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# FITT FORUM

Newsletter of Foundation for Innovation and Technology Transfer,
Indian Institute of Technology Delhi, New Delhi

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# RESEARCH TALE

## INVERSE STOCHASTIC FILTERING IN ELECTRONIC WARFARE

**Dr. Arpan Chattopadhyay**

*Assistant Professor, Electrical Engineering Department,IIT Delhi.*

Electronic warfare (EW) is a military action that can determine/exploit/reduce/prevent the use of electromagnetic (EM) signal of the enemy and retains/facilitates friendly use of the EM spectrum. EW capabilities are increasingly becoming important in modern warfare. The latest interesting EW instance allegedly comes from the Baltic region in Europe, where it is claimed that the Russian military forces are jamming or spoofing the GPS signals of enemy airplanes [1]. Obviously, this is only one specific form of EW activity, and there could be many more. Some other forms of EW include: (i) jamming the enemy's wired/wireless communication, (ii) spoofing the enemy's sensor observations, (iii) breaking the encryption used by the enemy, especially in real-time applications, (iv) using the enemy's signal to infer information about enemy, and (v) taking actions in such a way that the enemy is misguided. While the first three can be understood by a layman, the fourth and fifth need little more explanation. Let us consider a radar seeking to track a target by sending EM pulses and measuring the target returns. While this is a classical and well-understood problem, the twist comes when the target is equipped with antennas to receive the EM pulses transmitted by the radar- these received pulses can reveal useful information to the target about the radar, such as the radar's location, strategy and the radar's estimate of the location of the target. Thus, an intelligent target can perform inverse cognition about the radar. Additionally, if the radar is cognitive, the target can use its measurements to infer the beam scanning strategy of the radar, and then perform motivated maneuvers to train the cognitive radar to adopt a poor beam scanning strategy that is not suitable for tracking the target.

Inverse stochastic filtering is a technique by which a target can track the estimate made by the radar of the target's state. To this end, it is assumed that a cognitive radar seeks to track an intelligent target's kinematic state {xk}k≥0 using a stochastic filter that is fed with the signal received by the radar. The filter outputs x^ at the radar, based on the radar's measurements up to time k. However, the target is equipped with receive antennas or some sensors, through which it can make a noisy observation of the action made by the radar, where the radar's action could be the transmit beam pattern or transmit waveform or simply the transmit power. These noisy observations can be fed to an inverse stochastic filter employed by the target in order to compute \hat{x} , an estimate of \hat{\hat{x}}. They key idea here is to treat \hat{x} as an unknown state and estimate it at each time k by using the inverse filter employed by the target.

The Stochastic Systems Research Group (SSRG) at IIT Delhi, led by Dr. Arpan Chattopadhyay, has recently made significant progress in developing inverse stochastic filtering algorithms to facilitate inverse cognition in a radar-target setting. These algorithms can be applied to a radar-target setting, and the results are mostly analytical in nature, validated by simulation. It is worth mentioning that the first paper [2] on inverse Kalman filters for linear state dynamics and linear observation models has been published through a collaboration between two researchers from Cornell University and the US Air Force Research Laboratory (AFRL). However, SSRG@IITD has extensively worked on developing inverse filters for non-linear target dynamics and observation models, and also incorporated learning into these inverse filters to address the challenge of unknown system model. In particular, they have developed algorithms for inverse extended Kalman filter (I-EKF) for simple nonlinear systems [3] and for highly nonlinear and uncertain systems [4], inverse cubature and quadrature Kalman filters [5], and inverse unscented Kalman filters (I-UKF) [6]. The inverse filtering schemes were analytically developed and sufficient conditions for the error stability of these filters were provided. Additionally, learning schemes were provided by using reproducing kernel Hilbert space (RKHS) techniques to handle unknown model of the dynamical system.

Inverse stochastic filtering and inverse cognition in general, have become popular research topics in recent times, owing to significant interest from funding agencies such as the US Army Research Lab. This area has a lot of open problems that need to be solved before the results can be used in real EW systems. For example, the inverse filtering algorithms developed by the SSRG group do not consider the possibility of a strategic interaction between the radar and the target, which requires game-theoretic formulation. Also, inverse filtering needs to be developed for non-Gaussian noise, and the learning algorithms need to be model-free. Convergence rates of these inverse filters are still unexplored, and providing guarantees here involves a lot of challenges. The inverse filters need to be resilient to jamming and spoofing attacks by the enemy. All these challenges have the potential to give rise to interesting theoretical problems on algorithm design, and at the same time have huge impact on our national security.

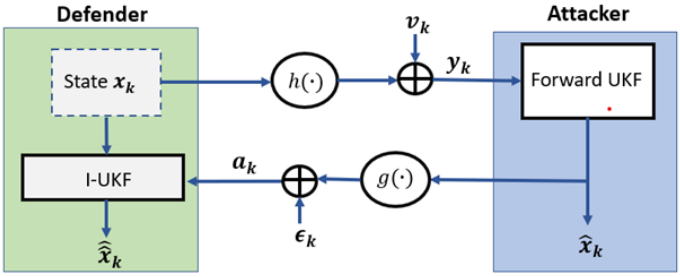



*Fig. 1. An illustration of inverse UKF's recursion at k-th time step. The defender's (i.e., target's) true state at k-th time is x_k, which the attacker (i.e., radar) observes as y_k through observation function h(·) with additive measurement noise. Forward UKF provides estimate of x_k using y_k. The target observes this estimate through observation function g(·) with additive measurement noise. Finally, with a_k and x_k as inputs, I-UKF computes estimate of the attacker's estimate. Diagram has been drawn by Himali Singh.*

*[1] "https://www.politico.eu/article/airlines-flying-baltic-region-report-gps-signal-russia-gets-blame/," 2024.*
*[2] V. Krishnamurthy and M. Rangaswamy, "How to Calibrate your Enemy's Capabilities? Inverse Filtering for Counter-Autonomous Systems," in 22th International Conference on Information Fusion (FUSION). IEEE, 2019, pp. 1–6.*
*[3] H. Singh, A. Chattopadhyay, and K. V. Mishra, "Inverse Extended Kalman filter - Part I: Fundamentals," IEEE Transactions on Signal Processing, vol. 71, pp. 2936–2951, 2023.*
*[4]——,"InverseExtendedKalmanfilter–PartII:Highlynon-linearanduncertainsystems,"IEEETransactionsonSignalProcessing,vol.71,pp.2952–2967, 2023.*
*[5] H. Singh, K. V. Mishra, and A. Chattopadhyay, "Inverse Cubature and Quadrature Kalman filters," IEEE Transactions on Aerospace and Electronic Systems, 2024, in press.*
*[6] ——, "Inverse unscented kalman filter," Accepted with minor revisions in IEEE Transactions on Signal Processing, 2024.*

# TOWARDS PRECISION ASSEMBLY: EXACT-CONSTRAINED DESIGN AND COMPLIANT MECHANISMS

## Prof Jitendra Prasad Khatait

*Department of Mechanical Engineering, IIT Delhi*

The precise function of assembly is achieved through the exact-constrained design of the system, as opposed to the case with single components where precision is obtained through accurate machining. Precision assembly of various components requires an exact number of constraints to allow the desired degree of freedom (DOF) between the components. Exact-constrained design or kinematic design, with the use of compliant mechanisms or flexures, enables required precision through desired adjustments and alignments after assembly.

Exact-constrained design utilizes the concepts of DOF and constraints. Parts are assembled using various kinematic constraints while allowing for the desired DOF. If the number of constraints applied to a part matches the total number of required constraints, it is considered an exactly constrained design. However, if the number of applied constraints exceeds the desired number, the design becomes over-constrained. Over-constraint can lead to internal stresses caused by conflicts among constraints controlling the same DOF. Over-constraint in design entails precision manufacturing of components, tight tolerances, and precision assembly, thereby increasing overall costs. Additionally, precise adjustment and alignment of parts during assembly and operation are also required.

Compliant mechanisms allow for the design of precision mechanisms by carefully manipulating the geometry to alter stiffness in different directions. This approach also facilitates monolithic design, aiding in miniaturization and reducing overall component count. Exact-constrained design principles can be implemented using compliant mechanisms.

