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INDIAN INSTITUTE OF TECHNOLOGY DELHI,
NEW DELHI

INSIDE

Editorial

30 years young...

As the country celebrates 75 years of Independence under the aegis of the Govt.'s "*Azadi ka Amrit Mahotsav*" program, we at the Foundation for Innovation and Technology Transfer (FITT) are glad to announce completion of 30 years of our operations. For a truly self-sustaining organization where many of the activities are promotional and non-revenue generating, the journey can be considered commendable. While we are constantly self-critical of an odd target not having been adequately met, we continue, till date, to function like a start-up - nimble and boot strapped! The 3-decade period has seen FITT crossing several milestones - both as a Technology Transfer Organisation (TTO) and as a Technology Business Incubator (TBI). For instance, FITT has filed more than 1200 patent applications, signed more than 130 technology transfer deals and physically incubated more than 150 startups. The above numbers do not reflect the full story of the impact that FITT has been able to create over the years - a bustling innovation and entrepreneurial environment where FITT has become a partner of choice for engagement and a preferred administrative entity for various programs at IIT Delhi. As an effective interface body, FITT is active in fostering value-accretive partnerships, support programs and innovation and start-up enabling setups like accelerators and a Research Park. Besides, working as a catalyst in knowledge transfer, FITT is a designated nodal agency for administering several Government support programs of DST, DBT, MeitY, MSDE and MSME. Importantly, many corporate entities including several marquee names like Pfizer, Sona Comstar, POSOCO, Samsung, Ericsson etc have a durable working relationship with FITT. Over the years FITT has evolved as a comprehensive TTO with scaled up programs. The expected expansion of team FITT has not seen any dilution in its flexible approach or frugality in its operations. The constantly evolving relationship between industry and academia largely determines FITT's approach in shaping its outreach for regional economic development. The 30 years' of smooth ride would not have been possible without exemplary cooperation by IIT Delhi's faculty colleagues, our corporate and institutional partners, government bodies and all the staff associated with FITT. We take this opportunity to express our gratitude to and wish for continued support and cooperation from our stakeholders.

Anil Wali

Ground-borne Vibration from Underground Moving Trains in Tunnels for Delhi NCR

Prof. Bappaditya Manna
CE, IIT Delhi

Underground railway tunnels are the most preferred option for Mass Rapid Transit Systems (MRTS). The circulation of trains inside underground tunnels generate vibrations, which propagate through soil and reach building foundations to cause vibrations inside the building. Buildings susceptible to vibration damage such as heritage structures and sensitive buildings may show signs of distress like damage of architectural façade or widening of cracks in members. In the present study, a two-stage coupled analysis is carried out to estimate ground-borne vibrations in the free field due to moving train for different soil stiffness, tunnel depths and train speeds. Two sub models are generated – (a) train-track sub-model and (b) tunnel-soil coupling sub-model. The first model estimates the dynamic force exerted by a moving train on track structure. In the second model the calculated dynamic force is applied at track locations of a 2D FE model generated in PLAXIS. Thenumerical models are validated using measured results available in the literature. The train data and tunnel dimensions are taken from the MRTS projects in Delhi, India.It is found that the vibration due to underground rail depends on distance and depth of tunnel, stiffness of soil and train speed.

Train-track sub-model: When a train moves on infinitely long rail then dynamic force is generated on the substructure which gets transmitted to the tunnel structure. This dynamic problem can be solved analytically by classical theory of beam on elastic foundation. The differential equation of motion considering vertical equilibrium of forces on beam element is solved and closed form solution for the deflection due to moving load P is given by Kumari et al. (2012). The load P is the wheel load of the train and spring constant k is obtained from a static FE analysis of tunnel section embedded in soil.

Tunnel-soil coupling sub-model: This is the second stage of analysis where calculated dynamic force from first stage analysis is applied on a 2D plain strain model using finite element (FE) software PLAXIS 2D (2015). A plain strain analysis is done with 6 noded elements. Concrete is considered as an elastic material, soil is considered as Mohr-Coulomb elasto-plastic material. The dynamic soil properties are co-related with SPT values for Delhi region (Hanumantharao and Ramana, 2008). For material damping Rayleigh damping coefficients are calculated. The train details used in analyses are similar to metro rail corridors managed by Delhi Metro Rail Corporation (DMRC). For Delhi Silt soil, damping ratio of 5% is considered (Bowles, 1996). Train speeds of 40, 60, 80, 100 and 120 km/hr are considered for the study. Dimension and loading details of one passenger coach is shown in Figure 1. The train is made up of four coaches. The present FE model is validated with site measured data from metro tunnel of the EC-Growth project CONVURT (Chatterjee, 2003).

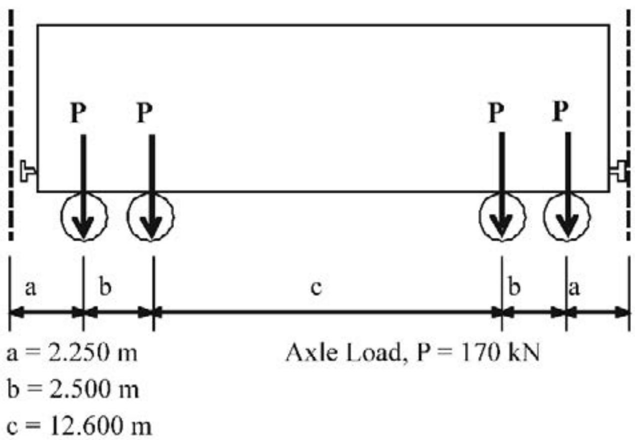

Figure 1.*Details of a passenger coach used in analysis*

Analysis results: Cut and cover tunnel in rectangular box shape having tunnel lining thickness of 0.7 m and internal clear dimension of tunnel 5.25 m x 5.75 m is considered in present study. Time versus vertical velocity in free field are plotted for different distances from tunnel axis for a 10 m deep tunnel in soil having SPT value of 20 and for a train speed of 120 km/hr as shown in Figure 2. It can be seen from the obtained results that the amplitude of vibration reduces drastically as the distance from the tunnel increases. With increase in distance from tunnel axis the vibration wave reaches there later than the nearer points. This happens as the wave travels through the soil with certain velocity depending on stiffness of soil.

