Siddhant Manocha	RoadMap-based robot motion planning	ng Dr. Amitabha Mukherjee			
	Computer Science & Engineering		Computer Science & Engineering			
6	Garima Khandelwal	Development of a paper-based microfluidic	Dr.Siddhartha Panda			
	Chemical Engineering	immunosensor for detection of prostate cancer	Chemical Engineering			
7	Gaurav Laddha	Free energy calculations for protein and ligand	Dr.Raghvendra Singh			
	Chemical Engineering	binding	Chemical Engineering			
8	M.Arvind	Influence of an insoluble surfactant monolayer on	Dr. Naveen Tiwari			
	Chemical Engineering	the stability of a thin	Chemical Engineering			
		liquid film flowing over a heated surface				
9	Moumita Roy	Synthesis, structure and chiral resolution of 1,1'-	Dr. Basker Sundararaju			
	Chemistry	spirobiindane based chiral ligands Chemistry				
10	Madhav R Sakariya	Investigation of air quality at Dabauli, a residential	Dr.Anubha Goel			
	Civil Engineering	location in Kanpur :	Civil Engineering			
		development of Matlab programs				

11	Tejas Baid	A Study of causes of early corrosion of HYSD	Dr. S.K. Chakrabarti	
	Civil Engineering	rebars used in reinforced concrete structures	Civil Engineering	
12	Anadi Chaman	Inventory management using computer vision	Dr. Nishchal Verma	
	Electrical Engineering		Electrical Engineering	
13	Ayushi Singhal	Novel NAH techniques for computing truly	Dr. R M Hegde	
	Electrical Engineering	spherical HRTFs in rendering 3D Audio	Electrical Engineering	
14	Saurav Prakash	Channel learning in multiple input multiple output	Dr. Aditya K jagannatham	
	Electrical Engineering	MIMO based wireless communication	Electrical Engineering	
15	15Aakriti MittalEstimating volatility in the Indian financial marketHumanities and Social Sciences:a time series		Dr. Praveen Kulshreshtra	
			Humanities and Social Sciences	
16	Akshay VChaudhari	Tire modeling	Dr.Anindya Chatterjee	
	Mechanical Engineering		Mechanical Engineering	
17	S Gautham Raj	Study Of Flow Past Bluff Bodies	Dr. Arun K Saha	
	Mechanical Engineering		Mechanical Engineering	
18	Swapnil jain	Dropwise Condensation of Heavy metals(Case	Dr. Sameer Khandekar	
	Mechanical Engineering	Study of Bismuth)	Mechanical Engineering	
10	Akash Bajai	Size-dependent changes on panomagnetic	Dr Sompath Bhowmick	
12	Material Science & Engineering	properties in quantum dots, quantum wires and quantum wells	Material Science & Engineering	

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

Participants of SURGE 2014 at IITK from other universities					
S.No	Name of the Participant	Project Title	Mentor		
1	Rhythm Mehra	Modeling, fabrication and calibration of 4-component	Dr. D. Das		
	Aerospace Engineering	external force balance	Aerospace Engineering		
2	Suresh Sharma	Single motor collective pitch quadrotor	Dr. Abhishek		
	Aerospace Engineering		Aerospace Engineering		
3	Debalina Datta	Engineering a conditional	Dr. S Ganesh		
	Biological Sciences &	expression construct and express PTG protein in	Biological Sciences &		
	Bioengineering	neuronal cells	Bioengineering		
4	Abhirup Basu	Effect of gold loading in electrochemical oxidation of	Dr. Sri Sivakumar		
	Chemical Engineering	methanol	Chemical Engineering		
5	Sazal Kumar Methi	Synthesis of core/shell quantum dots for solar energy	Dr. Raju Kumar Gupta		
	Chemical Engineering	application	Chemical Engineering		
6	RAJA LAKSHMI P	zinc thiolate complexes in sulfur	Dr. Raja Angamuthu		
	Chemistry	dioxide binding	Chemistry		
7	Vaddadi. Sai Sowmya	Attempted synthesis of centrolobine	Dr. Ramesh Ramapanicker		
	Chemistry		Chemistry		
8	Vaishali Chugh	Efforts towards the synthesis of hydroxy amino acids	Dr. Ashwani Kumar Thakur		
	Chemistry with defined stereochemistry from natural amino acids		Chemistry		
		serine, aspartic acid and glutamic acid			
9	Saumya Mishra	Case study on recycling of construction and demolition	Dr. Sudhir Mishra & Dr. Syam		
	Civil Engineering	waste in India	Nair		
			Civil Engineering		
10	Sarthak Jain	Implementation of secure hash algorithms in Haskell	Dr. Rajat Mittal & Dr. Nitin		
		& C with comparison across different architectures	Saxena		
	Computer Science & Engineering		Computer Science & Engineering		

11	Jahnwi Tiwari	Application programming interface (API) design for	Dr. Y. N. Singh
	Electrical Engineering	Brihaspati -4	Electrical Engineering
12	Prakhar Swarup	Design of diamond colorimeter	Dr. Pradeep Kumar K.
	Electrical Engineering		Electrical Engineering
13	Rachit Jain	Real time monitoring and control of load through	Dr. Saikat Chakrabarti
	Electrical Engineering	ZigBee	Electrical Engineering
14	Shashin Singh	Local periodic motion detection and modeling in	Dr. K. S. Venkatesh
	Electrical Engineering	videos	Electrical Engineering
15	Yasharth Srivastava	Technical efficiency in the Indian automobile	Dr. Praveen Kulshrestha
	Humanities and Social Sciences	industry: a stochastic frontier analysis	Humanities and Social Sciences
16	L6 Chaitali Garain Aging behavior of LAT971 & LATZ9531 Mg alloy		Dr. Kantesh Balani
	Material Science and Engineering		Material Science and Engineering
17	Prathamesh Bhalchandra Vartak	Microstructure evolution & incipient melting during	Dr. Kaustubh Kulkarni
	Material Science and Engineering	two stage solutionizing heat treatment of sast aluminium alloys	Material Science and Engineering
18	Shayaree Sengupta	Study of corrosion behavior of Mg AE-42 IN 3.5%	Dr. Kallol Mondal
	Material Science and Engineering	NaCl and 0.5N NaOH solutions 2. Evaluation of activation energy for carbide precipitation during tempering of Matensite through thermal analysis	Material Science and Engineering
19	Hasanur Rahman	Computation of fundamental group	Dr. Abhijit Pal
	Mathematics & Statistics		Mathematics & Statistics
20	Aditi Sengupta	Computer simulation of convective heat transfer of	Dr. PS Ghoshdastidar
	Mechanical Engineering	iron oxide based ferrofluids in a microchannel	Mechanical Engineering

21	Ankita Awasthi Mechanical Engineering	Comparison of signal-to-noise ratio of reconstructed images of particle field using digital holography	Dr. Pradeep Kumar Panigrahi Mechanical Engineering	
22	Arun Kumar	Hydrodynamics of magnetic drug targeting using magnetic nano-particles: experiments and simulation	Dr. Pradeep Kumar Panigrahi	
	Mechanical Engineering			
23	Ashwin Sridhar	Study of directional damping using polymer blocks with helical micro channels	Dr. Shantanu Bhattacharya	
	Mechanical Engineering		Mechanical Engineering	
24	Suthar Raj Rameshchandra Mechanical Engineering	Steady-state and transient analysis of helium cooled pebble bed (HCPB) test blanket module (TBM) using RELAP5	Dr. P Munshi & Dr. Sikha Prasad Mechanical Engineering	

