



# R&D Newsletter

Indian Institute of Technology Kanpur



SAE Formula Racing Car - designed & built by  
Students of IIT Kanpur

soft copy of the newsletter is available at  
[www.iitk.ac.in/dord/newsletter.htm](http://www.iitk.ac.in/dord/newsletter.htm)

Central Manufacturing Technology Institute (CMTI) Bangalore developed Abrasive Flow Finishing (AFF) machine in collaboration with Professor V.K. Jain, Department of Mechanical Engineering. The machine can do nano level finishing along with deburring and radiusing.



AFM @ IMTEX 2013



Machine developed jointly with IITK

## ICIUS 2013

9th International Conference on Intelligent Unmanned Systems (ICIUS 2013) was jointly organised by Department of Aerospace Engineering, Indian Institute of Technology Kanpur, Aeronautics Research and Development Board, Hindustan Aeronautics Limited and Department of Science and Technology – in collaboration with the International Society of Intelligence Unmanned Systems (ISIUS) from 25th to 27th September 2013 in the beautiful city of Jaipur. The Chair of the Conference was Prof. C. Venkatesan and Co-chairs were Dr. Debopam Das and Dr. Abhishek of the Department of Aerospace Engineering.



Inauguration Ceremony held on 25th September 2013

## STUDENTS' RESEARCH CORNER

The Society of Automotive Engineers (SAE) club of IITK participated in the 9th edition of the Formula SAE 2013 event at Ricardo Paletti Circuit - Varano de' Melegari (PR) Italy, during 13th - 16th September. The team stood overall at 33rd position among 47 teams which participated worldwide and obtained 9th and 13th rank respectively in 'cost' and 'business plan' events. The team was led by Kewal Dharmashi, Rohit Arora and several other undergraduate students under the mentorship of Prof. Avinash Kumar Agarwal, Department of Mechanical Engineering. Dr Dhananjay Kumar Srivastava and Mr Roshan Lal of Engine Research Lab accompanied the team to Italy. This is the first such student effort to build a large engineering device having various sub-systems. Most of the components except engine, tyres and wheel rim were designed and manufactured in-house by the team members themselves. The car is powered by a Royal Enfield 500 cc engine and it reaches its top speed within 5 seconds. The car has a minimum turning radius of 2.5 m. On 28th August 2013, Director Prof. I Manna flagged off the car at 4.00 PM in the faculty building parking lot.

The model car was designed and fabricated inside IIT Kanpur with active collaboration from the newly opened Tinkering Laboratory.

Some of the components were also fabricated in the Central Workshop and 4i-lab of the institute. The Tinkering laboratory initiative promotes active student involvement in design and manufacturing of hardware; the SAE student team worked enthusiastically, in unison with the staff members of the tinkering laboratory, to bring their ideas to fruition.



## RECENTLY REGISTERED PROJECTS

### Satellite Stereo Triplet Image Matching for Digital Elevation Model Generation

PI: Prof. Phalguni Gupta, Dept. of Computer Sc. & Engineering  
Sponsor: ISRO-IITK Space Technology Cell



The aim of this project is to develop a suitable triplet image matching technique for high resolution satellite stereo imagery towards digital elevation model generation. This technique should be able to generate the analogous points (conjugate points) in a set of given

imagery (two or more). It should be reliable, can take care various geometrical and radiometric constraints of the given imagery and can take into account of the triplet views available for a given point. These matching points generated through the triplet matching are primarily useful in

many applications like generating accurate digital elevation model (DEM)/ digital surface model (DSM)/ digital terrain model (DTM) of the given ground area and also for registering the given images precisely one with respect to other.

## RECENTLY REGISTERED PROJECTS

### Heterogeneous Advanced Cache and Memory Architectures for Emerging Applications and Systems

PI: Dr. Mainak Chaudhuri, Dept. of Computer Sc. & Engineering  
Sponsor: Intel Technology India Pvt. Ltd.



