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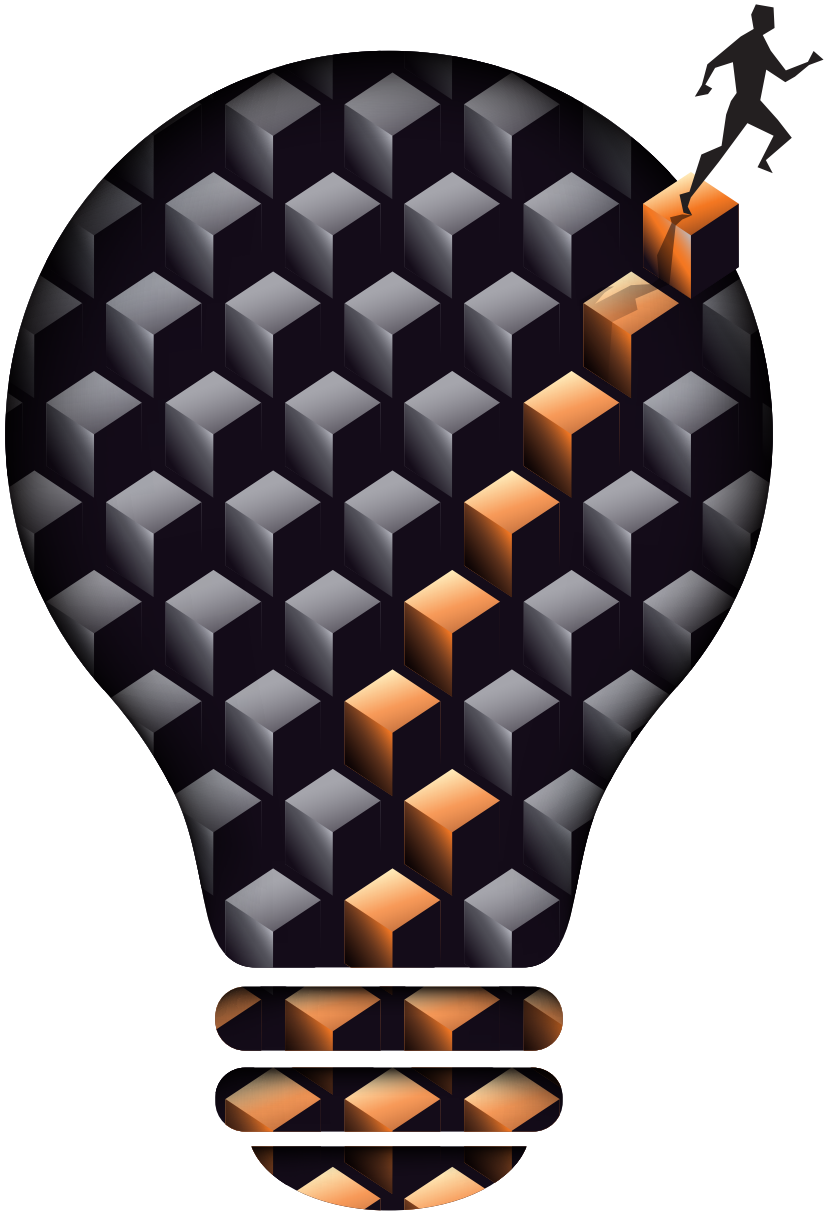


INSIDE

RESEARCH TALES | PROFILES | FITT FOOTPRINT

INNOVATION CHALLENGES WITH INDUSTRY 4.0

Prof. Preeti Ranjan Panda

Managing Director, FITT, and Dean, Corporate Relations, IIT Delhi

A significant amount of FITT's activity in the innovation and project spaces directly or indirectly revolves around the efficiencies associated with Industry 4.0. What is this new wave and how does it affect us?

The rapid industrial automation seen everywhere in the last decade or so, now possesses a glitzy label – Industry 4.0, or the fourth industrial revolution. What trends does it include? The answer is satisfactory to almost every engineer on the planet – Industry 4.0 subsumes a wide range of pretty much all major recent developments in automation. It includes swarms of connected Internet-of-Things (IoT) devices monitoring the health of machines and structures in ways that were impossible with manual inspection, resulting in efficient predictive maintenance. It encompasses the decentralisation of observation, analysis, computing, and control, to the very edge of the networked infrastructure, leading to significant efficiencies in the sense-compute-control cycle. It involves the ability to derive new correlations from disparate data streams, leading to sophisticated analysis mechanisms. It relies on powerful engines of the cloud for simultaneously and silently crunching away at the data streams in the background while sensors and devices at the edge intelligently interact with the environment in the foreground. While much of the technological progress is evolutionary, the speed with which businesses are adapting has led to the movement being hailed a new revolution, quick on the heels of the third industrial revolution – the name given to the digital age of the late twentieth century.

What does Industry 4.0 mean to us as we look for innovation and research challenges of the future? The trends entail major innovations all along the business and production chain. Every assembly line and manufacturing pathway can now be re-imagined with new possibilities: Can we introduce new monitoring capabilities? Can we provide immediate feedback and prevent costly re-spins? Can we provide a safer environment for workers by outsourcing some repetitive and mundane tasks to drones and IoT devices? Can we traverse up and across the supply chains and establish correlations that help in detecting defects before they occur?

How can this gigantic infrastructure operate in an inexpensive, safe, and environmentally friendly way? The innovator has plenty of problems to choose from. How do we design and build the IoT devices when the requirements are apparently contradictory – sophisticated computation and yet low cost? How is the intelligent processing partitioned – on-device with low resources vs. cloud with heavy resources? What new technologies would be used to enhance simple sensors with computational intelligence? How would the analysis techniques themselves adapt to newer scenarios where resources may be thin, and deadlines might be tight? The field brims with possibilities and invites us to explore new frontiers.

RESEARCH TALE 02

Optimization of grain distribution for PDS in India

Prof. Nomesh B. Bolia

Deptt. Of Mech. Engg., IITD

Introduction

Food crops in India are grown and harvested in two seasons every year: Kharif and Rabi. the demand for grains is continuous throughout the year but due to the presence of these two distinct seasons, grains are not continuously available. A major portion of grains is grown in the states of Punjab and Haryana. Grains must therefore be transported from these states to deficit areas where very less or no crops are grown. The Food Corporation of India (FCI), has assumed the responsibility for procurement, storage, transportation, and bulk allocation of food grains to the State Governments. These movement operations are undertaken by FCI every month, by rail, and if rail is not feasible, then by road or waterways. These grain movements are large-scale operations when not done optimally, lead to incurring high costs. A greedy algorithm that transports grains from a given surplus source to the nearest deficit source does not work since there are many other constraints involved. The quantity of grains transported by FCI across the country, in a year, amounts to about 400 to 420 lakh metric tons (LMT). FCI undertakes this massive movement operation of food grains all over the country encompassing around 2000 FCI-owned and hired depots/Silos, 557 rail heads (owned by Indian Railways and others), and 98 FCI-owned sidings. As of 1st April 2020, FCI has a total storage capacity of 755.94 lakh metric tons.

Once the grains are received in bulk by states, the operational responsibility including allocation to Fair Price Shops (FPSs) rest with the State Governments. Under the PDS, presently wheat, rice, sugar, and kerosene are the primary items being distributed. The items are first allocated to the States/UTs for distribution and then they manage logistics for delivery of these goods to FPS. Apart from the above-mentioned items, some states/UTs also distribute additional items of mass consumption through the PDS outlets such as pulses, wheat flour, fortified rice, edible oils, spices, etc.

There have been few attempts to address this problem of suboptimal transportation of grains. (Mogale et al., 2017) solved optimization of food grain distribution and they further extended their work to optimize three echelon supply chain of food grain procurement and distribution by FCI. However, their model optimizes the PDS supply chain only for one type of grain (Mogale et al., 2018). (Chakraborty & Sarmah, 2020) use simulation to address the impact of random supply and transportation disruption in the distribution of grains by FCI.

There are following two objectives of this research:

1. To minimize the distribution cost incurred by FCI for the transport of grains from surplus states to deficit states, i.e., the inter-state movement of grains.
2. To minimize the distribution cost incurred by the state government for transportation of grains, from procurement to delivery to the FPS, i.e., intra-state movement of grains.

Methodology

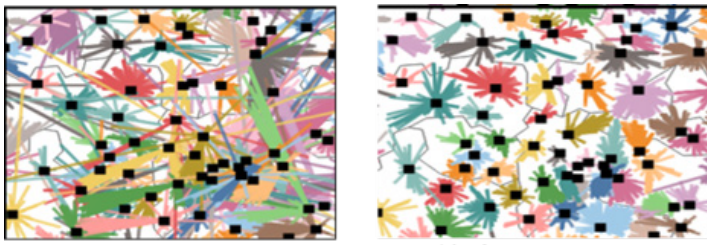
To solve the problem relevant logistical data on location-wise procurement, demand, and storage capacity is obtained. All of this data is used as input parameters for the optimization model. The data is then cleaned thoroughly over multiple iterations to obtain usable data. In the absence of this process, the whole exercise of optimization would be rendered meaningless.