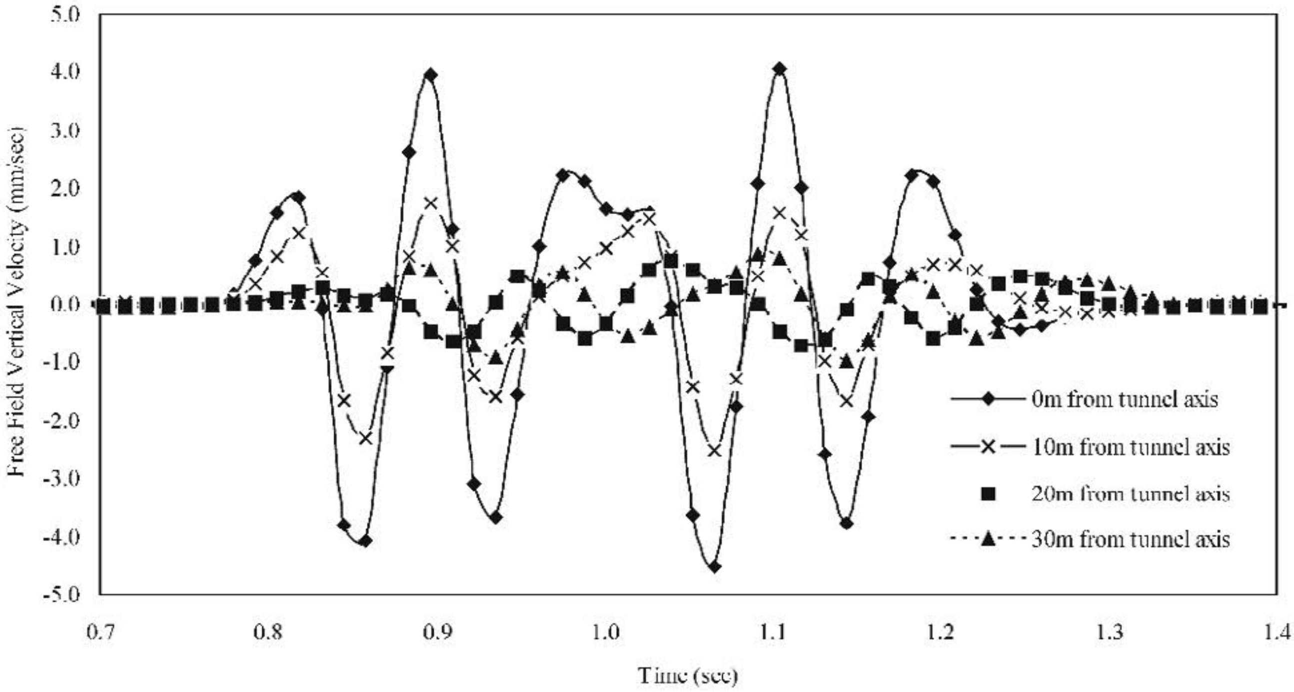

Figure 2. *Time vs. vertical velocity in free field at different distances from tunnel axis for train speed of 120 km/h in 10 m deep tunnel*

Figure3 shows PPV versus distance from tunnel axis for different trainspeeds when all other parameters are unchanged, such as tunnel depth of 10 m and soil stiffnesscorresponding to SPT value of 20.It can be seen that with increase in train speed the observed PPV increases. At 40 km/hr speedthe maximum PPV observed at ground at 0 m from tunnel center is just 1.0 mm/sec whereaswhen the train speed increase to 120 km/hr, the PPV at the same location increases to 4.5mm/sec.

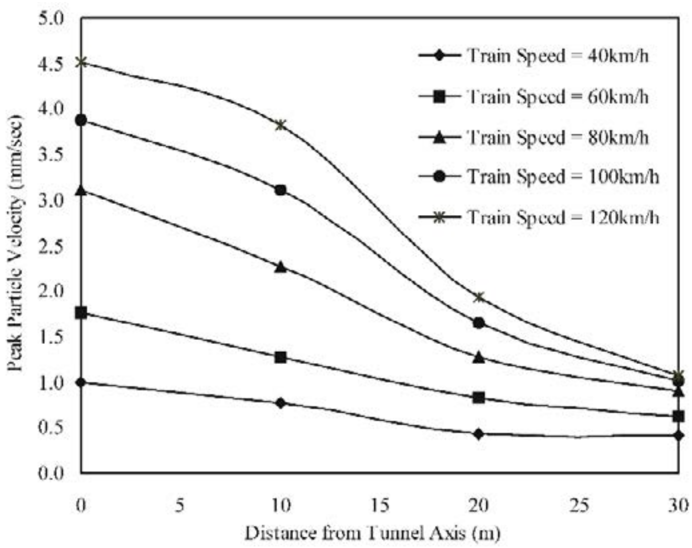

Figure 3. *PPV vs. distance from tunnel axis for different train speeds for 10 m deep tunnel*

The shear wave velocity is a function of soil stiffness. As the soil stiffness increases theshear wave velocity also increases. Figure 4 shows the change in PPV with ground stiffness for 10 m deep tunnel with train speed of 100 km/hrand it can be seen that the vibrationat ground increases in softer ground condition.

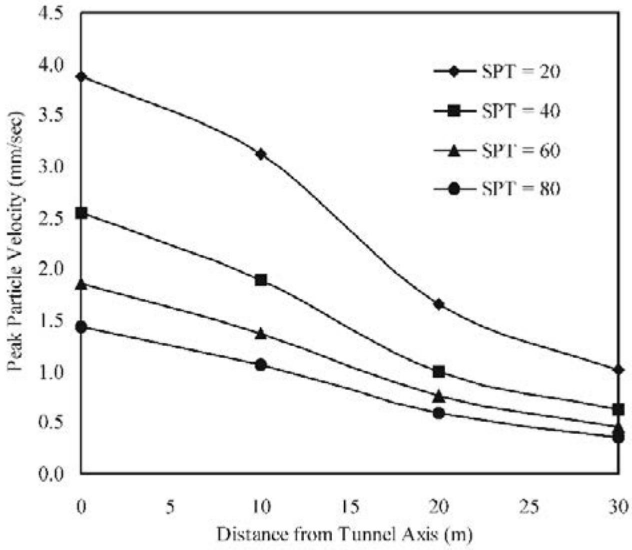

Figure 4. *PPV vs. distance from tunnel axis for different soil stiffness for 10 m deep tunnel*

The soil vibrations attenuate due to radiation damping and material damping with distancefrom the source of vibration. A parametric study is done considering tunnel depths of 10m, 20 m and 30 m while all other parameters are kept unchanged. It can be seen from Figure 5 that the increase in tunnel depthreduces the vibration at ground level. With increase in tunnel depththe distance of source of vibration increases from the observation points at ground level. Dueto attenuation of vibration when waves are propagating through the ground, the vibration amplitudereduces with increasing tunnel depth.

