

R&D Newsletter



Hovering Flapping bird developed at
Unsteady Aerodynamics Laboratory, I.I.T. Kanpur

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

Industry Connect Talk Series

The Industry Connect Talk Series, organized by the Industrial Collaboration Advisory Group (ICAG), has been initiated where 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.

Mr. Biju Uthup, Project Director, IUSAV, ADA, DRDO, delivered a talk on 21st March, 2014.



ADA is involved in the development of advanced aircraft to satisfy future strategic needs. Developing such an aircraft requires integration of vast number of advanced technologies into a complex system. These technologies can be technologies directly onboard or enabling technologies that ensure an advanced system. He presented some of the advanced technologies being developed at ADA as well as initiated at various partner labs across the country. Collaborations were invited on all technologies that could lead to the development of an advanced aircraft.

R&D News

Symposium on Dynamics of Complex Chemical and Biological Systems (DCCBS14)

A three-day symposium on Dynamics of Complex Chemical and Biological Systems (DCCBS14) was organized in IIT Kanpur during February 13-15, 2014 by the Department of Chemistry under the convenorship of Professors Amalendu Chandra, Madhav Ranganathan, Nisanth Nair, IIT Kanpur and Ranjit Biswas, S.N. Bose National Center for Basic Sciences, Kolkata. The conference showcased the most recent theoretical and experimental studies to understand the complex chemical and biological systems in terms of chemical and physical principles. Many eminent international and national researchers presented research papers and delivered invited lectures.



Prof. Graham R. Fleming, University of California Berkeley, delivered lecture in the symposium



Lock-In-Thermography for Solar Cell and Module Characterization

PI: Prof. P. K. Panigrahi, Center for Lasers & Photonics and Photonics Science and Engineering Programme
 Co-PI: Prof. Monica Katiyar, Dept. of Materials Sc. & Engineering
 Sponsor: Dept. of Science & Technology



Specific Objectives of the Project:

- ◆ Experimental Implementation of the Lock-in-Thermography Technique
- ◆ Characterization of silicon and organic solar cell
- ◆ Implementation of the technique for solar cell module characterization

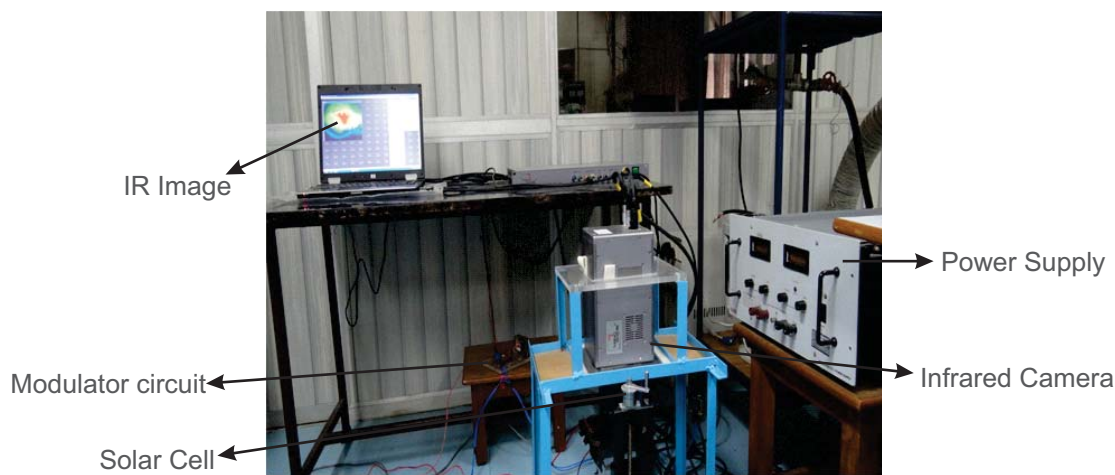
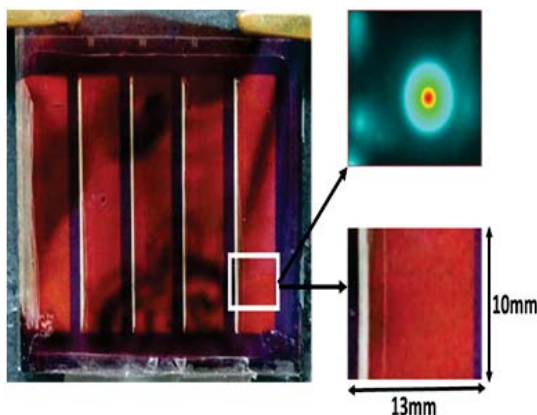


