

Volume 12, Issue 1

February 2024

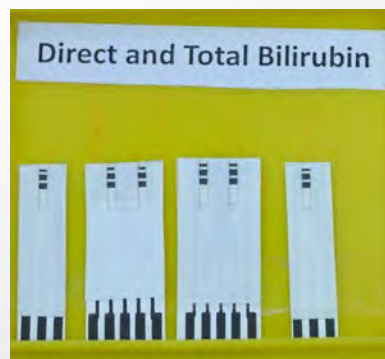


R&D Newsletter

Indian Institute of Technology Kanpur



IIT Kanpur showcased
3 Technologies
in IInvenTiV 2024



more highlights

- Tech Corner
- Collaborations
- Recent Major Projects
- Technopark @iitk
- Institute Lecture Series

www.iitk.ac.in/dord

License 5G RAN to Tejas Networks, a Tata Group Company

A 5G Radio Access Network (RAN) technology, collaboratively developed at IIT Kanpur, IIT Madras & SAMEER, has been officially licensed to Tejas Network – a Tata Group company. The technology, from a multi-institutional 5G Test Bed project funded by the Department of Telecommunications, Government of India, will enhance India's pioneering efforts in groundbreaking transformative innovation and create significant growth opportunities for the rapidly evolving telecommunications industry.



Technology Transfer to Ecotech Instruments

IIT Kanpur licensed a technology titled 'Selective Collection of PM10 and PM2.5 Particles from Dust Samples for Chemical Analysis,' a technical know-how, developed by Prof. Mukesh Sharma from the Department of Civil Engineering, to Ecotech Instruments Pvt. Ltd on November 10, 2023. The novel technology is the PM10 and PM2.5 Profile Sampler, selectively collects PM10 and PM2.5 particles from dust samples or direct source emissions onto a chosen filter matrix.

Pan-IIT Global Technology Summit

The Pan-IIT Global Technology Summit held on December 8th and 9th, 2023 in Bengaluru witnessed an unprecedented gathering of around 5000 participants hailing from diverse sectors such as industries, academia, government, startups, and various stakeholders.

IIT Kanpur made a significant impact at the summit with three distinctive stalls that highlighted its prowess in innovation, research, and technology transfer.

The Startup Incubation and Innovation Centre (SIIC), the Cyber Physical Systems Innovation Hub (C3i Hub), and a comprehensive overview of research at IIT Kanpur were the focal points, serving as a testament to the institute's commitment to pushing the boundaries of knowledge and fostering industry collaborations. Our faculty members actively engaged in various panel discussions. The summit solidified the institute's global presence, showcasing its dedication to shaping discourse and fostering collaborations for impactful solutions in real-world challenges

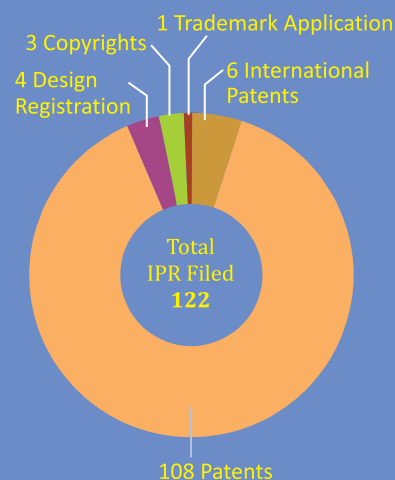


IIT Kanpur Breaks Records with 122 Intellectual Property Rights (IPRs) in 2023

IIT Kanpur has achieved a significant milestone by filing 122 Intellectual Property Rights (IPRs) & achieving an exceptional licensing rate of around 14% in the calendar year 2023.

A total of 167 IPRs have been granted in the calendar year 2023, and 15 technologies have been licensed. The patents cover a wide range of domains, from MedTech to Nano Technology, including groundbreaking healthcare solutions like a portable medical suction device and a continuous lung health monitoring system. Other notable patents filed this year encompass solid-state sodium-ion batteries and a low-cost Braille learning device for the blind and visually impaired.