*Fig. 1: Assembly of porous air bearings. Linear motors and air bearings used in developing ultra-precision motion stage [1].*

Semiconductor manufacturing, for example, requires deterministic behaviour to achieve overlay accuracy of the order of nanometre through repeated overlays. Both front-end and back-end process equipment achieve precision using exact-constrained design and compliant mechanisms. An arrangement of air bearings provides frictionless constraints and desired DOF, enabling deterministic behaviour and better repeatability. Linear motor direct drive helps eliminate backlash from transmission, achieving sub-micron levels of accuracy. Porous air bearings and linear motors are used to achieve high-speed as well as ultra-precision single-axis motion stage for such application, as shown in Figure 1.

An air-bearing XY-stage using a serial architecture with an H-type configuration provides better dynamics for high-speed applications. Using air bearings for support over a granite guideway eliminates errors due to friction, such as hysteresis and backlash. The non-contact and direct drive features of the motion stage provide better positioning performance than traditional ball screws and sliding support stages (see Figure 2).

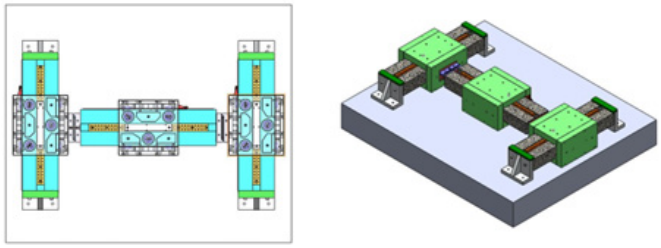


*Fig. 2: Air bearing xy-stage. Air bearing and flexures enable smoother motion by eliminating over constraints [2].*

A microfluidic chip requires microchannels to be created on a substrate. A precision hot embossing machine for replication of microstructures on a polymethyl methacrylate (PMMA) substrate is designed and developed using exact-constrained design principles and compliant mechanisms, as shown in Figure 3. Kinematic coupling using three spherical balls in radial V-grooves is employed to achieve precise positioning of the mold insert with the base. A flexure-based parallel guidance mechanism is utilized for one DOF motion required for the embossing process, allowing movement of the mold normal to the substrate surface. Additionally, a flexure-based kinematic coupling with the thermal centre is designed to mitigate thermal stress build-up during the heating and cooling of the mold insert [3, 4].

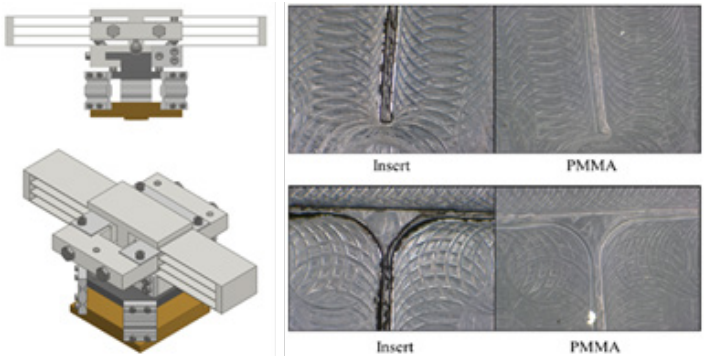



*Fig. 3: Compliant mechanism for nano-imprinting. Kinematic design and thermal centre concept used for 1-DOF motion. Micro-feature on microfluidic PMMA substrate [3].*

*[1] "https://www.politico.eu/article/airlines-flying-baltic-region-report-gps-signal-russia-gets-blame/," 2024.*
*[2] V. Krishnamurthy and M. Rangaswamy, "How to Calibrate your Enemy's Capabilities? Inverse Filtering for Counter-Autonomous Systems," in 22th International Conference on Information Fusion (FUSION). IEEE, 2019, pp. 1–6.*
*[3] H. Singh, A. Chattopadhyay, and K. V. Mishra, "Inverse Extended Kalman filter - Part I: Fundamentals," IEEE Transactions on Signal Processing, vol. 71, pp. 2936–2951, 2023.*
*[4]——,"InverseExtendedKalmanfilter–PartII:Highlynon-linearanduncertainsystems,"IEEETransactionsonSignalProcessing,vol.71,pp.2952–2967, 2023.*

A compliant 5-DOF flexure-based passive gripper is designed for pick-and-place and insertion tasks (Figure 4). It eliminates the use of actuators and sensors to achieve proper alignment during insertion. The gripper consists of picking, aligning, and releasing mechanisms. The gripper can pick up a 1.5 kg rectangular object and handle 2 mm linear and 5° rotational misalignments. Additionally, the gripper can be customized for various geometric shapes, sizes, and alignment requirements depending on the application [5].

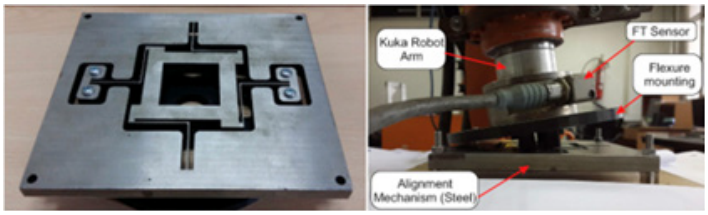
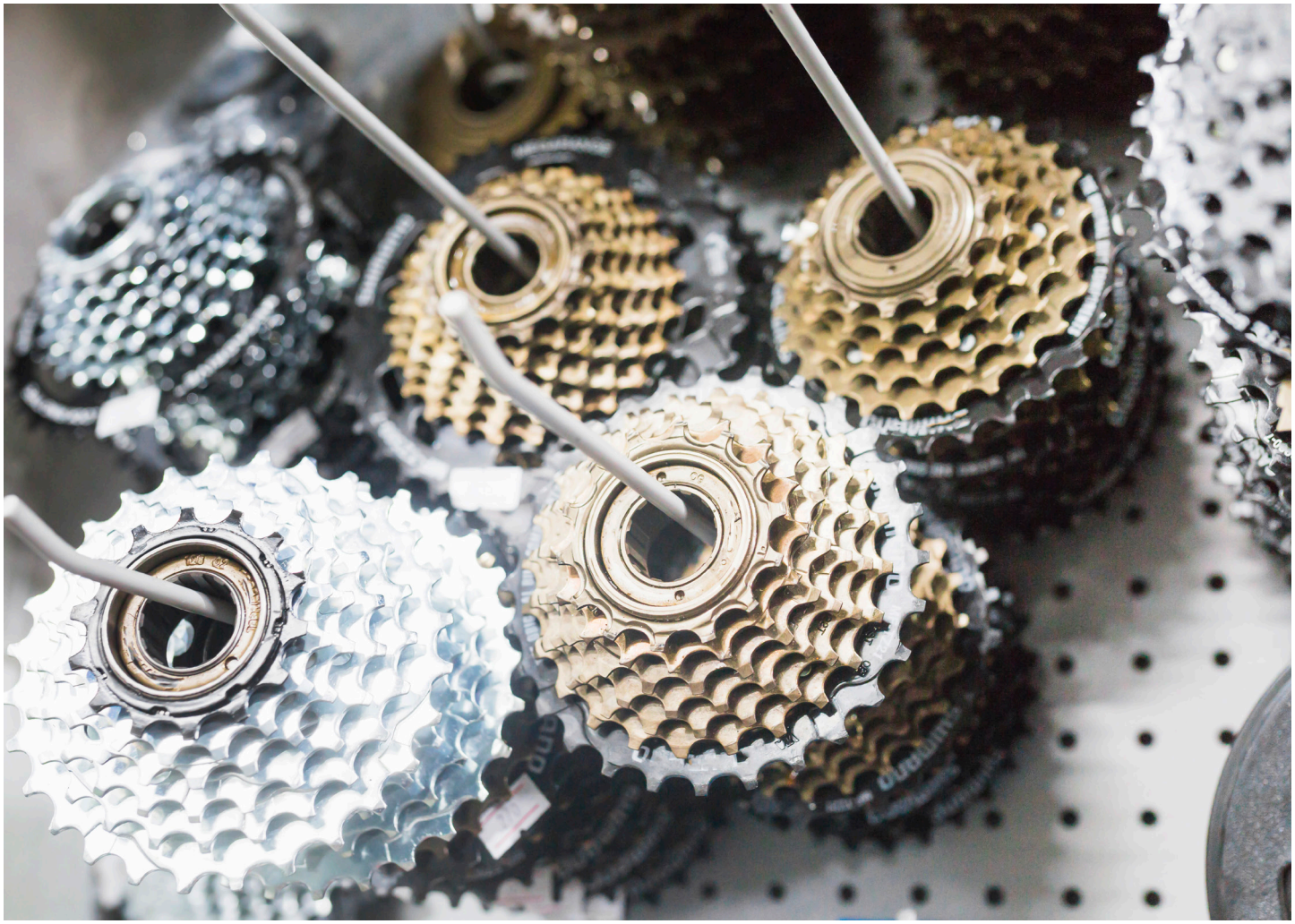



