



R&D Newsletter

Indian Institute of Technology Kanpur

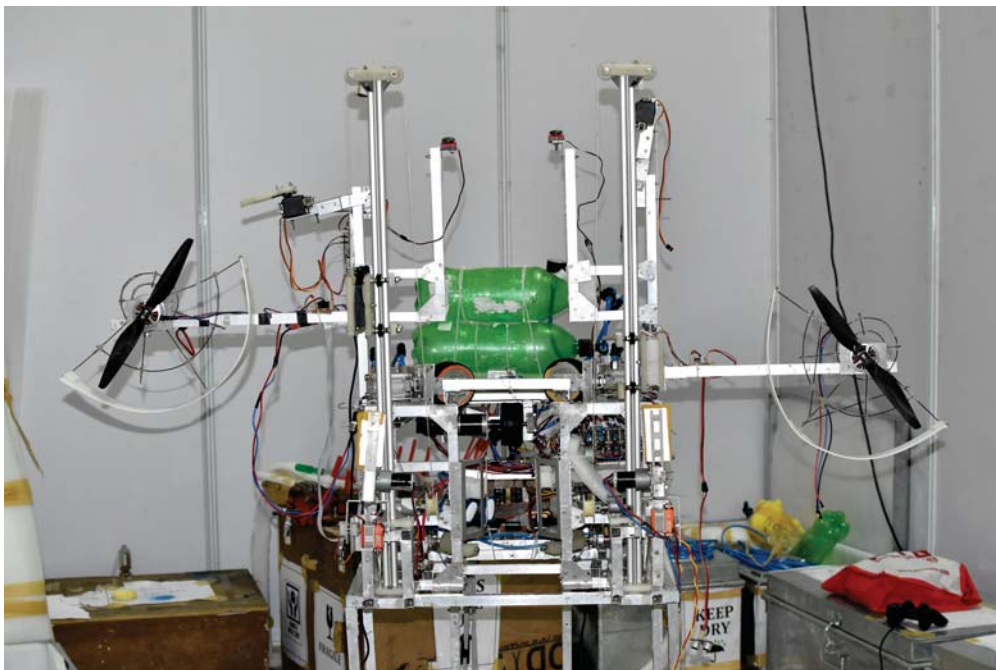


IIT Kanpur @
Robocon 2016
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ROBOCON 2016

A team of IIT Kanpur students participated in ROBOCON 2016. The team stood second runner up among 105 teams from all over the country. ABU ROBOCON is an Asia Pacific Inter Colligate Robotics competition which aims at providing a platform to robotics enthusiasts and help drive advancements in robotics technology. IIT Kanpur has been participating in the event since its inception.

Advances in eco-friendly technology is the need of the hour. Keeping that in mind the problem statement of ROBOCON 2016 dealt with this theme of 'clean energy recharging the world'. This year the objective was to develop two semi-autonomous Robots, with one (Hybrid bot) providing non-contact driving energy to propagate the other (Ecobot) on a path containing Slopes and Hills, River, and Down Hill, then exchange a wind propeller to climb up a Wind Turbine Pole (about 2m) in order to assemble Wind Turbine in automated mode. Wind energy was used as the non-contact energy source by the team. The Ecobot was fabricated using light weight balsa wood and implemented Image processing to steer along the course. Other techniques like wall following (using ultrasonic sensors), line following (using line sensors), pneumatic pressure actuation (for the pole climbing) and PCB Designing were also used in its functioning. The team successfully executed the full problem statement.





Invent Incubator

An Orientation of the INVENT program, a program for incubation of 'For profit Social Enterprises' was held on 29th July, 2016. The objective of the meeting was two-fold

- ❖ Disseminate the information about the program to various stakeholders
- ❖ Invite and partner with the stakeholders for their participation in the program for the purpose of sourcing, further dissemination, technical and advisory inputs.

About 26 stakeholders were present which included representatives of technical Institutes, Central Research Institutes, Entrepreneurs from the social enterprise space, representatives of few NGOs and representative from Villgro Innovation foundation, the executing partner organization for INVENT program.

National Initiative for Developing and Harnessing Innovation (NIDHI) Programme is an initiative by the Department of Science and Technology for nurturing ideas and innovations into successful startups. SIIC has started recently two initiative under NIDHI - NIDHI EIR Program and NIDHI PRAYAS program.

NIDHI-EIR (Entrepreneur in Residence) Program



The objective of Entrepreneur in Residence (EIR) program under NIDHI is to encourage graduating students to take up entrepreneurship as a career option by providing fellowship support. It will give opportunity to the deserving and budding entrepreneurs to pursue their ventures without any additional risks involved in technology-based businesses. SIIC will facilitate fellowship grant to budding entrepreneurs for pursuing a promising technology business idea. Subsistence grant will be provided to the selected entrepreneur to partially set off their opportunity costs of high paying jobs. Thus it will help to create, nurture and strengthen a pipeline of entrepreneurs for incubators.