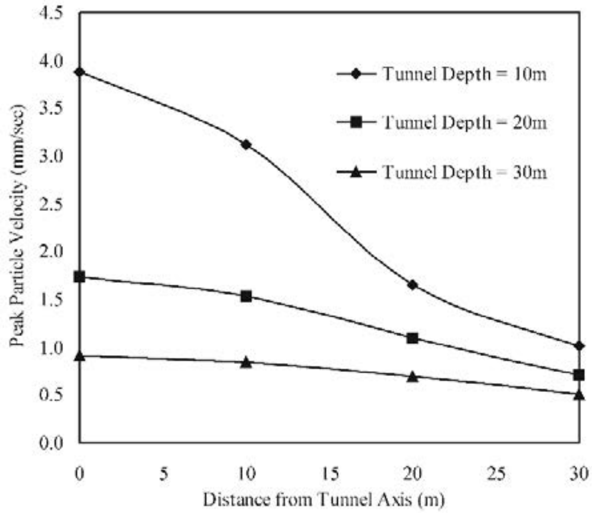

Figure 5. *PPV vs. distance from tunnel axis for various depths of tunnel for train speed is 100 km/hr*

Conclusions: In the present scope of study, vibration problem of underground moving train is studied.The tunnel dimensions are taken from MRTS Projects in Delhi, India. The present studyincludes the calculation for generated dynamic loads from moving trains, propagation of thewave through the tunnel lining and soil medium.From this study it is noticed that the Free Field ground vibration depends on parameters: (a) Distance from tunnel, (b) Train speed, (c) Soil stiffness, (d) Depth of tunnel belowground. The ground vibration is found to be inversely proportional to distance from tunnel,soil stiffness and tunnel depth, while the vibration is directly proportional to the train speed.Buildings closer to the tunnel alignment are more susceptible to get damaged.The tunnels in soils having SPT value higher than 40 generally do not exhibit any significantvibration. In case the soil is poor, then vibration can be reduced by either increasingthe proposed depth of the tunnel or by reducing the design speed of the tunnel in the affectedsection.

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Sonomyography: Towards better bionic control

Prof. Biswarup Mukherjee
CBME, IIT Delhi

The history of bionic devices starts 3000 years back in the ancient Egyptian city of Luxor. The earliest prosthetic device is said to be a leather and wood wrapped toe that was intended to be a cosmetic replacement for an Egyptian nobleman's daughter's missing appendage. While this device had cosmetic utility, we see the first evidence of truly functional and intricate prosthetic devices in the works of the French surgeon AmbroiseParé IV in the late 16th century. Prosthetic devices designed by Paré have been worn by generals in battle; a testament to the utility and robustness of his inventions. It took another battle, World War II, to spur a new round of innovations in the world of prosthesis.United States army veterans were provided with body-powered prosthetic devices that could be actuated with a string attached to the contralateral shoulder (see Fig. 1). These devices were (and are) incredibly popular with amputees for their robustness and ease of use. Recent advances due to massive investments by DARPA has led to the development of the LUKE arm which is perhaps the most life-like, artificial recreation of the human hand. The LUKE arm can replace all joints from the shoulder and below and has integrated sensors to sense object interactions. However, all this comes at a massive cost and as a result the LUKE arm has primarily been relegated to research labs. Increasingly, studies have shown that rejection rates of advanced prosthetic devices (like the LUKE arm) can be as high as 50%. This begs the question – why do amputees still prefer purely passive prosthetic devices over their modern active counterparts? Several large-scale studies have found that the answer lies in the lack of the means to achieve intuitive control for these multi-articulated devices[1]. Amputees find it extremely challenging to control the several degrees-of-freedom provided by these arms as intuitively as their own arm.

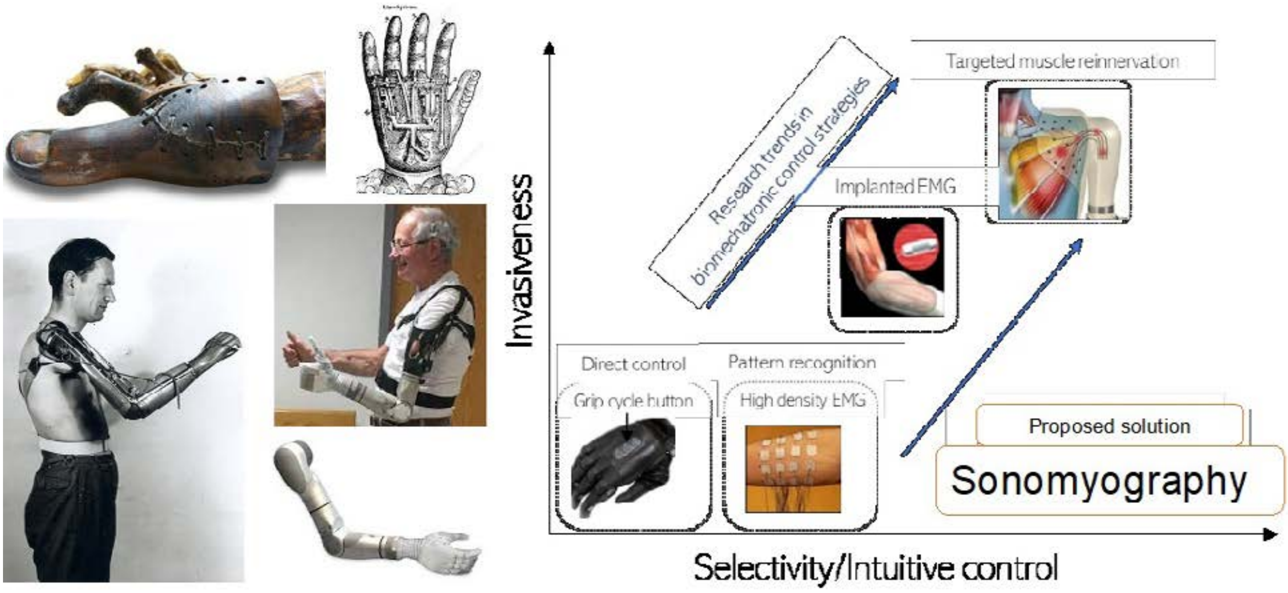

Figure 1: *History of the evolution of upper-extremity prosthetic devices from passive devices to the DARPA LUKE arm. Control technologies have moved towards invasive approaches to overcome limitation with surface electromyography.*

Surface electromyography or sEMG is the most prevalent modality to control active prosthetic devices. At its core, sEMG non-invasively measures the motor neuronal action potentials (MUAPs) that cause muscle contraction. However, sEMG presents multiple challenges due to poor signal to noise ratio and limited spatiotemporal specificity that limits it ability to resolve deep-seated muscle activity. Therefore, sEMG based control of bionic devices requires sophisticated signal processing techniques to overcome the inherent limitations with the signal. As a result, myoelectric control modalities have also started to explore invasive approaches such as implantable electrodes that direct transduce signals from the motor neurons. Targeted muscle reinnervation is a surgical procedure where motor neurons from the residual limb are transplanted to vestigial muscles to act as natural biological amplifiers. However, invasive approaches suffer from long-term electrode stability issues and require surgical intervention which has prevented widescale adoption.

In recent years, sonomyography has been proposed as exciting alternative to traditional myoelectric control strategies. Sonomyography utilizes ultrasound waves to image deep-seated muscles and measure the underlying activity. Ultrasound waves are emitted into the body and are reflected by echogenic structures. The reflected waves are sensed to form ultrasound images of the internal anatomical structures. Ultrasound imaging provides excellent spatial and temporal resolution with the ability to clearly differentiate dynamic muscle activity in deep muscle compartments in real-time. By utilizing the ultrasound images, several groups have demonstrated the utility of sonomyography for accurate and intuitive control of bionic devices[2]. However, there are several fundamental challenges to be solved for sonomyography to be a practically feasible for biomechatronic control. Typical clinical ultrasound systems, that are routinely used for musculoskeletal examinations have a large form-factor and require electronic components that cannot be scaled down for wearable applications. In our research group, we are attempting to solve these key challenges with the aim to develop wearable sonomyography systems for controlling the next-generation of bionic devices.