*Fig. 4: A compliant 5-DOF flexure based passive gripper integrated with Kuka robot for pick-and place and insertion task [5].*

A remote center compliance manipulator is designed for robot-assisted minimally invasive surgery, as shown in Figure 5. A flexure-based compliant mechanism is incorporated to compensate for any deviation and inaccuracy resulting from manufacturing and assembly [6].

*Fig. 5: Remote Centre of Compliance Manipulator for robot-assisted minimally invasive surgery. A compliant mechanism is used to facilitate adjustment post assembly [6].*

Exact-constrained design principles are used to design machines, systems, or products with high repeatability, enabling achievement of ultra-precision in terms of geometry and performance at the hardware level. Compliant mechanisms enable finer adjustments and eliminate friction-related problems. The application areas are very diverse, ranging from the semiconductor industry, precision machines and instruments, medical devices, rehabilitation and surgical robotics, to opto-mechatronic applications, MEMS/NEMS, and actuator development for micro-manipulation.



*5. Khatait, J.P., & Gupta, V. (2016). Flexure Based Passive Grippers. India Patent No. 460994. Granted on 20 Oct 2023. India Patent Application No. 201611020355. Filed on June 14, 2016.*
*6. Singh, A., Khatait, J.P. (2024). RCM adjustment for a double-parallelogram based RCM mechanism used for MIS robots. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, March 2024, Volume 238, Issue 6, Pages 2267-2282.*

# FACULTY PROFILE


## Prof. Sanjay Mitra

*Professor of Practice, School of Public Policy, IITD*

"Sanjay Mitra joined as a Professor of Practice in the School of Public Policy after he retired as the Defence Secretary. Prior to that he was Secretary in the Ministry of Road Transport of Highways and Chief Secretary, West Bengal. For more than six years during 2004-11, he served as Joint Secretary to the Prime Minister.

His interests cover, the infrastructure sector, electricity reforms and deep renewables penetration, defense indigenization, Centre-State relations and the political economy of decision making.

His teaching experience includes public policy in infrastructure, electricity reforms in a renewables era and case studies in public policy.

Professor Mitra is a member of the Supreme Court Committee on Road Safety and serves on several corporate boards and the editorial advisory board of the Journal of Defense Studies.

Within IIT, he has been a member of the Faculty Review Committee, the Vision subcommittee of IIT D- Abu Dhabi and several other committees ".

# TECHNOLOGY PROFILE

## SHOCK TUBE TEST FACILITY, RI PARK IIT DELHI

**Rashmi Singh[1], Prof. Tanusree Chakraborty[2]**

*Ph.D. Scholar, Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi, India*
*Professor, Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi, India*

Shock tubes are one of the leading laboratory-scale blast simulators for blast load testing of structural members and geological media in the context of civil engineering. The shock tube test facility established at RI Park IIT Delhi has both horizontal and vertical orientations. The horizontal shock tube is mainly used for blast load testing of structural members (composite, RCC, and PC members), however vertical shock tube is mainly used for testing geological media under blast and shock load, hence proving to be an invaluable resource.

A shock tube mainly comprises a high-pressure driver section and a low-pressure driven section which are separated by a flange section. The diaphragm is placed inside the flange section of the shock tube. Depending upon the requirement of strength of the shock wave, diaphragms are made up of cellophane, Mylar, Lexan, Copper, Aluminum, or steel. The diaphragm of the shock tube is either ruptured by increasing the pressure difference between the driver and driven sections or by puncturing it with a mechanical device. The end of the driven section of the shock tube which is attached to the test specimen is kept inside the dump tank considering safety precautions. The test specimen is subjected to the shock/blast wave which develops along the length of the driven section of the shock tube upon diaphragm rupture.

Presently, we have used vertical shock tube for the blast load testing of geological media (different sand), which will help in understanding the dynamic behavior of sand under blast loading; attenuation of pressure wave, and vibrational characteristics along the sand specimen depth. The horizontal shock tube is used to perform blast load testing of damper assemblies, PC, and RCC slabs, providing crucial data that can be further used for the design of more resilient and safe structures.

Inclusively, the RI Park IIT Delhi shock tube test facility can help in advancing civil engineering design by providing precise and reliable data on the performance of various civil engineering materials and structures under extreme loading conditions; leading to safe and effective design. Furthermore, shock tubes can also be used for testing and optimizing protective systems to be used in civil structures. These shock tubes can also be employed to evaluate the performance of blast-resistant members, such as blast-resistant doors and windows, and reinforced barriers under blast load to assess their effectiveness and to make necessary improvements to enhance the safety of critical infrastructures.

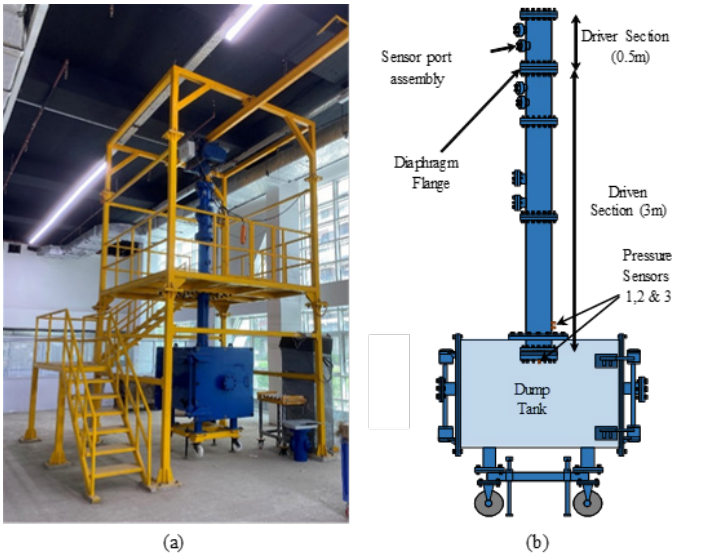



*Fig 1: (a) Vertical shock tube test facility; and (b) schematic representation of the vertical shock tube.*

*Fig 2: Horizontal shock tube test facility.*

# EXPLORING THE FRONTIERS OF LANGUAGE TECHNOLOGIES AT LCS2, IIT DELHI

## Prof. Tanmoy Chakraborty

*Deptt. of Electrical Engineering, IITD*

At the forefront of innovative research in Natural Language Processing lies the Laboratory for Computational Social Systems (LCS2) at Indian Institute of Technology Delhi. Under the visionary leadership of Dr. Tanmoy Chakraborty, LCS2 is pioneering breakthroughs across a spectrum of disciplines including Natural Language Processing (NLP), Social Computing, Graph Mining and Machine Learning (ML).

LCS2 has contributed to fundamental ML/NLP problems, including sequence modelling, model distillation, ensemble learning, code-mixing and large language models. Furthermore, they have applied their theoretical models to various application domains, including cyber-safety and mental health counselling. The lab's research has yielded publications in top-notch venues, including NeurIPS, SIGKDD, ACL, EMNLP, AAAI, IJCAI, TACL, Nature Machine Intelligence, Communications of the ACM, and several IEEE/ACM Transactions, and received awards including "ACL'23 Outstanding Paper Award" and "IJCAI'23 AI for Social Good Award". The lab's technologies have been funded/adopted by tech giants such as Meta, LinkedIn, Samsung, Accenture, Adobe and Wipro. LCS2's major contributions are summarized below.