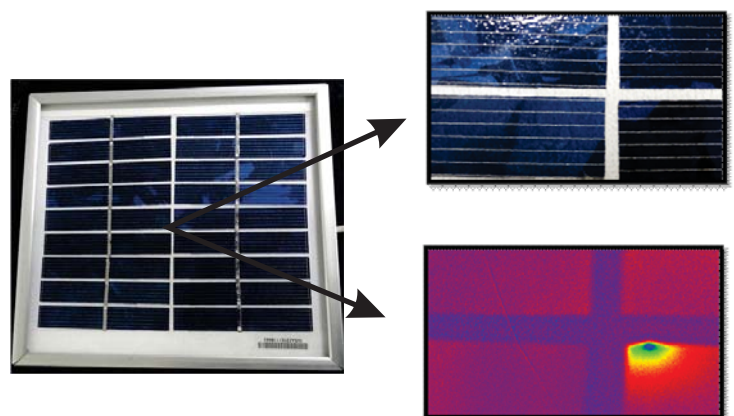
Figure: Experimental setup for lock-in-thermography of solar cell developed at IITK

Technical Results Obtained:

- The hardware setup for both dark and illuminated lock-in-thermography has been developed.
- The software for analysis of the lock-in thermal images have been developed.
- The technique is implemented for both multi-crystalline and organic solar cell.
- The technique can be suitably modified depending on requirements of fabrication, testing and degradation study of various solar cell.



Picture of organic solar cell with defect obtained from LIT measurement



Picture of a multi-crystalline solar cell and a measured defect from Lock in technique.



Design and Fabrication of Autonomous Flapping Wing Unmanned Air Vehicle for Surveillance and Aerial Photography

PI: Prof. Debopam Das, Dept. of Aerospace Engineering
Co-PI: Prof. K.S. Venkatesh, Dept. of Electrical Engineering
Prof. Abhishek, Dept. of Aerospace Engineering

Sponsor: IITK & Prabhu Goel Foundation



Flapping wing micro/mini air vehicle research is an ongoing activity of the Unsteady Aerodynamics Laboratory of the Department of Aerospace Engineering, IIT Kanpur. Dr. Debopam Das and his students have developed a design methodology for building flapping wing MAV with the support from 'National Programme of Micro-air-vehicle (NPMICAV)' of AR&DB

and DST. Dr. Das and his student Joydeep Bhowmik have successfully built several flying birds including

hovering bird with wing span of 30cm to 100cm.

The current project, aims at taking this research forward by building an autonomous, 1.5m wing span flying bird which will carry a small

camera as payload and will be able to take pictures for surveillance. Dr. Abhishek will focus on making the bird autonomous while Dr. K. S. Venkatesh's attention will be on the image capture and surveillance.



Curious crows following a Flapping Wing MAV at IIT Kanpur



Molecular and Biochemical Characterization of *Sachharomyces Cerevisiae* Actin Related Proctein 8 (ARP8)

PI: Prof. Saravanan Matheshwaran

Dept. of Biological Sc. & Bioengineering

Sponsor: Science and Engineering Research Board



The eukaryotic genome is packaged into nucleosomes, in which the DNA is wrapped around histone octamers and forms higher order chromatin. Alteration of chromatin structure is essential for DNA transaction processes like replication, transcription, recombination and repair. It has been shown that Actin Related Proteins (ARPs) are part of INO80 chromatin remodeling complex, the only known complex have role in DNA damage recognition and repair. Several studies have demonstrated that access to the DNA damage buried in nucleosome core is essential

to repair the DNA damage. Recent studies have shown that Arp8 can binds to core histone and hypothesized that it may have role in nucleosome assembly and disassembly during and after the repair. However it is not clear, how these complexes have such role and what is the molecular function for Arp8. The project will help us to understand the molecular and biochemical function of Arp8 on its own or with other interacting proteins.