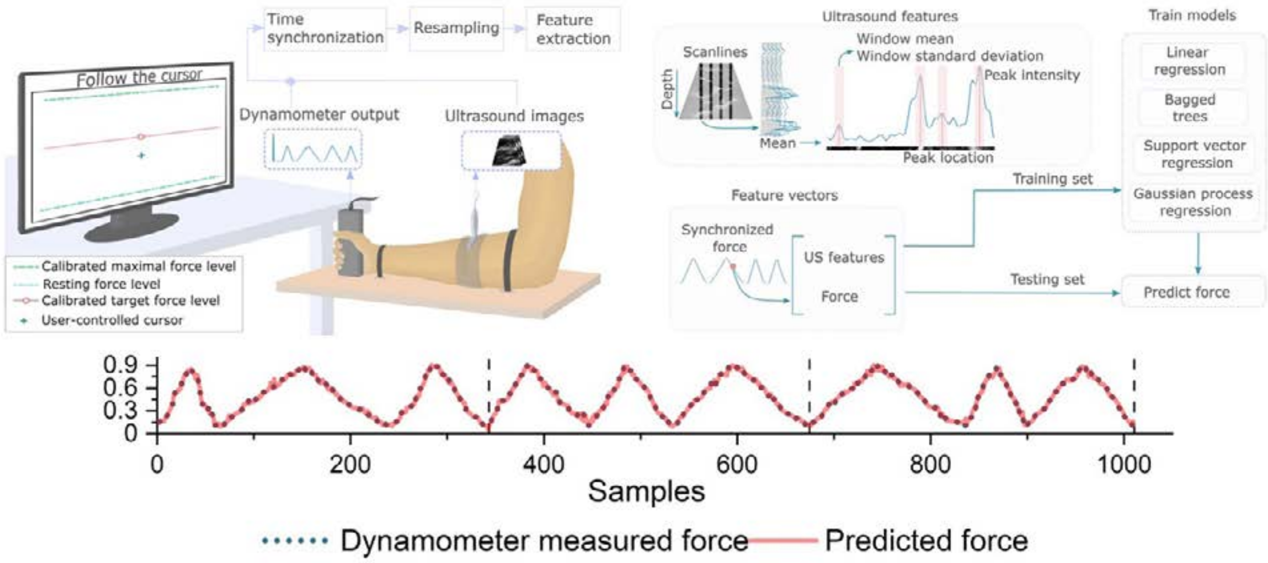

Figure 2: *Sonomyography setup showing the process of estimation of isometric force from ultrasound images obtained from forearm muscles.*

Typical clinical ultrasound imaging systems consist of an array of 64 or 128 piezoelectric elements or transducers that are used to transmit and receive ultrasound waves and form interpretable ultrasound images. However, in a recently published study from our group, we wanted to evaluate the effect of the number of transducersand their placement on the ability to predict muscle activity[3]. We selected only a subset of scanlines from ultrasound images obtained from healthy individuals and regression models were trained to predict the muscle activity. We demonstrated that it is possible to achieve excellent results with only four transducers. We further demonstrated that an equispaced array of transducers can provide excellent results and that that placing transducers on areas of maximal muscle activity may not be necessary. Our results indicate that it is perhaps possible to strip down an ultrasound imaging system to its bare minimum and still get intuitive and dexterous control of bionic devices.

We are now focused towards developing a new class of wearable sonomyography devices that will leverage only 4 to 8 sensors to achieve proportional control of multiple degree-of-freedom. PhD student, Anne Tryphosa Kamatham, who is supported by the Prime Mininster's Research Fellowship is currently working on developing novel wearable transducers consisting of arrays of piezo-sensitive elements that can be placed on the residuum of individuals with amputation to enable continuous imaging of muscles. She is also developing miniaturized pulse-echo ultrasound systems that can transmit and receive ultrasound signals from the transducer arrays. Due to severe form-factor limitations, she is developing a unique time-multiplexing strategy to minimize the requirement for dedicated hardware for each transducer.

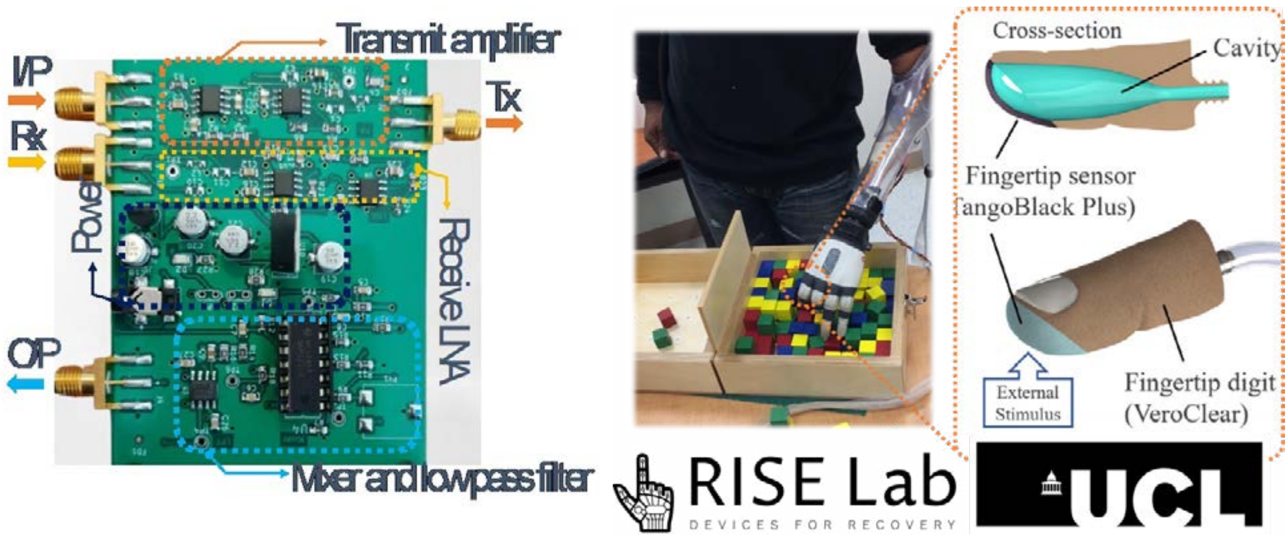

Figure 3: *Low-power FMCW ultrasound system for wearable imaging applications. Sonomyography combined with soft haptic devices from UCL to complete the sensorimotor control loop in amputees.*