**Combating harmful content on social media:** LCS2 has contributed to the automated combating of harmful online content such as misinformation, hate speech, and harmful memes. They primarily focused on detecting and verifying factually sensitive claims. They extended their findings toward fine-grained delimitation of potential misinformation cues. The lab also worked on detecting hate speech and its diffusion over social media by leveraging content, user, and network-related characteristics. Their investigation of harmful memes has been a pioneering attempt in which several multimodal datasets, tasks, and neural network frameworks have been proposed.

**Language technologies for effective mental health counselling:** LCS2 has worked on building novel models to identify dialogue acts in mental health counseling conversations. They contributed to mental health dialogue summarization coupled with domain knowledge. Furthermore, they worked on mental health symptom identification by exploiting gender information on online Reddit-based conversational threads. They extended this work on mental health dialogue generation guided by dialogue acts. They presented an extensive analysis of counselling conversations on mental health subreddits, explaining the unique behavioral dynamics of mental health patients.

**Empowering frugal language models:** Of late, the lab's effort has been to empower parsimonious LMs. They showed how frugal models (7-13 billion parameters) achieve better task-specific performance with task-aligned pretraining. They then sought semantic and task-based alignment of prompts in cross-lingual, resource-constraint settings. They considered prompt design a more general problem of aligning the prompt template and the input examples. Their model showed dramatic improvements over multiple cross-lingual tasks in a zero-shot setting. They also showed how a Transformer model could be realized as a multi-particle dynamical system that, in turn, decreased the parameter size and complexity with improved performance.

In essence, LCS2's pioneering research endeavours underscore the transformative potential of NLP in addressing pressing societal challenges. Through interdisciplinary collaboration and technological innovation, LCS2 continues to push the boundaries of knowledge, paving the way for a brighter, more inclusive future.

# NURTURING INNOVATION

## THE CRUCIAL ROLE OF HUMAN CONNECTIONS IN TECHNOLOGY TRANSFER


## Himani Vashisth

*Dy. Manager-Technology Transfer, FITT-IIT Delhi*


### Introduction

In the ever-evolving landscape of technology transfer, where the translation of academic research into real-world applications takes center stage, it is often tempting to focus solely on the technical aspects of the process. However, beneath the layers of patents, licenses, and market analyses, a fundamental element consistently proves to be the linchpin—the human factor. This article delves into the multifaceted dimensions of effective technology transfer, emphasizing the importance of strong communication, collaborative efforts, and the cultivation of genuine relationships among researchers, industry partners, and Technology Transfer Office (TTO) staff. By exploring these interpersonal dynamics, we uncover the pivotal role they play in transforming groundbreaking research into tangible solutions for society.

### Communication: The Bridge of Understanding

Clear and consistent communication stands as the bedrock of any successful collaboration. Researchers, deeply entrenched in the precise language of academia, may find it challenging to convey the commercial potential of their inventions to industry partners unfamiliar with the intricacies of their research. Simultaneously, industry representatives might employ business jargon that eludes researchers, resulting in misunderstandings and missed opportunities.

The TTO emerges as a crucial bridge between these two worlds, playing a pivotal role in facilitating effective communication. By adeptly translating technical language into practical terms and vice versa, TTO staff ensure that both parties understand the value proposition and potential challenges of the technology at hand. Regular meetings, workshops, and even informal discussions become vehicles for fostering open communication and building trust, ultimately paving the way for successful partnerships.

### Collaboration: From Silos to Synergy

Traditionally, academic research has been perceived as a solitary pursuit, with individual researchers competing for grants and recognition. However, the intricate and dynamic nature of technology transfer necessitates a paradigm shift toward collaborative mindsets. Researchers, industry experts, and TTO staff must unite as a cohesive team, leveraging their unique expertise and perspectives to overcome challenges and expedite the innovation process.

Joint working groups, collaborative research projects, and knowledge-sharing initiatives become essential in fostering this collaborative spirit. Through collective efforts, stakeholders can identify market needs, adapt technologies for commercial viability, and develop effective go-to-market strategies, ultimately leading to faster and more impactful outcomes.

### Building Relationships: The Mortar of Trust

The success of technology transfer hinges on more than just contracts and deadlines; it is built on strong, long-term relationships. Trust and mutual respect form the foundation for navigating the inevitable bumps and detours along the innovation journey. Researchers must trust industry partners to handle their inventions with respect and expertise, while industry representatives must trust researchers to deliver robust and commercially viable technologies.

Consistent efforts by TTO staff to demonstrate commitment to ethical practices and transparency are critical in fostering this trust. Regular interactions, personalized support, and timely updates further solidify these relationships, creating a shared sense of purpose and commitment to the success of the technology transfer process. When trust takes root, it creates an environment where challenges can be tackled collaboratively, risks can be shared, and success can be celebrated collectively.

### Navigating Challenges: The Human Touch in Overcoming Obstacles

In the pursuit of technological advancement, challenges are inevitable. Whether they stem from regulatory hurdles, financial constraints, or unforeseen technical difficulties, the human touch becomes a guiding force in navigating these obstacles. A collaborative and communicative environment allows stakeholders to share insights, pool resources, and brainstorm innovative solutions to complex problems.

Moreover, the human factor injects a level of adaptability and resilience into the technology transfer process. Strong relationships built on trust enable parties to weather uncertainties together, fostering a sense of collective responsibility for the success of the innovation journey.

### Embracing Diversity: A Catalyst for Innovation

The human factor in technology transfer extends beyond individual relationships to encompass a broader perspective—embracing diversity. Bringing together individuals with diverse backgrounds, skills, and experiences enriches the collaborative process. Diversity sparks creativity, encourages different viewpoints, and broadens the scope of problem-solving. Technology transfer benefits immensely from a diverse array of talents and perspectives, as it ensures a comprehensive and holistic approach to innovation. Inclusivity becomes a driving force, propelling the collaborative effort forward and enhancing the potential impact of the transferred technologies.

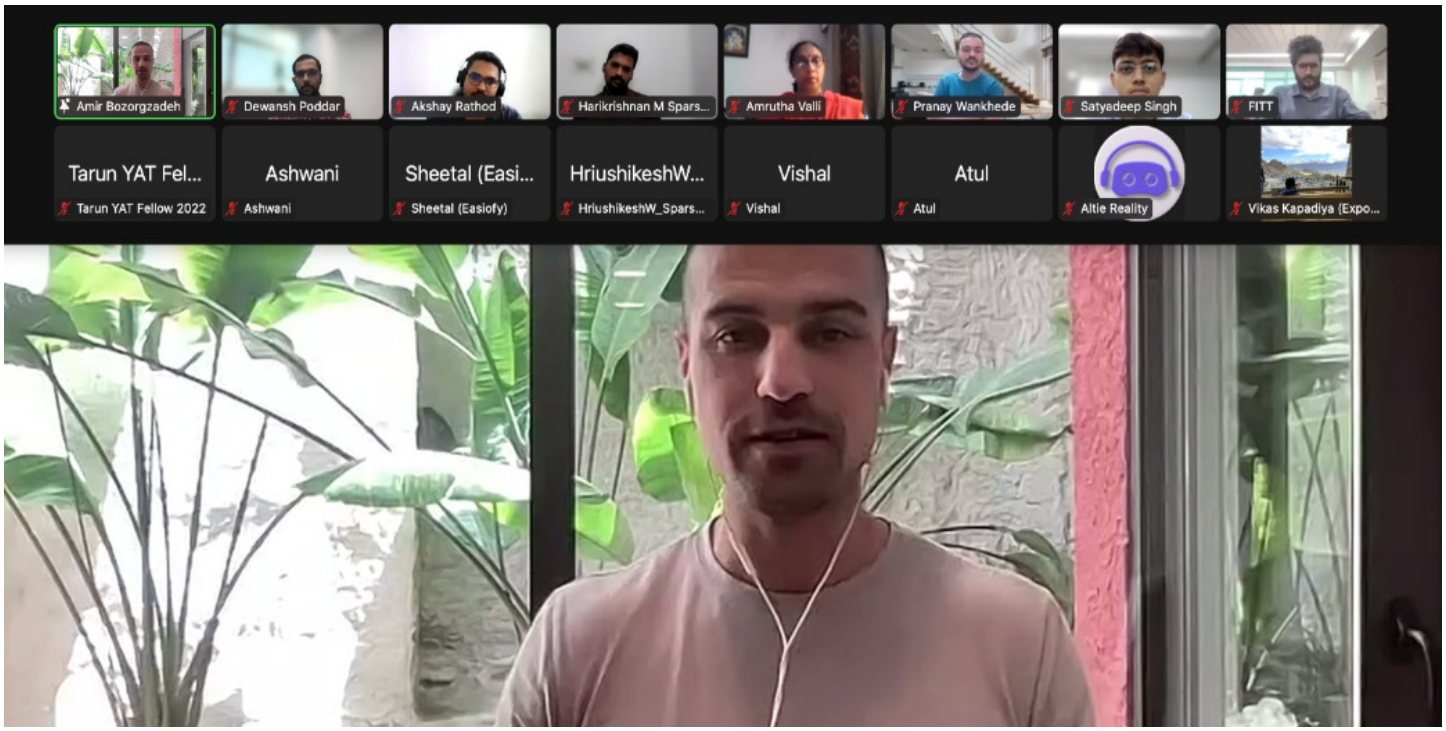
### Conclusion: The Human Touch in a Technological Landscape