The IP and Technology Transfer Office at IIT Kanpur has also facilitated increased technology transfer transactions, disseminating technologies from academia and research to the commercial sector.



Collaborations

MOU Signed with CWE



IIT Kanpur signed an MoU with Commander Woks Engineer (CWE) Lucknow to work in the areas of Net Zero Carbon and Solid Waste Management in Lucknow Cantonment.

Col Mayank Sundriyal (CWE Lucknow), Maj Ankit Kumar (GE E/M) signed the MoU with Prof. Tarun Gupta, Dean Research and Development (DORD) IIT Kanpur.

MoA Signed with Samsung India

IIT Kanpur and Samsung India Electronics Private Limited entered into an MoA to mutually work on following scope of collaboration during the tenure of this Agreement i.e. Research Projects, Hiring good resources, Training programs & Higher education. The MoU was signed by Prof. Tarun Gupta, DORD IIT Kanpur and Mr. Kyungyun Roo, MD Samsung, Mobile R&D Division Noida.



MoU Signed with Trimble Applanix



IIT Kanpur signed an MoU with Trimble Applanix to develop a pool of domestic knowledge and capacity working with the Trimble Applanix UAV product portfolio within

India. The MOU was signed by Prof. Tarun Gupta, DORD IIT Kanpur and Sales Director, President and Managing Director of Trimble Applanix.

MoU Signing with Organo Technologies Pvt. Ltd.

Organo Technologies Pvt. Ltd and IIT Kanpur entered into a research collaboration MoU to work in the areas of Road construction / Maintenance. The MOU was signed by the Mr. Shailendra Srivastava, CEO of Organo and Prof. Tarun Gupta, DORD, IIT Kanpur.



MoU between the Gangwal Medical School, IITK, and Faculty of Medicine, Dentistry, and Health Sciences, University of Melbourne

IIT Kanpur has signed an MoU with the University of Melbourne's Faculty of Medicine, Dentistry, and Health Sciences to collaborate on academic and research activities at the Gangwal School of Medical Sciences and Technology. The Memorandum of Understanding was signed by Prof. S. Ganesh, Director IIT Kanpur, Prof. Mike McGuckin, Deputy Dean FMDHS, University of Melbourne, and Prof. Muthupandian Ashokkumar, Assistant Deputy Vice-Chancellor International (India), University of Melbourne.



MoU Signed with IIS Kanpur

IIT Kanpur will mentor Indian Institute of Skills (IIS) Kanpur and has entered into an MoU with IIS Kanpur in establishing State-of-the-art Laboratories on Advanced Manufacturing, Robotics and Automations and develop cutting-edge curriculum. The event was organised by the Ministry of Skill Development and Entrepreneurship and graced by the Hon'ble Minister Shri Dharmendra Pradhan.



Recent Projects

Next generation AAV9 Vectors for Duchenne Muscular Dystrophy Gene Therapy

PI: Prof. Jayandharan G Rao

Co-PI: Prof. Santosh K Misra

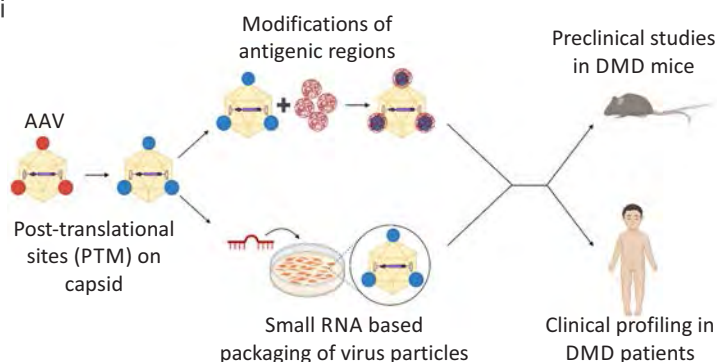
Dept. of Biological Sciences & Bioengineering

Sponsor: DBT-Wellcome trust Team Science grant

Collaborator: Ratna Puri Dua, Sir Gangaram Hospital, New Delhi

Duchenne Muscular Dystrophy (DMD), is a severe neuromuscular disorder in humans (1:3500 male births). DMD leads to progressive muscle wasting in affected boys, who ultimately succumb to the disease due to heart or lung failure. Gene therapy, a method to replace the altered gene (dystrophin) with a normal copy, has not been very effective for this condition.