NIDHI-PRAYAS Program

Promoting and Accelerating Young and Aspiring technology entrepreneurs (PRAYAS) program under NIDHI is specifically created to support young innovators to turn their ideas into proof-of-concepts. The support will allow the innovators to translate their innovative idea into a prototype and to reach a stage where they have a ready product and are willing to approach incubators for commercialization. Hence, NIDHI-PRAYAS can be considered a pre-incubation initiative and a source of pipeline for incubators. The program will attract a large number of youth who demonstrates problem solving zeal and abilities to work on their new technology/knowledge/innovation based startups. SIIC, IIT Kanpur will facilitate prototype funding to an innovator for a maximum amount of Rs. 10 lakhs with a cap of supporting 10 such innovators per year and will provide a dedicated fabrication lab facility in IIT Kanpur campus to the innovators funded under this scheme for developing their prototype. It will help to build a vibrant innovation ecosystem, by establishing a network between innovators.





Deciphering the Neuroprotective Mechanisms of Ayurvedic Formulations *Amalaki Rasayana* and *Rasa Sindoor* using Animal Models of Lafora Neurodegenerative Disorder

PI: Prof. S. Ganesh, Dept. of Biological Sciences and Bioengineering
Sponsor: Science and Engineering Research Board, DST

Progressive decline in neurocognitive functions, memory, and voluntary coordination of muscle movement are often associated with the death of neurons and are the common symptoms associated with a diverse set of neurodegenerative disorders such as Alzheimer's disease, Parkinson's disease and several forms of ataxia. Despite the progress made in the diagnosis, effective therapies are currently lacking for a majority of the neurodegenerative disorders. Emerging concepts suggest that the neurons die due to “imbalance” in a number of cellular and metabolic pathways and that restoring the “balance” might protect the neurons and delay the disease progression. Indeed the Ayurvedic formulations are thought to provide such “holistic” protection to the central nervous system, but the underlying mechanisms have not yet been dissected using appropriate model systems, and their mode of actions are yet to be fully understood. Towards this goal, this proposal aims at elucidating the molecular mechanisms behind the neuroprotective functions of two Rasayanas, namely the Amalaki Rasayana and Rasa-sindoor, using genetically created animal models for a neurodegenerative disease known as Lafora disease. The knowledge thus gained would help us in establishing the scientific basis of rasayan functions, and in furthering our understanding of the Ayurvedic concepts. Such comprehensive knowledge would also help us in advancing our “holistic” approach to “Healthy Aging” since a majority of the symptoms seen in progressive neurodegenerative disorders are also seen in the aging process.

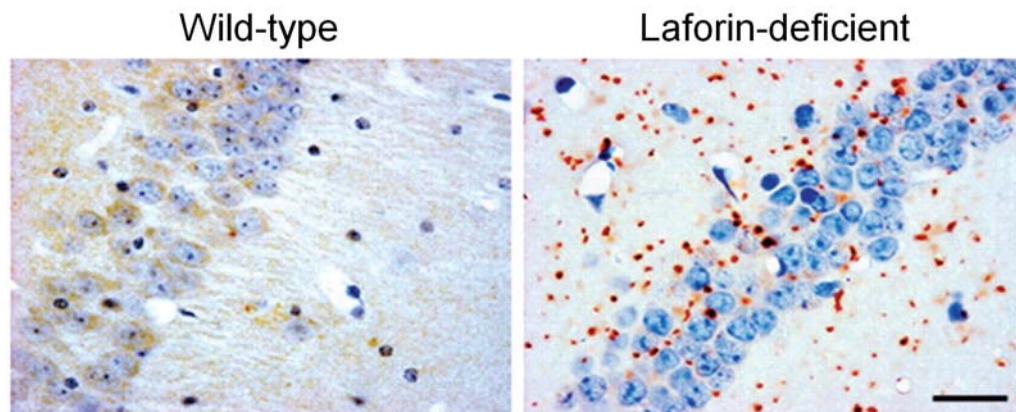


Figure : The presence of neurotoxic intraneuronal Abeta amyloids (brown color spots) in the hippocampal region of the laforin deficient mouse brain (Laforin KO; Lafora disease mouse model) and not in the age-matched healthy animal (wild-type).