An Operations Research based constrained optimization model is used for the optimization. The model is solved using Data Science tools. The problem of intra-state distribution of grain has been solved for two scenarios as described below:

- Without District Restriction: - In this scenario, there is no restriction to the flow of food grain with respect to district boundaries. All the grains can move anywhere within the state as per the optimization.
- With District Restriction: - In this scenario, the flow of food grain is restricted with respect to district boundaries. Grains will move only to selected district from the given district.

Fig. 2 provides a cross sectional view of the grain flow, the before and after optimization. In the first image, the logistics paths are intersecting each other, which means that the flow is inefficient. In the second image, the grain flow paths almost never intersect which is a characteristic of efficient flow.

Fig. 2 Grain flow path before and after optimization for a cross-section of the state.

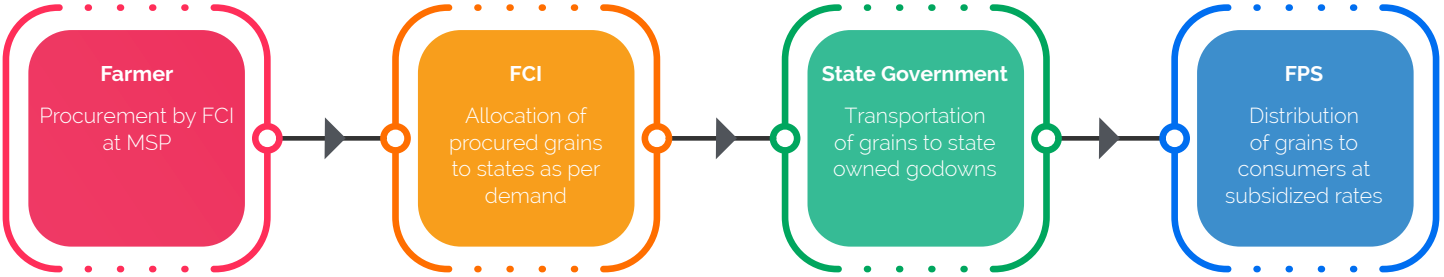


a) Before optimization b) After optimization

Results & Conclusion

There is a huge potential to optimize the transportation of grains and other essential commodities. We are working to solve the problem of inter-state grain movement and have solved the problem of intra-state transportation of grain for some states. Our models enable up to 30% reduction in the transportation cost, implying huge savings of tax payers' money. This money can be used for better capacity building or further support to the vulnerable segments of the population. Of course,

Fig. 1 An overview of grain flow in the PDS supply Chain



this cost reduction is the model output and may change during the implementation phase due to inputs received or additional constraints faced at ground level. We are now working with the government for scaling this optimization exercise across the country. In other states, the optimization of the supply chain may have additional constraints as different states have their unique constraints. Different states have different echelons for distribution which adds to logistics complications. Some states have hilly regions, leading to transportation restrictions while others also include commodities other such as edible oil, wheat flour, parboiled rice, etc. in the PDS, which have their unique supply chain restrictions. Due to all these constraints, the optimization of states/UT's PDS distribution becomes challenging. The project is being done at the Public Systems Lab and in partnership with the United Nations World Food Programme whose experience with the PDS has been crucial for the path breaking outputs of the project.

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Building quantum computers with high precision lasers and cold atoms

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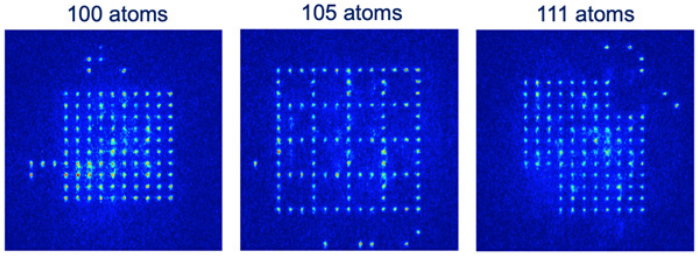
Quantum technologies represent a variety of technologies based on the ability to observe and control the reality at subatomic or quantum level. Quantum technology enabled computing is refer to as quantum computing. This fundamentally new way of computing, which is not an extension of classical computing, has the ability to break the encryption used by today's advanced communication systems, blockchain and artificial intelligence. Because of many such predictions quantum computing became geopolitically strategic among the leading economies over the globe.

Fig. 1: Defect free arrays of more than 100 single atom qubits [1]. Single atoms were loaded into optical microtraps from a cold atom reservoir at few micro-Kelvin temperature. This ability lies at the heart of neutral atom quantum information processors [2, 3, 4, 5].



A classical computer works with bits which can have values 0 or 1. In contrast, quantum computers use quantum bits or qubits which can have values not only 0 and 1 but anything in the range of 0 and 1. Moreover, there is a probability to find 0 and 1 at the same time in a qubit – this operation known as superposition is not present in classical computing bits. These attributes of qubits together with entanglement and interference enables to design algorithms to tackle problems which are too difficult for a classical supercomputer. At this point, one might think whether quantum computers are going to replace present days classical computers. The answer is 'No'. Rather both type of computing will work in a complementary manner to lead us in a niche era of computation to unfold many unresolved mysteries and problems in the world. For example, browsing internet, reading and writing emails, copying data in everyday life does not require quantum algorithms. On the other hand, energy requirement for the production process of ammonia (fertilizer), which is responsible for producing approximately 1-2 % of total carbon dioxide emission worldwide, can not be modeled by the existing powerful supercomputers due to the complex nature of the ammonia molecule consisting of one Nitrogen and three Hydrogen atoms. Quantum computers can mimic and model the complex process of molecule formation using dedicated quantum algorithms involving inter-qubit interactions at subatomic levels. Similar quantum algorithms can be used for decreasing energy costs for green hydrogen production, carbon sequestration, study of perovskites to create more efficient solar cells and design batteries for energy storage systems. As human body is part of nature, it is composed of various molecules. Quantum computers can help more efficient drug design and genome sequencing to facilitate

precision and personalized medicine to improve the quality of human life. Quantum efficient supply chain management, quantum protected cybersecurity in the era of post quantum cryptography are few examples among many more expected quantum advantages in endless number of domains.

To explore the maximum potential of quantum advantages, real quantum computers are required. Although, all components of a quantum computing system are important, the physical hardware on which the actual quantum circuit will run is arguably the most critical component. There are multiple hardware platforms with specific requirement of cryogenic cooling, laser cooling, ultrahigh vacuum technologies, high precision lasers, precise control of magnetic and electric fields. Although, two physical platforms, superconducting qubits and trapped ions have reached more advanced stages than other candidates in demonstrating quantum gates and algorithms, demonstration of error corrected quantum computation at large enough scale to be relevant for practical problems is still elusive. In last few years, neutral atoms has emerged as a powerful hardware platform for quantum technologies in general and for quantum computing [6, 7, 8, 9, 10, 11] in particular. Neutral atom quantum computers require high precision lasers, ultra-high vacuum chamber and single atom resolved microscopes to laser cool the atomic qubits, manipulate their internal states for quantum circuit implementation and quantum state sensitive fluorescence imaging for measuring the final outcome after running the quantum circuits. Cooling down superconducting qubits require dilution refrigerator at great expenses. In contrary, neutral atoms are cooled to few micro-Kelvin temperatures via Nobel prize winning technique of laser cooling, which can function at room temperature. Another challenge faced by superconducting qubits is, every qubit fabricated on solid state devices are slightly different from other, which introduces an additional error starting from the initial state preparation. As a consequence, scaling up of superconducting qubit based quantum computers is extremely challenging and costly. In trapped ion quantum computers, ions which are electrically charged atoms are confined in vacuum using electrostatic forces. Due to the electrical charges, these ion qubits repel each other, making it challenging to scale up the number of qubits to millions. On the other hand, neutral atoms are fundamentally identical and neutral, hence scaling up the number of qubits is a rather straight forward process. In order to fabricate one million optical traps for neutral atom qubits, an optical grid consisting of 100 x 100 x 100 nodes need to be created. This is a well-known technique used in optical lattice experiments for analog quantum simulation of Bose and Fermi Hubbard models using Bose-Einstein condensation and degenerate Fermi gas. Multi qubit gates can be realized using all optical techniques via Rydberg spectroscopy involving precisely frequency and power stabilized lasers giving the opportunity to switch on and switch off multi qubit interactions on demand, which is a unique feature of neutral atom quantum computing hardware.