However, the traditional pulse-echo paradigm of ultrasound imaging requires high voltage signaling (typically > 100V) and high-speed digitization (typically >20 MSPS) which leads to ultimately translates to high power consumption and presents safety concerns for wearable applications. Our group along with Prof Ankesh Jain of Department of Electrical Engineering have been working on an alternative ultrasound imaging modality inspired by Frequency Modulated Continuous Wave (FMCW) approach traditionally used in radar-based ranging applications. In FMCW ultrasound, a low-voltage continuous wave chirp signal is transmitted rather than a short-time wide-band pulse as in pulse-echo approach. The returned reflected echo signal is delayed in time wherethe delay represents the depth of the target. However, the delay can be deciphered simply by measuring the instantaneous frequency difference between the transmitted and received chirp signal using simple frequency demodulation techniques. The downmixed difference frequency is typically in the audio frequency range (few kHz) and can be sampled using traditional ADCs. Desh Deepak Lawania, our PhD student has quickly developed a practical FMCW ultrasound system and is currently working towards implementing a low-power, on-chip FMCW transceiver. His work has the potential to disrupt wearable ultrasound imaging systems with transdisciplinary applications across rehabilitation engineering, cardiovascular health monitoring, sports medicine to name a few.

So far, we have discussed how our efforts may lead to more intuitive control of bionic devices. However, in order to truly achieve dexterous control, bionic devices, particularly prosthetic hands must close the "sensorimotor" control loop. Just like our hands, prosthetic devices must have the ability to sense tactile interactions with objects and more importantly, be able to convey the information as feedback to the user. There is a lot of exciting research in this space with electronic skins embedded onto prosthetic devices and neuromorphic feedback technologies that have shown promise in restoring tactile sensations in amputees. However, these approaches require complex sensing and haptic feedback methods that can significantly add to the cost, weight, and complexity of the device. We have recently collaborated with Prof Helge A. Wurdemann from University College London, supported by a generous MFIRP grant from IRD, IIT Delhi to integrate soft haptic devices to prosthetic hands. These passive 3D printed soft haptic fingertipsdeveloped by the UCL team deform when pressed, just like a human finger[4]. The fluid contained inside the fingertip transmits the tactile force to a deformable soft haptic actuator placed on the residuum of the amputee. Therefore, the user can feel the grasp forces directly on the residuum without the need for any active component. We are now in the process of integrating our wearable sonomyography device to control the prosthetic hand equipped with UCL's soft haptic fingertips. We believe that the integrated sonomyography-soft haptic feedback device will allow users to intuitively modulate grasp forces to intuitively manipulate objects of daily living.

We hope that in the coming years, the technologies that we are developing will be translated into practical bionic control devices and improve the lives of countless individuals living with neuromuscular disorders.

Acknowledgement:

We are extremely grateful for the support and funding from the following sources:

1. Faculty startup grant, Planning Unit, IIT Delhi
2. Equipment Matching Grant, IRD, IIT Delhi
3. UCL-IITD MFIRP grant, IIT Delhi
4. Core research grant, SERB, DST
5. Prime Minister's Research Fellowship
6. IMS Graduate Fellowship Award, IEEE Instrumentation and Measurement Society

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FACULTY PROFILE

Prof. Shashank Bishnoi
CE, IIT Delhi

Shashank Bishnoi is a Chair Professor and Associate Dean (Infrastructure) at the Indian Institute of Technology Delhi. His areas of interest include cement chemistry, sustainability in construction, durability, repair, retrofitting and strengthening of structures. He got his Ph.D. from EPFL, Switzerland in the area of modelling of cement hydration. He did his Masters from the University of Tokyo, with a thesis on freeze-thaw deterioration of concrete. Before that, he completed his Bachelors in Civil Engineering from IIT Kanpur. He worked as a post-doctoral fellow at Laval University, Canada and has also been a Visiting Professor at EPFL, Switzerland and University of Tokyo, Japan.

At IIT Delhi, he set up a group working on cement and concrete. The group now has facilities to study a wide variety of subjects from cement hydration to the durability of concrete. He has made significant contributions in the area of supplementary cementitious materials. The most significant contribution has been in the area of Limestone Calcined Clay Cement (LC3). Being one of the pioneer researchers in the area, he has been instrumental in bringing the technology from the laboratory to cement plants around the world. The cement promises to reduce CO2 emissions from cement production by more than 30% and also allow the use of low grade raw materials. He has established a very strong relationship with the industry, with many of his research projects and students working on industry-sponsored projects. At the same time, he is also an active consultant in the area of structural assessment.

He has over 150 publications, in the area of cement and concrete technology. He has worked on over 290 industry and government sponsored research and consulting projects for sponsors like Lafarge, Chryso, BPCL, JK Lakshmi Cement, ACC, Shree Cement, NBCC, RITES, CPWD, Governments of Switzerland, Sweden and Norway and the Reserve Bank of India. He has served as expert in various capacities to the Supreme Court of India, High Court of Delhi, Rashtrapati Bhawan, Delhi Police and other Government organisations. He was awarded the Indian Concrete Young Scientist Award in 2015. He is chairman of CED 06 sectional committee of Bureau of Indian Standards. He is a member of several Bureau of Indian Standards committees on cement and concrete and has led Indian delegations at an ISO Technical Committees. He is also a member of several technical committees of RILEM. He is a member of the Editorial Board of Cement and Concrete Research and an Associate Editor of RILEM Technical Letters.

Technology Profile

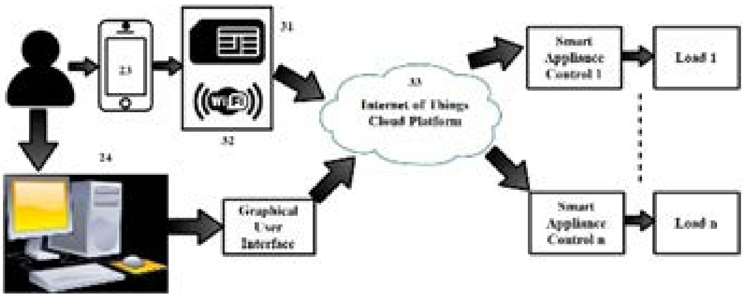
Apparatus for Shear Test on Geomaterial Contacts for Determining Interface Micromechanical Properties Developed at IIT Delhi

Prof. Prashanth Vangla
Department of Civil Engineering
IIT Delhi

Mr. Lalit Kandpal
Ph.D. Candidate Department of Civil Engineering
IIT Delhi

Researchers at IIT Delhi's Department of Civil Engineering have developed an apparatus and methodology for shear tests on geomaterial contacts such as sand–sand particles and sand particle–continuum material (e.g., steel, geomembrane, glass) for determining their interface micromechanical properties. This invention (device and method) helps estimate some fundamental inputs needed to understand the complex behavior of geomaterials and to improvise the numerical simulations for the accurate design of geomaterial systems. The apparatus is the most comprehensive and versatile device for investigating the rolling and sliding friction of various geomaterial contacts under different testing parameters, including normal load, strain rate, and dry and submerged conditions. This device can also study the tribological aspects of continuum materials whose friction depends on the direction of motion. The device consists of custom-designed interchangeable adapters for particles and sample clampers for the continuum materials for conducting experiments on different materials under conditions relevant to contact's interface motion (sliding and/or rolling). It also has provisions at the bottom of the sliding platform for image analysis and acoustic emission sensors for advanced characterization of tribological aspects of the contacts. The device also finds its application in other engineering disciplines dealing with particulate and particulate-continuum materials interfaces, such as processing, mining, pharmaceuticals, and food industries. No custom-designed, simple, and economical equipment is currently available for conducting shear tests for particle-particle and particle-continuum materials under different configurations that simulate the mechanisms and conditions relevant to geomaterial contacts. IIT Delhi has filed an Indian patent application for the same and is in the process of initiating talks with potential industry partners.