In the dynamic field of technology transfer, marked by complexities and challenges related to intellectual property intricacies and market fluctuations, it is highly imperative to underscore the pivotal role played by human interactions. Clear communication, collaborative spirit, and strong relationships ultimately determine the success of translating academic research into solutions that benefit society deeply and truthfully.

By prioritizing open communication, fostering collaboration, actively building trust, and embracing diversity, TTOs and stakeholders can unlock the true potential of technology transfer. This transformative process turns groundbreaking research into tangible innovations, improving and enhancing our lives. By acknowledging the importance of the human touch, we can continue to refine and improve our approaches to technology transfer, ensuring that the fruits of academic research reach their full potential and make a lasting impact on the world.

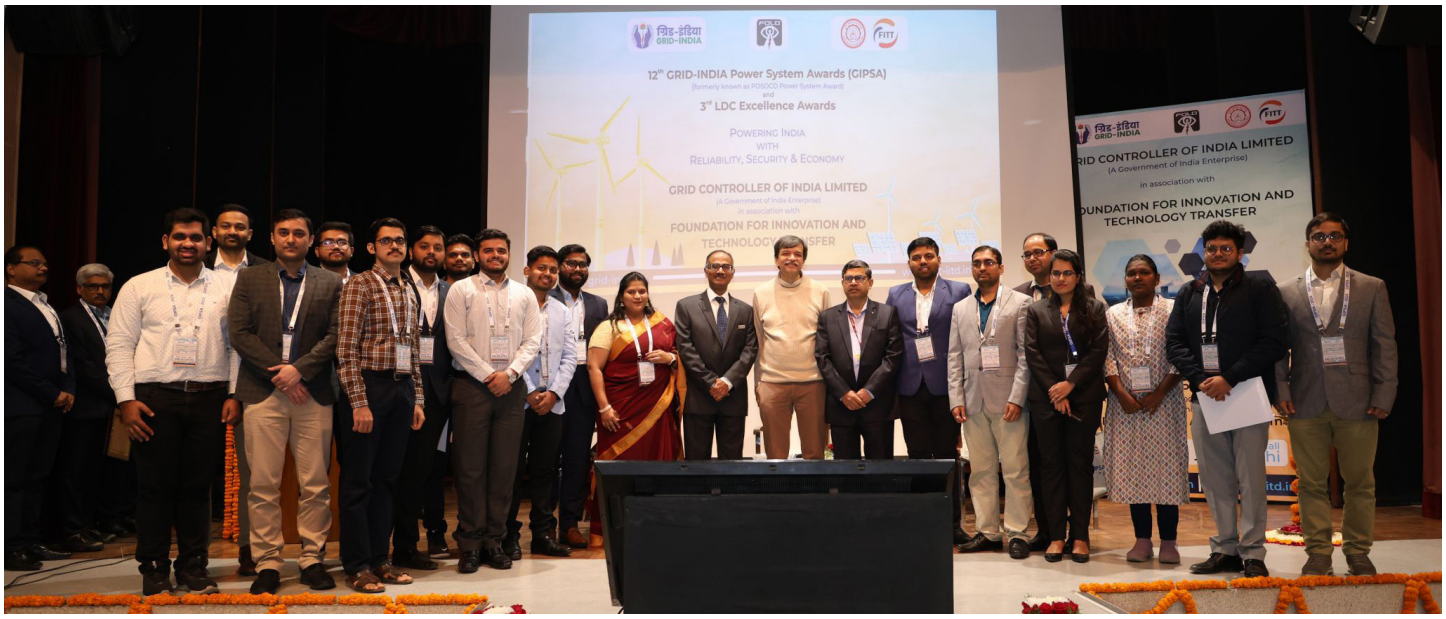
# FITT FOOTPRINT

## OUTREACH & EVENTS




**XR Nexus Workshop:** Meta XR Nexus was an online workshop arranged for all the startups in the Meta Accelerator program and the Meta Grand Challenge. The workshop was arranged with an objective for the founder's to have exposure to the XR technology and to build connects for them across the globe. In total we had arranged for 10 workshops over the period of 1 month.


**IDEX:** iDEX Startup & Innovation Showcase- Following his bilateral meeting with Raksha Mantri Shri Rajnath Singh, German Federal Minister of Defence Mr Boris Pistorius attended a showcase of iDEX - DIO supported startups at the Research & Innovation Park, Indian Institute of Technology, Delhi on June 06, 2023 association with FITT - Foundation for Innovation and Technology Transfer, IIT Delhi.




**Grid India Power System Award 2024:** FITT - Foundation for Innovation and Technology Transfer, IIT Delhi in collaboration with Grid Controller of India Limited, successfully organized the GIPSA 2024 on December 18, 2023, at the Seminar Hall, Indian Institute of Technology, Delhi.

The primary objective of GIPSA is to acknowledge outstanding research achievements in the realm of power systems. At the award ceremony, held in the presence of Prof. Rangan Banerjee, Director of IIT Delhi, Member (PS), CEA and CMD, GRID-INDIA, a total of 30 individuals, with 15 recipients in each, masters' and doctoral categories were awarded with GIPSA.


**GLOBAL BIO India Pragati Madain (BIRAC) Austrian Delegation:** Foundation for Innovation and Technology Transfer, IIT Delhi participated at hashtag#GlobalBioIndia2023, organized by the Biotechnology Industry Research Assistance Council (BIRAC) and the Department Of Biotechnology, Government Of india.

Over three dynamic days, team briefly interacted on the startup ecosystem with esteemed dignitaries of the innovation space, including Dr. Jitendra Kumar, Managing Director of Biotechnology Industry Research Assistance Council (BIRAC).


**Tech.Future Hackathon 2.0 (Challenges & Rewards Post):** The 2 months of the arduous journey have come to an end. FITT successfully organized Tech.Future Hackathon, which is a nationwide initiative to provide innovators with a platform to solve some of the most pressing problems.

Out of the pool of 120+ applications that we received, we selected 26 teams after the strenuous process of evaluation. Based on our 5 problem statements in sectors such as #Drone, #Computervision, #Deeptech, #cybersecurity, and #smartcity, we shortlisted 12 teams for the final pitching round.


**Finance 101:** "Finance 101 Workshop" for portfolio startups, featuring Abhishek Gupta, Founder of Starters' CFO as a distinguished expert. The workshop was crafted to address the critical financial aspects that tech entrepreneurs often grapple with.