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

	Participants of SURGE 2014 from IITK to Overseas Universities						
S.No	Name of the Participant	Name of the Institute	Project Title	Mentor			
1	Aditya Nigam Civil Engineering	Melbourne School of Engineering,University of Melbourne	Energy dissipation devices in composite moment resisting frames	Dr.Helen Goldsworthy Civil Engineering			
2	Aniruddha Baral Civil Engineering	Melbourne School of Engineering,University of Melbourne	Studying bleeding of normal and fiber reinforced geopolymer concrete using sedimentation model	Dr. Rackel San Nicolas, Dr. Priyan Mendis, Dr.Tuan Ngo Civil Engineering			
3	Subhajit Mohanty Electrical Engineering	Melbourne School of Engineering,University of Melbourne	Neural Response Based Phosphene Simulator for the Bionic Eye	Dr. David B. Grayden Electrical Engineering			

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

























Abstracts: SURGE 2014 Research projects done at IIT Kanpur

Estimating volatility in the Indian financial market: A time series analysis Aakriti Mittal (IIT K)

Mentor : Dr. Praveen Kulshreshtha

The study aims to examine the pattern of volatility in the Indian financial market, using closing prices of various BSE and CNX stock price indices. The work comprises of making a comparative analysis of volatility and returns in BSE100, BSE200, BSE500, BSE Sensex, CNX100, CNX200, CNX500 and CNX Nifty stock price indices from 2000 to 2014, as well as studying the impact of the global financial crisis on the returns and volatility of BSE Sensex and CNX Nifty stock indices, by splitting the time series into three phases: the *pre-crisis* period (2000-06), the *crisis* period (2007-10) and the *post-crisis* period (2011-14).

The ARCH and GARCH time series econometric models are used to analyze the volatility in the Indian financial market. Also, the study employs the Augmented Dickey Fuller (ADF) Test for stationarity of a time series, the ARCH LM Test for presence of ARCH effects in a time series, and the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) to identify the optimal lag length of the ARCH and GARCH models. The best fitted model is then used to predict the conditional variance of the differenced series of returns (which is found to be stationary). The STATA statistical package is used to conduct the data analysis. The study indicates that GARCH (1, 1) is the best fitted model of volatility during 2000-14, for all the stock price indices. In the period-wise analysis of BSE Sensex and CNX Nifty, GARCH (1, 1) is the best fitted model, except for Nifty in the post-crisis period (2011-14), where GARCH (1, 3) is found to be the best fitted model.





Effect of gold nanoparticles loading on electro catalytic methanol oxidation

Abhirup Basu (Jadavpur Univ.)

Mentor : Dr. Sri Sivakumar

We have prepared highly stable gold nanoparticles (AuNps) tailored multilayer over indium tin oxide (ITO) substrates via click chemistry for electro catalytic methanol oxidation. Tailored multilayer of AuNps were fabricated by alternate deposition of azide and alkyne functionalized AuNps. Formation of tailored multilayer was confirmed by scanning electron microscopy (SEM) images and profilometry. Further the electro catalytic activity of fabricated nanostructures and effect of AuNps layer was evaluated for methanol oxidation. From the cyclic voltammetry results, it was observed that three layers of gold nanoparticles showed maximum activity, which we attributed to the limited activity of AuNps beyond 40 nm size.

Tire Modeling Akshay Chaudhari (IIT K) Mentor : Dr. Anindya Chatterjee

The objective of this work is to develop a set of equations/formula that explains the behavior of a tire with the surface in contact with it. The work is mainly focused towards mathematically representing the microscopic lateral slip of a tire in motion upon application of a lateral force. The duration of project was broadly divided into three phases – literature survey in the initial phase relating to the major work done in tire modeling, conduction of an experiment in the next phase and then coming up with a formula in the last phase that would relate the normal force, lateral force, lateral slip and the longitudinal distance covered by the tire. The number of parameters used for curve fitting is decided on the basis of the nature of dependence chosen – linear, quadratic or whatever seems to fit perfectly. The values of the parameters will be different for different tires depending on the nature of tread, carcass and many other parameters of the tire.



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Computer simulation of convective heat transfer of iron oxide based ferrofluids in a microchannel

Aditi Sengupta (Manipal Inst. of Tech.)

Mentor : Dr. P.S. Ghoshdastidar

A numerical study of laminar forced convection, fully developed flow of ferrofluids in a microchannel subjected to constant heat flux on both sides of the channel is conducted to observe heat transfer enhancement (if any) occurring using Buongiorno Model[4]. A comparison is made between the current study with a microchannel (length = 0.025 m, height = 257 μ m, width = 807.3 μ m) and the experiment conducted by Kurtoglu et al. [6] for a microtube keeping the hydraulic diameter and cross sectional area the same. Characterizing the convective heat transfer enhancements with lauric acid coated iron oxide (Fe_3O_4) nanoparticles based ferrofluids having volume fractions varying from 0% to 5% and average particle diameter of 25 nm is the objective of this study. The surface temperature rise shows the characteristic of increasing with the applied heat flux which is common with the trends shown in the experiment [6], however, the nature of the growth is not nonlinear as is observed in the experiment [6] conducted in absence of magnetic field. The heat transfer coefficient shows almost no variation with applied heat flux, which contradicts the growth in heat transfer coefficient with applied heat flux depicted in the experimental results [6]. Moreover, the enhancement in heat transfer increased with nanoparticle concentration; however the maximum enhancement at volume fraction 5% and heat flux $7x10^5$ W/m² is increased by only 7.8% compared to 60% increase observed in the experimental results [6] for the same set of parameters. The present numerical results are supported by Azizian et al. [7] wherein they claim that a marked heat transfer enhancement is possible only when magnetic field is imposed.





Size-dependent changes on nanomagnetic properties in quantum dots, quantum Wires and Quantum Wells Akash Bajaj (IIT K)

Akasıl Dajaj (III K)

Mentor : Dr. Somnath Bhowmick

The objective of this work is to study changes in the magnetization and spin density of a nanomagnetic sample as observed by changing the dimensions of the sample. Nanomagnetism is widely employed in data storage in hard disk drives. Sizedependent effects of nanomagnetism are of great concern in such areas. Initially, we have prepared a preliminary model of magnetism in nanomagnetic samples which is based on the free electron theory. The nanomagnetic sample has been visualized as a three dimensional box containing a finite number of electrons. We introduce a "coloumbic interaction energy" term into our system and then our MATLAB code arranges the electrons in different energy levels to obtain the lowest energy configuration of the system. The spin unpaired electrons account for the magnetization of the sample. Based on the dimensions of the three dimensional box, we model it as a quantum dot (0-Dimensional), quantum wire (1-Dimensional) or a quantum well (2-Dimensional). We verify our model by plotting density of states for each of the above three systems. We further vary the volume of the sample for each system, at a fixed interaction energy value of 1eV and study the changes observed in the magnetization (i.e. number of spin-unpaired electrons per unit volume) of the sample and plot the changes. The plots suggest different behavior for each system. For lower volumes, quantum dots are better sources of magnetization whereas for higher volumes, quantum well and quantum dot have comparable values. Quantum wires are ineffective in both cases. We have also calculated spin density plots for the above systems at a fixed columbic interaction energy of 1eV. The plots suggest that spin density is more concentrated closer to the outer walls of a quantum dot as compared to the inner regions. For a quantum well, spin density becomes more concentrated on going along the shorter axis while it becomes less concentrated on going along the longer axis. For a quantum wire, same behavior is observed as for a quantum well.