Smart Appliance Control for Building Energy Management



Prof BK Panigrahi, EE & Prof A Verma, DESE

IIT Delhi

Controlling of Building Energy Management

An appliance control device is developed for operating a plurality of appliances in a building to manage building energy system. It provides a system for data logging and monitoring health of an electrical appliance and allows time based scheduling of switching ON/OFF of a plurality of appliances and reduces overall energy consumption.

A plurality of appliances can be operated in various operating modes as per the requirements. The device provides data logging for individual appliance. Health of appliance (whether on/off has occurred or not) is monitored and a notification is sent to the user. Allows a manual control of a plurality of appliances, in an event of failure/malfunction of the appliances control device. Time based scheduling of switching ON/OFF of a plurality of appliances to reduce overall energy consumption. IoT/Cloud server/wi-fi/GPS based control is provided, Increased user convenience, Less installation cost.

Some Technology Transfers at FITT during Jan- June 2022

Sl. No.	Title	PI	Dept/ Centre
1	Reusable Sanitary Napkin	Prof. Sabhyasachi	DOD
2	RoboAnalyzer	Prof. S.K. Saha	ME
3	Cellulosic fabric with pollution absorbing characteristics	Prof. A.K. Agrawal	TFE
4	Antimicrobial and anti-covid coating	Prof. H. Singh	CBME
5	Nanoparticle based chromogenic regent and preparation	Prof. H. Singh	CBME
6	Process development to remove sizing agents on aramid fabric and laminate	Prof. J. Bijwe	CART

Some IPR Applications filed during Jan- July 2022

Sl No	Title	PI	Dept/ Centre
1	Redox Flow Battery and an Anolyte material for the Redox Flow Battery	Prof. B. P. Tripathy	DMSE
2	Method of Designing Windows and Doors and System thereof	Prof. N. M. Anoop Krishnan	CE
3	Reporting Tool for Mammography for AI-driven, Image-based Structured Reporting	Prof. C. Arora	CSE
4	A Sulfur activated Graphite Electrode and Method of Preparation thereof	Prof. A. Shukla	CHEME
5	Nostril Analyzer	Prof. D. Joshi	CBME
6	Design of an efficient Magnetostrictive Material based Vibration Energy Harvester with a modified Flux Path	Prof. S. Santapuri	AM

Sl No	Title	PI	Dept/ Centre
7	Roboanalyzer: 3D Model-based Robotics Learning Software	Prof. S.K. Saha	ME
8	Two stage Three phase High Resolution Transformerless Hybrid Multilevel Inverter for grid connected Solar PV Application	Prof. S. K. Chattopadhyay	DESE
9	A Holographic Filter-based Ultra-low Frequency Raman System with Multi-Excitation capabilities	Prof. A. Sengupta	PHY
10	Temperature regulated Shape Memory Polymers and a Method of Preperation thereof	Prof. B. Kumar	TFE
11	A Lithography Free Flexible Tactile Sensor for Fruit Ripeness Detection	Prof. B. Mitra	EE
12	Counter Battery System to determine Geolocation Point of Unpowered Object and Method thereof	Prof. S. Kar	EE
13	Apparatus for Embossing and a Method thereof	Prof. S. Aravindan	ME
14	An Additive to improve the Tribo-Performance of Engine Oils, Gear Oils, and Greases	Prof. J. Bijwe	CART
15	A novel process for preparation of Pegylated Recombinant Human Granulocyte Colony Stimulating Factor (PEG-GCSF)	Prof. A. S. Rathore	CHEME
16	Green Chemistry Method for One-Pot Synthesis of Biologically Active 1, 1-DI-TRI-, and Tetra-Substituted Alkanes	Prof. C. K. Hazra	PHY
17	Regenerable Anodized Porous Alumina Device and a Method of Fabrication thereof	Prof. B. Mitra	EE
18	A System and Method for Prosthetic Control	Prof. S. Malik	SENSE
19	Autoclave for Sterilization of Medical Equipment	Prof. S. Venkataraman	DOD
20	Tactile Diagram Analyser	Prof. P.V.M. Rao	DOD
21	Enhanced Hydrogen Yield from Hydrogen Iodide Decomposition with Iodine Impregnated Activated Carbon as an Adsorbent and a Catalyst System in Intermixed Assembly	Prof. A. N. Bhaskarwar	CHEME
22	A Method for Training Upper Limb of Subjects / Patients for Activities of Daily Living	Prof. A. Mehndiratta	CBME
23	A System and Method for preparing Ultra-Thin Spread Tow Fibers for Composite Manufacturing	Prof. R. Alagirusamy	TFE
24	New Bidirectional Isolated DC-DC Converter for Exchanging Power with the DC Grid	Prof. A. Das	EE
25	System Facilitating Power Supply in Communication Network and Method thereof	Prof. T. C. Kandpal	DESE
26	An Organic-Additive Enables Highly-Stable and Reversible Sodium Metal-Anode for High energy Rechargeable Batteries	Prof. V. Kumar	DESE
27	An Occular Drug Delivery Device	Prof. D. Kalyanasundaram	CBME
28	Miniscrew Implant Supported Bi-Hilix Appliances (MISBA)	Prof. G. Singh	AM
29	Transferring a Film from a First Substrate to a Second Substrate to Enhance Device Performance	Prof. R. Singh	PHY
30	Development of High-Performance Eco-Friendly Greases using Natural Resources	Prof. D. Kumar	ITMMEC
31	Total Elbow Replacement Prosthesis Set	Prof. D. Kalyanasundaram	CBME
32	Lavatory System for Processing Organic Waste Matter	Prof. V.M. Chariar	CARE