**T**raditional microprocessor caches are designed with static random access memory (SRAM) technology. However, growing such caches in capacity leads to high chip area overhead. Dynamic random access memory (DRAM) technology, on the other hand, offers high density at the expense of slow access latency. The increasing memory footprints of the important existing and emerging applications such as databases, web servers, photo-realistic animation, and large-scale

scientific computing simulations have motivated the microprocessor industry to look into heterogeneous cache hierarchies that are built with SRAM as well as DRAM technologies. This project squarely focuses on the design challenges of such cache hierarchies. Specifically, we explore the design of DRAM caches along several different dimensions such as optimal utilization of DRAM cache pages, replacement algorithms in DRAM caches, prefetching and scrubbing mechanisms in DRAM caches, etc..

When a DRAM cache level is added to a traditional SRAM cache hierarchy, interesting optimization problems arise. One such problem is to compute the optimal placement of data in these two parts of the hierarchy so that both latency and delivered bandwidth are optimized. This research effort is done in collaboration with the Intel architecture group.

### Development of a General Purpose CFD Solver Over a Hybrid Unstructured Grid

PI: Dr. Malay K Das, Dept. of Mechanical Engineering  
Co-PI: Prof. K. Muralidhar, Dept. of Mechanical Engineering  
Participating Institutions: IITK, IITG, IITH, BARC  
Sponsor: Board of Research in Nuclear Sciences



**T**he project is a BRNS-funded multi-institute initiative for the development of robust, general-purpose CFD-software for solving the mass, momentum and scalar transport equations at the continuum scale. The goal is to provide fast and accurate analysis to the multiphysics problems relevant to the Department of Atomic Energy (DAE)

applications. The project includes development of the basic unstructured solvers, practical engineering applications, pre- and post-processing tools, as well as a graphical user interface. The solvers will be optimized for parallel, high-performance, cross-platform computing environment. The IITK team is primarily responsible for the development and performance testing of some of

the key modules and engineering applications. The outcome of this project will be crucial for the future technology development of the DAE establishments.



## RECENTLY REGISTERED PROJECTS

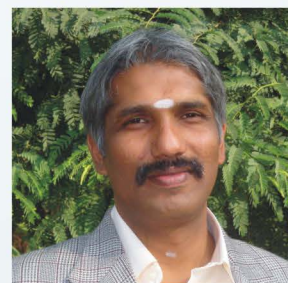
### Carbon Nanofibres Dispersed PVA-Based Microchannels: Synthesis, Fabrication and Application to Separation Processes

PI: Prof. Nishith Verma, Dept. of Chemical Engineering  
Co-PI: Dr. J. Ramkumar, Dept. of Mechanical Engineering  
Sponsor: Department of Science & Technology

Presently, a DST-sponsored project on the laser-mediated fabrication of poly vinyl alcohol (PVA)-based microchannels is underway. The polymeric film is in-situ dispersed with the transition metals- (Fe/Ni/Ag/Cu-) grown carbon nanofibers (CNFs). CNFs will be grown on activated carbon microfibers (ACF) substrate by chemical vapor deposition (CVD) using metal nanoparticles (~50 nm) and incorporated within the polymeric film during a polymerization stage. The pulsed nanosecond excimer UV laser will

be used to create microchannels (250  $\mu\text{m}$  long x 75  $\mu\text{m}$  wide) in the polymeric films (~ 1 mm thick). The fabrication-parameters such as pulse energy, pulse-frequency, and scanning speed will be optimized. By this technique, the nanometal particles and ACFs/CNFs dispersed within the film are exposed to the surrounding aqueous phase through the porous walls of fabricated microchannels, when the film is brought in contact with water to be treated. In addition to providing large adsorptive/catalytic surface area, the dispersed carbon fibers

enhance the mechanical strength of the polymeric film. The application of the fabricated microchannels in the purification of water includes arsenic and phenol removal and microbial (\*E. coli\* and \*S. aureus\*) control.



### Biosensors for Multi-Analyte Disease Detection

PI: Dr. Sidharth Panda Dept. of Chemical Engineering  
Co-PI: Prof. P.K. Panigrahi, Dept. of Mechanical Engineering  
Sponsor: Science and Engineering Research Board

Early detection of cancer is needed for effective remedial measures. A vast segment of our country's population does not have easy access to diagnostic centers due to prohibitive costs and location issues, adding to the burden of the disease. Measuring the concentration of disease biomarkers in the body

fluids is one diagnostic route. And one path of making healthcare affordable is by developing low-cost portable disease diagnostic units. This project activity is the phase II of an earlier IRHPA funded project to develop a microfluidic based electrolyte-insulator-semiconductor biosensor. Here further answers to specific research

questions will be sought and the scientific learning will be utilized to develop an integrated unit.



