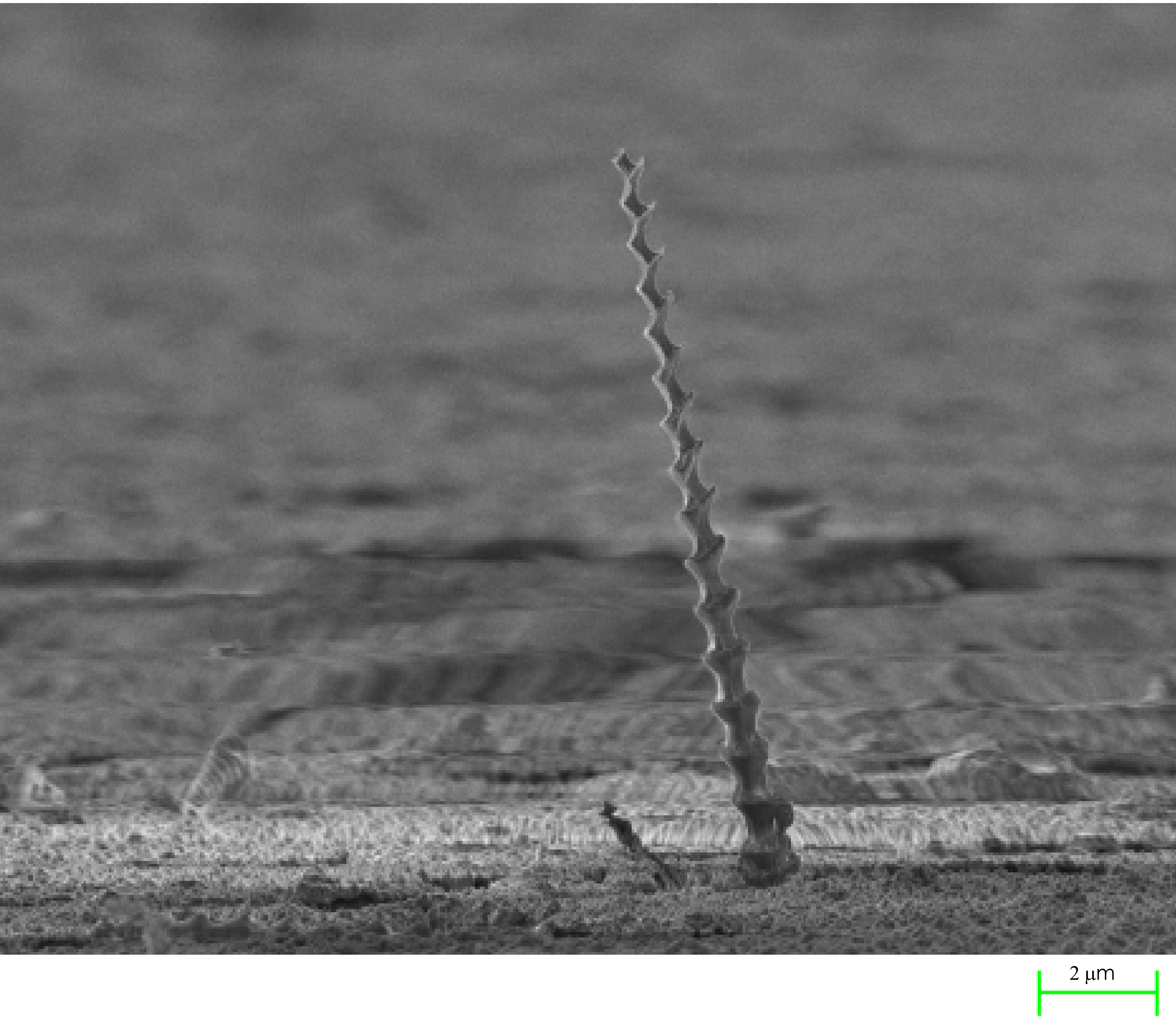
PressCeNSE

Newsletter | Issue 2, 2019



Centre for Nano Science and Engineering (CeNSE)

Indian Institute of Science

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Cover photo: "Deer Horn" created on nanomaterial, by Lavendra Yadav.

MESSAGE FROM THE CHAIR

We had several important events during the last quarter. The annual student research symposium is one of the most important events that we conduct in our centre. This is the platform where our research students share their latest research breakthroughs and technology innovations. It is also attended by our industry partners. This year the annual research symposium was held on 1st and 2nd March, 2019. The symposium was inaugurated by Mr. S D Shibulal, co-founder and former CEO, Infosys & Co-founder, Axilor Ventures. He highlighted on the need for attracting young minds to science to solve global problems in future and the necessity for interdisciplinary research in nanosciene and nanotechnology.