Sl No	Title	PI	Dept/ Centre
33	Peptide-based Mixture Composition for Piezoelectric Energy Harvesting and a Method of Fabricating the Device	Prof. A. Sinha	PHY
34	An Asymmetrical 31-Level Inverter System	Prof. B. Singh	EE
35	Multi-Anode Assembly Microbial Fuel Cell	Prof. S.W. Ali	TFE
36	Synthesis of New Organic-Inorganic Hybrid Materials as Light-Emitting Lumophores, and Designing OLED Devices using the same	Prof. C. K. Hazra	CHY
37	A System for regulating the power generated by a Three-Phase Squirrel-Cage Induction Generator (SCIG)	Prof. B. Singh	EE
38	Method for Manufacturing an Electrode from Biochar obtained from Pyrolysis of Rice Straw	Prof. A.K. Saroha	CHEME
39	Cellular Artificial Skin Substitute & Method of Preparation thereof	Prof. V. Koul	CBME
40	A Nanoparticle based Chromogenic Regent and Preparation Method, Methods, and Kits for Semi-Quantitative	Prof. H. Singh	CBME
41	Apparatus and Method for determining Mechanical and Acoustic Properties of Geomaterial Contacts	Prof. P. Vangla	CE
42	A Hybrid Power System for Continuous Power Supply to base Transceiver Station	Prof. T.C. Kandpal	DESE
43	Implementation of AC-DC Charging of Electric Vehicles (EVs) from distributed Microgrids based on Solar Wind Battery and Fuel Cell Sources	Prof. B. Singh	EE
44	A Single Current Sensor based Phase Current Reconstruction of Four-Phase Switched Reluctance Motor	Prof. B. Singh	EE
45	3-Dimensional Tracking and Navigation Simulator for Neuro-Endoscopy	Prof. C. Arora	CSE
46	Printable Vanadium Oxide (V2O5) Ink	Prof. M. Singh	EE
47	A Chelating Compound and Method of Preparation thereof	Prof. J. Jacob	DMSE
48	A Fluid Flow Measurement Apparatus	Prof. S.N. Singh	AM
49	Tunable Microwave Photonic Bandpass Filter using the Mach Zehnder Interferometer and Stimulated Brillouin Scattering	Prof. A. Choudhury	EE
50	Photonic Generation of Multiband Dual or Cross LFM Waveform with Bandwidth Doubling using a Single Dual-Drive Mach-Zehnder Modulator	Prof. A. Choudhury	EE
51	System and Method for Personalizing First Person Games Egocentric Gait Transfer	Prof. C. Arora	CSE
52	A Process for Sequestering of Metal Ion Impurities from Triethyl Borate	Prof. K.K. Pant	CHEME
53	An Integrated Fog-Computing based Hybrid AI-ML Method and System for enhancing user Experience towards Tourism	Prof. A.K. Kar	DMS
54	Grid-Interactive Solar PV-Battery -Wind Microgrid and Control Method thereof	Prof. B. Singh	EE
55	System and Method for Detecting Characteristics of an Embossed Surface of a Sheet	Prof. K. Khare	PHY
56	System for Rehabilitation of a Limb of a Patient	Prof. A. Mehndirtta	CBME
57	Memory Device and Method for Performing Computing Operations within Memory Device	Prof. M. Suri	EE
58	Wound Rotor Induction Machine Drive Unit	Prof. A.K. Jain	EE

Some Development/ Investigative Projects January- June, 2022

Sl. No.	Title	PI/ Dept / Centre
1	Technical support for monitoring and implementation of transport polices for improving traffic safety and bus system in NCTD	Prof. G. Tiwari, TRIPP
2	Technical analysis and vetting of the estimate of construction of 33/11 KV sub-station in Vill-Nagla Charandas Phase-2, Noida	Prof. S. Mishra, EE
3	Analysis of BRPL's distribution networks loss levels (voltage level wise) and suggested measures for loss reduction (non-economic loss) in BRPL	Prof. S. Mishra, EE
4	Smart pharmacy operations	Prof. V. Ramamohan, ME
5	Impact assessment of Atal tinkering labs implemented by IBM	Prof. J. Kumar, DOD
6	Assessment of plant condition of 300 KLD capacity, based on Sequential Batch Reactor (SBR) technology at BEL Kotwara, Uttrakhand by Sombansi Enviro Engg Pvt Ltd	Prof. V. Kumar, CRDT
7	Tribo-performance Analysis of Alto passenger brake-pads	Prof. J. Bijwe, CART
8	Preparation of action plan on "Alternate technology for management of wastewater drains" for major drains under the jurisdiction of NDMC	Prof. V. Kumar, CRDT
9	Designing and characterization of copper/cotton yarn and fabric samples for compression products	Prof. B. Kumar, TFE
10	Design, development and trial of contents of a curse social entrepreneurship	Prof. V.M. Chariar, CRDT
11	Independent opinion report on lithium ion & lithium ion Polymer cells	Prof. A. Gupta, ME
12	Development of CQD based SWIR photo detectors	Prof. S. Sapara, Chy
14	Tests on Couplers	Prof. P. Mahajan, AM
15	Evaluation of cellulosic fabrics with pollution absorbing characteristic	Prof. A.K. Agrawal, TFE
16	Development and delivery of specialized education in digital media and design curriculum for High End 21st century skills SoS	Prof. J. Kumar, DoD
17	Social-aware recommendations for E-commerce 2	Prof. S. Ranu, School of AI
18	Utilization of passenger data to generate actionable commercial insights	Prof. V. Ramamohan, ME
19	Airbrone delay prediction and event playback methodology	Prof. V. Ramamohan, ME
21	Modelling and analysis for agility in restructuring the flexibility of resources in ground operation process	Prof. J. Madaan, DMS
22	Detect water seepages along the joint of runways	Prof. B.R. Chahar, CE
23	Process development to remove sizing agents on Aramid fabric and liminate	Prof. J. Bijwe, CART
24	Investigations on selected friction materials, analysis for functioning, eco-friendliness, performance and sustainability	Prof. J. Bijwe, CART
25	Development of antimicrobial (antibacterial snd antiviral) nanocoating for paper products	Prof. A.K. Agrawal, TFE
26	Development of OGR coating for paper products	Prof. A.K. Agrawal, TFE