Dynamic Response of Foundation Components through Full-scale Field Tests

PI: Prof. Prishati Raychowdhury, Dept. of Civil Engineering

Collaborator: Mr. G. Prabhakar, NPCIL, Mumbai

Sponsor: Department of Atomic Energy (BRNS)



The objective of this research is to carry out field tests on full-scale foundations to understand the behavior of rocking shallow foundations under seismic loading. An eccentric mass shaker will be procured for this purpose. The mass shaker will be used to excite structural and/or foundation components, while the responses of the footing and nearby soil will be measured using acceleration and displacement sensors. Instrumentation will include strain gauges, accelerometers and displacement transducers. The

measured responses of the footing and surrounding soil are expected to shed light on following behavior of the soil-foundation interface: nonlinear force-deformation behavior, strength and stiffness degradation, kinematic interaction, hysteretic and radiation damping contribution, gap formation, and so on. The results of the experiments will be used to validate and update the existing theoretical models for predicting soil-foundation interface

Science and Technology of Water Harvesting and Management in the Medieval Fort of Kalinjar in Central India

PI: Prof. Shivam Tripathi, Dept. of Civil Engineering

CO-PI: Prof. Naren Naik, Dept. of Electrical Engineering

Prof. Javed Malik, Dept. of Civil Engineering

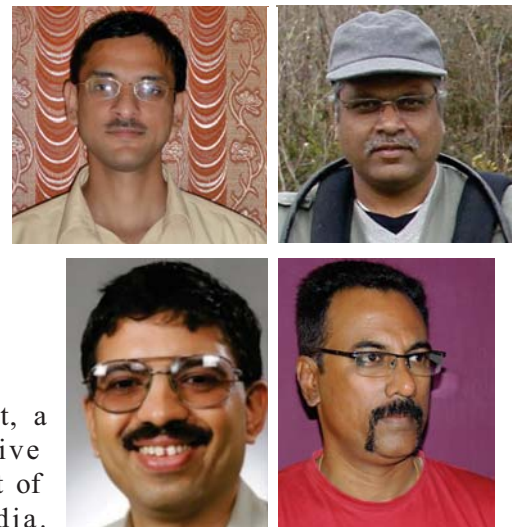
Dr. Bhuvan Vikrama, Archaeological Survey of India

Sponsor: MHRD

The project aims at understanding the science and technology of water harvesting and management in medieval forts of Central India. We are studying the role of hydrology in selection of fort sites, the principles of design and maintenance of surface and sub-surface water harvesting bodies, water distribution and drainage network in a fort, and measures adopted to mitigate the effects of hydrological extremes. A detailed hydrological investigation will be carried out at

Kalinjar fort, a representative medieval fort of Central India.

The research team involves experts in archeology, hydrology, and sub-surface imaging. The knowledge accumulated will be used to develop a short course on water harvesting and management of medieval forts.



(a)



(b)

Figure: Water bodies in the Kalinjar fort (a) Ram Katora and (b) Connected surface pond

Recently Registered Projects



National Facility for Application of Science & Technology in Archaeology and Cultural Resource Management (CRM)

PI: Prof. Onkar Dikshit, Dept. of Civil Engineering

Sponsor: MHRD

The objective of the MHRD funded project is to set up a National facility in the area of application of science and technology in archaeology and Cultural Resources Management (CRM). The facility is expected to contribute in multi-disciplinary areas such as: (i) Promotion of Cultural Tourism by creating a GIS based database (ii) Assistance in the preservation and dissemination of cultural heritage by developing a Cultural Resource Management (CRM) System (iii) Betterment of techniques for archiving, preservation and dissemination of Cultural Heritage of India (iv) Paradigm shift in learning of archaeological sciences, development of resource material in digital archaeology and capacity building in use of science and technology in Archaeology.

The project activities will encompass strengthening of existing facilities for S&T application in archaeological research in five broad areas (i) Integrated

Geoinformatics Technology (ii) 3D scanning for data generation (iii) Dating (iv) Analysis of construction materials, foundation studies and seismic retrofitting and (v) Archaeo-materials and by executing relevant collaborative research projects with researchers from IIT Kanpur, other academic institutions and government departments and extend all support to potential researchers in the area with the help of developed facilities. Various stake holders in the activities of the center include (i) Technical institutions (IITs, NITs and other engineering colleges (ii) Universities and research institutes involved in the area of archaeology, history, culture (iii) Archaeological Survey of India and State departments of Archaeology (iv) National & State museums (v) Ministries of Culture and Tourism of Centre and State governments.