Quantum technology development is ongoing in almost all parts of the globe with national level flagship initiatives in most of the G20 countries. Growing number of research labs in academia and in startups are starting their journey with the aid of both public and private funding. The variety of hardware development required for a full-fledged quantum computer are propelling the growth of product development in the sector of lasers, high precision electronics, opto-mechanical components, single atom sensitive imaging microscopes etc. These sub-systems can serve also as major part in other experimental facilities, such as, analysis, diagnosis and characterization of various chemical, biological, fluid dynamics and atmospheric science problems to name a few. This reality as a whole is helping to rapidly grow the economy all over the world. Very recently, the government of India has approved a National mission of approximately Rs. 6000 crore to scale up scientific and industrial R&D for quantum technology. It will boost Indian startups to manufacture quantum computing subsystems at internationally competitive level.

As the business boom is about to start, there is a need of skilled employees in the field of quantum technologies. Most of the present job requirements are technical in nature. For the core development of quantum technology subsystems, specialized knowledge is required in quantum engineering which consists of quantum physics, electronics, optics, mechanical engineering, mathematics, computer science etc. Employees with techno-commercial background on relevant technology domains are needed to shape the roadmap of business model. Finding appropriately qualified people for both technology development and business expansion is already scares. The universities and startups must put significant effort to train enough number of people with required skill sets.

In summary, quantum computing is still in infancy. No hardware platforms has demonstrated large scale industrially relevant quantum computation till date. It is also not clear which platform will be the most successful. However for various platforms, roadmaps are clear. Hence demonstration of quantum advantage for industrially relevant problems is just a matter of time. Because of complex hardware architecture, it could be very costly to maintain quantum computers in each organization. Instead, quantum computers can be shared by many organizations via cloud service for running quantum circuits. This would facilitate the organizations to buy computation time in place of quantum computer, making the access to quantum advantage more affordable.

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Faculty Profile

03

Prof. Vivek Kumar

CRDT, IITD

Dr. Vivek Kumar is a Professor at the Center of Rural Development and Technology (CRDT) at the Indian Institute of Technology, Delhi (IITD) and is also the Chairman, JEE (2023-24). His domain of interests include: Process Audit and Pinch Analysis, Air Pollution Emission Inventory, Industrial Pollution Abatement, Environment, Human Health & Safety, Green Product Development, Biomass Valorization, Utilization of Waste in Composites and Building Materials, and Clean & Sustainable Technologies.

Dr. Vivek, obtained his Bachelors in Pulp and Paper Engineering and his Master's with specialization in industrial pollution abatement from the Indian Institute of Technology, Roorkee (earlier University of Roorkee). Post his PhD from IIT Delhi, he worked in the area of waste management for the small scale Pulp & Paper Industry. For his post-doctoral research, he received the fellowship at IWT, Applied Science University, Wolfenbüttel, Germany. In addition, he has been a visiting Research Professor in the Department of Chemical Engineering and Applied Sciences at University of Toronto, Canada. Before joining IIT Delhi, he was working as an Associate Professor at the Department of Paper Technology, IIT Roorkee and has also served as a scientist at TIFAC, Department of Science and Technology, Govt. of India.

At IIT Delhi, Dr. Vivek, has set up a group to work in the field of energy, environment and sustainable harvesting and utilization of natural resources for livelihood generation. The group possess expertise in a wide variety of subjects ranging from air pollution to waste utilization and sustainable food diversity. He has over 125 publications in waste and biomass management, environment and pollution, sustainable agriculture, and food systems and has since completed around 75 industry and government agency sponsored research projects. Dr. Vivek is working collaboratively with more than 12 national and international institutes and was elected as an International Director of Bio-Forest Product Division of American Institute of Chemical Engineers (AIChE) for the period of 2014-2017. He has served as an Expert Committee member in various capacities of SEED Division of Department of Science and Technology, CSIR-NIScPR, Common Research & Technology Development Hubs (CRTDHs) Programme of DSIR, Common Review Mission, Ministry of Rural Development (MoRD), Jan Sampada Divison, IGNCA, CPCB and IPMA. Prof. Kumar is the Co-coordinator of MoE sponsored program "Unnat Bharat Abhiyan (UBA)" and provides leadership to the Subject Matter Specialist Group on different themes for sustainable management and development of

rural areas throughout India by involving the regional technical institutes for community and village level interventions.

Dr. Vivek is also a clean technology and sustainability analysis expert for several industrial sectors and in situ remediation of drains & water bodies. And is actively involved in several projects of pollution prevention and control in the Ganga Basin including Charters in paper, textile, tannery, and sugar industries. Due to his deep knowledge and expertise, he is member of several Central Pollution Control Board's committees, working for pollution control in textile industries and paper industries including the committee on 'Zero Liquid Discharge' in Pulp & Paper Mills.

Dr. Vivek, is associated with a joint project being executed by the consortium of IITs (Indian Institute of Technology) on "National River Ganga Basin Environmental Management Plan". Some of his technical reports in this area are (i) Rapid assessment of industrial pollution of the River Ganges in Uttarakhand, and (ii) Strategy for improving condition of water bodies in the vicinity of pulp and paper industries in Ganga River basin. In addition, he is mentoring a start-up 'Kriya Lab' incubated at FITT, IIT Delhi, which is working towards the development of ecofriendly processes for paddy straw pulp-based cutlery product development. Dr. Vivek is presently working in the area of low footprint domestic sewage treatment systems and sustainability analysis of technology systems in water and wastewater management.

Prof. Amit Mehndiratta

CBME, IITD

Prof. (Dr.) Amit Mehndiratta is an Associate Professor at the Centre for Biomedical Engineering (CBME), IIT Delhi, which was established as a joint venture of the IIT Delhi & AIIMS, Delhi. Prof. Amit Mehndiratta has a unique profile, whilst he has undergone his medical education with a Bachelor in Medicine and Bachelor in Surgery (M.B.B.S) from Dr. MGR Medical University, Chennai followed by a Masters in Medical Science and Technology (M.M.S.T) from IIT Kharagpur he has also completed his D.Phil. in Biomedical Engineering Sciences from the University of Oxford, United Kingdom in area of "Quantitative Perfusion Magnetic Resonance Imaging". Prof. Mehndiratta has more than 10 years of experience with global leading research institutes such as the German Cancer Research Center (DKFZ) Heidelberg Germany, Massachusetts General Hospital & Harvard Medical School Boston USA, and University of Oxford United Kingdom. He has worked with the medical imaging industry leaders such as Siemens Healthcare before joining IIT Delhi as a faculty.

Presently, Prof. Mehndiratta is at a very exceptional position where he leads the research activities in the field of Biomedical Engineering at IIT Delhi jointly with AIIMS New Delhi. His areas of interest includes quantitative medical imaging and assistive technologies in rehabilitation and leads two research groups at IIT Delhi - a) Medical Imaging (MedImg) group and b) SensoriMotor Assistive Rehabilitation Technology (SMART) group.

The MedImag group is working in area of Magnetic Resonance (MR) and Computed Tomography (CT) imaging for cancer. Over the last decade his medical imaging research group has developed expertise in diffusion and perfusion MR imaging for cancer diagnosis, prognostication, and treatment response assessment and has published more than 30 papers in journals of international repute in this area, including Lancet, NeuroImage, European Radiology, NMR in Biomedicine, Translational Medicine to name a few. The group has deployed four medical image processing software tools through an open access network to various medical institutes, where these tools are currently being utilized for a wider research impact in cancer monitoring. His medical imaging group works very closely with AIIMS New Delhi across different units such as Department of RadioDiagnosis, Department of NMR, and Dr. B.R.A. Institute Rotary Cancer Hospital along with other institutes such as Medanta - The Medicity, NIMHANS Bangalore, and Mahajan Imaging.

The SMART group works towards developing novel devices and solution in the area of assistive technologies in neuro-rehabilitation. This group has recently received a large grant from ICMR to establish the first joint COE of IIT Delhi with AIIMS titled "Centre for Advanced Research and Excellence in Disability & Assistive Technology (CARE-DAT)". His group has developed a robotic exoskeleton called "RoboExo SMART" for rehabilitation training of upper limb in patients suffering from stroke. Stroke is a devastating disease caused by compromised blood supply to brain because of ischemia or hemorrhage, leading to a sensory and motor deficit. Patients with this loss in motor functionality require rehabilitation which is conventionally delivered in form of physiotherapy or occupational therapy. Thus, in a resource limited country like India it becomes very critical to develop technologies that can assist in area of rehabilitation to aviate the burden on the current healthcare system. The "RoboExo SMART" device is exactly designed for this purpose; the device can assist in upper limb rehabilitation training of stroke patients in passive as well in active mode of rehabilitation. The device was patented in 2017 through FITT at IIT Delhi and recently the device has been granted with a US patent. The device is currently in its pivotal stage of national phase of clinical trials under the leadership of Prof. M.V. Padma Srivastava, Head of Neurology and Chief of CN Centre at AIIMS New Delhi, supported by ICMR. "RoboExo SMART" is planned to enter an international phase of clinical trials with UNSW Australia in the first quarter of 2024. Prof. Mehndiratta has made a significant contribution in area of assistive technologies for Neurorehabilitation and is one of pioneers in this area in India, evident by the facts that he has secured 11 IPRs (including patents and copyrights), published more than 12 publications in international journals in this area. In 2020 he was awarded with the "Technology Translation Award" in Engineering by Science and Engineering Research Board (SERB) and in the year 2022 conferred as the "Abdul Kalam Technology Innovation National Fellow" by Indian National Academy of Engineering for his contribution in the field of biomedical engineering and assistive technologies.