Exploiting ADENO-Associated Virus (AAV) Modulated Host Cellular MicroRNAome to Improve its Therapeutic Gene Transfer



PI: Prof. Jayandharan G. Rao, Dept. of Biological Sciences & Bioengineering

Sponsor: Department of Biotechnology (DBT), India

Cellular microRNAs are known to modulate the life cycle of different viruses such as hepatitis virus and human immunodeficiency virus. Surprisingly, there are no reports on AAV - induced global changes in the host microRNAome. It has been reasoned that AAV induced variations in the host cellular microRNAome may contribute to differences seen in their gene expression in different tissues. Understanding this phenomenon in a tissue-specific manner can be exploited to fine-tune gene expression from AAV vectors used for gene therapy. This is possible by regulating the microRNAs that might interfere with the virus cellular entry, cytoplasmic trafficking, nuclear entry, uncoating to until the final stage of gene expression. Further, we propose to test their functional effects on AAV mediated gene therapy in a transgenic model of a coagulation disorder such as hemophilia.

Cobalt Catalyzed C-H bond Functionalization

PI: Prof. Basker Sundararaju, Dept. of Chemistry

Sponsor: Science & Engineering Research Board, DST



The primary objective of the proposed research is to develop general, efficient, cost-effective, new and useful transformations through carbon-hydrogen bond activation reactions. While extensive synthetic methodologies have been developed based on oxidative addition reactions of C-X bonds (X=halogen, heteroatom), catalytic C-C bond forming reactions arising from C-H bond activation are less common despite the wider availability, price and environmental advantages of the starting hydrocarbons compared to functionalized compounds. The reactions arising from C-H bond activation will complement the current methods for C-C bond formation and will have a substantial impact on synthetic methodologies. Though Noble metals have been exploited for carbon-hydrogen functionalization for about a decade, application of these methodologies in large scale synthesis is not viable due to their higher cost.

In this project, Cobalt-catalyzed alkylation, vinylation, alkynylation, amidation, allylation, atom transfer reactions of sp^2 and unactivated sp^3 C-H bonds will be explored with an objective to apply them in the synthesis of biologically relevant unnatural derivatives. Furthermore, low-valent, electron-rich cobalt complexes as catalysts for direct activation of alkanes including methane will also be explored. Indeed, the preliminary results have already been found by the PI, which show that the developed cobalt-catalyzed C-H bond functionalizations are effective for sp^2 C-H bond atom transfer reaction, redox cyclization, and allylation. The proposal relies on a substantial preliminary results that firmly point to the fact that the chemistry proposed is viable and will lead to useful methodologies. The proposed research involves the formation of structural motifs that are prevalent in bioactive molecules. The successful implementation of the research offers the potential to lower the costs associated with the production of pharmaceuticals.

Recently Registered Projects



Engineering of Security Hardened Cryptographic Protocols for Critical National Infrastructure

PI: Prof. Sandeep K. Shukla , Dept. of Computer Science and Engineering
Prof. Manindra Agrawal , Dept. of Computer Science and Engineering

Industry PI: Manish Bajpai, Nivetti Systems, Bangalore

Sponsor: MHRD/Department of Science & Technology
Ministry Of Communication & Information Technology

Industry Partner: Nivetti Systems Private Ltd. (NSPL)

SSL/TLS provides the secure tunnel for https traffic while using world wide web to purchase products, or login securely on a website. Transport Layer Security (TLS) and its predecessor Secure Socket Layer (SSL) are cryptographic protocols used for secure communication over a computer network, and are widely used for providing data confidentiality, and data integrity during e-commerce, banking, VPN, secure tunneling in IP-SEC, and other data communication in a critical infrastructure, and possibly in the Internet-of-things (IoT). SSH is another protocol to establish secure login, file transfer etc., to a remote server.

It has been revealed by Edward Snowden that VPN tunneling is not secure against snooping by the US National Security Agency (NSA), and more recently at the 2015 CCS conference it was revealed that the US NSA is breaking Diffie-Hellman key exchange protocol to obtain secret keys established for SSL/TLS sessions. Most commonly used implementations for SSL/TLS is openssl and for SSH, openssh libraries which are suspected to have back doors, and weaknesses. A powerful national agency such as the US NSA might have implanted such trojans or can exploit such weaknesses. From a National Security perspective, it is an imperative to either (i) use program analysis/formal methods to verify that these library implementations do not have trojans, or other exploitable vulnerabilities; and/or (ii) implement our own on top of a trusted kernel carved out of the existing implementation that we could verify. Nivetti Systems is a company developing a fully indigenous routing and switching equipment using its next generation Network Operating System 'OmniOS' which has been indigenously developed using a grounds up approach for nationally critical and strategic applications such as defense and critical government infrastructure. IITK and Nivetti Systems are partnering in this project to develop such a secure implementation of SSL/TLS libraries which Nivetti system will commercialize both by implementing it in their routers and switches, and also possibly as standalone libraries to be mandated by the government to be used in critical products in the country. It is also planned to develop cryptographic co-processors for the symmetric key encryption to speed up the performance of the secure communications through cryptographic tunneling. Nivetti system plans to commercialize such coprocessor cards as well.