A Study on the Interaction Between Formal and Informal Institutions and Its Effect on Entrepreneurship

PI: Prof. Tanika Chakrabarty, Dept. of Humanities & Social Sc.

Co-PI: Prof. Sarani Saha, Dept. of Humanities & Social Sc.

Collaborator: Prof. Anirban Mukherjee, University of Calcutta

Sponsor: Indian Council of Social Science Research



This study focuses on legal barriers that prevent new small and medium entrepreneurs to enter the market and create jobs. In the context of

developing countries informal dispute resolution mechanisms thrive parallelly, and often come in the way of, formal court system. Such interactions have

consequences for upholding contracts involved in starting a new business. This project has important policy implications in India where making the formal court system stronger is one of the focus area of governance related policies. Unilateral strengthening of the court system may bring some negative impact and therefore much caution is needed while designing these institutions.

CO₂ Sequestration in Marine Hydrate Sediments with Simultaneous CH₄ Recovery

PI: Prof. Malay K. Das, Dept. of Mechanical Engineering
 CO-PI: Prof. Naveen Tiwari, Dept. of Chemical Engineering
 Sponsor: Department of Science & Technology



Sequestration of CO₂ in geologic formations is a technologically and financially viable option for controlling CO₂ concentration in ambient atmosphere. Present proposal involves sequestration of CO₂ in marine hydrate reservoirs, which are the repositories of naturally formed CH₄-hydrates. While CH₄-hydrate constitutes the largest resource for CH₄ fuel, recovery of CH₄ from the marine hydrate reservoir seems to be quite challenging. Injection of CO₂ in the CH₄-hydrate reservoir enhances CH₄ recovery via formation of CO₂-hydrate. Sequestration of CO₂ in its hydrate form ensures safe and long-term storage of CO₂ in large amount. Finally, the sequestration of CO₂-hydrate in marine hydrate reservoir helps to maintain the structural integrity of the fragile marine ecosystem. The proposed research involves modeling of CO₂ sequestration in marine hydrate reservoir followed by the development of 3-D, transient, hydrate reservoir simulator. The model involves the nonlinear coupling of mass, momentum and energy transport with the kinetics of hydrate formation/dissociation as well as

phase changes. The fundamental model comprises multiphase flow in an unsaturated porous media where the media properties vary in space and time. The kinetics of formation and disappearance of gas, liquid, and hydrate phases are adapted from experimental results available in the literature. The model includes the effects of water salinity, CO₂ solubility in liquid H₂O as well as the influence heat transfer and ice formation on the overall dynamics of the process. Simulations are proposed to be carried out for Indian conditions, predict the amount of CO₂ that can be disposed off in the marine environment and the consequent amount of methane produced from the reservoir.



Investigation of Solute Interdiffusion in Aluminum Alloys

PI: Prof. Kaustubh Kulkarni, Dept. of Materials Sc. & Engineering
 Sponsor: General Motors Global R&D, Warren, MI, USA



Aluminum alloys are the most attractive materials in the automobile industry today due to their low cost and high strength-to-weight ratio. Significant light weighting has already been achieved by use of Al-alloys in automobiles. Developing next generation of alloys based on Aluminum and the new processing routes that give the desired properties at low cost are the two critical requirements for increasing the utility of Al-alloys to obtain further light-weighting and fuel efficiency. Understanding the diffusion behavior of multicomponent aluminum alloys is the key factor in

development of innovative alloys and processes. Hence, the objective of this project is to study the interdiffusion behavior of various alloying elements (e.g. Si, Cu, Mg, Li, Mn, Zn etc.) in the Al matrix. Various binary as well as ternary systems will be investigated to get the multicomponent interdiffusion coefficients in these systems as functions of compositions. Single phase and multi-phase diffusion couples will be assembled for the diffusion studies. The focus will be mainly on understanding the multicomponent effects in the interdiffusion of various elements in Aluminum.

