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INDIAN INSTITUTE OF TECHNOLOGY KANPUR

R&D Newsletter

Advanced Imaging Facility at IIT Kanpur Page5

soft copy of the newsletter is available at
www.iitk.ac.in/dord/newsletter.htm

Industry Connect Talk Series

In The Industry Connect Talk Series, organized by the Industrial Collaboration Advisory Group (ICAG), speakers from the industry are invited to present their company's research areas of interest to explore possibilities of collaboration with researchers at IIT Kanpur.

Dr. Badri Gomatam and Dr. Arvind Mishra from the Sterlite Technologies Limited delivered a talk on 27th November, 2014. Sterlite Technologies Limited (STL), Aurangabad develops & delivers products, solutions and infrastructure for telecom & power transmission networks, globally. STL is among the global leaders in all its business areas of Optical Fiber, Fiber Optic Cables, Power Conductors and HV / EHV Power Cables through its operations in India, China & Brazil. Areas of possible collaboration were discussed. A possibility of supporting fellowships for students is under discussion.

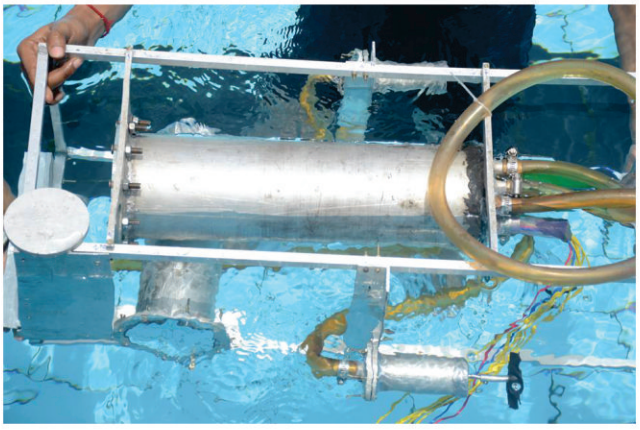
R&D News

The 5th International and 41st National conference on Fluid Mechanics and Fluid Power (FMFP-2014) was organized at IIT Kanpur during December 12-14, 2014. A total of 418 participants registered and attended this conference. Prof. Sumanta Acharya from University of Memphis, USA was the chief guest of the conference. The Plenary lecture was delivered by Prof. M. G. Worster, University of Cambridge and seven keynote lectures were delivered by eminent researchers from academia and industry. Technical presentations in eight parallel session, poster sessions on the current state-of-the–art research and technically challenging industrial applications in the areas of computational fluid dynamics, turbulence, turbomachinery, multiphase flows and nuclear reactor thermal hydraulics and displays from several industrial sponsors were organized.

Tinkering all the way!

Tinkering Laboratory is a platform for the student community of IIT Kanpur to try out ideas, iterate on designs, work with their own hands, put their ideas into action, and bring concepts to fruition. It has enabled the students to build large engineering devices, develop complex systems and represent IIT Kanpur at various national and international competitions.

Several student projects and national and international competitions have been accomplished in the laboratory. There are many student teams who are extensively using the facilities at Tinkering Lab for the events such as ROBOCON, a major festival for robotics enthusiasts, National Student Competition on Student AUV (SAVe), BAJA student India 2015 and other Formula Racing events. Tinkering Lab presently witnesses 18-20 student footfalls per day with students from all departments, batches and program working on various academic as well as club projects under the Science and Technology Council, IITK. It greatly helps the cause that the laboratory is open beyond the usual working hours.



Autonomous Underwater Vehicle (AUV)

All-Terrain Vehicle (ATV)

With “learning by doing” as its motto, Tinkering Lab is evolving each passing day. Along with the conventional machining setups for drilling, milling, lathe, sheet metal working and welding, Tinkering Lab has been equipped with the latest technologies like 3d Scanner, Injection Molding Machine and Water Jet Cutting machine to accelerate the manufacturing process and to enable the students to design, model, manufacture and inspect the sophisticated machine parts. It has also added a series of electronic devices such as function generator, controllable power supply and oscilloscopes and a wide selection of raw materials and fittings for use by students.