IISc open day, held on 23rd March, attracted thousands of science enthusiasts to the campus. The students and staff from our centre had put together several hands-on science exhibits, along with specific illustrations on nanoscience and nanotechnology. The tour of cleanroom was also arranged for the winners of science quiz. About 8,000 visitors, from school children to senior citizens, visited our centre. This was a great opportunity for us to connect with the society at large. For instance, it was very heartening to see a marginal farmer from a village near Tumkur, bring along his daughter studying in the 6th standard in the village school. Her excitement and inquisitiveness were testimony to the fact that scientific fervour is very active in the remote corners of the country. These are great signs for creating a vibrant future for the Indian science and technology ecosystem.

The Technology Business Incubator (TBI), funded by the Government of Karnataka has now become operational at CeNSE. The proposals are now accepted for incubating a start-up in nanotechnology. This facility is open to anybody who has a great idea for nanotechnology product. Our centre will provide necessary facilities and mentoring. We hope that a large number of start-ups will emerge from this TBI, in the next few years.

-Navakanta Bhat

What's new in research at CeNSE?

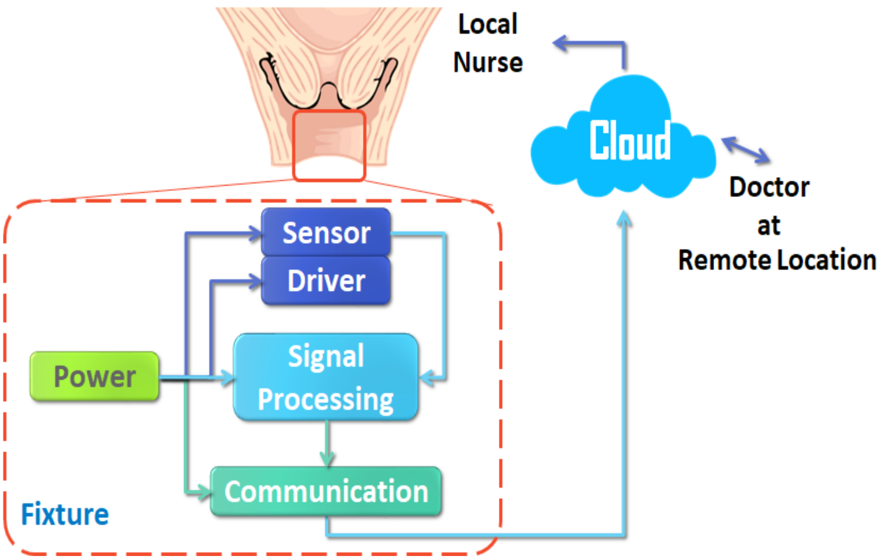
MICRO-NANOFLUIDICS LAB

Cervical Dilatation Monitoring System

Namratha Nayak, N.S. Dinesh and Prosenjit Sen

Monitoring labor progression is of utmost importance to avoid complications during child birth. The parameters that are commonly monitored during labor are frequency, strength, and duration of uterine contractions, cervical effacement and dilatation, and foetal head station. Cervical dilatation is one of the most important parameters used to gauge the progress of labor. Monitoring cervical dilatation alone allows healthcare professionals to take decisions regarding subsequent intervention.

In a clinical setting, cervical dilatation is almost always estimated manually with fingers, using a technique called digital examination. Although it is known that digital examination is a subjective measurement, with a high degree of inter- and intra-observer variability, that it often causes discomfort, pain and embarrassment to the expectant mother, and that it can increase the risk of infections; the method continues to be a universal practice due to its simplicity, ease of implementation, and cost-effectiveness. When conducted by an experienced practitioner, the examination is treated as a gold standard for the measurement of cervical dilatation.



In an attempt at improving the accuracy of measurement, different methods have been explored in the literature. Various mechanical measurement tools that were devised were found to be heavy and to cause distortion of the cervix. Ultrasound-based monitoring methods require the sensors to be screwed into the cervical tissue at exact locations. This may lead to local trauma and any error in sensor placement could lead to increased measurement errors due to which this may not be the preferred method of measurement for cases of normal labor. Though high-resolution, real-time ultrasound imaging systems are available, they are prohibitively expensive and difficult to use for measurement of cervical dilatation, because of obstruction from maternal pelvis and foetal skull. None of the methods mentioned above have managed to reach the hospital setting.