SandHISangrahalaya

Museum of Scientific Study of Indian Knowledge Systems

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

CO-PI: Prof. Saikat Ghosh, Dept. of Physics

Prof. Anurag Gupta, Dept. of Mechanical Engineering

Prof. Mahendra K. Verma, Dept. of Physics

Sponsor: MHRD

The SandHISangrahalaya is envisaged as an interactive platform for displaying the finest intellectual achievements of the Indian mind in the field of science and technology as expressed and manifested in its material culture. It is a celebration of Indian science and technology as understood through the remnants of the past in the archived as well as living traditions of the country. The SandHI projects decoding and analyzing various areas of science and technology such as water harvesting systems, sound engineering, tectonic and seismic analyses as well as metallurgy will feed into the museum content directly. The museum will thus mark the progress of the projects and also be in a constant stage of evolution as data is added, modified or

deleted from its content. Therefore, unlike the traditional museums, content here is open ended, improvisatory and evolutionary. More interestingly, it follows a bottom up approach of constructing scientific principles from the knowledge embedded in artifacts or other tangible manifestations of their creators as well as their environment. In most museums, principles are displayed independent of their applications but the interactivity of this museum would lie in the manner in which it would facilitate the derivation of a principle rather than its elicitation. In this sense, the museum content is designed as a learning pedagogy rather than an exhibition or a display.

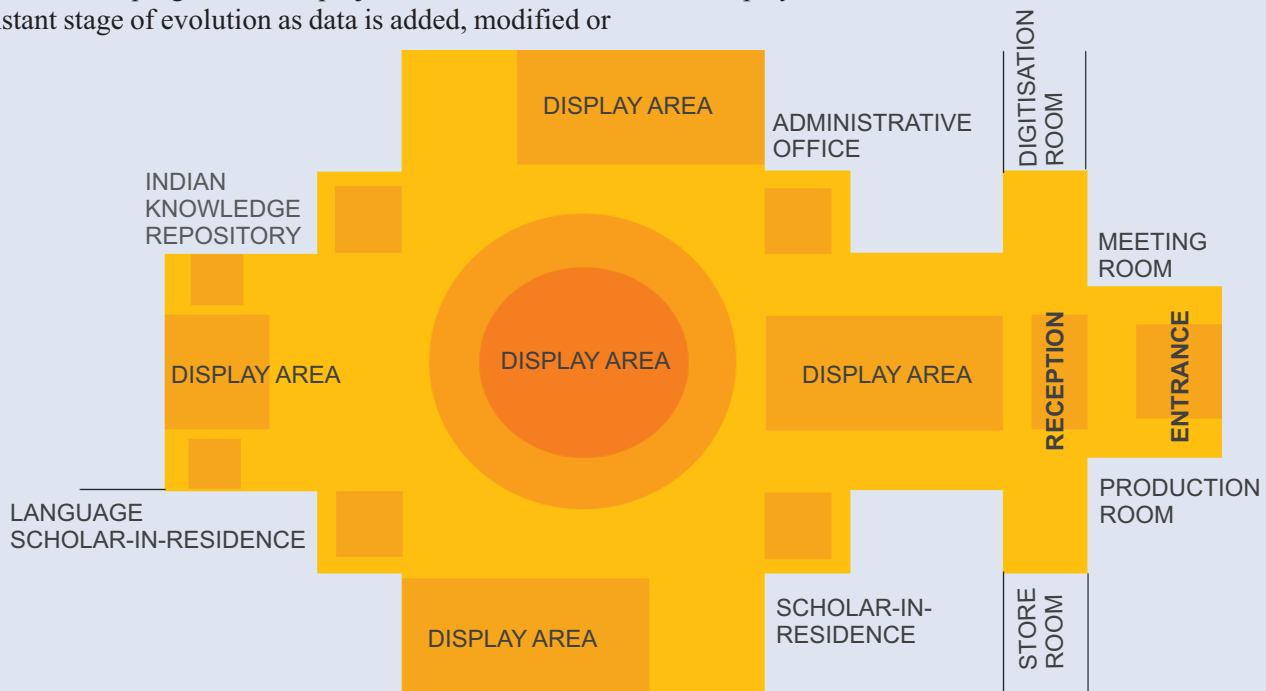


Figure: This is an artistic rendition of the possible museum plan which only denotes the activities associated with the museum.

Feedback/Suggestions

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