Prof. Amit Mehndiratta is an active member of International Society of Magnetic Resonance (ISMRM), USA since 2012. He has been awarded with various research award (Magma cum Laude, Magma cum Summa and E.K. Zavoisky) by International Society of Magnetic Resonance in Medicine, USA in 2015, 2017, 2019 and 2020. Currently, he is a member of the Education Committee of ISMRM since 2021 where his contribution has been instrumental in developing study materials in MR imaging for international community across the globe with readership for more than 10 million users. He is also the current serving Secretary of ISMRM-India Chapter and Member Secretary for the International Conference by Asian Society of Magnetic Resonance in Medicine (ASMRM) 2023.

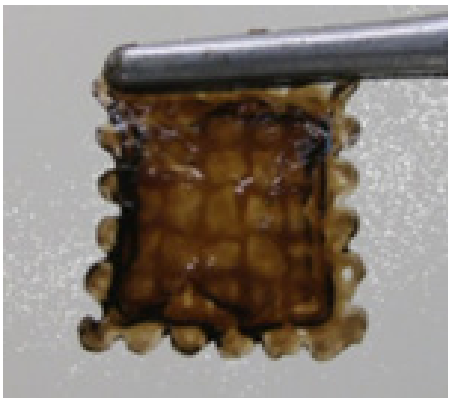
In total he has authored more than 65 journal papers in international journals, nine book chapters, one book and more than 100 proceedings and abstracts. Prof. Mehndiratta has supervised six PhD students from IIT Delhi, along with nine MDs in Radiology, 10 M.Tech (Engineering) and more than 30 B.Tech students in various research areas of both medical imaging and assistive technologies. Prof. Mehndiratta has a strong inclination to support startups in the healthcare sector of India. He is currently mentoring more than five startups directly, and working with various incubators across India to guide many more startups and projects on behalf of several eminent funding organizations such as ICMR, SERB, DBT, DST, and TDB. He also serves as an expert member in Area Review Panel for Medical Devices of Biotechnology Industry Research Assistance Council (BIRAC) to support the startup ecosystem in India at large in medical instrumentation, signal & image processing and rehabilitation technologies.

Footprint Profiles

Technology Profile by Prof. Sourabh Ghosh (TFE, IITD)

3D Bioprinted skin disease models

Global Pharmaceuticals and Cosmetics companies invest millions of dollars for in vitro and in vivo animal trials for clinical as well as cosmetic applications, only to find disappointing performance in human clinical trials later. RegenArtis Private Limited developed in vitro skin disease models (Aging skin, Psoriasis, Scar) by controlling orientation of cells and ECM using 3D Bioprinting to replicate the architectural features. We replicated the pathophysiological environment by immobilization of inflammatory mediators, that could trigger a cascade of matrix degrading signaling by forming ternary complex with cellular receptors. We have completed a project from Indian cosmetics company and BIG funding from BIRAC.



Technology Profile by Prof. Suresh Bhalla (CE, IITD)

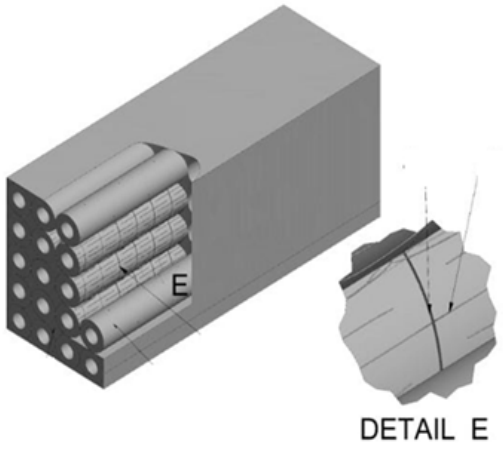
FIBRE-REINFORCED BAMBOO COMPOSITE (FRBC) TECHNOLOGY FOR HIGH CAPACITY SEISMIC/ WIND RESISTANT SUSTAINABLE INFRASTRCUTRE. Dr. Diwakar Bhagat1 Prof. Suresh Bhalla2

INTRODUCTION

Indian bamboo species are endowed with high compressive strength (50-100 MPa) as well as high tensile strength (100-200 MPa). This high strength coupled with low density imparts bamboo the advantage of "high strength to weight ratio" as compared to traditional construction materials, namely steel and concrete, in addition to contributing towards negative carbon footprint in the process. However, the main factor inhibiting the widespread use of bamboo for structural engineering applications is the high slenderness ratio of the single shoot bamboo available naturally, which leads to under utilization of its strength in compression. Stacking of multiple bamboo culms might offer some advantage in compression but the absence of composite action renders the entire matrix underutilized for bending or flexure. In order to bring bamboo into mainstream construction, it is necessary to alleviate the above structural deficiencies of single shoot bamboo.

The bamboo research group at IIT Delhi has developed an indigenous technological solution to above problem through the invention of fibre-reinforced bamboo composite (FRBC) (Bhagat et al., 2021). This technological process (Figure 1) structurally binds the individual bamboo culms into a composite rectangular section imparting high capacity in compression and flexure on account of composite structural action characterized by perfect strain compatibility. In contrast to conventional stacking of bamboo culms, the FRBC technology leads to an optimized utilization of the constituent bamboo culms, giving the resulting section a high flexural capacity whist resulting in smaller cross-section. The process involves small quantities polypropylene fibres and epoxy adhesive apart from bamboo culms.

Figure 1 FRBC system



The FRBC technology, developed indigenously at IIT Delhi, has been internationally peer reviewed and widely scrutinized (Bhagat, 2017; West et al., 2017; Bhagat et al, 2021). High flexural capacity and composite behaviour have been validated at Structural Engineering Laboratory of IIT Delhi, as illustrated in Figure 2(a) (Bhagat et al, 2021). FRBC beams have been experimentally found to act as composite units until close to failure. The strain distribution has been found to be linear throughout the depth of the beam right up to the point of failure (Figure 2b). At ultimate load, the failure is found to be typically occurred by local crushing of the outermost bamboo culms radially at the supports and crushing of the bamboo spreader under the loading points. The beams' post peak behaviour has been found to display a plastic response by sustaining the peak load during prolonged additional deformations displaying high and effective ductility. Upon removal of the loads, the beam has been found to almost return to its original shape. Neither major rupture in the

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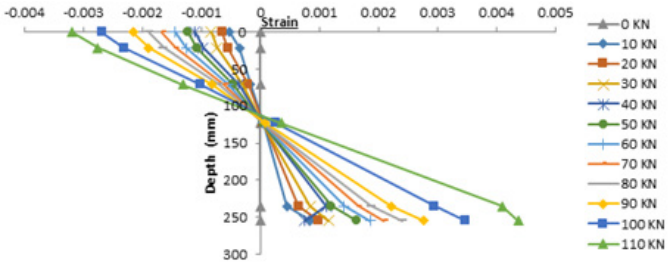
2Professor, Department of Civil Engineering, IIT Delhi

bamboo culms nor inter-bamboo shearing failure have been noticed visually, thereby displaying excellent ductility and recovery

Figure 2: (a) Typical experimental set up for lab testing of FRBC elements in flexure (b) Typical strain profile under across depth validating strain compatibility and composite action

(a)

(b)



- Indigenous technology fitting into "vocal for local"
- Internationally peer reviewed technology
- Environment friendly
- Speedy construction (couple of hours)
- Factory production of members => high quality
- Framed structure-much better performance under earthquake/ wind
- Walls are non-load bearing, so flexibility of expansion/ alteration
- Potential for rural job creation

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5. *Bhagat, D. and Bhalla, S., (2016) "A Novel Fibre Reinforced Bamboo Composite (FRBC) High Capacity Flexural Member" , Invention Disclosure, BCVL 3055, 09 August 2016, Foundation of Innovation and Technology Transfer (FITT), IIT Delhi.*
6. *Bhalla, S., Gupta, S., Sudhakar, P., and Suresh, R. (2008), "Bamboo as Green Alternative to Concrete and Steel for Modern Structures", Journal of Environmental Research and Development, 3(2), 362-370.*

Start-Up Journey

Kritikal Solutions

KritiKal Solutions is the first 'student and faculty led' start-up incubated at IIT Delhi. It was co-founded in 2002 by 7 graduating students and 5 faculty members of the department of Computer Science and Engineering (CSE), as a 'Technology Business Incubation Unit' (TBIU) incubated by Foundation for Innovation and Technology Transfer (FITT).