Comparison of signal-to-noise ratio of reconstructed images of particle field using digital holography

Ankita Awasthi (KNIT)

Mentor : Dr. P.K.Panigrahi

The objective of this work is to obtain and compare the three dimensional information about an object field of interest by both in-Line and off-Axis Digital Holography set-up. The improvement in reconstructed effectiveness and SNR (signal-to-noise ratio) of reconstructed image due to off-axis set-up is reported and compared with in-line set-up. With digital holography techniques, nondestructive, non-invasive, full-field-view and quantitative investigations of object field can be performed. Dynamic imaging capabilities, non-scanning and non-touch features of digital holography make it revolutionary in various scientific and industrial applications. One of the advantages of Holography is its applications in small scale operation. The depth of field is related to the smallest resolution of the image and at the microscopic level the depth requirement is very small. The simulation results demonstrate the three terms of reconstruction wave field i.e. zero order term, virtual image term & real image term, which are spatially separated in an off axis arrangement as the object wave and reference wave are separated by an angle. The effect of offaxis angle, wavelength & pixel size of CCD camera on the location of the reconstructed real image is reported. This technique is successfully applied for particles. The results from this study indicate that off-axis digital holography has superior performance compared to in-line holography.

Inventory management using computer vision Anadi Chaman (IIT K) Mentor : Dr. Nishchal K. Verma

Automation of inventory management has become a very important task in today's world for the manufacturing firms. Automated counting of objects is useful for the firms to keep a track of the number of objects present in the inventory and, accordingly, adjust their production rate so as to efficiently cater to the market demand of goods. In this paper, a technique has been proposed for automatically counting objects using a fuzzy histogram implementation followed by the application of two spatial filters. An image, in which the number of occurrences of an object, called prototype, is to be found, is taken as an input from a camera. Fuzzy color histogram of the prototype is compared with the histograms of all the possible regions in the input image, which have the same dimensions as that of the prototype. This is done by computing histogram intersection. The regions with high intersection values are then segmented out. Thereafter, sum of squared differences, SSD, are computed between the pixel values of the prototype and the pixels of various regions of the segmented image. The minima points in the SSD values are recorded, and two spatial filters, namely size filter and dip filter are applied to reject false alarms.





Hydrodynamics of magnetic drug targeting using magnetic nanoparticles:experiments and simulation S. Arunkumar (SASTRA Univ.) Mentor : Dr. P.K. Panigrahi

The present study reports the localization of magnetic nanoparticles (MNPs) inside a micro capillary (500 μ m × 500 μ m square cross section) in the presence of an externally applied magnetic field produced by a permanent magnet. Numerical Simulations (2D) are carried out for the localization of MNPs in the presence of a magnetic field and the results are validated with the experimental measurements using confocal microscopy system. The simulation results matches well with that of confocal measurements. The aggregate forms chain like clusters due to dipole-dipole interaction between the MNPs. The size of aggregate is larger for a low flow rate as compared to high flow rate of ferrofluid through the capillary. Volume of aggregation of MNPs at the target site increases with time and becomes steady for time T > 350 s. In presence of magnetic field, the flow field shows a strong transverse velocity towards the magnet as compared to the case of no magnetic field.

Study of directional damping using polymer blocks with helical microchannels Ashwin Shridhar (NIT,Calicut)

Mentor : Dr. Shantanu Bhattacharya

The objective of this research is to design and fabricate a vibration damper using Polydimethylsiloxane (PDMS) blocks with helical micro channels carved within in which a fluid of high viscosity is filled. This device is now tested for its ability to perform directional damping by applying an excitation signal and determining its fundamental mode frequency along the three axes viz. X, Y and Z. Also the micro channel array density is varied up to a maximum keeping the dimensions of the PDMS block unaltered and a change in fundamental frequency is observed. All vibration experiments have been performed using a single-point laser to ascertain the experimental behavior of the system. We have also modeled the vibration suppression characteristics of such systems by using simulation tools.







Inteligent tutoring system to teach basic programming (ESC101) Ayush Sekhari (IIT K)

Mentor : Dr. Amey Karkare

An intelligent tutoring system (ITS) is a computer system that aims to pro-vide immediate and customized instruction or feedback to independent learners usually without intervention from a human teacher. We aim to develop an Intelligent tutoring system to teach basic programming to students. We have developed technology for automatic problem and corresponding solution generation for the following categories:

•Matrix Problems

- •String Problems
- •Series Problems
- •Pattern Problems
- •Recursion Based Problems
- •List Based Problems

We have also been able to synthesize problem progressions on this automatically generated pool of problems to downgrade a given question to the student to suit her level of understanding. We have also come up with innovative methods to give immediate and intelligent feedback to the students assisting her learning. This work has been integrated with an online framework (called *PROGENE*) which would be used during the next semester to teach ESC101 to the students.

Novel NAH techniques for computing truly spherical HRTFs in rendering 3D Audio

Ayushi Singhal (IIT K)

Mentor : Dr. Rajesh M. Hegde

In our project we have efficiently computed truly spherical generalized HRTFs, in the near field of the listener, using spherical near field acoustic holography (SNAH) techniques. In order to simulate generalized HRTFs, the head and the torso have been modeled by spheres of appropriate radii, which is popularly known as the "snowman" model. In addition to providing improved low-frequency response for music reproduction, the model provides major low-frequency localization cues, including cues for low-elevation as well as high-elevation sources. For effective implementation, the snowman-HRTFs have been approximated using SNAH for the spherical head model and Gaussian optics (image-source method) to model the reflections due to the torso. The two models are then combined to generate HRTFs for this HAT (head and torso) model which provides accurate localization cues. Sample stereo-audio tracks have also been generated, using the HRTFs calculated above, that accurately localize the sound sources in 3-dimensions (3D Audio).





Aging behavior of LAT971 & LATZ9531 Mg alloys Chaitali Garain (NIT,Durgapur) Mentor : Dr. Kantesh Balani

In this study, an aging treatment was performed to investigate the microstructure and mechanical properties of LAT971 (Mg-9wt%Li-7wt%Al-1wt%Sn) and LATZ9531 (Mg-9wt%Li-5wt%Al-3wt%Sn-1wt%Zn) Mg based alloys. The results show that when the solutionizing temperature was chosen as 350°C for LAT971, all the precipitates did not get dissolved. So a decreasing trend in the hardness values was observed on aging at 250°C. The solutionized temperature was chosen to be 450°C for aging at 100°C & 150°C. At that solutionizing temperature almost all the precipitates got dissolved & the peak hardness values were reached at 2 hours (900 MPa) & 0.5 hour (750 MPa) for 100°C aging & 150°C aging respectively. After reaching the peak hardness, there was a decreasing trend in the hardness values by age softening, which occurred due to the growth & agglomeration of the primary (Mg-Li-Sn) & secondary (Mg-Li-Al) precipitates present in both $\alpha \& \beta$ phase.

In case of LATZ9531, solid solution strengthening occurred at the solutionized temperature, the hardness value (710 MPa) being 1.2 times the hardness (620 MPa) of as cast alloy. As the aging process goes on, the precipitation hardening phenomena predominates over the solid solution strengthening (the hardness (770 MPa) after aging for 6 hrs is about 1.13 times that of as quenched state(710 MPa).

Engineering a conditional expression construct and express PTG protein in neuronal cells Debalina Datta (Univ. of Hyderabad) Mentor : Dr. S Ganesh

Neurons are one of the most active body cells. However, they store very basal amount of glycogen as compared to other body cells. The state of metabolic activity in neurons can be compared to cancerous cells, which store glycogen and divide. Therefore, a causal relationship between glycogen and cell-cycle is being hypothesized. Neuronal cell line has been selected because under normal conditions they neither store significant amount of glycogen nor do they divide. To check this, an inducible construct to control the synthesis of glycogen in the cells is required. Hence, PTG (Protein targetin to glycogen) was chosen which is known to increase glycogen when expressed in the cells. By the technique of molecular cloning, a construct is made with an inducible promoter (under the Ecdyson Repressible System) along with the PTG gene inserted in the multiple cloning site of the vector. This construct can now be used to make the cells synthesize glycogen and thus analyze its role in cellcycle.