The project proposes to address this, first by designing AAV9 vectors with improved transduction and immune evasive potential. A combination of rational engineering of viral capsids strategically modified at the rate limiting post translational modification (PTM) sites, and which overlap with antigenic epitopes, combined with nanoparticle mediated epitope masking is likely to overcome these major barriers in DMD gene therapy. Further optimization such as the microRNA-based vector production, will further complement and enhance the functionality of AAV9 vectors. Finally, in preparation for a possible clinical translation, we will also profile the genetic alterations and immune status in a large number of patients with DMD to provide clinical insights on the role of recipient status in future gene therapy trials.



Schematic representation of the work flow for developing the efficient AAV vectors by targeted modifications on the antigenic sites, and their masking by nanoparticles along with small RNA based virus packaging for preclinical and clinical studies.

InvenTiv-2024

InvenTiv-2024, 2nd edition of R&D Innovation Fair of Higher Education Institutes of India, is being held at IIT Hyderabad on Jan 19-20, 2024. In this event, 90 institutions participated and showcased their innovations. The participants of various institutes included 23 IITs, 31 NITs, 7 IISERS, 6 IIITs, IISc and top 50 NIRF engineering institutes. Honorable Sri. Dharmendra Pradhan, Minister of Education, and Minister of MSMEs, GOI was the Chief guest of this event.

IIT Kanpur showcased three technologies:

- ❑ Svan M2: quadruped robot research platform (*Domain: Defense and Space*)
- ❑ Self starting novel J shaped blade vertical axis wind turbine to harvest energy at low to high windspeeds (*Domain: Sustainable technologies*)
- ❑ Strips for simultaneous electrochemical detection of total and direct bilirubin in (*Domain: Affordable health care*)



Recent Projects

Fatigue based Endurance Limit for Perpetual Pavement

PI: Prof. Prabin Kumar Ashish

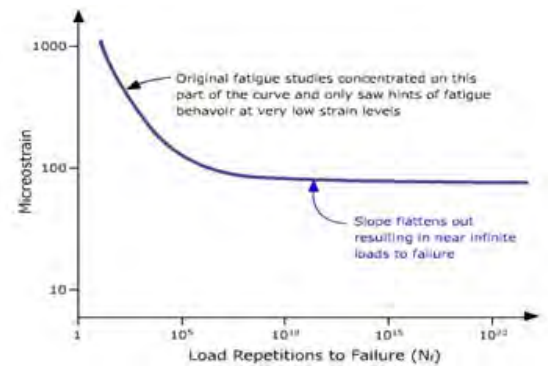
Dept. of Civil Engineering

Sponsor: Ministry of Road Transport & Highways

The current design guideline for asphaltic pavement in India (IRC:37-2018) recommends constructing long-life/perpetual pavement (for the design life of 50 years and above) for expressways and high-density corridors. Such pavement structures are essentially thicker pavement structures which are less susceptible towards bottom-up fatigue cracking, which has essentially led to the development of the concept of an "endurance limit". The following figure provides the pictorial view of the basic perpetual pavement structure (Newcomb et al., 2001).

Although IRC 37-2018 suggests constructing perpetual pavement, the corresponding technical recommendations are purely based on published research work from overseas research laboratories. Since India's traffic loading pattern and environmental conditions are significantly different from other countries, the recommendations from overseas countries may not be fully appreciated. Unfortunately, no research work has been published so far in this area from Indian research laboratories. This clearly indicates the need for in-house detailed research work to make appropriate recommendations, which is based on our own materials, prevalent Indian climatic conditions, and in-line with our own design specifications.