Sl. No.	Title	PI/ Dept / Centre
27	Biopolymer based nanocomposite coating for high-barrier applications (low water vapor and oxygen tramission rates)	Prof. G. Goel, CHEME
28	A pre-clinical in vivo study for evaluating anti-biofilm FDA approved drugs in reducing treatment duraiton of anti-TB drugs	Prof. D. Sundar, DBEB
29	Development and launch of assessment and learning reinforcement solutions for K-10 and higher	Prof. A. Mittal, KSBS
30	Development of a deep learning platform for structure-based antibody screening	Prof. G. Goel, CHEME
31	To provide technical expertise towards the analysis of consultant sacubitril tablets provided by Dr Reddy's Laboratories Ltd	Prof. A. Ramanan, CHY
32	Synthesis and activity evaluaiton of catalysis for convesion of alpha pinene to camphene	Prof. D. Bhatia, CHEME
33	Knowledge graph embeddings and recommender systems	Prof. Mausam, CSE
34	Feasibility study of the development of protocol stack for smart meter applications of Probus Smart Things Pvt Ltd	Prof. A. Dixit, EE
35	Assessment and certificaiton of Yogyata courses	Prof. J. Kumar, DOD
36	Utilization of passenger data to generate actionable commercial insights	Prof. V. Ramamohan, ME
37	Detect water seepages along the joint runways	Prof. B.R. Chahar, CE
38	Airborne delay prediction and event playback methodology	Prof. V. Ramamohan, ME
39	Vibration analysis of bellows	Prof. A.K. Drape, ME
40	Modificaitons of SARS-CoV-2 diagnostic primers to allow improved detection of the Omicron variant	Prof. V. Perumal, KSBS
41	To study the effect of cleaning product on degradation process of anaerobic microbnial inoculums used in IR-DRDO bio-toilet system of Indian railway coaches	Prof. V. Kumar, CRDT
42	Air quality progress report	Prof. S. Dey, CAS
43	Testing fatiuge test of lug suspension 243	Prof. P. Mahajan, AM
44	Development of FNSA dashboard for Rajasthan	Prof. N.B. Bolia, ME
45	Modelling and analysis for agility in restructuring the flexibility of resources in ground operation process	Prof. J. Madaan, DMS
46	Lamination of mica system with protective polymer for PV panels	Prof. N.V. Datla, ME
47	Planning,designing and supervision of the Foundation Structure for the Statue of Netaji Subhas Chandra Bose under the canopy behind India Gate	Prof. S. Gupta, CE
48	Traffic performance evaluation and optimisation of highways in Delhi using simulation analysis-for Delhi PWD roads	Chakka M. N. Sai Chand, TRIPP
49	Design thinking workshop on usage of technology in bal vidyalaya	Prof. J. Kumar, DOD
50	Impact Assessment Study on Tablet usage in CSC Bal Vidyalayas	Prof. J. Kumar, DOD
51	Development of a machinery health monitoring system of Main Circulating Pump (MCP)	Prof. A.K. Darpe, ME
52	Testing of Rebar Couplers for Multitech Splicing	Prof. P. Mahajan, AM
53	Testing of Rebar Couplers for Harsh Industries	Prof. P. Mahajan, AM
54	Endurance test on lugs for Star Wire	Prof. P. Mahajan, AM

Sl. No.	Title	PI/ Dept / Centre
55	Water balance of the industry and performance assessment of ETP of Ashoka Pulp &Paper Mills Ltd	Prof. V. Kumar, CRDT
56	Enhancing ThePriceX - Pre-owned price prediction engine	Prof. Mausam, CSE
57	Design and development of a compact electromechanical harvester for high shock environments	Prof. D. Mallick, EE
58	Design and prototyping of industrial IoT sensor for smart warehouse	Prof. S. Jha, ME
59	Investigating electrical characteristics of the dynamic capacitance of a 4T pixel enhance dynamic range	Prof. M. Sarkar, EE
60	Analysis of of potentisal of High Strength Steel in tramisison tower	Prof. J. Jain, DMSE
61	Handloom research and development project	Prof. S. Mukhopadhyay, TFE
62	Characterization of NR vulcanizates with AFM and TEM	Prof. N.N. Gosvami, DMSE
63	Analysis of efffect of chemical composition (High level of Phosphorus) on Mechanical Properties of DI pipes	Prof. J. Jain, DMSE
64	Analysis of failure in C grade steel during low temperature exposure	Prof. J. Jain, DMSE
65	Light weight RM & Welding processes study for Rotational Seat	Abhishek Das
66	Special paper development	Prof. A.K. Agrawal, TFE
67	Scoping exercise to understand the landscape of multisectroal integration in India for Assistive Technology (AT) innovation and improving access	Prof. P.V.M. Rao, DOD
68	Energy and sustainability Initiative	Prof. A.D. Sagar, Public Policy

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
DESE:	Department of Energy Science and 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
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...

Happenings

FITT has entered into a license agreement withPune based SVR InfoTech on March 7, 2022 for RoboAnalysersoftware an educational software for learningrobotics in a fun and effective way.

FITT in partnershipwith BIRAC andTISS hosted BIRAC'sSPARSH GraduationDay and Investors'Meet, at the Researchand Innovation Park,IIT Delhi on March 22,2022

Delhi International Airport Limited (DIAL) has signed an agreement with FITT, IITDelhi to enhance passenger experience andoperational excellence by leveraging artificial intelligence-based predictive analytics. The agreement, signed on February21, 2022 has been inked for a period of five years through FITT will carry out AI-based predictive analytics on identified areas ofimprovement and come up with next-level innovative solutions.

Samsung Launches Solve for Tomorrow Contest In Collaboration With FITT, IIT Delhi

Samsung, has launched a new youth-centric national education and innovation competition called Solve for Tomorrow on June 2022, inviting India's brightest young minds to come up with innovative ideas that may transform lives of people and communities around them.

POSOCO signs MoU with IIT Delhi to encourage research on India's power sector

MoU was signed by Rajiv Kumar Porwal, Head of NRLDC (POSOCO) and Colonel Naveen Gopal (Retd), COO, FITT at the Committee Room FITT, on April 20, 2022

License Agreement Signed with ARF Life Sciences on April 29, 2022

Kit for Semi-quantitative detection of iron fortified cereals - Inexpensive, rapid, reliable method for identification of iron fortificants in cereals. The method can identify: EFe, FeSO4, FeFum, FeCit, NaFeEDTA, and FePP. PI: Prof Harpal Singh,IITD. Licensee: ARF Life Sciences

IITs to collaborate in entrepreneurship development in Ladakh

Dr Anil Wali, MD FITT (2nd from right) interacted with various agencies and budding entrepreneurs from Ladakh during the series of workshops on 'Enterprising Ladakh' organised by Industries and Commerce Department, Ladakh to assist in the development of an entrepreneurship and incubation eco-system for the entrepreneurs of Ladakhon May 8, 2022.

Panel discussion on Conundrum of Incubators in India at Assam Biotech Conclave 2022

Dr Anil Wali, MD FITT(2nd from left)as a panelist during the Assam Biotech Conclave at Biotech Park Guwahati on May 21, 2022

Technology Transfer at FITT- Anti microbial and anticovid coating - The developed coating can be applied on the walls specifically in hospital settings. PI: Prof Harpal Singh, CBME, IITD. Licensee: Fibrex Construction Chemicals Pvt Ltd on April 29, 2022

SNIPPETS

FITT invites proposals under the 21th Biotechnology Ignition Grant (BIG) Scheme of BIRAC from July 1, 2022 to August 16, 2022. For details: www.fitt-iitd.in

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 programmes of the Institute on a priority basis with FITT providing the interface. Membership form can be downloaded from www.fitt-iitd.in

LEADERSHIP @ FITT

Prof. Rangan Banerjee, Director, IIT Delhi, Chairman, FITT

Dr. Anil Wali, MD, FITT

Col. Naveen Gopal (Retd.), COO, FITT

Research and Innovation Park, IIT Delhi

FITT promotes innovation and offer best of the incubation facilities especially in NCR and the country as a whole to nurture ideas and develop technology solutions. Interested can e-mail us at: **mdfitt@gmail.com**

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