Development of a paper-based microfluidic immunosensor for Detection of Prostate Cancer Garima Khandelwal (IIT K) Mentor : Dr. Siddhartha Panda

"Paper-based microfluidics" or "lab on paper" has shown promise as point-of-care diagnostics because paper is inexpensive, portable, disposable by burning, and has the ability to wick fluids by capillarity .The use of microfluidic chips for immunoassays has been extensively explored in recent years. Our paper based microfluidic device is based on the principle of sandwich immunoassay for determination of PSA biomarker. First, the experimental study of flow rate, capillary length and capillary flow time of PBS on a Whatman Grade-1 chromatography paper of finite width had been done to optimize the length of the strip, volume of sample solution, and approximate distance between reaction-test-control zones, by taking care of reaction kinetics at these zones. The flow rate proved very difficult to measure accurately since the rate decayed rapidly as the liquid moved farther along the membrane. Then the effect of the distance between reaction, test and control zones and volume and concentration of reagents on the sensitivity of the immunostrip was examined. The need was to ensure the minimum use of reagents within an acceptable time limit and detection range. Then, finally an immunostrip with optimized parameters is employed to test the PSA with different concentrations. The limit of detection of immunostrip comes out to be 1 ng/ml, which could be set to 4 ng/ml which is a decisive level for prostate cancer. The intensity of color is measured using Image-J software for different concentrations. This immunoassay strip system for testing PSA is small, disposable, easy to use (and carry), and requires no external equipment, or power sources, that is appropriate for low-resource settings.

Free energy calculations for protein and ligand binding Gaurav Laddha (IIT K) Mentor : Dr. Raghvendra Singh

The objective of my work is to find the free energy of the protein system and to utilize it so as to find various other properties of protein and/or protein-ligand complex. The method used to find free energy is the thermodynamic integration method in which the Hamiltonian is made dependent of a coupling parameter λ representative of the state of the system. The simulations were performed on the software GROMACS and the results were used in finding the free energy of the system. The free energy data were then used to find the solvation energy of a ligand named B-Octylglucoside (BOG). The free energy calculations were also used to find the binding energy of the ligand BOGattached to themonomeric outer-membrane porin OmpG (a protein-ligand complex).





Computation of fundamental group Hasanur Rahman (IIT Delhi) Mentor : Dr. Abhijit Pal

In this article, we compute the fundamental groups of compact orientable surfaces without boundary. We begin by reviewing the idea of basic homotopy theory. We then define amalgamated product of groups and state Seifert Van Kampen theorem. This will help us in computation of fundamental groups.

Application programming interface design for Brihaspati-4 Jahnvi Tiwari (SMVDU)

Mentor : Dr. Yatindra Nath Singh

Brihaspati-4 is a platform independent facilitator, which provides a highly scalable content-delivery tool for web based e-learning systems. The third version of Brihaspati, also known as, Brihaspati 3 is currently operational in 250 different centers all over India and is administered by IIT Kanpur. Brihaspati-4 is an evolved form of the previous version. The main change is in the network architecture which is peer to peer, unlike the administrator-client model of Brihaspati-3. This change in the architecture has rendered the system with scalability, high efficiency, reliability and cost-effectiveness. JXTA has been chosen as the platform for development of this software tool. The project involves the API development for the basic functions of Brihaspati-4 which includes, file sharing module among peers and their groups.

The file sharing system is supposed to work as hybrid of an e-mail system. The key feature of this file sharing system is that it's all files are secure and stored in a programmed peer until the receiver peer is online in the network. The earlier versions of Brihaspati were based on Java language using Turbine and Apache, but for the development of the fourth version, JXTA has been chosen as the platform. The main reason for the choice was the feature of language independence, portability and convenience in software development provided by JXTA.





Normality of the ehrenfeucht-Mycielski sequence Kundan Krishna (IIT K)

Mentor : Dr. Satyadev Nandakumar

We study the binary Ehrenfeucht Mycielski sequence seeking to prove a balance between the occurrences of different strings. There have been numerous attempts to prove the balance conjecture of the sequence, which roughly states that 1s and 0s occur equally often in it. We studied the weaker forms of the conjecture proved in the past where the ratio of 0s and 1s are proved to be bounded in an interval. Keiffer and Szpankowski in 2007 proved the tightest bound regarding the conjecture. Unfortunately, their paper lacked most proofs. We worked out elaborate proofs for its theorems. To assist in further study of the sequence, we wrote code in Mathematical to generate and analyze the sequence graphically as binary trees . We further extend the claim of balance to that of normality. We prove a weaker form of simple normality to word length 2 in which we give a lower and upper bound for the number of occurrences of two bit words in the sequence. Lastly, discuss the performance of the proof method for higher word lengths.





Influence of an insoluble surfactant monolayer on the stability of a thin liquid flowing over a heated surface M.Arvind (IIT K) Mentor : Dr. Naveen Tiwari

There are many applications which involve the flow of thin liquid films over locally heated surfaces. Such flows involve marangoni stresses which cause formation of capillary ridges. These ridges are found to be prone to instabilities. In this project, we try to prevent these instabilities in such flows by the introduction of an insoluble surfactant monolayer on the surface of these films which helps in flattening the ridges formed and stabilizes the film. An attempt was made to study the dynamics of such flows by simulating base profiles using the commercial software package 'Comsol'. This attempt was initially made with a non-evaporative film and then extended with an evaporative film. One important aspect of this project was to understand the effect of surfactant on the evaporation of volatile liquids.

The dynamics of such flows were studied under the lubrication approximation. The base profiles were plotted for various values of each parameter in order to understand the effect of each parameter on the flow. The linear stability analysis was performed by perturbing the evolution equations of the local film height and surfactant concentration. An equation in terms of the perturbed quantities was obtained and was reframed into an eigen value problem. The eigen values were obtained by solving the eigen value problem and were plotted against wave number and these plots were analyzed to comment on the stability of the system. The analysis results revealed that the introduction of surfactant monolayer helped in stabilization of the films.

Investigation of air quality at Dabauli, a residential location in Kanpur: development of Matlab programs Madhav R Sakariya (IIT K) Mentor : Dr. Anubha Goel

The objective of this research is to study the ambient air quality of Dabauli locations of Kanpur city in terms of major air pollutants (SPM, RSPM, NO2 and SO2). Kanpur is the second most polluted city in India according to World Health Organization (WHO) urban air pollution database. Kanpur with high population density is major industrial city in northern India. Data for this study was obtained from CPCB environmental data bank of automatic monitoring stations in Kanpur city during the period 2005-2010. Based on that, MATLAB-program for calculating Air Quality Index (AQI) and Air Quality Health Index (AQHI) were developed, where AQI and AQHI are parameters which represents air quality. Also the statistical data analysis was carried out for the pollutant concentrations and AQI using MATLAB program. Some Time-plots were also produced to see the trends and seasonal variation among the pollutant concentrations. The study may help in making new policies to make environment safer and cleaner.





Synthesis, structure and chiral resolution of 1,1'Spirobiindane based chiral ligands programs Moumita Roy (IIT K)

Mentor : Dr. Basker Sundararaju

The objective of this project is to synthesize 1,1' spirobiindane based chiral legend and its chiral resolution in order to separate the two enantiomers. Potential chiral calalyst can be prepared from this ligand by substitution of 7,7' position with various other chelating groups. The work describes the method of preparation of the ligand which is a six step procedure starting from meta anisaldehyde. The ¹H and ¹³C NMR spectra of the intermediates are studied. We end up getting 1,1'-spirobiindane-7,7'-diol with two bromine groups at 4,4' positions as a recimic mixture. The ligand can be further modified by substitution of the bromo groups to get more effective catalyst for asymmetric synthesis.