Continuing with the dream of building 'creations (Kriti) for tomorrow (Kal or future)', KritiKal has grown across industries and geographies over these 20+ years. It has come a long way in terms of deep-tech capability and innovations. Striving towards fulfilling the founders' vision, KritiKal has been producing cutting-edge technology products through disruptive innovations, across 100s of projects and clients across the globe.

With presence in India, USA, Europe and Middle East, KritiKal group has expanded its footprint to become a truly global organization and is now home to some of the best engineers, techies and innovators. KritiKal looks at innovation as a means to advance the world around us, as well as society at large. KritiKal's core purpose is innovation.

KritiKal offers R&D services and products in Health & Wellness, Automotive/Mobility, EdTech and other domains, primarily around the following technologies:

Vision Systems (AI) - KritiKal has worked on a full spectrum of computer vision and image processing products and solutions, including ADAS (Advanced Driver Assistance Systems or autonomous/semi-autonomous vehicles), automated traffic counting & classification (ATCC), intelligent document processing or optical character recognition (OCR), skin and hair analysis.

Embedded Systems (IoT) - Comprehensive range of electronics hardware and firmware development services to enable building solutions such as personal emergency response systems for elderly people, refreshable braille display for visually impaired, smart wearables, vehicle control units, vehicle telematics (electric, connected vehicles) and more.

Software Systems (Cloud, Mobile) - With deep-domain expertise in cloud, mobile and web solutions, KritiKal has helped enterprises in developing solutions like cloud-based operations management, interactive learning management, loyalty rewarding apps, predictive maintenance apps and many more.

KritiKal has been helping clients across the globe innovate via its services and products. The offerings are flexible across co-investments/co-development of Ventures/Products/Platforms/IP (intellectual property), engineering/R&D services as well as talent and team building/augmentation services. Whether it's a small panel of consultants or a pool of talent or setting up an offshore development center, KritiKal has successfully deployed its talent, infrastructure, experience and resources for varying client/business requirements.

KritiKal has come a long way since its inception and its motto continues to be to help organizations transform their ideas to reality, including by helping translate research from academia to market!

Tensor Dynamics

Faizan Khan (Founder) founded Tensor Dynamics after realizing the potential and lack of resources in the field of specialized weather forecasting for RE and Power sector my M. Tech guide and professor at IIT-Delhi Dr. Somnath Baidya Roy and got incubated at FITT IIT Delhi in 2018. For 2 Years we operated as a weather consultation company for Renewable Energy and Power sector successfully executed multiple projects with industry's giants like Power Grid of India, NTPC, Genesis Ray & Adani Green Energy Ltd. In 2020, We also received funding support from FIIT-IIT Delhi which helped us to survive through tough times.

After learning about the technological requirements and industry's needs, we filed a patent application on Hybrid weather forecasting for Renewable Energy in 2021 which became base technology for our Weather Forecast API product, we partnered up with Pad-up ventures to raise Seed round for building our 1st product.

In 2022 we successfully graduated from incubation and joined accelerator program at Research and Innovation Park IIT Delhi and started to get initial client traction after meta & beta testing of our SaaS product SKYCASTERTM. Very recently in 2023, Tensor Dynamics has entered a strategic partnership with SHELL Renewables and Energy Solutions for global roll out of services and has won a Geospatial Hackathon Challenge launched by Microsoft and Government of India.

Products –

SKYCASTER™ - Plug & Play API based weather data platform offering high resolution weather forecasts at multiple time and space scale. Our platform highly dynamic and accurate weather data with cutting edge analytics for past, near future and yearlong projections to fulfil the needs of renewable energy and power sector with a unique patented technology for industry leading accuracy with a triangulation of satellite, numerical weather prediction and regional neural network.

Team Image -

Faizan Khan, Founder, CEO

Sanaj Mehta, Co-Founder, CGO

Dr. Somnath Baidya Roy, Director

Vasudev Gupta, CTO

Jagjeet Agarwal, CTO

Dr. Mrinalini Manohar, Operations Head

Aman Khan, Developer

Nanosafe Solutions

Microbes (bacteria, virus, fungi, algae) are omnipresent in our surroundings and cause many life-threatening diseases including COVID19, influenza, hepatitis, measles, dengue and diarrhoea. To eliminate growth of these microbes, we invented antimicrobial active copper technology (ACT) applicable on textiles, polymers and coatings. ACT is a 4-in1 technology with >99% proven effectiveness against bacteria, virus, fungi and algae. The microbe inhibiting action stems from interaction of active copper cation released from ACT treated materials with microbial proteins, thereby denaturing them within a short span of time. Unlike silver and drug based antimicrobial technology, active agent of ACT is a micro-nutrient, thereby making it extremely safe for food and water applications. We have more than 35+ ACT products and solutions in the market with 4000+ happy customers and adopters spread across 8+ nations. A bootstrapped start-up with expertise in lab-to-market commercialization, we have been completely running on revenue without external fund-raising for the past 3 years. We are winners of many awards including prestigious National Tech Excellence Award by DST 2022, BIRAC BIG and DST NIDHI programmes, and we envision becoming a global leader of antimicrobial technology in materials.

Products

We are providers of active copper based functional materials with excellent antimicrobial capacity, conforming to EU and FDA regulations.

Our B2B technologies consists of-

1. Active copper based antimicrobial nanomaterials- for application in coatings and foams.
2. Active copper based antimicrobial finish- for application in textiles.
3. Active copper based Polymer masterbatches- for application in plastics.

Our consumer product section consists of-

4. NSafe- India's first copper treated antimicrobial mask, reusable for 50 washes, with filtration standards certified by SITRA.
5. AqCure is a first of its kind antimicrobial water bottles.
6. RubSafe is an FDA approved zero alcohol sanitizer.

The AqCure technology has won the Biotechnology Ignition Grant (BIG) sponsored by BIRAC, DBT and the NSafe technology has won DST NIDHI Seed Scheme Support Fund. All our formulations and products are rigorously tested and validated by leading biotechnology labs across the world and are certified by ISO, CE, GMP, HACCP and FDA (US).

FITT's Automating Progress: Navigating the Path of Transformation

Viswaroop Bhattacharya

Consultant (Corporate Communication) FITT, IITD

Automation, a product of technological innovation, has emerged as a transformative force across industries, revolutionizing the way tasks are executed, and redefining the concept of efficiency. It offers infinite benefits and it has become an integral part of modern society and business operations

FITT, established in 1992 has always endeavoured to provide the best services and that too in the most transparent manner to the Institute. To keep pace with the changing time the need to automate its services had become essential. Therefore, after many deliberations, a rigorous vendor selection process, umpteen meetings, discussions, and to take its services, a notch higher the project for automating FITT activities was green lighted. The current team has worked diligently towards capturing the existing processes, carrying out BPR(Business process reengineering). The entire process was helmed by the inhouse team lead by Col Naveen Gopal, Chief Operating Officer FITT.

The objective of the project was to provide timely and "at the click of a button services" to the Institute and its various stakeholders. The key focus has been on usability, security, and a commitment to providing a seamless and convenient user experience.

Some of the salient features envisaged in the FITT portal are as follows.

1. Updated website with easy navigation and enquiry module where any user can query on aspects of Incubation, Funding, Services at RI park Technology development/Research consultancy Projects, IPR filing etc.
2. Single sign on for progressing Technology development/Research consultancy Projects, IPR filing, Technology transfer and Incubation for the Institute faculty and incubated startups.
3. Seamless visibility of financials, documentation, inventory, team resources to the faculty.
4. Online requisition for project initiation, purchase requisition, resource hiring, booking f services etc.
5. Dashboard analytics and notifications.

It is envisaged that when the project is fully implemented the FITT clientele of faculty, entrepreneurs, industry representatives etc can take full advantage of the portal in a seamless manner. The visualised benefits of the portal are :-

1. Enhanced Efficiency and Productivity the inputs
2. Improved Accuracy and Consistency in data inputs
3. Rapid and Consistent services related to Projects, PR and TT
4. Data Analysis and Insights on the financials
5. Scalability and Flexibility required in a ready manner.

The project roll out is planned in phases and the defined phases are as under: -

1. Website and Enquiry Module: The same is already live and can be accessed at https://www.fitt-iitd.in/web/home
2. Technology development/Research consultancy Projects, Inventory management and Research park modules
3. Innovation and Entrepreneurship modules which will include funding for the startups also
4. Intellectual Property rights management and Technology Transfer module

In the grand symphony of progress, automation serves as a transformative note. It is hoped and anticipated the our collective efforts resonate and we shape FITT's future where automation is not just a solution, but an amalgamation of boundless prospects and possibilities of the digital age.