# LIST OF CONSULTANCY PROJECTS UNDERTAKEN FROM JULY - DECEMBER, 2023

| Project Title | Project Incharge | Dept./Centre/School |
|---|---|---|
| DEVELOPMENT AND PERFORMANCE EVALUATION OF THE GRAPHITE AND NON-GRAPHITE BASED LUBRICANTS AND MATERIAL CHARACTERIZATIONS FOR NANOMATERIALS. | PROF.DEEPAK KUMAR | CART |
| DEVELOPMENT OF SINTERED POLYETHYLENE FILTERS | PROF. BIJAY P. TRIPATHI | DMSE |
| DEVELOPMENT OF ADHESIVE TO SEAL SEPTUM WITH POLYPROPYLENE CAPS | PROF. BIJAY P. TRIPATHI | DMSE |
| DEVELOPMENT OF INTELLECTUAL PROPERTY FOR BEHAVIOR ANALYSIS OF SOFTWARE DEVELOPERS | PROF. BREJESH LALL | Bharti School |
| ANALYSIS OF PORE CHARACTERISTICS IN AL CASTINGS | PROF. JAYANT JAIN | DMSE |
| RETROSPECTIVE ASSESSMENT OF ROAD INJURIES AND FATALITIES IN DELHI REFERRAL TRAUMA HOSPITALS, POST-MORTEM CENTERS, CITY WIDE AMBULANCE SERVICES, AND POLICE CONTROL ROOM (PCR) CALLS. | PROF. RAHUL GOEL | TRIPC |
| DESIGN OF METAL-ORGANIC FRAMEWORK (MOF) BASED SENSORS FOR DETECTION OF CONTAMINANTS IN WATER | PROF. SAMEER SAPRA | Chemistry |
| DEVELOPMENT OF HIGHLY ACTIVE ELECTRODE FOR ANION EXCHANGE MEMBRANE WATER ELECTROLYZER | PROF. SUDDHASATWA BASU | Chemical |
| GENDERED APPROACH OF ADDRESSING ADAPTATION CAPACITY TO HOT WEATHER CONDITIONS | PROF. DEEPTY JAIN | TRIPC |
| SYNTHESIS OF ROAD TRAFFIC CRASH DATA FOR SEAR COUNTRIES AND DRAFT REGIONAL STATUS REPORT ON ROAD SAFETY | PROF. GEETAM TIWARI | TRIPC |
| TESTING OF "HEERA AND JWALA" COOK-STOVES | PROF. PRIYANKA KAUSHAL | CRDT |
| MULTI-SENSOR DIAGNOSIS OF MOTOR-ALTERNATOR SYSTEM-PHASE-I | PROF. DARPE, A. K. | ME |
| TORSIONAL VIBRATION ANALYSIS OF VERTICAL PUMPS | PROF. DARPE, A. K. | ME |
| CHARACTERIZATION OF SCRATCH MECHANISM AND SURFACE FAILURE ON COMPOSITES | PROF. NITYA NAND GOSVAMI | DMSE |
| DEVELOPMENT OF LOW-COST BATTERY PACK ENERGY STORAGE SYSTEM FOR STATIONARY APPLICATIONS USING RETIRED BATTERIES AFTER THEIR FIRST LIFE FOR COMMUNITY SERVICE | PROF. DAS ABHISHEK | ME |
| DEVELOPMENT OF A MATHEMATICAL MODEL OF IMMERSION COOLING OF PRISMATIC LITHIUM-ION BATTERIES | PROF. GUPTA, AMIT | ME |
| INTERNATIONAL COURSE ON ROAD SAFETY | PROF. GIRISH AGARWAL | TRIPC |
| FUNDAMENTALS OF EV COURSE | PROF. SANTANU KUMAR MISHRA | CART |
| DC UPS FOR AUXILLARY POWER IN STORAGE SYSTEM | PROF. SANTANU KUMAR MISHRA | CART |
| GAN BASED DC TO DC CONVERTERS | PROF. SANTANU KUMAR MISHRA | CART |
| STRUCTURAL AUDIT OF TOWERS IN PALM OF 12 TOWERS IN OLYMPIA PHASE -1 GREATER NOIDA WEST GAUTAM BUDDHA NAGAR UP. | PROF. GUPTA SUPRATIC | CE |
| FEASIBILITY STUDY OF USING POLYMER MATRIX AS A SUBGRADE LAYER IN A HIGHWAY ROAD PAVEMENT TO ENHANCE PERFORMANCE & DURABILITY. | PROF. HUSAIN KANCHWALA | CART |
| DESIGN AND DEVELOPMENT OF QUANTUM DOT BASED SWIR SENSORS THROUGH IRD GRANT | PROF. MUKUL SARKAR | EE |
| A STATISTICAL AND EMPIRICAL EXAMINATION OF GAMES OF SKILL V4. | PROF. S. DHARMARAJA | MATHEMATICS |
| EMPOWERING WOMEN ENTREPRENEUR THROUGH DIGITAL AND FINANCIAL LITERACY. | PROF. SEEMA SHARMA | DMSE |

| Project Title | Project Incharge | Dept./Centre/School |
|---|---|---|
| RESEARCH ON CRYSTALLINE WATER PROOFING AND DURABILITY ENHANCEMENT COMPOUND | PROF. GUPTA SUPRATIC | CE |
| NEUROMORPHIC COMPUTING AND APPLICATIONS OF SPIKING NEURAL NETWORK (SNN) FOR RESEARCH PROGRAMME. | PROF. MANAN SURI | EE |
| FATAL ROAD CRASH SYSTEM (ND-FRCS DEVELOPMENT) | PROF. RAHUL GOEL | TRIPC |
| DOWNSTREAM DEVELOPMENT FOR PRODUCTION OF BIOPHARMACEUTICAL RAW | PROF. ANURAG S. RATHORE | Chemical |
| EXTERNAL MID-TERM EVALUATION OF A SWISS CLEAN AIR PROJECT IN INDIA (CAP INDIA) | PROF. KOTA SRI HARSHA | CE |
| REVERSE VENDING MACHINE | PROF. SHAHID MALIK | SeNSE |
| GRAPH BASED ANTIBODY DESIGN PHASE 1 | PROF. SAYAN RANU | CSE |
| PSL EXECUTION SUPPORT | PROF. BOLIA NOMESH | ME |
| ULTRASONC DEGASSING | PROF. AYAN BHOWMIK | DMSE |
| DEVELOPMENT OF VANADIUM REDOX FLOW BATTERY | PROF. ANIL VERMA | Chemical |
| LIGHT WT RM, WELD PROCESS STUDY | PROF. AYAN BHOWMIK | DMSE |
| MECHANICAL CHARACTERIZATION OF ALTERNATIVE TO ENGLISH WILLOW | PROF. SITIKANTHA ROY | AM |
| RESEARCH AND DEVELOPMENT OF FINANCIAL TRADING MODELS, ALGORITHMS AND OPTIMIZATION TECHNIQUES | PROF. SANDEEP KUMAR | EE |
| DESIGN AND DEVELOPMENT OF LEARNING MANAGEMENT SYSTEM | PROF. JYOTI KUMAR | DoD |
| NANOTRIBOLOGY AND NANO MORPHOLOGICAL INVESTIGATION OF DIFFERENT HAIR TYPES USING ATOMIC FORCE MICROSCOPY | PROF. NITYA NAND GOSVAMI | DMSE |
| MOLECULAR LEVEL CHARACTERIZATION OF NON-ENVELOPED CAPSID INACTIVATION | PROF. MANIDIPA BANERJEE | KSBS |
| TECHNICAL EVALUATION OF PRODUCT FOR SISO/MIMO CLASSIFICATION | PROF. BREJESH LALL | Bharti School |
| LOW CARBON CEMENT-PHASE-IV | PROF. SHASHANK BISHNOI | CE |
| HEALTH AND CLIMATE CO-BENEFITS OF POLLUTION MANAGEMENT | PROF. SAGNIK DEY | CAS |
| OVERVIEW OF PARTIAL RISK GUARANTEES ESTABLISHING NEEDS AND ADVANTAGES THROUGH BIBLIOMETRIC ANALYSIS. | PROF. SANJAY DHIR | DMSE |
| INTEGRATED AUTOMOUS TRANSPORTATION OF FRIGHT AND PASSENGERS. | PROF. LOKESH KALAHASTHI | TRIPC |
| RESEARCH DEVELOPMENT AND STUDIES ON GRAIN SIZE OPTIMIZATION OF ALUMINIUM (AI) ELECTRODES FOR AI-AIR BATTERIES. | PROF. SURYANARAYANA VIKRANT KARRA | DMSE |
| DESIGN AND DEVELOP AN ADVANCED WRSM BASED HIGH PERFORMANCE MOTOR AIMED FOR HEAVY DUTY APPLICATIONS. | PROF. AMIT KUMAR JAIN | EE |
| CYCLE TENSILE AND LOW CYCLE FATIGUE TESTING OF REBAR COUPLERS. | PROF. PRADYUMNA S. | AM |
| FAIL SAFETY VALIDATION AND RELIABILITY ANALYSIS OF LED SIGNALS AS PER INDIAN RAILWAYS SPECIFICATION. | PROF. ABHISHEK DIXIT | EE |
| DEVELOPMENT OF A DROPLET-GENERATION MICROFLUIDIC DEVICE FOR COSMETICS. | PROF. BAHGA SUPREET SINGH | ME |
| STUDY THE PERFORMANCE AND ANALYZE THE ENVIRONMENTAL BENEFIT OF REPLACING WHITE SEAL WITH ACTIVE ZINC OXIDE. | PROF. SREEDEVI UPADHYAYULA | CHEMICAL |
| CONFIGURATION DESIGN FOR SUGARCANE BUNDLING SYSTEM | PROF. KHATAIT JITENDRA PRASAD | ME |
| DESIGN AND EVALUATION OF EVAPORATIVE CONDENSERS AND USING PILLOW PLATE HEAT EXCHANGERS. | PROF. SUBBARAO P.M.V. | ME |
| CONCRETE MIX DESIGN | PROF. GUPTA SUPRATIC | CE |