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Design of a diamond colorimeter Prakhar Swarup (ISM ,Dhanbad) Mentor : Dr. Pradeep Kumar K

The main objective of our work is to design various modules which are required for the proper functioning of the optical, electrical and computational systems of a diamond colorimeter. The main objective of a diamond colorimeter is to classify gemstones into different grades based on their color appearance. In order to objectively determine the color of a gem, a well known method is used (with slight modifications). The gem is illuminated from the pavilion side by white light and the spectrum is recorded and processed to obtain a set of normalized RGB values which determine the grade of the gem. A new algorithm for processing the observed spectrum is proposed and tested on some test gems. Also, a set of functions have been created to calculate the various optical angles and distances for pavilion side as well as table side entry of light into the light. To automate the whole process of spectrum acquisition and subsequent processing, use of an FPGA along with a CCD camera is proposed. Various modules required for initializing the camera through the FPGA, storing the data obtained from the camera and then processing it to display the required RGB values have been designed and simulated. These modules are designed using the VHDL language.





Microstructure evolution and incipient melting during two Stage solution zing heat treatment of cast aluminium alloys Prathaemsh B. Vartak (College of Engg.,Pune) Mentor : Dr. Kastubh Kulkarni

The purpose of this study is to investigate the effect of single stage and two stage solutionizing heat treatment on the microstructure evolution & incipient melting in modified A354 Aluminum alloys with varying copper content of 1.5, 3 & 3.5 wt %. The samples were subjected to single stage solutionizing heat treatments at 520°C for 7 days and two stage solutionizing heat treatments at 490°C for 4 days followed by 520°C for 7 days. Phase Fraction Analysis was carried out by analyzing samples after each stage under Scanning Electron Microscope. Also Optical Microscopy was utilized to observe microstructural changes and to detect incipient melting. Differential Scanning Calorimetric analysis and Hardness measurements were also performed. Incipient melting was detected during 520°C single stage treatment of all the alloys as well as during two stage treatment of alloy with 3.5 wt % Cu and hence two stage treatment is recommended for alloys up to 3 wt% Cu.

Real time monitoring and control of load through ZigBee Rachit Jain (Manipal Inst. of Tech.) Mentor : Dr. Saikat Chakrabarti

This project is aimed to control the various loads in our home via the ZigBee protocol using the Xbee S2 wireless modules. Load consists of anything that consumes power. These various loads are simulated in the Real Time Digital Simulator (RTDS). In this project the commands are given via the computer which are being sent via RF communication through the Xbee modules and are then interpreted by the microcontroller and given to the RTDS machine. Using different commands different loads can be switched on/off. The feedback of the voltage and the power consumption from the RTDS machine is also available at the computer. This simulates an automatized home where the control of various appliances can be controlled via different electronic gadgets like mobile phone, laptops, tablets etc. This also gives us the opportunity to view our electricity consumption, as simulated in the project. This can also introduce Real-time pricing of electricity which is one of the pillars of Smart Grid.





Zinc thiolate complexes in sulphur dioxide binding P. Raja Lakshmi (MTWU,Kodaikanal) Mentor : Dr. Raja Angamuthu

The insertion of SO2 into M-C bonds has been studied extensively during the 1960's and 1970's many transition – metal alkyl and aryl complexes have been shown to undergo this reaction, and several types of linkages have been observed. A mechanism has been proposed that still holds in the majority of cases, while current interest in this reaction has decreased, SO2 remains the subject of numerous studies because of its diverse coordination properties and its role in acid rain production. The reaction of Zinc(II) acetate with a variety of benzothiazolines afforded tetrahedral mononuclear complexes with a N2S2 donor set, [Zn(R-Ph-C(H)= N- C6H4-S)2]. The cis-dithiolate N2S2Zn complex takes up two equivalents of sulfur dioxide in which thiolate-sulfur to SO2 – sulfur interactions are well-defined by IR spectroscopy, NMR spectroscopy and visual color changes upon reversible SO2 adduct formation. In addition, the stability of Zn. SO2 to vacuum and removal of SO2 by heating make Zn a possible storage/ controlled release complex for SO2 gas.



Modeling, fabrication and calibration of 4-component force balance Rhythm Mehra (PEC Univ. of Tech.)

Mentor : Dr. Debopam Das

The objective of this work is to model a four-component external Force Balance to measure forces and moments on fixed wing models as well as flapping models in a wind tunnel. This four-component Force Balance can measure two forces- lift and thrust; and two moments- roll and pitch. The number of measuring components and the position of the balance with relation to the model and wind tunnel chamber determine the wind tunnel balances designs. Different dimensions were decided by optimization of different reaction forces in Microsoft Excel. The model has been fabricated from aluminum sheets of different thicknesses, bearings, steel linkages and ball joints. Piezo-resistive transducers have been used for the measurement purpose. These transducers can measure only compressive loads. In order to take tensile forces into account, compression springs have been used. Sensors used have response time of less than 5 micro-seconds which will be useful for measuring forces in unsteady aerodynamics.





Study of flow past bluff bodies S.Gautham Raj (IITK) Mentor : Dr. Arun.K.Saha

Two dimensional flow past three different bluff bodies have been studied : a square , triangular and circular cylinder. The Direct Numerical Simulation(DNS) of two dimensional incompressible flow past the three bluff bodies were carried out at various Reynolds numbers for both the steady and unsteady cases. The Navier Stokes equation are solved using higher order spatial and temporal discretizations. Numerical simulations were carried out using the MAC method. In the case of the equilateral triangular cylinder, both the cases of vertex facing the flow and base facing the flow were studied. The flow past circular cylinder was carried out by using the Immersed Boundary Method(IBM) in the Cartesian grid . The *direct forcing* IBM approach was employed for that study. In all the above cases, the recirculation length and strouhal number were determined for various Reynolds numbers .The drag coefficients and lift coefficients were determined in the square cylinder case for different Reynolds numbers. For each of the three different bodies, the range in which the critical Reynolds number lies was also determined. The results obtained were compared with those found from earlier studies carried out in this topic.



Passive control of sonic orifice jets by altering the orifice geometry Rishav Choudhary (IITK)

Mentor : Dr. E. Rathakrishnan & Dr. R.K. Mathpal

The property of free jets to entrain mass from the quiescent atmosphere is well known. This has resulted in the use of jets in a wide range of areas, i.e. from household appliances to rocket engines. Control of jets is the modification of the flow field in a way, which increases engineering efficiency, technological ease etc. It can be categorized as active (where an external power source is used) or passive (where no external power source is used). The aim of this project is to achieve passive control of the jets by altering the geometry of the jet exit device (orifice), and also to provide an explanation of the observed phenomena. The most commonly used jet is the circular jet. Non-circular jets can act as an efficient technique of passive flow control that allows significant improvements of performance in various practical systems at a relatively low cost because noncircular jets rely solely on changes in the geometry of the orifice. The applications of noncircular jets include improved large- and small-scale mixing in low- and high-speed flows, and enhanced combustor performance, by improving combustion efficiency, reducing combustion instabilities and undesired emissions. Additional applications include noise suppression, heat transfer, and thrust vector control (TVC).