In its bid to inspire the students to unleash their manufacturing skills, Tinkering Lab also organizes 'Tinker Trips' to introduce them to various modern machining processes and to put their ideas into action at on-the-spot competitions. Tinkering Lab further envisions to create a design environment where students can not only develop their ideas into mechanical models and working prototypes but also intellectual property and patents. This process has already started with BT projects getting patented in the last few years.

visit Tinkering Lab at http://www.iitk.ac.in/cw/

Contact: Prof. Sameer Khandekar
samkhan@iitk.ac.in

Centre of Excellence for Large Area Flexible Electronics

Key-Personnel: Prof. Monica Katiyar, Prof. Baquer Mazhari, Prof. Y.N. Mahapatra, Prof. Deepak Gupta, Prof. Ashish Garg, Prof. Siddhartha Panda, Prof. S. Sundar Kumar Iyer, Prof. Anshu Gaur,

Sponsor: Department of Electronics and Information Technology (DeitY)

A Proposal from Samtel Centre for establishment of Centre of Excellence for Large Area Flexible Electronics at IIT Kanpur was approved in the month of November, 2014 by the Department of electronics and information technology (DeitY).

Large area electronics is on the threshold of an imminent revolution that is driven by innovative applications made possible at a much lower cost than conventional methods of manufacturing. At the heart of this revolution lie two significant capabilities: designing products that are flexible and form fitting, and their manufacturing by printing based processes. The combination of the two will lead to roll-to-roll, large volume and high throughput manufacturing much the same way as newspapers are printed on substrates that are plastics, paper, textiles or metal foils. The applications of this technology are wide and diverse including sectors such as consumer electronics, energy and health.

Owning to use of new materials and methods of manufacturing, Flexible Electronics represents a break from the past and provides India with a fresh opportunity to become a significant manufacturer of electronics. The aim of the centre is to act as a catalyst for development of flexible electronics industry in the country. Its objectives include development of a national technology roadmap in coordination with other academic and industrial partners in the country, establishment of a broad research program that leads to development of a critical set of electronic components and partner with industry to develop prototypes and commercialize the technology. The Centre would endeavor to facilitate development of a complete ecosystem for flexible electronics by bringing together equipment, material and product industry and academic and government research and development Centres. The center would have a dedicated building, an interdisciplinary team of more than 50 scientists and engineers and state of the art facilities for fabrication and characterization of electronic components on flexible substrates using printing technology.

The Centre has a broad mandate and would benefit from participation and suggestions from all faculty, research staff and students. Samtel Centre will house the Centre for Flexible Electronics till the construction of a new building.

For further details visit http://www.iitk.ac.in/scdt/

Investigating the Role of Retinoic Acid Signaling in the Development of Medical Forebrain Structures

PI: Prof. Jonaki Sen, Dept. of Biological Sciences & Bioengineering
Co-PI: Prof. Amitabha Bandyopadhyay,
Dept. of Biological Sciences & Bioengineering

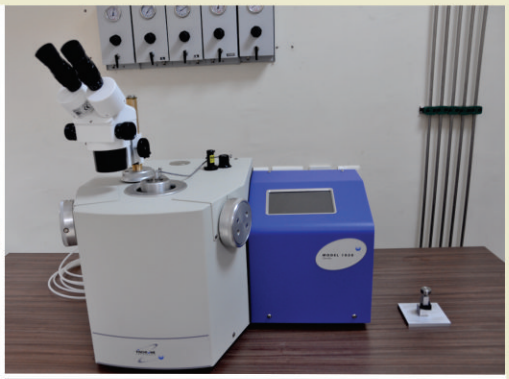
Sponsor: Department of Biotechnology

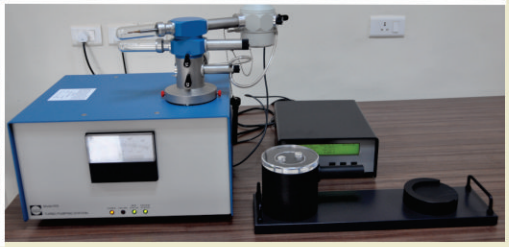
The forebrain in vertebrates develops through an intricate process involving the complex interaction of multiple regulatory factors. We have recently discovered a novel function of retinoic acid (RA), a vitamin-A derived molecule, in forebrain development. RA appears to be critical for separation of the single forebrain vesicle into two cerebral hemispheres in the chick embryo. In fact a block in RA activity leads to the failure of separation of the two cerebral hemispheres. This results in a condition closely resembling a devastating developmental disorder in humans known as holoprosencephaly (HPE).