# LIST OF INTELLECTUAL PROPERTY APPLICATIONS FILED DURING JULY - DECEMBER, 2023

| TITLE | INVENTOR | DEPT./ CENTRE/ SCHOOL |
|---|---|---|
| A SOLAR PANEL WIND SHIELDING SYSTEM FOR HARNESSING WIND ENERGY, AND METHOD THEREOF | PROF. ARNAB BANERJEE | DEPARTMENT OF CIVIL ENGINEERING |
| "A SYSTEM AND METHOD FOR MANUFACTURING AN INSERT OF A CUTTING TOOL" | PROF. PULAK MOHAN PANDEY | DEPARTMENT OF MECHANICAL ENGINEERING |
| A SULFUR CATHODE, ROOM-TEMPERATURE SODIUM-SULFUR BATTERY AND METHOD OF PREPARATION THEREOF | PROF. VIPIN KUMAR | DEPARTMENT OF ENERGY SCIENCE AND ENGINEERING |
| SYSTEM AND METHOD FOR GREEN SYNTHESIS OF LITHIUM BASED OXIDE (LBO) FOR BATTERY APPLICATIONS | PROF. MADHUSUDAN SINGH | DEPARTMENT OF ELECTRICAL ENGINEERING |
| METHOD AND SYSTEM TO PROTECT CLEAR TEXT TRANSMISSION OF USER IDENTITY IN WIRELESS NETWORKS | PROF. BREJESH LALL | DEPARTMENT OF ELECTRICAL ENGINEERING |
| "FORMULATION OF A QUASI-SOLID STATE POLYMER ELECTROLYTE AND SODIUM METAL BATTERIES THEREOF" | PROF. VIPIN KUMAR | DEPARTMENT OF ENERGY SCIENCE AND ENGINEERING |
| DE NOVO PEPTIDE WITH HIGH SPECIFICITY AGAINST NOSOCOMIAL ACINETOBACTER BAUMANNII BACTERIAL BIOFILMS | PROF. ARCHANA CHUGH | KUSUMA SCHOOL OF BIOLOGICAL SCIENCES |
| A METHOD FOR DETECTION, CLASSIFICATION OF BACTERIA AND IMPLEMENTATIONS THEREOF | PROF. NEETU SINGH | CENTRE FOR BIOMEDICAL ENGINEERING |
| "CATIONIC SOFTENER PRODUCT, PROCESS OF SYNTHESIS THEREOF, AND METHOD OF TREATING A TEXTILE THEREFROM" | PROF. JAVED NABIBAKSHA SHEIKH | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |
| METHOD AND APPARATUS FOR DDoS ATTACK DETECTION AND MITIGATION IN IOT NETWORK SLICES | PROF. VIRESHWAR KUMAR | DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING |
| SYNTHESIS OF AROMATIC DIIMIDES AS ANOLYTES FOR NEUTRAL PH AQUEOUS REDOX FLOW BATTERIES | PROF. BIJAY PRAKASH TRIPATHI | DEPARTMENT OF MATERIAL SCIENCE AND ENGINEERING |
| PRINTABLE METAL SULFIDE INKS | PROF. MADHUSUDAN SINGH | DEPARTMENT OF ELECTRICAL ENGINEERING |
| AN ARCHITECTURE TO ACHIEVE HIGH EXTINCTION MICROWAVE PHOTONICS FILTER USING BRILLOUIN SCATTERING | PROF. AMOL CHOUDHARY | DEPARTMENT OF ELECTRICAL ENGINEERING |
| SYSTEM FOR DETECTION OF A PLANE OF POLARIZATION OF LIGHT AND METHOD THEREOF | PROF. ALOKA SINHA | DEPARTMENT OF PHYSICS |
| " A BIOSIGNAL-GUIDED SYSTEM FOR REHABILITATION OF PATIENTS WITH DISABILITY" | PROF. AMIT MEHNDIRATTA | CENTRE FOR BIOMEDICAL ENGINEERING |
| CELLULOSIC SUPERGEL AND PROCESS OF SYNTHESIZING THE SAME FOR OIL SORPTION | PROF. RAJIV KUMAR SRIVASTAVA | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |
| "HIGH PRESSURE COLLOIDAL GAS APHRONS GENERATOR AND A METHOD OF GENERATION OF CGAs" | PROF. ASHOK NIWRITTI BHASKARWAR | DEPARTMENT OF CHEMICAL ENGINEERING |
| RESAZURIN NANOPARTICLES COMPLEX AMD METHOD FOR DETECTING MICROBIAL CONTAMINATION IN MILK | PROF. HARPAL SINGH | CENTRE FOR BIOMEDICAL ENGINEERING |
| COHERENT DIFFRACTION IMAGING SYSTEM EMPLOYING VORTEX PHASE ILLUMINATION FOR PRODUCING REAL-TIME IMAGES AND METHOD THEREOF | PROF. KEDAR BHALCHANDRA KHARE | DEPARTMENT OF PHYSICS |