Implementation and comparison of secure hash algorithms in programming languages (Haskell & C) across different architectures

Sarthak Jain (LMNIIT, Jaipur) Mentor : Dr. Piyush P. Kurur

The aim of the work is to implement the cryptographic hash algorithms such as SHA1, BLAKE, BLAKE2 in programming languages in Haskell, C with comparison across different architectures such as Intel 64-bit, ARMv-7. Several open source cryptographic libraries written in C language are still facing security vulnerabilities because of side channel attacks (for ex timing attacks) and bad coding techniques (for ex -heartbleed bug). We are trying to develop a secure cryptographic network library in Haskell which will be used to implement high performance servers and clients. To make our cryptographic primitives (for ex - hashes) fast, we also implemented them in C by working on some optimization techniques and avoiding any security flaws. BLAKE - a family of cryptographic hash functions (Blake256, Blake2b, Blake2s)are implemented in Haskell and C which actually provides the optimum speed to compute the hashes of very large input strings. Our results depicted that Blake-2b outperforms SHA-1 on Intel-64 bit architectures and Blake-2s outperforms SHA-1 on ARMv-7 architecture.

Case study on recycling of construction & demolition waste in India

Saumya Mishra (NMIMS,Mumbai) Mentor : Dr.Sudhir Misra

We have studied a case study on Recycling of Construction and Demolition Waste in India. Use of recycled aggregate in concrete can be useful for environmental protection. Recycled aggregates are the materials for the future. The application of recycled aggregate has been started in a large number of construction projects of many European, American, Russian and Asian countries. Many countries are giving infrastructural laws relaxation for increasing the use of recycled aggregate. Currently, most of the waste generated in construction and demolition sites is composed of materials such as concrete, bricks and blocks which are disposed of in landfill sites due to the absence of markets for their recycled forms. Important guidelines of recycled aggregates concrete in various countries are stated here with their effects, on concreting work. In general, present status of recycled aggregate in India along with its future need and its successful utilization are discussed here. Development and extraction of natural aggregate resources (primarily crushed stone and sand and gravel) are increasingly being constrained by urbanization, increased costs, and environmental concerns, while use of recycled materials from roads and buildings is growing as a supplement to natural aggregates in road construction. Recycled aggregate can

(1) extend the life of natural resources by supplementing resource supply.

(2) reduce environmental disturbance around construction sites

(3) enhance sustainable development of our natural resources.



Analysis of the importance and amount of channel learning required in MIMO based wireless communication Sauray Prakash (IITK)

Mentor : Dr. Aditya K. Jagannatham

Multiple-Input-Multiple-Output(MIMO)systems have been found to provide high data rates in wireless communication in a rich scattering environment. In MIMO systems, multi element antenna arrays are used at both the receiver and the transmitter. This is done to achieve higher spectral efficiency as compared to the earlier used SISO systems, where SISO stands for Single Input Single Output. The Channel State Information (CSI) forms an important component in Wireless Communication. This information describes how a signal propagates from the transmitter to the receiver and represents the combined effect of scattering, fading, power decay with distance and other properties associated with wireless signal transfer. The CSI makes it possible to dynamically adapt transmissions to the current channel conditions, which is crucial for achieving reliable and efficient communication with high data rates in wireless multi antenna systems, where the scattering environment is changing continuously. In a practical environment, the wireless transmission channel is not known either at the receiver or at the transmitter. Moreover, the channel keeps changing dynamically and so the channel estimations have to be repeated from time to time. Moreover, as we relatively increase the time of estimation, the reliability of channel estimation increases. However, this compromises the time available for data transmission, which decreases the throughput. Transmission power available is also fixed in most practical situations, so data and training powers also need to be considered while optimizing the capacity. This project aims at optimizing the data throughput for a system model following simple Block-Fading Law. The channel is estimated using the Linear Minimum Mean Square Error (LMMSE) estimator.



Synthesis of core/shell quantum dots for solar energy application Sazal Kumar Methi (Amity Inst. of Nanotechnology,Noida) Mentor : Dr. Raju Kumar Gupta

In this project, we have synthesized core/shell quantum dots through greener route. Our aim in this project is to synthesize Core/shell quantum dots for making Schottky diode based solar cells and depleted hetero junction based solar cells for solar energy applications. Our main objective in this project is towards green synthesis of PbSe (Lead selenide) quantum dots through hot injection method and after that synthesis of PbSe/CdSe core/shell quantum dots utilizing cation exchange method. We have utilized natural Olive oil as a solvent. X-ray diffraction and Raman spectroscopy have been utilized to confirm the synthesis of PbSe quantum dots. Transmission electron microscopy and Scanning electron microscopy have been used to observe the morphology, shape and size of materials. UV-Visible-Near infrared spectroscopy technique have been utilized to get the absorbance spectra of as synthesized material. Fourier transform Infrared spectroscopy and Nuclear magnetic resonance spectroscopy characterizations have been performed on as synthesized material to confirm the capping material and reaction mechanism.





Local periodic behavior detection and modeling in videos Shashin Singh (MANIT,Bhopal) Mentor : Dr. K S Venkatesh

The objective of this work is to design and develop an algorithm for compressing videos showcasing periodic content of some type. There are many situations where visual data has periodic content, e.g., in videos of mechanism such as a shaft and crank mechanism, a person walking, cycling, exercising etc. For such data, where the data needs to be stored and reproduced, it is interesting to find a means of exploiting the periodicity in the information to cause additional compression of the data. Conventional video compression techniques do not exploit periodicity in video content, and are therefore completely based on continuity of motion. In this project, we take the first steps towards encoding and exploiting periodicity. We proceed by evaluating the periodic content in video data. To this end, we construct temporal pixel sequences at each location in the scene. Then these strings are subjected to temporal Fourier analysis to examine the frequency content closely. Strings with only very low content signify background pixels, and can be easily compressed with preservation of just the first coefficients. Other strings which higher components signify activity strings with clear-cut line or line-like spectral content significant periodic content. The three categories can be separated, and processed, stored and compressed separately. For retrieval, the reverse process will reproduce the video with minimal error.

Study of corrosion behavior of Mg AE-42 in 3.5 wt% NaCl and 0.5N NaOH solutions Shayaree Sengupta (NIT,Durgapur) Mentor : Dr. Kallol Mondal

Corrosion behavior of Mg rare earth alloy designated as AE-42 (Al-4%, RE-2% and rest Mg) has been studied by immersion test, salt fog test and electrochemical polarization tests. Polarization studies are carried out in two different media (3.5 wt% NaCl solution (pH-7.5) and 0.5N NaOH solution (pH-12)) ambient temperature. Electrochemical impedance at spectroscopy (EIS) and polarization tests reveal a striking difference in electrochemical responses in two different solutions. Micro structural studies have been carried out using optical microscopy and scanning electron microscopy (SEM). The corrosion products are characterized after immersion test and the salt fog test by X-Ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). Electrochemical tests clearly reveal significantly improvement in corrosion resistance than that of the reported commercial pure Mg (99.9%) and some recently reported Mg alloys due to presence of rare earth alloying elements. The micro alloying addition has also contributed in strengthening to the alloy and corrosion resistance.





Single motor collective pitch quadrotor Suresh Sharma (Amrita School of Engg.) Mentor : Dr. Abhishek

Roadmap based robot motion planning Siddhant Manocha (IITK) Mentor : Dr. Amitabha Mukerjee

In this work , we attempt to learn robot trajectories that can be generalized to unknown environments. We use vision based methods to learn an effective path from source configuration to destination using roadmap based approach. We capture images of random robot configuration(Y) with corresponding joint parameters(θ).Both data are separately processed and are coupled to learn an effective map $Y \rightarrow \theta$ using Gaussian Process Regression. Dimensionality Reduction Techniques including Random Projections and Gaussian Process Latent Variable Model are implemented to form a lower dimensional embedding of image feature space to improve the mapping. Statistical evaluation of generated joint parameters against ground truth data for path generation match favorably.