This grant aims to characterize the role of RA in this process and elucidate any interactions of RA with other molecules in this context using the chick embryo as a model. It is very likely that understanding this process at the molecular level will shed light on the etiology of developmental disorders such as HPE in humans.

Advanced Imaging- New Research Infrastructure

Advanced Imaging at IIT Kanpur was started with a generous internal grant from the Institute to procure high-resolution transmission electron microscopes for researchers engaged cutting-edge materials research. State-of-the-art building infrastructure was created to house these microscopes, which also consists of sample preparation and wet laboratory facility and conference rooms. The following machines are installed/being installed: FEI Titan G2 60-300 TEM and FEI TECHNAI G2 12 Twin TEM; ultramicrotome for room and cryo-temperature sectioning and a Vitrobot for vitrification process.





Dynamic Graph Algorithms

PI: Prof. Surender Baswana, Dept. of Computer Science and Engineering
Collaborator: Dr. Liam Roditty, Bar-Ilan University, Israel

Sponsor: University Grant Commission and Israel Science Foundation

Graphs are used to model various computational problems and structures in real life. For example, a network of routers, network of roads, network of users on Facebook/Twitter can all be modeled as a graph so that solving any problem on these networks amounts to solving some problem on the corresponding graph. A few well known problems on graphs are connectivity, shortest paths, and matching. There exist classical algorithms which solve these problems quite efficiently for any given static graph. However, we all know that most of the graphs in real life are prone to changes. These changes may be insertion of new links or failures of existing links. These changes may cause a change in the solution of the corresponding problem as well. A trivial way to handle these changes is to run the best static algorithm for the problem after every change. However, this may take a huge amount of time. Therefore, the objective of any dynamic algorithm is to maintain some clever data structures so that the solution of the problem can be updated quite efficiently after any change in the graph. In case the changes are only failures and transient in nature, the aim is to design data structures for these problems which are resilient to these failures.

This project aims at designing efficient dynamic algorithms and fault tolerant data structures for various fundamental graph problems.

Fluid Dynamical Methods for Gravity

PI: Prof. Sayantani Bhattacharya, Dept. of Physics
Collaborator: Prof. Amos Yarom, Technion Haifa, Israel

Sponsor: University Grant Commission and Israel Science Foundation

One of the pinnacles of early 20th century physics is the theory of general relativity laid out by Einstein almost one hundred years ago. Even a century after its dawning, the geometric nature of general relativity together with some of its distinctive solutions, black holes, still captivate the imagination of scientists and amateurs alike. The complex non-linear structure of the equations of motion of general relativity, together with its talent to evade a full quantum description has kept it at the forefront of research in a variety of subfields of physics.

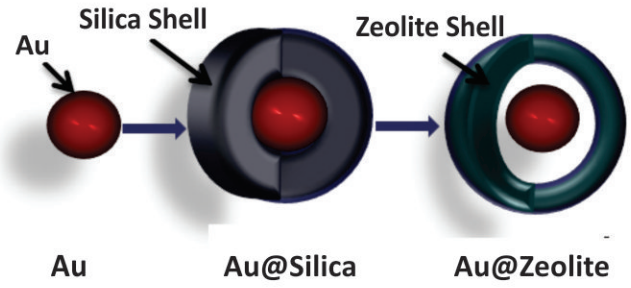
Fluid dynamics is a venerable branch of physics, its origins dating back to early Greek science though its more modern form is a few hundreds of years old. While there are facets of fluid dynamics which are not fully understood, over the last century fluid dynamics has permeated all aspects of modern life with applications ranging from atmospheric sciences to automotive aerodynamics.