List of Technologies Transferred during July 2022 to June 2023

Main Inventor	Department	Technology
Prof. Jayashree Bijwe	Centre for Automotive Research & Tribology	Process development to remove sizing agents on Aramid Fabric and Laminate
Prof. Sangeeta Kohli	Department of Mechanical Engineering	Ignition pellets for TLUD Cookstove
Prof. Satya Narayan Naik	Centre For Rural Development And Technology	Liquid Fuel from Plastic Waste
Prof. Apurba Das	Department of Textile and Fibre Engineering	Multidirectional thermal protective performance testing instrument
Prof. Meenakshi Balakrishnan	Department of Computer Science Engineering	A Device for Providing Assistance to Visually Impaired for Boarding of Public Buses
Prof. Meenakshi Balakrishnan	Department of Computer Science Engineering	Indoor Mapping and Navigation Technology
Prof. Swades De	Department of Electrical Engineering	"Smart Sensing Technology"
Prof. Swades De	Department of Electrical Engineering	Smart Real-time/Non-Real- Time Data Handling Technology
Prof. Bhuvnesh Gupta	Department of Textile and Fibre Engineering	Bio Surfactant
Prof. Subir Kumar Saha	Department of Mechanical Engineering	MechAnalyzer
Prof. Ashu Verma	Department of Energy Science and Engineering	Smart Energy Metring Solution for a Building management
Prof. Sandeep Kumar Jha	Centre for Biomedical Engineering	Rapid Detection of Pathogens
Prof. Ashwini Kumar Agrawal	Department of Textile and Fibre Engineering	Aquasilver technology
Prof. Sri Harsha Kota	Department of Civil Engineering	IoT Based PM Detector

IPR Applications filed during January 2023 to June 2023

TITLE	MAIN INVENTOR	DEPARTMENT
A SPLIT - HIT ERROR DECOMPOSITION SCHEME (SHEDS) BASED CONTIGENCY TABLE	PROF. C.T. DHANYA	DEPARTMENT OF CIVIL ENGINEERING
HIGH VELOCITY HYBRIDIZED-FLOW DIFFUSION PROCESS FOR SURFACE TREATMENT OF STEELS	PROF. DEEPAK KUMAR	CENTRE FOR AUTOMOTIVE RESEARCH AND TRIBOLOGY
A METHOD FOR SYNTHESIZING AND PATTERNING LEAD FREE PIEZOELECTRIC COMPOSITE MATERIAL	PROF. BHASKAR MITRA	DEPARTMENT OF ELECTRICAL ENGINEERING
DETECTION OF MULTIVARIATE HEAVY METAL IONS USING TRANSITION METAL DICHALCOGENIDE SENSORS	PROF. MADHUSUDAN SINGH	DEPARTMENT OF ELECTRICAL ENGINEERING
NATURAL FIBER-BASED TRANSPARENT COMPOSITES FOR FOOD PACKAGING AND METHOD FOR FABRICATION THEREOF	PROF. ARCHANA SAMANTA	DEPARTMENT OF TEXILE AND FIBRE ENGINEERING
A STENT STRUCTURE	PROF. KUSUM MEENA	DEPARTMENT OF MECHANICAL ENGINEERING
METHOD AND APPARATUS FOR SWITCHABLE BRIGHTFIELD,DARKFIELD AND GREYSCALE SCHLIEREN IMAGING	PROF. MANISH KUMAR	CENTRE FOR SENSORS, INSTRUMENTATION AND CYBER PHYSICAL SYSTEM ENGINEERING
AN ADAPTABLE SHAPE CHANGING AERIAL VEHICLE AND METHOD THEREOF	PROF. VALIPE RAMGOPAL RAO	DEPARTMENT OF ELECTRICAL ENGINEERING

TITLE	MAIN INVENTOR	DEPARTMENT
REGENERABLE ANODIZED POROUS ALUMINA DEVICE AND A METHOD OF FABRICATION THEREOF	PROF. BHASKAR MITRA	DEPARTMENT OF ELECTRICAL ENGINEERING
STANDALONE PORTABLE METER AND MICROFLUIDIC STRIP AND KIT FOR MULTI-VARIATE BIOSENSING AND QUANTITATIVE LATERAL FLOW ASSAY	PROF. SANDEEP KUMAR JHA	CENTRE FOR BIOMEDICAL ENGINEERING
MICROFLUIDIC CHIP BASED CELL SORTER AND ENRICHMENT DEVICE	PROF. SANDEEP KUMAR JHA	CENTRE FOR BIOMEDICAL ENGINEERING
FLEXIBLE FREE-STANDING ELECTRODES AND A METHOD OF PREPARATION THEREOF	PROF. BHANU NANDAN	DEPARTMENT OF TEXILE AND FIBRE ENGINEERING
MICROFLUIDIC ANALYSER FOR IN-VITRO BIOSENSING AND DIAGNOSTICS	PROF. RAVIKRISHNAN ELANGOVAN	DEPARTMENT OF BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY
A NON-PRISMATIC SELF-LOCKABLE FOLDABLE TRUSS TOWER	PROF. ARNAB BANERJEE	DEPARTMENT OF CIVIL ENGINEERING
BANDGAP REFERENCE VOLTAGE GENERATOR WITH A FAST STARTUP CIRCUIT	PROF. ANKUR GUPTA	CENTRE FOR APPLIED RESEARCH IN ELECTRONICS
SMART-SENSORIMOTOR ASSISTIVE REHABILITATION TECHNOLOGY	PROF. AMIT MEHNDIRATTA	CENTRE FOR BIOMEDICAL ENGINEERING
RoBoExo UPPER LIMB REHABILITATION ROBOT	PROF.AMIT MEHNDIRATTA	CENTRE FOR BIOMEDICAL ENGINEERING
LOW SOURCE CURRENT RIPPLE BI-POLAR BUCK-BOOST DC-DC CONVERTER	PROF. MUMMADI VEERACHARY	DEPARTMENT OF ELECTRICAL ENGINEERING
HARVESTING PICO-SCALE WATERPOWER USING ZERO-HEAD		
HYDROKINETIC TURBINE AND A SYSTEM THEREOF	PROF. PARUCHURI MOHAN VENKATA SUBBARAO	DEPARTMENT OF MECHANICAL ENGINEERING
AUTOMATED SOIL PESTICIDE ANALYZER	PROF. SANDEEP KUMAR JHA	CENTRE FOR BIOMEDICAL ENGINEERING
A PICO HYDROKINETIC TURBINE FOR GENERATING POWER IN CANAL AND SEWAGE SYSTEM	PROF. PARUCHURI MOHAN VENKATA SUBBARAO	DEPARTMENT OF MECHANICAL ENGINEERING
SYSTEM FOR FACILITATING MULTI-LEVEL STREAM-BASED EDGE ANALYTICS IN MULTI MODAL COMMUNICATION AND MET	PROF. BREJESH LALL	DEPARTMENT OF ELECTRICAL ENGINEERING
A SELF-ADAPTIVE CLOSED LOOP IRRIGATION DEVICE FOR ROOT CANAL TREATMENT	PROF. BISWARUP MUKHERJEE	CENTRE OF BIOMEDICAL ENGINEERING
STANDARDIZED NET PRECIPITATION DISTRIBUTION INDEX (SNEPI): A NEW DROUGHT INDEX	PROF. C.T. DHANYA	DEPARTMENT OF CIVIL ENGINEERING
SIMULATOR OF CODED OPTICAL COMMUNICATION SYSTEM	PROF. ABHISHEK DIXIT	DEPARTMENT OF ELECTRICAL ENGINEERING
A LOW ENERGY DEMANDING AND EFFICIENT SUBTERRANEAN STORAGE STRUCTURE FOR ONION AND GARLIC	PROF. RAM CHANDRA	CENTRE FOR RURAL DEVELOPMENT AND TECHNOLOGY
RIGID-ELASTIC VIBRATION ISOLATOR (REVI)	PROF. ARNAB BANERJEE	DEPARTMENT OF CIVIL ENGINEERING
A METHOD AND AN APPARATUS FOR WIRELESS INFORMATION AND ENERGY TRANSFER USING DISTRIBUTED BEAMFORMIN	PROF. SWADES DE	DEPARTMENT OF ELECTRICAL ENGINEERING
AN AUTOMATED INSTRUMENT AND MICROFLUIDIC CHIP FOR IMPROVED AND RAPID TESTING OF NUCLEIC ACID	PROF. SANDEEP KUMAR JHA	CENTRE FOR BIOMEDICAL ENGINEERING
SYNTHESIS AND CYTOTOXICITY OF MONOFUNCTIONAL PT(II) COMPOUND BEARING (NOSE)- HETERODONOR SCAFFOLD	PROF. JAI DEO SINGH	DEPARTMENT OF CHEMISTRY
APPARATUS AND METHOD FOR DETECTING MICRO-ORGANISM-BASED DISEASES	PROF. SATISH KUMAR DUBEY	CENTRE FOR SENSORS, INSTRUMENTATION AND CYBER PHYSICAL SYSTEM ENGINEERING (FORMERLY IDDC)
HYDRO-BASED GRID FORMING CONVERTER HAVING POWER SHARING AND SYNCHRONIZATION CAPABILITY BETWEEN TYPE-III BASED WIND ENERGY CONVERSION SYSTEM AND UTILITY GRID	PROF. BHIM SINGH	DEPARTMENT OF ELECTRICAL ENGINEERING
BUSBAR DESIGN FOR A THREE PHASE VOLTAGE SOURCE INVERTER	PROF. SOUMYA SHUBHRA NAG	DEPARTMENT OF ELECTRICAL ENGINEERING