This project aims to design and build a quad rotor using a novel design: one that runs on a single motor, and is controlled using four collective pitch propellers. This enables the quad rotor to be powered by an internal combustion engine (ICE), so that the endurance is increased greatly, enabling us to use the quad rotor for larger and more meaningful missions. In traditional, fixed-pitch quad rotors, stability and flight control are achieved by changing the relative RPM of each of the four fixed-pitch propellers, by the use of four brushless motors. Due to this, the control bandwidth is limited by the rotational inertia of the motors and the propellers, and they are also unable to achieve reverse thrust, making inverted flight impossible. These limitations in fixedpitch quad rotors can be overcome with the addition of variable-pitch propellers, and the use of a single motor with constant RPM enables the use of an ICE to power the quad rotor. While variable-pitch propellers add complexity to the otherwise simple design of a quad rotor, the advantages of increased agility and maneuverability, the addition of reverse thrust capabilities and the increased endurance justify the design.



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Steady state and transient analysis of helium cooled pebble bed test blanket module using RELAP5 Suthar Raj R (SVNIT,Surat)

Mentor : Dr. Prabhat Munshi & Dr. Shikha Prasad

A simulative study of the Thermal-hydraulics of HCPB TBM was done. The main objective of this work is to demonstrate that the HCPB TBM with its own cooling system does not impede the safe operation of International Thermonuclear Experimental Reactor (ITER). The solid breeder for this blanket is Lithium Orthosilicate, the neutron multiplier is Beryllium and the structural material is Ferritic-Martensitic steel. This test blanket concept employs high pressure Helium (8 Mpa) for cooling the system. A RELAP model has been developed for conducting the highly transient accident sequences of the loss of coolant type. The In-vessel leak of TBM coolant has been simulated. The present report describes the modeling for TBM as a network of numerous parallel and serial flow channels & external cooling circuit with Circulator, Heat exchanger, Piping systems etc. The analysis performed show that the Test Blanket system allows to conduct a suitable programme in ITER and meets the integration requirement in the fusion reactor.

Dropwise condensation of heavy metals (case study of bismuth)

Swapnil Jain (IITK)

Mentor : Dr. Sameer Khandekar and Dr. K Muralidhar

Dropwise condensation is a heterogeneous phase-change process in which vapor condenses in the form of discrete liquid drops on or underneath a cold substrate. The Dropwise condensation of bismuth vapor on inert surface has been studied and the condensation pattern of the vapor through a C++ program has been simulated. The C++ program was provided (earlier PhD work) but the execution time of the program was large. So parallelization has been done using Open MP for fast simulations and the execution time has been reduced by typically half. These simulations have been done to understand the condensation pattern of bismuth, deduce the transport coefficients like heat flux, shear force, minimum and critical drop radius, and hold up time before falloff takes place. Using the results obtained the total mass of bismuth collected with time has been calculated. These results are compared with the experimental data from Bhabha Atomic Research Centre (BARC), Mumbai to draw a co-relation between the experiment and the simulation and suggest improvements in the experimental design setup.



A study of causes of early corrosion in HYSD rebar used in reinforced concrete structures Tejas Baid (IITK)

Mentor : Dr S.K. Chakrabarti

Steel bars have always been known for their high tensile strength. Concrete on the other hand, has high compressive strength but low tensile strength. So, concrete is commonly reinforced with steel reinforcing bars (rebars) to form a composite construction material called Reinforced Concrete (RC) which has appreciably better tensile strength along with high compressive strength. Various types of Steel rebars are used; but common ones are Mild Steel Plain rebars and High Yield Strength Deformed rebars (HYSD rebars). Such composite construction materials behave ideally if bond between its components is perfect. HYSD bars are corrugated on the surface in order to develop desired bond between concrete and the bar itself in conformity with its material strength as per the demand of actual construction requirements, which cannot be met by the mild steel plain bars. It has been reported that RC structures using HYSD bars are failing earlier than predicted due to the occurrence of early corrosion of such bars. It is proposed to undertake a study to understand the causes of early corrosion in the HYSD bars used in reinforced concrete structures.

Attempted synthesis of centrolobine Sai Sowmya.Vaddadi (Univ. of Hyderabad) Mentor : Dr.Veejendra K. Yadav

The objective of this work is to synthesize (-)-Centrolobine which shows activity against Leishmania *amazonensis promastigotes* which has been identified as a major health risk in Brazil. Consequent to this, numerous syntheses of this molecule have appeared in the literature. We ourselves have devised a new approach to the synthesis of this molecule which is based on a strategy that we have developed in our laboratory.







Efforts towards the synthesis of hydroxy amino acids with defined stereochemistry from natural amino acids serine, aspartic acid,glutamic acid

Vaishali Chugh (Hansraj College,D.U.) Mentor : Dr.Ramesh Ramapanicker

Efforts were made to synthesize various chiral hydroxy amino acids from natural amino acids like L-serine, L-aspartic acid and L-glutamic acid. Enantiopure oxo-amino alcohol derivatives were synthesized from chiral iodide derivatives of the above amino acids by coupling them with aromatic dithianes using n-BuLi at -50 °C. Proline catalyzed α -functionalization of these oxo compounds were attempted as an effort to generate hydroxy derivatives, which could be converted to the target compounds.

Estimation of the temperature profile of a premixed LPG flame using an image intensifying digital camera Vishal Srivastava (IITK)

Mentor : Dr. Abhijit Kushari

The aim of this project was to have a non-intrusive, portable and robust technique to estimate the temperature of a flame which was then chosen to be accomplished through an image intensifying digital camera. The same was also done using a spectrometer. For this, first a series of experiments were carried out to know the spectrum of a flame of a known equivalence ratio. Then based on the results obtained and using the Planck's law of electromagnetic radiation theoretical black body temperatures corresponding to the results were calculated. Then, using a thermocouple, the actual temperatures of the flame were measured. Then both the readings obtained by spectrometer and thermocouple were correlated. After this an image intensifying digital camera with an optical filter was used and then its image output was correlated to the temperatures obtained by the thermocouple for this flame. The aforementioned correlations hence provided a way to know the temperatures of the flame using an image intensifying digital camera (equipped with optical filters) or a spectrometer.







Technical efficiency in the Indian automobile industry: a stochastic frontier analysis Yasharth Srivastava (Madras school of Eco.)

Mentor : Dr. Praveen Kulshreshtha

The Indian automobile industry is one of the major contributors to the country's GDP and has been growing at a fast pace during the last two decades. As the number of firms in the industry continues to increase, the productivity and economic efficiency of firms need to improve if the industry has to become competitive globally. In particular, it is important to examine the technical efficiency (TE) of Indian automobile firms to determine whether the firms are utilizing the available inputs efficiently. A firm is said to be technically inefficient, if the available inputs, or resources are misutilized, so that the firm's actual output is less than its potential output (i.e. the maximum possible output given the existing resources). The study employs the stochastic frontier production function methodology to measure the TE of 10 Indian automobile firms, using the latest available panel data from 2002-03 to 2012-13. The study finds that labor and capital are statistically significant determinants of automobile production in India, while advertising is statistically insignificant. Also, TE varies widely across firms (18.7% to 91.59%) and is decreasing over time (i.e. time-variant). Mean TE decreased from 67.6% in 2002-03 to 34.9% in 2012-13, which indicates that there is scope for raising automobile production by 65.1% without employing additional resources. We hope that our findings can aid managers and policy-makers in adopting appropriate strategies to improve automobile production in India.