Our goal, in this research program, is to use fluid dynamical methods to study black hole solutions of general relativity. While the two theories seem strikingly different at first glance, recent developments over the last five years allows for a formal mathematical construction which enables a clean relation between the two theories, a 'fluid-gravity correspondence'. Since its discovery the fluid-gravity correspondence has been used extensively to uncover novel features of relativistic fluid dynamics using geometrical methods associated with black holes in general relativity. Here we propose to use the more mature field of fluid dynamics to get a better handle on black hole physics. Apart from new types of black hole solutions and the revealing of new features of black holes in three spatial dimensions, successful completion of this program will provide us with an original viewpoint on black hole physics and new tools by which one may study general relativity.

Development of Sinter-Resistant Nanoparticles Encapsulated by Zeolite Nanoshell as Bifunctional Catalyst

PI: Prof. Sri Sivakumar, Dept. of Chemical Engineering
Co-PI: Prof. Raj Ganesh S. Pala, Dept. of Chemical Engineering
Sponsor: Science and Engineering Research Board

Modulation of activity and selectivity of catalytic nanoparticles is correlated to the control of their shape, size and surface composition. However, a formidable problem associated with such nanocatalysts is sintering due high temperature or reactants. An approach to prevent sintering of catalytic nanoparticle is to enclose them within a shell material, preferably possessing the shape selectivity. Towards this end, we propose a generic hydrothermal synthesis of sinter-resistant single metallic nanoparticle (e.g. Pt, Pd, Au, Co, Ni) and bimetallic nanoparticles (CoPt, CuLa) encapsulated by different zeolite shells (e.g. ZSM-5, MCM-22, MCM-41), which serve the dual role of stabilizing the nanoparticles against sintering and facilitating the selective catalysis. The synthesized zeolite encapsulated nanoparticles will be characterized using TEM, SEM-EDX, XRD, UV-Vis, and BET. The prepared catalyst will be tested in the various reactions such as, ring opening of methylcyclopentane, conversion of hydroxymethyl furfural (biomass conversion), conversion (biomass conversion) of p-xylene to terephthalic acid (AMOCO process).



Courts, Networks and Start-Ups: Institutions Matter for South-Asian Small Enterprises

PI: Prof. Tanika Chakrabarty, Dept. of Humanities & Social Sciences
Co-PI: Prof. Sarani Saha, Dept. of Humanities & Social Sciences
Sponsor: IDRC, Canada

The growth of business, especially small and medium scale enterprises (SME) is critical for employment generation in less developed countries. The optimism that small scale enterprises, and their traditional way of doing business, are just a transitory phase in the process of development does not hold much ground anymore. Instead, we see that large and small firms are thriving together in different types of complementary roles. Hence, understanding the growth of small enterprises and their way of doing business is critical for understanding the development process. In this study, we examine how two competing institutions of contract writing -- formal and informal legal institutions -- complement, substitute and interact with each other to affect people's decision to do business.

Students's Research Corner

The students of SAE Club, IIT Kanpur have designed and manufactured an off-road racing vehicle using institute's in-house facility. The car is powered by a Briggs and Stratton 305cc engine coupled with a Continuously Variable Transmission (CVT) and a FNR gearbox. This setup gives a peak Torque of 560 N-m after final reduction, and makes the car capable of climbing an inclination of 41^{o} from a dead stop. Maximum tested speed of the vehicle so far is 55 kmph, which will go up further with testing and tuning. The car has an adjustable double wishbone suspension at the front and a 3-link trailing arm suspension at the rear. 4-wheel hydraulic disc brakes with custom designed rotors are capable of producing a deceleration of 0.9g. The car has ergonomically designed pedal assembly to facilitate driver comfort and has large traction forces for a safe and thrilling ride in off-road conditions.

The team recently participated in the Baja Student India 2015 competition held at NIT Jamshedpur from January 5th – 11th, 2015 and was awarded with the best incoming winner trophy.

Feedback/Suggestions

dord@iitk.ac.in
chitrab@iitk.ac.in

Address for Correspondence

Dean, Research & Development
Indian Institute of Technology Kanpur
Kanpur 208016
dord@iitk.ac.in
Phone: +91-512-259 7578
www.iitk.ac.in/dord/

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