Figure: Post Doctoral fellow Dr. Asan Basiri working on a cryptographic co-processor development on a Xilinx FPGA based prototyping environment

This Project is under the scheme of Uchhatar Avishkar Yojana (UAY) of Govt. of India

Numerical and Experimental Investigation of Water Movement in Heterogeneous Unsaturated Soils



PI: Prof. Richa Ojha, Department of Civil Engineering
Sponsor: Science & Engineering Research Board, DST

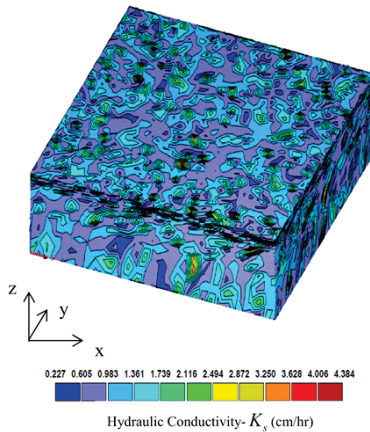


Figure: Heterogeneity in saturated hydraulic conductivity at field-scale

Describing field-scale water movement in unsaturated soils is complex because of the nonlinear nature of the governing equations and the natural variability exhibited by different controlling factors (e.g soil properties, topography, boundary conditions). In India, where more than 60 % of the land is used for agricultural purposes, till date only a few studies for understanding the effect of heterogeneity on water movement at field-scale have been performed. In this project, a field-scale experimental set-up will be established to study the effects of soil heterogeneity on water transport in agricultural fields with rice and wheat crops. Measurements of soil hydraulic parameters at field-scale will be utilized to develop analytical and numerical models for water movement in heterogeneous unsaturated soils.

Agarose based Wound Dressing

PI: Prof. Vivek Verma, Dept. Materials Science and Engineering
Co-PI: Prof. Ashok Kumar, Dept. Biological Sciences & Bioengineering
Prof. T.S. Sampath Kumar,
Metallurgical and Materials Engineering, IIT Madras
Sponsor: Department of Science & Technology
(Technology Systems Development Programme)



India is a developing nation where the quality of life of people is also improving. This necessitates the improvement in healthcare products. Indian wound care market is expected to reach US\$5.5 billion by 2020. However the wound care market is still ruled by multinational players raising cost of the final product.

In the current project, it is proposed that fabrication of cost-effective agarose based materials that can be used for wound dressing as well as drug delivery patches. Different cross-linkers, reinforcements and functionalization strategies would be employed to manipulate the strength of the material, swelling percentage, water vapor transmission rate and gas permeability to suite various wound types.

Recently Registered Projects



A Framework for Synthesizing Robust Motion Primitives for UAVs

PI: Prof. Indranil Saha, Dept. of Computer Science and Engineering

Sponsor: Science and Engineering Research Board, DST

Unmanned Aerial Vehicles (UAVs) have potential to be useful in many application domains such as mail and good delivery, monitoring and surveillance, search and rescue, law enforcement etc.. However, currently, the use of UAVs has been limited to applications where they can be controlled manually either by following them visually or based on the video feedback that is obtained from onboard cameras. The biggest challenge for a UAV to operate in outdoor environments automatically is its lack of capability in dealing with the environmental disturbances, such as wind gusts. The aim of the project is to build a framework for synthesizing robust motion primitives for UAVs and a reactive motion planning technique that can utilize those primitives to navigate the robot safely in the presence of environmental disturbances.

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| 7 | 15 | 23 | | 39 | 47 | | | | | | | 103 | 111 | 119 | 127 | 135 | 143 | |
| 6 | 14 | | | 3 | | | | | | | | 102 | 110 | | | 134 | 142 | |
| 5 | 13 | | | 37 | 45 | 53 | 61 | 69 | 77 | 85 | 93 | 101 | 109 | | | 133 | 141 | |
| | 12 | 20 | 28 | 36 | 44 | 52 | 60 | 68 | 76 | 84 | 92 | 100 | 108 | 116 | 124 | 1 | | |
| | 11 | | | 35 | 43 | 51 | 59 | 67 | | 83 | 91 | | 107 | | 123 | 1 | | |
| | 10 | | | 34 | 42 | 50 | 58 | | | | | 90 | 98 | | | 130 | 138 | |
| 1 | 9 | 17 | | | | | | | | | | 89 | 97 | 105 | 113 | 121 | 129 | 137 |

Mails and Packets being delivered by UAVs

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