Abstracts: SURGE 2014 research projects done in overseas universities



Energy dissipation devices in composite moment resisting frames Aditya Nigam (IITK) Mentor : Dr. Helen Goldsworthy

The approach underlying more advanced techniques for earthquake resistance is not to strengthen the building, but to reduce the earthquake-generated forces acting upon it. To address this need, new energy dissipating devices and connections with better hysteretic properties or the so called "flag shaped behavior" have to be designed. This paper focuses on two types of dissipation devices: one which combines the buckling restrained fuse type dissipater with shape memory alloy rods while the other with sliding friction energy dissipater. The fuse is made up of a dog-bone shaped steel plate and a confining tube filled with either epoxy or grout to resist buckling. The SMA rods are anchored to the beam and base plate. The base plate is slotted for the second device for sliding and cause energy dissipation by friction. The purpose of the project was to provide a comprehensive parametric study and determine the possible dimensions of the proposed replaceable devices. Also the force-displacement relationship of the two devices was tested to be in compliance with the design basis earthquake.



Studying bleeding of normal and fiber reinforced geopolymer concrete using sedimentation model

Aniruddha Baral (IITK)

Mentor : Dr. Rackel San Nicolas, Dr. Priyan Mendis, Dr.Tuan Ngo

Bleeding of concrete is an important phenomenon as excessive bleeding affects the mechanical properties of concrete and makes concrete less durable. Excessive bleeding causes channeling and it allows water containing sulfate, chlorine etc. ion from outside to enter inside the concrete. As steel fibers are homogeneously distributed and no clear cover of concrete is provided, durability of steel fiber reinforced concrete is of more importance than normal concrete. Geopolymer concrete has recently gain popularity due to its durability, fire resistance and environment friendliness. In this project, we have studied bleeding of geopolymer concrete containing steel fibers. Some researchers have found that geopolymer concrete does not bleed within practical w/b ratio; however they did not mention the reason of that. It was found that viscosity of the fluid present in geopolymer concrete in some cases is as high as ten times that of water, depending on the activator used. In general, steel fiber in concrete arrests initial bleeding rate. It was found that adding 0.25% steel fiber arrests initial bleeding rate significantly in geopolymer concrete, but not in normal concrete.







Neural response based phosphene simulator for the bionic eye Subhajit Mohanty (IITK)

Mentor : Dr. David B. Grayden

Retinal degenerative diseases such as age-related macular degeneration (AMD) and retinis pigmentosa (RD) result in the degeneration of photoreceptors in the macula and peripheral region of eye that causes impaired vision which can range from limited vision to total blindness. However the retained retinal ganglion cells (RGC) and their axons provide a method to restore some vision by a retinal prosthesis. Bionic eye is such a method which uses a microelectronic retinal prosthesis to replicate objects in our visual field. It uses an array of electrodes placed on retina to stimulate the RGCs to generate a visual scene composed of large isolated spots of light called "phosphenes". Several studies have already been done on how retina works, how retinal neurons and RGCs respond to electrical stimulation, how they process to regenerate image using models of neural activation and mathematical description of axon path. The goal of the current project is to bring all these findings together and use fine image processing techniques to create an effective simulator which will replicate the activity of the microelectronic retinal prosthesis. The current project uses Matlab as its tool to generate an epiretinal phosphine simulator. This simulator takes an image as input which acts as a representative of our visual scene. It converts the brightness of image into current scale to stimulate an electrode map on implant. Then the simulator uses the models of RGC activation, models of nerve fibre layer activation and image processing techniques to generate a visual field composed of phosphenes of different size and brightness which imitates the actual input image. It was found that both RGC and Axon activation contributes to the generation of phosphenes. RGC activation creates local phosphenes i.e. around the electrode on implant whereas axon activation generates distant phosphenes i.e. away from the electrode. The subsequent phosphene map showed good resemblance with the original picture.



SURGE 2014 – Popular lectures

Dr. Shantanu Bhattacharya

Prof. Shantanu Bhattacharya is currently Associate Professor in the Department of Mechanical Engineering at Indian Institute of Technology, Kanpur. His interest lies in Micro-system design and fabrication.

Title: Integrated Micro/nano systems for sensing and diagnostics

Abstract: Miniaturization technology starting with the famous talk by Sir Richard Feynman, "There is plenty of room at the bottom" has led to the mimicking and realization of newer phenomena both physiological and physical at the micro and nano scales. The advantages that miniaturization offers is the realization of physical systems at scales and dimensions similar to biological entities such as bacterial and mammalian cells, viruses, spores, etc. which further leads to enhancement in our capabilities to mimick biological systems with better sensing capabilities, accuracy of physical manipulation and control. We have used micro architectures to exclusively study the behavior of biological entities like bacterial cells, DNA etc. I will be reviewing some of the research in this direction done by our group. The areas are focused to the design and development of an integrated bacterial detection system, surface electrophoresis of ds]DNA across orthogonally intersecting surfaces, micro scale transport, mixing and pumping of biological fluids through arrays of micro]channels, designing and development of antivibration pads with embedded micro channel arrays and fabrication of nanoporous films and nanowires of Zinc Oxide developed with a purpose of gas sensing applications. He will also be quickly providing an overview of the Microsystems fabrication laboratory which has been commissioned within the Mechanical Engineering department.





Dr. Sanjay Mittal

A recipient of the Shanti Swarup Bhatnagar Prize for Science and Technology Prof. Sanjay Mittal is currently Professor in the Department of Aerospace Engineering at Indian Institute of Technology, Kanpur. His interest lies in Aerodynamics, CFD, FEM.

Title: Flight: The Final Frontier

Abstract: A brief history of flight will be recapitulated. This will be followed by describing the anatomy of the modern airplane. The very basic principles of flight will be reviewed. The relevance of stability and control of a flight vehicle will be motivated and simple prescriptions to achieve these will be discussed.



Dr. Ajit Chaturvedi

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

Title: The World of Mobile Phones and Computers

Abstract: A discussion on some of the key ideas that have lead to the initial development and later rapid progress in communications, specially mobile phones. An elementary description of the basic principles involved in the working of modern mobile phones will be presented. The talk will then naturally veer towards an introduction of Information Theory - the bedrock of the communication revolution. We will point out that unlike most other branches of engineering, Information Theory is a virtual contraption which is seemingly neither inspired by, nor a result of, observing or analyzing any naturally occurring phenomena.































Dr. Elizabeth and Dr. Verkey Cherian award for SURGE 2014 best project

S.No.	Student	Home Institute	Research Title	Department	Mentor
	Participant				
1	Kundan Krishna	IIT Kanpur	Normality of the Ehrenfeucht Mycielski Sequence	Computer Science & Engineering	Dr. Satyadev Nandakumar
2	Vaishali Chugh	Hansraj College	Efforts towards the Synthesis of Hydroxy Amino Acids with defined stereochemistry from Natural Amino Acids Serine,Aspartic acid and Glutamic acid	Chemistry	Dr. Ramesh Ramapanicker

SURGE 2014- outstanding poster award

S.No.	Student	Home Institute	Research Title	Department	Mentor
	Participant				
1	Ashwin Shridhar	NIT Calicut	Study of directional damping using polymer blocks with helical microchannels	Mechanical Engineering	Dr. Shantanu Bhattacharya
2	Debalina Datta	University of Hyderabad	Engineering a conditional expression construct and express PTG protein in neuronal cells	Biological Sciences & Bioengineering	Dr. S Ganesh
3	Prakhar Swarup	Indian School of Mines ,Dhanbad	Design of diamond colorimeter	Electrical Engineering	Dr. Pradeep Kumar K.

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Ms. Ankita Shukla of DORA office for coordinating the SURGE program and other staff members of the office.



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Madhav Ranganathan (Chemistry)
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From bottom to top

Row 1 (Right to Left) : Dr. Basker Sundararaju, Dr. Aditya Jagannatham, Dr. Sudhir Kamle, Ms. Ankita Shukla, Saumya, Rajalaxmi, Vaishali, Aakriti

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SURGE 2014 BATCH



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