TITLE	MAIN INVENTOR	DEPARTMENT
SYSTEM AND METHOD FOR FOOTSTEP-BASED CROSS DOMAIN PERSON IDENTIFICATION	PROF. SUBRAT KAR	DEPARTMENT OF ELECTRICAL ENGINEERING
A METHOD FOR PREPARATION OF A BILAYERED HALOCHROMIC FRESHNESS MARKER BASED PACKAGING FILM	PROF. BHABANI KUMAR SATAPATHY	DEPARTMENT OF MATERIAL SCIENCE AND ENGINEERING
WATER SPLITTING	PROF. BISWARUP CHAKRABORTY	DEPARTMENT OF CHEMISTRY
POLARIZATION SYNCHRONIZATION METHODS AND SYSTEMS FOR DISTRIBUTED OPTICAL BEAMFORMING (DOB)	PROF. SWADES DE	DEPARTMENT OF ELECTRICAL ENGINEERING
AN ANTIMICROBIAL HEMOSTATIC MATERIAL AND A FABRICATION METHOD THEREOF	PROF. BHUVANESH GUPTA	DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING
METHOD FOR DEVELOPING A FORMULATION	PROF. JAYANTA BHATTACHARYYA	CENTRE OF BIOMEDICAL ENGINEERING
IMPEDANCE BASED LIQUID BIOPSY SYSTEM & METHOD FOR DETECTING AND SCREENING CANCER	PROF. SHALINI GUUPTA	DEPARTMENT OF CHEMICAL ENGINEERING
A METHOD OF PREPARATION OF A TRANSITION METAL DICHALCOGENIDE (TMD) FILM ON A GROWTH SUBSTRATE	PROF. MADHUSUDAN SINGH	DEPARTMENT OF ELECTRICAL ENGINEERING
A SYSTEM AND METHOD FOR ENABLING A MULTI-OPERATOR EDGE ENVIRONMENT	PROF. BREJESH LALL	DEPARTMENT OF ELECTRICAL ENGINEERING
MULTIPLE SCANNER HEADS FOR NON-CONTACT CHEMICAL DETECTION, LAYER THICKNESS AND SURFACE ROUGHNESS MEASUREMENT	PROF. AMARTYA SEN GUPTA	DEPARTMENT OF PHYSICS
A METHOD FOR SYNTHESIS OF HYBRID ZINC STANNATE COPPER-TRIMESIC ACID BASED METAL ORGANIC FRAMEWORK	PROF. SYED WAZED ALI	DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING
A METHOD FOR PREPARING A POLYMER-BASED FILM AND COMPOSITION THEREOF	PROF. SAMPA SAHA	DEPARTMENT OF MATERIAL SCIENCE AND ENGINEERING

List of Consultancy Projects undertaken from January 2023 to June 2023

Project/Title	PI	Department/Centre
DEVELOPMENT OF A NOVEL 3D PRINTED DENTAL TRAUMA SPLINT AID	PROF. ARNAB CHANDA	CBME
INVESTIGATION OF EDGE-AI APPLICATIONS	PROF. MANAN SURI	EE
IMPROVEMENT OF A LAGRANGIAN PARTICLE SOLVER	PROF. PRAPANCH NAIR	DESE
DESIGN UPGRADATION OF GRAIN ATM MACHINE FOR HIGHER CAPACITY (A SUBPROJECT OF PSL-PROJECT No. PROJECT-FT/11/101/2021)	PROF. SUNIL JHA	ME
STRATEGIES FOR THE REDUCTION IN IMPURITIES IN RECYCLED SODIUM THIOCYANATE	PROF. SUDIP KUMAR PATTANAYEK	Chemical
SOUND ATTENYATION ANALYSIS OF SOUND PROOFING MATERIAL	PROF. ARUN KUMAR	CRDT
LENS-LESS IMAGING SYSTEM FOR BLOOD CELL CLASSIFICATION	PROF. KEDAR KHARE	Optics
PREPARATION OF TECHNO-ECONOMIC FEASIBILITY REPORT FOR THE REJUVENATION OF HANSAROVAR DAM (AGYARA DAM) ALWAR	PROF. VIVEK KUMAR	CRDT
DEVELOPMENT OF ACRYLIC BASED COIR BACKING MATRIX	PROF. SAMPA SAHA	DMSE
DEVELOPMENT OF CONTROLLER FOR CHILLED WATER VALVE FOR HVAC SYSTEMS	PROF. ANURAG GOYAL	ME
DEVELOPMENT OF ACRYLIE BASED HIGH MOLECULAR WEIGHT PROCESSING AID (HMWPA) FOR PVC AND WPC FOAM BOARD APPLICATION	PROF. SAMPA SAHA	DMSE
STATISTICAL DATA ANALYSIS	PROF. S. DHARMARAJA	Mathematics

Project/Title	PI	Department/Centre
WORK STUDY FOR RATIONALIZATION OF FIELD OFFICES AND MANPOWER REQUIREMENT.	PROF. JITENDER MADAAN	DMS
DESIGN, BUILD AND OPERATE (DBO) BASIS WITH 15 YEARS COMPREHENSIVE O&M FOR A UTILITY INFRASTRUCTURE PROJECT IN JITE, TALUKA PEN, DIST. RAIGAD "C.A. No. 08/CIDCO/EE (KONDHANE)/2022-23- ANALYSIS, REVIEW AND TECHNICAL ADVICE ON THE TECHNICAL BID EVALUATION BY PMC."	PROF. KUMAR NEERAJ JHA	CE
STUDY ON COLD PROTECTIVE CLOTHING	PROF. BIPIN KUMAR	TT
REACTOR MODELING FOR PRODUCTION ON BIOTECH THERAPEUTICS	PROF. ANURAG SINGH RATHORE	Chemical
PERFORMANCE EVALUATION OF MODIFIED DRY TOILET SYSTEM DESIGNED FOR POTENTIAL APPLICATION IN RURAL AREAS	PROF. VIVEK KUMAR	CRDT
DESIGN AND DEVELOPMENT OF ARTIFICIAL INTELLIGENCE (AI) BASED HYDROGRAPHIC DATA ANALYTICS USING MANUAL NAUTICAL CHARTS BASED ON HYDROGRAPHIC SURVEYS	PROF. BREJESH LALL	Bharti School
MULTI-MODAL TRAFFIC DEMAND ESTIMATION UTILISING CROWDSOURCED PERVASIVE DATA	PROF. SAI CHAND	TRIPP
CONTINUOUS MANUFACTURING OF BIOPHARMACEUTICALS	PROF. ANURAG SINGH RATHORE	Chemical
FACILITATE ONLINE LEARNING ON LOW CARBON URBAN MOBILITY AND LIVING LABS: ONLINE COURSE (DECARBONISING TRANSPORT IN INDIAN CITIES) – AN INTRODUCTION TO THE DECARBONIZATION OF TRANSPORT	PROF. DEEPTY JAIN	TRIPP
HOSTING THE DIGITAL INDIA ALT HACK-DELHI – 8 DAYS BOOTCAP / INTERNSHIP PROGRAM	PROF. SUNIL JHA	ME
SPECIAL MANPOWER DEVELOPMENT PROGRAM FOR ESDM SECTOR	PROF. ANKESH JAIN	EE
DEVELOPMENT OF WASTE HEAT RECOVERY SYSTEM FROM FORGINGS.	PROF. S R KALE	ME
NEURAL-GUIDED APPROACHER FOR AUTOMATED SYNTHESIS	PROF. KUMAR MADHUKAR	CSE
GRAPH-BASED ANTIBODY DESIGN	PROF. SAYAN RANU	ScAI
THE DEVELOPMENT OF FORECASTING TOOLS UNDER SCMS PROJECT-NACO	PROF. GOURAV DWIVEDI	DMS
EVEROLIMUS AND PROBUCOL DRUGS ELUTING BALLON CATHETERS.	PROF. NEETU SINGH	CBME
DEVELOPMENT, TRAINING AND DEMONSTRATION OF SMALL-SCALE ESSENTIAL OIL EXTRACTION PROCESS FROM AROMATIC/MEDICINAL PLANTS FOR LIVELIHOOD GENERATION IN THE PATI BLOCK OF CHAMPAWAT, UTTARAKHAND.	PROF. VIVEK KUMAR	CRDT
PERSON DETECTION AND MONOCULAR DEPTH ESTIMATION	PROF. CHETAN ARORA	CSE
DEVELOPING A ROADMAP FOR TRANSITION IN THE COMMERCIAL TRANSPORTATION SECTOR IN THE EASTERN REGION: A CASE STUDY OF BIHAR AND JHARKHAND	PROF. LOKESH KUMAR KALAHASTHI	TRIPP
DEVELOPMENT OF HEMP FIBRE BASED POLYMERIC COMPOSITES FOR THE LUGGAGE INDUSTRY	PROF. BIJAY P. TRIPATHI	DMSE
DEVELOPMENT OF TECHNOLOGY FOR EFFICIENCY IMPROVEMENT OF SOLAR PV SYSTEM WITH PHOTOVOLTAIC OPTIMIZERS AT AGEL.	PROF. BHIM SINGH	EE
ESTIMATION OF BLOOD GLUCOSE LEVEL USING PPG AND ECG SENSOR ON THE SAMSUNG WATCH.	PROF. ISHAN GUPTA	DBEB
ALGORITHM DESIGN AND SOFTWARE DEVELOPMENT FOR SIMULATIORS FOR DOPPER VELOCITY LOG AND ECHO SOUNDER.	PROF. ARUN KUMAR	CARE
NEXT-GENERATION THERMOCHEMICAL HEAT PUNP WITH THERMAL STORAGE FOR ENERGY-EFFICIENT AIR-CONDITIONING IN ELECTRIC VEHICLES.	PROF.ANURAG GOYAL	ME
SKILL AS PREDOMINANT FACTOR IN OUTCOME OF CARD GAMES IN ONLINE AND OFFLINE MODE.	PROF. TAPAN KUMAR GANDHI	EE
DEVELOPMENT OF ACTUATOR & PACKGING COMPONENTS FOR SMART COTTON HARVESTING MACHINE.	PROF. SUNIL JHA	ME
EXPERIMENTAL AND COMPUTATIONAL ANALYSIS OF DUCTILE IRON PIPES	PROF. JAYANT JAIN	DMSE