| TITLE | INVENTOR | DEPT./ CENTRE/ SCHOOL |
|---|---|---|
| VOLTAGE-CONTROLLED OSCILLATOR AND A METHOD THEREOF | PROF. KAUSHIK SAHA | DEPARTMENT OF ELECTRICAL ENGINEERING |
| LOW-COST HARDWARE FOR STATE-OF-CHARGE ESTIMATION FOR Li-ION CELLS USING CENTRAL DIFFERENCE KALMAN FILTER | PROF. AMIT GUPTA | DEPARTMENT OF MECHANICAL ENGINEERING |
| METHOD OF CAPTURING CARBON-DI-OXIDE FOR UTILISING IN METAL RECOVERY | PROF. VIKRAM SINGH | DEPARTMENT OF CHEMICAL ENGINEERING |
| TWO-WHEELER ELECTRIC VEHICLE FAULT SIMULATOR | PROF. S. FATIMA | CENTRE FOR AUTOMOTIVE RESEARCH AND TRIBOLOGY |
| DIGITALLY ASSISTED LOW NOISE SUB 1V CHOPPER LESS BANDGAP REFERENCE CIRCUIT | PROF. RAKESH KUMAR PALANI | DEPARTMENT OF ELECTRICAL ENGINEERING |
| ISORETICULAR METAL-ORGANIC FRAMEWORK CATALYSTS AND PROCESS SYNTHESIZING FOR SHAPE-SELECTIVE HYDROGENOLYSIS OF POLYMERS | PROF. KUNTAL MANNA | DEPARTMENT OF CHEMISTRY |
| A METHOD AND A SYSTEM FOR PEFORMING A MATRIX-VECTOR MULTIPLICATION USING IN-MEMORY COMPUTING | PROF. MANAN SURI | DEPARTMENT OF ELECTRICAL ENGINEERING |
| A SYSTEM AND METHOD FOR ENABLING A MULTI-OPERATOR EDGE ENVIRONMENT | PROF. BREJESH LALL | DEPARTMENT OF ELECTRICAL ENGINEERING |
| SLIP INDUCING DEVICE | PROF. BISWARUP MUKHERJEE | CENTRE FOR BIOMEDICAL ENGINEERING |
| "METHOD OF INCREASING SETTING TIME OF CALCINED CLAY BINDING MIXTURE" | PROF. SHASHANK BISHNOI | DEPARTMENT OF CIVIL ENGINEERING |
| "PROCESS FOR RECOVERY OF LITHIUM AND TRANSITION METALS FROM LITHIUM-ION BATTERIES" | PROF. KAMAL KISHORE PANT | DEPARTMENT OF CHEMICAL ENGINEERING |
| COVERAGE OF TEXTURED SILICON WAFER WITH PEROVSKITE LAYER VIA SPRAY DEPOSITION TECHNIQUE | PROF. VIRESH DUTTA | CENTRE FOR ENERGY STUDIES |
| AN ANTIMICROBIAL FIBRE REINFORCED BIOCOMPOSITE FILM AND METHOD THEREOF | PROF. DIPAYAN DAS | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |
| MULTIFUNCTIONAL DISPERSE DYES | PROF. JAVED NABIBAKSHA SHEIKH | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |
| TOMODYNAMOMETER INTEGRATED WITH ABRASION AND STRETCHING FUNCTIONALITY | PROF. BIPIN KUMAR | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |
| PLANT-BASED TITANIUM DIOXIDE-REDUCED GRAPHENE OXIDE NANOCOMPOSITES, METHODS OF PRODUCTION, SYSTEM AND APPLICATIONS THEREOF | PROF. ARYA VIJAYNANDAN | DEPARTMENT OF CIVIL ENGINEERING |
| ENHANCING LOW FREQUENCY ATTENUATION CHARACTERISTICS IN A HOLLOW TOWER USING AN OMNI-DIRECTIONAL RESONATOR | PROF. ARNAB BANERJEE | DEPARTMENT OF CIVIL ENGINEERING |
| SYSTEM FOR FACILITATING MULTI-LEVEL STREAM-BASED EDGE ANALYTICS IN MULTI MODAL COMMUNICATION AND METHOD THEREOF | PROF. BREJESH LALL | BHARTI SCHOOL OF TELECOMMUNICATION TECHNOLOGY AND MANAGEMNET |
| A CONTACT AND RADIANT HEAT SOURCE BASED TOMODYNAMOMETER CUT TEST APPARATUS AND METHOD THEREOF | PROF. BIPIN KUMAR | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |
| A SYSTEM AND A METHOD FOR DETECTING A TYPE OF POWER SOURCE | PROF. SWADES DE | DEPARTMENT OF ELECTRICAL ENGINEERING |
| A DESIGN OF AN OPTICAL CELL FOR OBSERVATION OF DENDRITES FORMATION IN METAL BATTERIE | PROF. VIPIN KUMAR | DEPARTMENT OF ENERGY SCIENCE AND ENGINEERING |

| TITLE | INVENTOR | DEPT./ CENTRE/ SCHOOL |
|---|---|---|
| PRACTICAL, SCALABLE, AND TRANSITION METAL-FREE REDUCTIVE FRIEDEL-CRAFTS REACTION: EFFICIENT SYNTHESIS OF ANAESTHETIC DRUGS | PROF. CHINMOY KUMAR HAZRA | DEPARTMENT OF CHEMISTRY |
| SOLUTION-PROCESSED LAMINAR GROWTH OF LI3VO4 (LVO) ANODE FOR ULTRA-LONG CYCLING IN HIGH-RATE METAL-ION BATTERIES | PROF. MADHUSUDAN SINGH | DEPARTMENT OF ELECTRICAL ENGINEERING |
| HYBRID ELECTROSTATIC ACTUATION SYSTEM | PROF. BHASKAR MITRA | DEPARTMENT OF ELECTRICAL ENGINEERING |
| AN AUTOMATED MULTIMODAL SYSTEM FOR ALEXITHYMIA SCREENING | PROF. VIJAYRAGHAVAN M CHARIAR | CENTRE FOR RURAL DEVELOPMENT AND TECHNOLOGY |
| UNIVERSAL LOW-SPEED SLURRY EROSION TESTER FOR EROSION TESTING OF SAMPLES OF MULTIPLE SHAPES | PROF. RAHUL GOYAL | DEPARTMENT OF ENERGY SCIENCE AND ENGINEERING |
| VISIBLE LIGHT-MEDIATED SITE-SELECTIVE TRIFLUOROMETHYLATION/PERFLUOROALKYALTION OF ARYL/ALKYLIDENE MALONONITRILES | PROF. RAVI P SINGH | DEPARTMENT OF CHEMISTRY |
| MAGNESIUM RICH MULTI PRINCIPAL ELEMENT ALLOY (MPEA) AND A METHOD OF PREPARATION THEREOF | PROF. PULAK MOHAN PANDEY | DEPARTMENT OF MECHANICAL ENGINEERING |
| FIBER-INTEGRATED BROADBAND SOURCE OF POLARIZATION- ENTANGLED PHOTONS IN TELECOM C- AND L-BANDS | PROF. JOYEE GHOSH | DEPARTMENT OF PHYSICS |
| "ASYMMETRIC SYNTHESIS OF HIGHLY SUBSTITUTED POLYCYCLIC AMINO PENTA-FULVENES" | PROF. RAVI P SINGH | DEPARTMENT OF CHEMISTRY |
| "PERSON IDENTIFICATION THROUGH DATA AUGMENTATION OF FOOTSTEP-BASED SEISMIC SIGNALS" | PROF. SUBRAT KAR | DEPARTMENT OF ELECTRICAL ENGINEERING |
| SYSTEMS AND METHODS FOR VERIFYING NAVIGATION SIGNALS | PROF. BREJESH LALL | BHARTI SCHOOL OF TELECOMMUNICATION TECHNOLOGY AND MANAGEMNET |
| OXYGEN-CONSERVING DEVICE AND METHOD FOR USE IN OXYGEN THERAPY | PROF. RAHUL MISHRA | CENTRE FOR APPLIED RESEARCH IN ELECTRONICS |
| MULTIFUNCTIONAL FLAME RETARDANT COTTON SUBSTRATES USING SUSTAINABLE AND ECO-FRIENDLY SODIUM LIGNIN SULFONATE DERIVATIVE BY ITS PHOSPHORYLATION AND THE SYNTHESIS THEREOF | PROF. SYED WAZED ALI | DEPARTMENT OF TEXTILE AND FIBRE ENGINEERING |

# DETAILS OF TECHNOLOGIES TRANSFERRED DURING JULY - DECEMBER 2023

| Faculty Name | Department Name | Technology Title | Company Name | Date |
|---|---|---|---|---|
| Shalini Gupta | Department of Chemical Engineering | Impedance-based Liquid Biopsy System and Method for Detecting and Screening Cancer | Asima Health Inc. | 4th July 2023 |
| Veena Koul | Centre for Biomedical Engineering | A bio-artificial skin substitute for use in the treatment of burn and other wounds/skin disease | Dr. Reddy's Laboratories Limited | 17 August, 2023 |
| Sandeep Jha | Centre for Biomedical Engineering | "Non-invasive system and method for glucose monitoring and A biosensor for detecting multi-analyte in oral fluid" | Gunsutra Pvt. Ltd. | 20 August, 2023 |
| Amit Mehndiratta | Centre for Biomedical Engineering | Robotic Exoskeleton for Upper Limb Rehabilitation | Proxmed Pty Ltd | 28 August, 2023 |
| Subir Kumar Saha | Department of Mechanical Engg. | AC motor powered Tulsi mala bead making device | Harraj Industries | 9th November 2023 |

# GLIMPSES OF TECHNOLOGY LICENSING DEALS

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