## RECENTLY REGISTERED PROJECTS

### Metamaterials and Designer Plasmonic Structures for Controlling Emission and Absorption of Light

PI: Prof. S.A. Ramakrishna, Dept. of Physics

Sponsor: Dept. of Science & Technology



The interaction of atoms and molecules depends on the electromagnetic environment in which the atom or molecule is placed and not only on the atomic/molecular structure. Structured materials including metamaterials can give rise to unique

and novel electric and magnetic environments, cause large local field enhancements as well as drastically modify the local density of photonic modes. These effects can affect very critically the absorption and emission of light by molecules deposited on metamaterials and plasmonic

structures. The project aims to develop control over the absorption and emission rates, and magnitudes from structured plasmonic materials and metamaterials as well as study amplifying and non-linear plasmonic structured media.

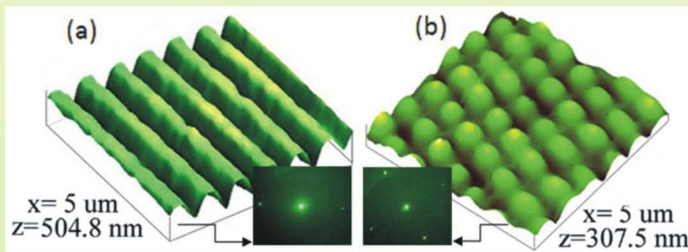


Fig. 1: Atomic force microscope image of corrugated sub-micron metal gratings with laser dye molecules deposited on them

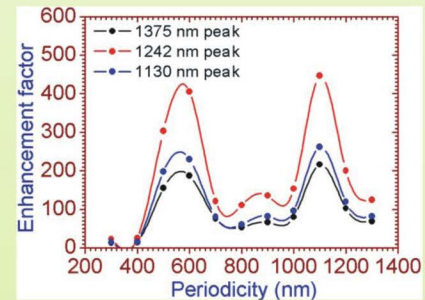


Fig. 2: Surface enhanced Raman scattering (SERS) from rhodamine 6G molecules placed on the plasmonic gratings varies with period of the grating as shown. The enhancement factors are relative to the emission from a plain gold film

### Interaction of Pulse Modulated Electromagnetic Waves with Plasmas: Electron Energy Distribution, Waves and Non-linear phenomena

PI: Dr. Sudeep Bhattacharya, Dept. of Physics

Sponsor: Council of Scientific & Industrial Research



Wave plasma interaction has been widely investigated especially with plasmas that are in steady state, inhomogeneous and nonmagnetic in nature. Its impact include generation of high-energy electron bunches in large amplitude electron plasma wave based plasma accelerator, excitation of temporal plasma-wave echoes in the ion wave regime and self-generation of magnetic fields.

However, propagation of electromagnetic waves through temporally growing plasmas has not attained much attention in experiments and is confined mainly in theory. There have been studies on pulsed plasmas in the power off phase (afterglow and interpulse plasmas) that indicate the presence of high energy electrons in this regime and need to be explored experimentally. Recently the excitation and damping of Buneman instability in

such an interaction with high power pulsed waves has been found. Furthermore, propagation of external em waves in such plasmas with high energy electron population should be explored for controlling the plasma parameters in a desired way. A detailed experimental investigation of such wave interaction with temporally growing plasma is proposed in the current research project.