This proposed research work is aimed at identifying the endurance limit of typically utilized asphalt mixtures in India for perpetual pavement structure. It will further investigate the role of temperature and asphalt mixture volumetrics in changing the endurance limit of typically utilized asphalt mixtures in India for perpetual pavement structures. In the overall context, these individual outcomes will immensely contribute towards upgrading the existing recommendation on endurance limit for perpetual pavement in IRC 37:2018.



Schematic representation of the presence of endurance limit (Newcomb et al., 2010)

Kotak School of Sustainability

IIT Kanpur and Kotak Mahindra Bank have come together to incubate the 'Kotak School of Sustainability' with the overall vision of providing thought leadership, developing solutions towards sustainability actions and preparing future generations to lead the cause of sustainable development.

The School will cohesively integrate cross-disciplinary professionals, ideas and entities relevant to the different facets of sustainability, enabling a transformative change in the actions towards sustainable development. It will be a conglomerate of the departments, centers and other entities at IIT Kanpur, thus providing an enabling environment or synergistic research collaborations across the identified thematic areas. These interdisciplinary collaborations will enable the conduct of impactful and diverse educational and outreach programs, solution-driven innovations, the development of entrepreneurship and collaborations with external stakeholders. The School would also act as a platform for upskilling of different stakeholders through its outreach and capacity-building programs. In particular, it will play a vital role in the sustainable development of the Indo-Gangetic region, using its location as an advantage. The emphasis will be on developing holistic and end-to-end solutions encompassing all aspects of sustainability.



Recent Projects

Mitigating Resource Burden of Heterologous Biomolecular Circuits in Escherichia Cell

PI: Prof. Abhilash Patel

Dept. of Electrical Engineering

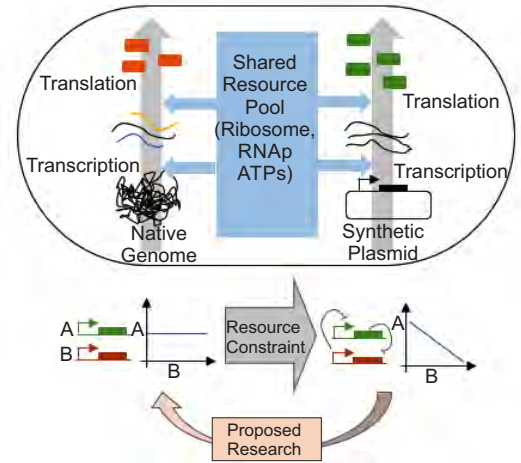
Sponsor: Wellcome Trust DBT



Synthetic biology, particularly in therapeutics, depend on the production of specific proteins through combinations of modified genes inserted into cells, such as bacteria. However, when these inserted genes are activated, they consume resources that would otherwise be used by the host cell for its regular activities. The aim of the project is to alleviate the strain on cells caused by the competition for resources, especially ribosomes, between natural cellular processes and synthetic genetic circuits in synthetic biological systems.

Fundamental Objectives

- Develop mathematical models to quantify the stress imposed on cells by implemented genetic circuits.
- Characterize functional maps that link genotypes to the resource demands of gene expression using machine learning techniques.
- Biomolecular feedback controllers to maintain the balance of translational resources, ensuring that both natural and synthetic gene expression demands are met.
- Aim to apply these principles to design synthetic biological systems that are robust against cellular burden by studying the regulatory pathways that natural organisms have evolved to cope with various stresses.



The multidisciplinary approach combines system theory, computational methods, and molecular biology experimentation to address these challenges. Ultimately, this research seeks to establish rational frameworks for reducing cellular burden, thereby advancing the frontier of synthetic biology and enhancing the reliability of living therapeutics.