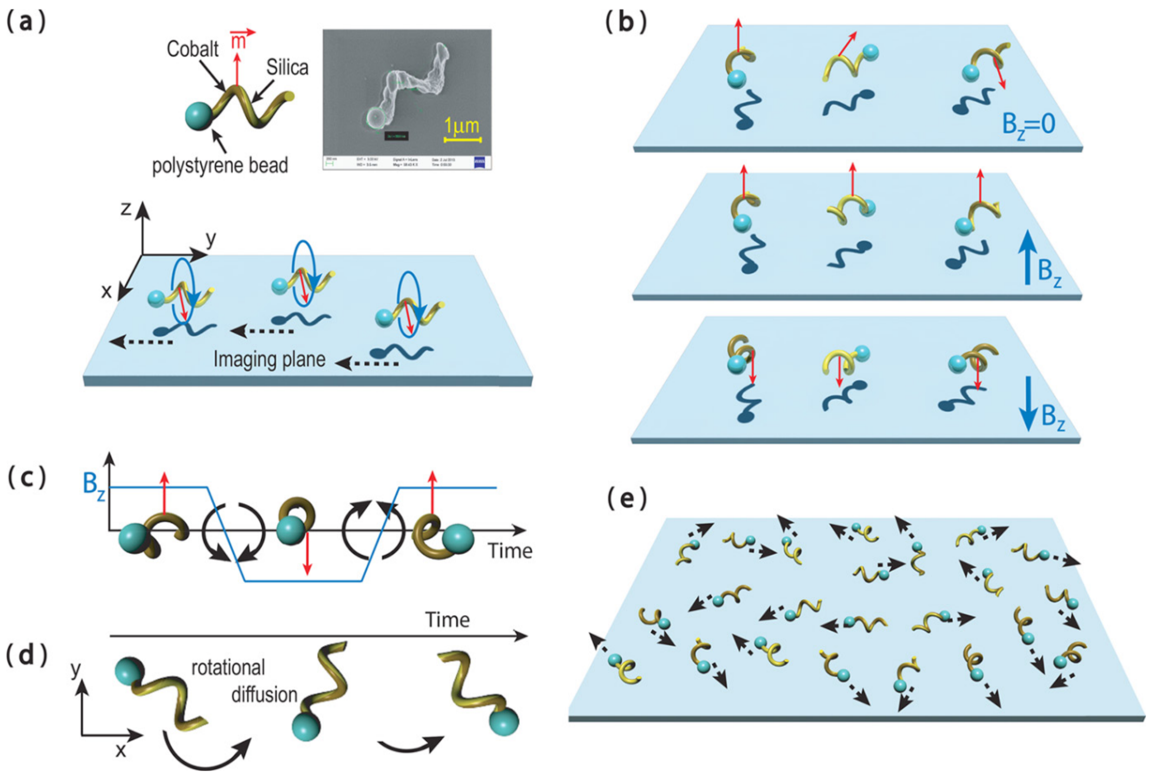
The aim of this work is to develop a labor progression monitoring system which is accurate, cost-effective, safe, and easy to use, and causes the least discomfort to the patient. The system consists of a sensor coupled with a manipulator housed in a biocompatible package, which is to be placed into the vaginal tract of the patient. The work involves testing of various sensors for suitability in the current application, development of the measurement technique, development and application of data processing algorithms, building of a suitable enclosure, plus animal and human trials.

OPTICS, NANOSTRCUTURES AND QUANTUM FLUIDS LAB

Active Matter: Physics of Life

Gouri Patil and Ambarish Ghosh

The importance of non-equilibrium aspects in soft matter science, due to kinetically arrested states or external driving forces, has come to the forefront in recent times, around three decades now. This special class of materials – active matter – is intrinsically out of equilibrium, because the particles continuously consume energy that is used for their active movement or to exert mechanical forces. The interplay between a large number of these active particles can lead to very complex patterns of collective motion and self-organized structures. Many such phenomena can be seen in biology: in flocks of birds, schools of fish, or in colonies of bacteria, and also at a smaller scale, where actively growing and shrinking microtubules and actin filaments control the structure and dynamics of living cells, together with motor proteins that exert forces on these filaments.



Schematic showing the mode of actuation (b,c,d) where the magnetic moment on each motor responds to the external magnetic field, (e) shows the collection of such propellers/motors randomly oriented.

Lately, there has been a growing interest in artificial systems for re-creating the natural collective phenomena of active matter, and this delineates the exact motivation for this work too. Micro- and nano-motors, as they are called, are non-living micro- and nano-particles that are rendered motile when energy is supplied by external sources, for example: – through asymmetric chemical reactions or the application of electric, magnetic, optical, or acoustic fields. Their study is interesting for two reasons. The first stems from the prevalence of self-powered systems in nature, ranging from intracellular transport to human migration, which are non-equilibrium phenomena yet to be completely understood. Nanomotors provide a promising route toward the study of complex active matter phenomena with a well-defined and possibly reduced set of variables. Secondly, nanomotors can impact future biomedical practices, where one envisions intelligent multifunctional nano-machines swarming toward a diseased site and delivering therapeutics with high accuracy. Among different ways of powering such nanomotors, magnetic fields deserve a special mention because of their inherent biocompatibility, minimal dependence on the properties of the surrounding medium, and remote powering mechanism. Unlike the other existing artificial and even living experimental systems like bacterial suspensions, the magnetic motors have the advantage of controlled motility and density; allowing the researchers to probe the statistics at extreme ends of motility. Initial efforts in the group had been directed towards engineering such a system with large-scale fabrication of uniform micro-motors and towards designing the magnetic field and actuation principles to achieve randomness in the system, rather than towards designing a driven system. Currently, the group is looking at swarms of such motors and the link between motility and enhanced diffusivity.