Abbreviations

AM	Department of Applied Mechanics
BSTTM	Bharti School of Telecommunication Technology and Management
CARE	Centre for Applied Research in Electronics
CAS	Centre for Atmospheric Sciences
CART	Centre for Automotive Research and Tribology
CBME	Centre for Biomedical Engineering
CE	Department of Civil Engineering
CHEME	Department of Chemical Engineering
CHY	Department of Chemistry
CRDT	Centre for Rural Development and Technology
CSE	Department of Computer Science and Engineering
DBEB	Department of Biochemical Engineering and Biotechnology
DESE	Department of Energy Science and Engineering.
DMS	Department of Management Studies
DMSE	Department of Material Science & Engineering
DOD	Department of Design
EE	Department of Electrical Engineering
HUSS	Department of Humanities and Social Sciences
KSBS	Kusuma School of Biological Sciences
MATHS	Department of Mathematics
ME	Department of Mechanical Engineering
PHY	Department of Physics
TFE	Department of Textile and Fiber Engineering

and many more...

Incubation Events

SAMRIDH

The SAMRIDH Scheme, an initiative by the Ministry of Electronics and Information Technology (MeitY), has effectively advanced its mission fostering growth and innovation in start-ups. The program's overarching goal to empower start-ups with promising solutions and facilitate their product enhancement using cutting-edge technologies has yielded remarkable outcomes.

The strategic establishment of an accelerator program has catalysed the growth of start-ups focused on social impact and addressing India's challenges at scale. Through a meticulous selection process, start-ups with viable solutions have been nurtured, aligning with the program's sector-specific approach.

The accelerator program's structure has proved instrumental, offering crucial services such as customer engagement, investor networking, expert diagnostics, mentoring, legal support, and networking opportunities and internationalisation support to fuel rapid growth.

Regular interactions among start-up founders, demo days, and investment deal assistance have amplified the impact. Start-ups have benefited from the SAMRIDH program, demonstrating impressive progress and innovation. Looking ahead, SAMRIDH remains steadfast in its commitment to nurturing start-ups, propelling technological advancements, and contributing to India's socio-economic development.

FCI Hackathon

FITT-IIT Delhi in association with FCI had invited start-ups, individuals, and teams of innovators to solve the challenge related to supply chain, logistics management, and product design.
FCI Hackathon aims to support innovators to grow from the ideation stage to developing workable prototypes and minimum viable products for the use cases.

Teams are invited to solve the supply chain and logistics management challenge.

Problem statement: Design an independent mechanical portable system to load/ unload gunny bags filled with food grains viz;

- Unloading from the wagon, loading into the truck, and vice versa.
- Unloading from the truck and stacking inside the Godown, de-stacking from Godown, and loading into the truck.

Thota Akhilesh, an individual has won a prototyping grant of upto Rs. 10 lakhs and emerged as a deserving winner of the Build-A-Thon.

Delhi Innovation Summit

The Delhi Innovation Summit, held at the Research and Innovation Park of IIT Delhi on April 13, 2023, celebrated innovation by uniting entrepreneurs, innovators, investors, and policymakers. The event showcased remarkable startups and innovations, inviting early-to-growth stage founders to benefit from FITT's esteemed mentor network, engage in one-on-one mentoring sessions, and refine problem-solving skills through interactions with seasoned scientists, alumni, entrepreneurs, and investors. The summit featured the PITCHFEST challenge, where 20 startups pitched for funding up to INR 1 Crore, with a distinguished panel including representatives from the World Bank, IvyCap Ventures, and Indian Startup Factory.

The event also hosted Investor Speed Dating and an innovation expo called "Saajhedari," offering invaluable exposure and opportunities for innovators to connect with partners, customers, and investors for advancing their technologies towards commercialization.

More than 75 startups participated in one-on-one investor speed dating sessions and mentoring clinics, with 30 more early-growth stage startups getting an opportunity to pitch for funding upto 1 crore. The event garnered participation from 40 investor groups and 25 technical and business mentors.

Samsung Solve for Tomorrow

The Samsung Solve for Tomorrow Program is a globally recognized competition designed to nurture problem-solving skills and harness the positive impact of young minds aged 16-22 in the realms of Science, Technology, Engineering, Math, and Design Thinking, all aligned with the UN's Sustainable Development Goals and Samsung's vision of "Together for Tomorrow - Enabling People." The program encourages participants to address pertinent themes such as Agriculture, Education, Environment, and Healthcare.

The program's focal point lies in empowering the top three winning teams to present a "Proof of Concept," which Samsung will support in creating prototypes through funding and collaboration with FITT, IIT-Delhi, for consumer validation. The initiative encompasses various activities, from roadshows and online training to physical boot camps and mentorship sessions, culminating in the incubation support and mentoring of the winning teams, along with the disbursement of funds and distribution of rewards like Samsung hampers and Flip 85" screens. The program's holistic approach aims to inspire young innovators to effect meaningful change.

With a reward Rs.1.14 cr to top 3 winning teams based on milestones decided by Samsung and FITT.

Tech. Transfer Happenings

Title - A Device for Providing Assistance to Visually Impaired for Boarding of Public Buses.
PI – Prof. M. Balakrishnan (CSE, IITD)
Licensee – Raised Line Foundation

Title – (a) Smart Sensing Technologies
(b) Smart Real Time / Non Real Time Data Handling Technology
PI – Prof. Swades De (DEE, IITD)
Licensee – I2Sage Technologies Pvt. Ltd.

Title – Bio Surfactant
PI – Prof. Bhuvanesh Gupta (TFE, IITD)
Licensee – Gujrat Flurochemicals Ltd.

Title – MechAnalyzer
PI – Prof. S.K.Saha (DME, IITD)
Licensee – M/s. SVR Infotech

Title – IoT Based PM Detector
PI – Prof. Sri Harsha Kota (CE, IITD)
Licensee – M/s. Airshed Planning Professional Pvt. Ltd.

CORPORATE MEMBERSHIP OF FITT

FITT invites the industry/industry associations/R&D organisations and financial institutions to become corporate members of FITT at a nominal annual subscription. A corporate client can participate in technology transfer and joint R&D programs of the Institute on a priority basis with FITT providing the interface.

Membership form can be downloaded from - www.fitt-iitd.in

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