Design and Development of Model Cargo-Hyperloop using Pipe Following Robot

PI: Prof. Bishakh Bhattacharya

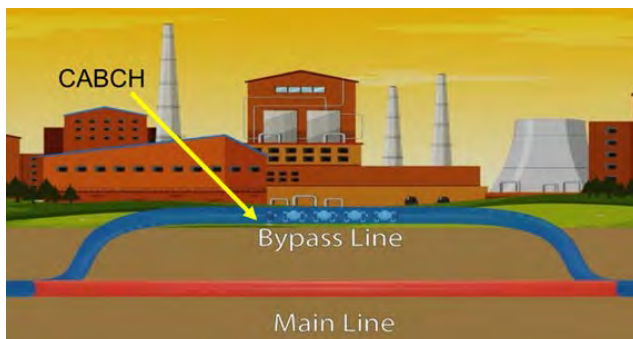
Co - PI: Prof. Gautam Biswas

Dept. of Mechanical Engineering

Sponsor: Central Mine Planning & Design Institute Limited



The traditional transportation system of industrial raw materials, such as coal, mineral ores, etc., accrues material loss and uncertainty in delivery time, causing environmental pollution and loss of productivity. A dedicated closed conduit transportation system can significantly reduce air pollution, material loss and travel time.



The project aims to develop a dedicated pipeline-based transportation system for the first/last mile connectivity from the mines to the user agencies by designing a pipe-following modular cargobot system driven by compressed air flow. The Compressed-Air Based Cargo Hyperloop (CABCH) can carry cargo in a series of cargobots equipped with a motion sensing system, passive speed control system and necessary electronic sensing system for loop health monitoring and data communication. Successful implementation of this innovative system has the potential to significantly reduce the reliance on trucks and railway wagons, alleviating congestion on overloaded freight tracks and roadways.

Technology Maturation of Variable Speed Traction Drive

Faculty involved: Prof. Tanmay Dutt Mathur, Department of Aerospace Engineering

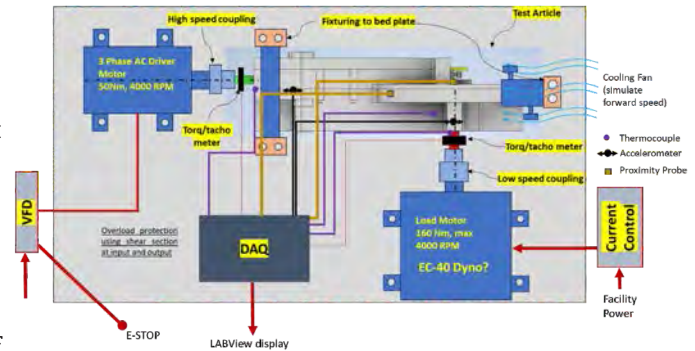
Project Status: Ongoing

Duration: 1 year

Sponsor: Toka Technologies Ltd.

Toka Technologies Limited is an energy-based company from Auckland, New Zealand. The company has developed a technology called Toka Trac CVT (Continuously Variable Transmission) using well established design principles to produce a CVT that can be designed according to specific torque, durability, and duty cycle requirements.

The project involves performance characterization of the traction drive and associated design tool development. The fabrication work on the test rig is ongoing and the delivery and commissioning of the test platform is expected by the end of February 2024.