## RECENTLY REGISTERED PROJECTS

### Cross Border Electricity Trade in South Asia: Prospects for Regional Cooperation

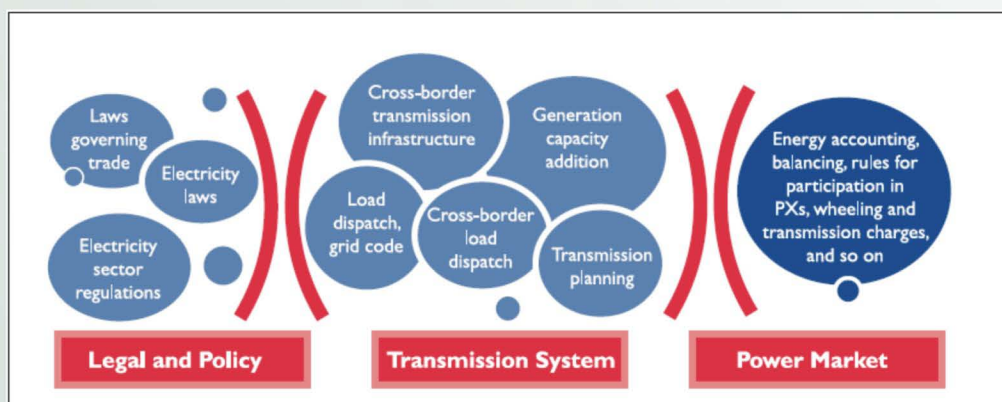
PI: Dr. Anoop Singh, Dept. of Industrial & Management Engineering  
Sponsor: Dept. of Science & Technology



South Asian nations continue to witness poor electricity access and power shortages amidst sufficient hydro-electric resources in the region. Cross border electricity trade between India-Nepal and India-Bhutan, and more recently India-Bangladesh highlight the growing cooperation in cross-border

electricity trade. International experiences, particularly those in East Asia, Africa and Europe, highlight a variety of benefits from regional cooperation in power sector. The project's objective is to produce a background paper that highlights the drivers for developing a regional power market in South Asia, draws

from international experiences and discusses existing and potential trading arrangements in the region. Paper published as an outcome of the project is "Prospects for Regional Cooperation on Cross-Border Electricity Trade in South Asia".



Key Issues for Enabling the Regional Power Market in South Asia

### Diagnosis of Cancer Using Fluorescence Lifetime Imaging

PI: Prof. Asima Pradhan, Dept. of Physics  
Sponsor: Dept. of Biotechnology



The investigation of optical techniques for the study of biomedical systems is a rapidly developing field that has seen a dramatic expansion in recent years. This project deals with development and evaluation of an all-optical method using combined

Fluorescence lifetime imaging (FLIM) and static auto-fluorescence spectroscopic measurement for the diagnosis of cancer. The facility will have a high end ultrafast gated optical intensifier, CCD and picosecond diode lasers.

The gated optical intensifier and CCD is useful for time-resolved imaging and spectroscopy applications in various areas such as plasma kinetics, fluorescence lifetime imaging, imaging through scattering media, time-gated Raman spectroscopy, LIDAR, etc.

# RECENTLY REGISTERED PROJECTS

## Project on Frugal Innovation in Design and Technology

PI: Kaumudi Patil, Dept. of Humanities & Social Sc.

Co-PI: Dr. Saikat Ghosh, Dept. of Physics

Sponsor: Ministry of Human Resource and Development

**D**espite the hurdles of low literacy, poor infrastructure, lack of access to mainstream markets and the hegemony of the manufacturing giants, small pockets of designers and innovators have survived at the grassroots level. These pockets are not just a source of livelihood but also a veritable pool of traditional knowledge which has been often neglected by the formal sector. A context specific combination of traditional skills and modern methods of design and innovation assisted by appropriate technology introduced early in the learning trajectory of a young apprentice can lead to a new generation of informed craftsmen and technicians adapted to the global scenario. This will ensure growth that is not limited to one time external interventions alone, but in the long run trigger a chain reaction of further innovations that may build a self-reliant community similar to all living and evolving practices. Therefore, the Project is envisaged as a Skill knowledge developer as well as a Skill Knowledge Provider of appropriate Design and Technology from the perspective of appropriateness, affordability and sustainability for craft communities as well as MSMEs in Uttar Pradesh. The Project aims at

- Developing appropriate designs in design communities for innovation and acceptability
- Developing appropriate technology that is either embedded in the design or helps in producing it
- Designing pedagogical methods for introducing skills for up-gradation in both design and technology in design communities at the grass-root level.
- Conceiving short modules for up-gradation of existing skills and development of related skills to enhance the level of design and technology appropriate to the community.
- Forming structures for evaluation that are community specific and geared towards employment rather than concept learning.
- Documenting knowledge of indigenous technology, design practices and systems of measurement (cues that help in deciding a furnace temperature without a thermostat or proportions without a drawing) and recognition (visual cues that help in deciding the age of wood)



### Feedback/Suggestions

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