Eliminating Chloroprene Rubber in Wrapped V-Belts: A Sustainable Shift

Faculty involved: Prof Kamal K. Kar, Department of Mechanical Engineering

Project Status: Ongoing

Duration: 2 years

Sponsor: JK Fenner (India) Ltd

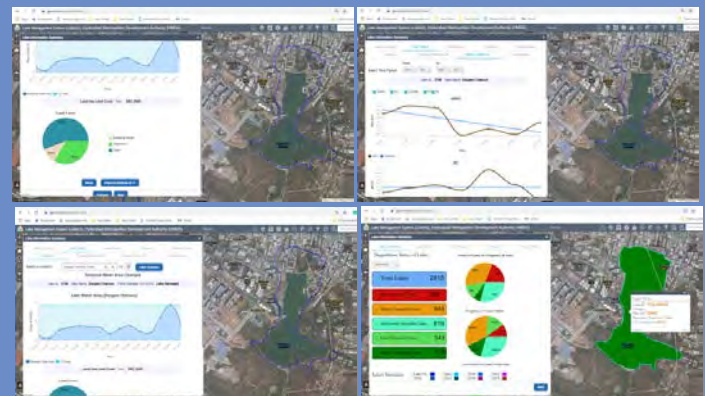
Wrapped V-belts have been an integral part of countless industrial applications. These have predominantly been manufactured using chloroprene rubber (CR) as it is highly resistant to oil and can operate efficiently within a wide temperature range. However, the production and disposal of CR have raised environmental concerns which has prompted industry to explore alternative materials and technologies.

The proposed project aims to carry out research to find a suitable alternative for CR to reduce the environmental risks as well as sourcing problems.

Technology Developed: LAMAS (Lake Management System)

Geo Climate Risk Solutions (GCRS) is a member company of Technopark@iitk since 2020 and actively collaborates with Prof. Rajiv Sinha at the Department of Earth Sciences.

The company has developed a new water body health status and monitoring tool called LAMAS. It is a web GIS platform designed for the comprehensive assessment and continuous monitoring and management of water body/lake/wetland health and suggests restoration plans. The algorithms at the core of LAMAS are developed in collaboration with IIT Kanpur.



Institute lecture (October 2023 - February 2024)



Dr. Akhilesh Gupta
Senior Advisor; DST

Anusandhan National Research Foundation: India's vision to achieve Global R&D leadership



Mr. Abhay K. Bhushan
chairman of Asquare Inc.

The Evolution of Internet



Dr. V. Balaji
Distinguished Fellow, Schmidt Futures

Climate models: whence they came, where they're going, and why you should trust them

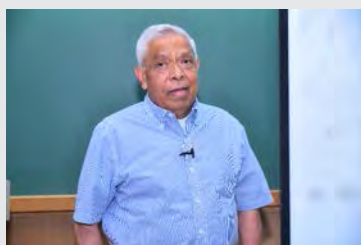


Dr. Renu Mehra
Vice President of Engineering, Synopsys, INC
Semiconductors: Fueling our Future



Dr. Anil K Rajvanshi
Nimbkar Agricultural Institute, Maharashtra

Exploring Deep Science in Patanjali Yoga Sutras

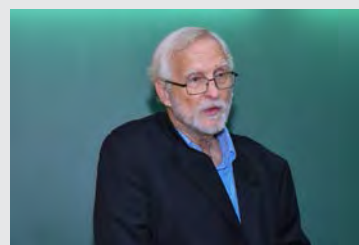


Professor Jagdish Narayan
Director NSF Center for Advanced Materials & Smart Structures, North Carolina State University
A New Frontier in Materials Science for Advanced Technology



Prof. Sanjit K. Mitra
University of California, Santa Barbara and the University of Southern California

My Incredible Journey: from Orissa, India to California USA



Dr. Walter Schneider
Chief Executive, General Atomics Global Corporation in San Diego, California
Transformative Imaging 21st Century Science Combined with Diagnosis of Brain Pathology – a focus area for India science excellence and meeting a national need.



Prof. Umesh K. Mishra
Dean College of Engineering, UC Santa Barbara

UC Santa Barbara: Innovating for Social Impact



Prof. Rajesh K. Gupta
Founding director of the Halicioğlu Data Science Institute & Distinguished Professor of Computer Science and Engineering at UC San Diego.

The Emerging Discipline of Data Science



Prof. Ashoke Sen
ICTS, Bengaluru

The Future of our Universe



Prof. Abhay Deshpande
Stony Brook University
Understanding the gluon - the "super-god particle" - that binds us all Subtitle: The Science of the Future Electron Ion Collider

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