References:

1.Magnetic active matter based on helical propulsion, P. Mandal et al., *Accounts of Chemical Research*, Oct 2018.

2.The Physics of life, Gabriel Popkin, *Nature News* feature.

MEMS LAB

Fluid Spectroscopy using PMUTs

Kaustav Roy and Rudra Pratap

The technology of Piezoelectric Micromachined Ultrasound Transducers (PMUTs) is one of the most advanced ultrasound technologies used lately. These are piezo-electrically actuated micro-plates which, when vibrated at resonance, produce sound waves that are generally used for medical imaging. Apart from imaging, ultrasound can also be used to probe fluids in order to determine their mechanical properties such as density, rheology, and particle distribution. A PMUT micro-sensor, if made, will add great new capabilities to R&D and can be used to characterize fluids of all kinds. The group calls this technique “fluid spectroscopy” and plans to realize such a sensor by combining advanced ideas of piezo-acoustics, micromachining, microfluidics, electronics, and signal processing.

The group has already demonstrated that PMUTs can be used for “macro density sensing” by developing a novel method of through-transmission of ultrasound in fluids, which they

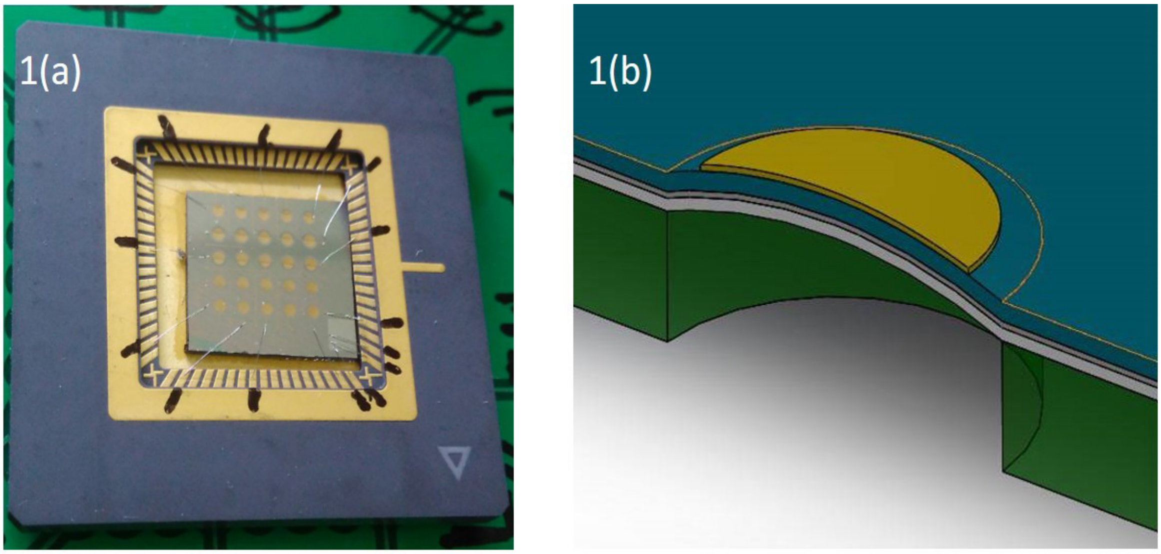
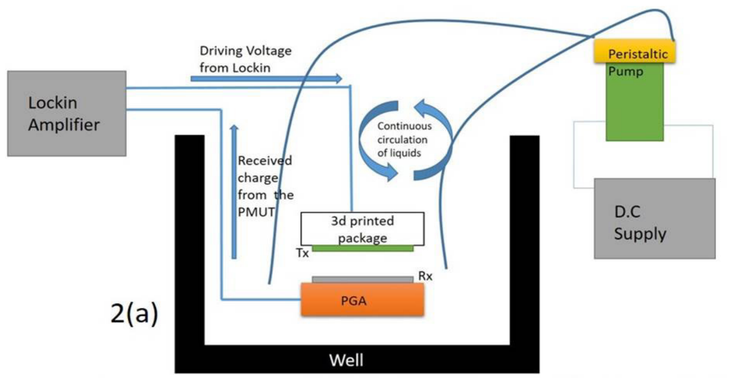


Fig. 1(a) A typical PMUT array bonded to a PGA package. (b) 3D cross-sectional view of PMUT



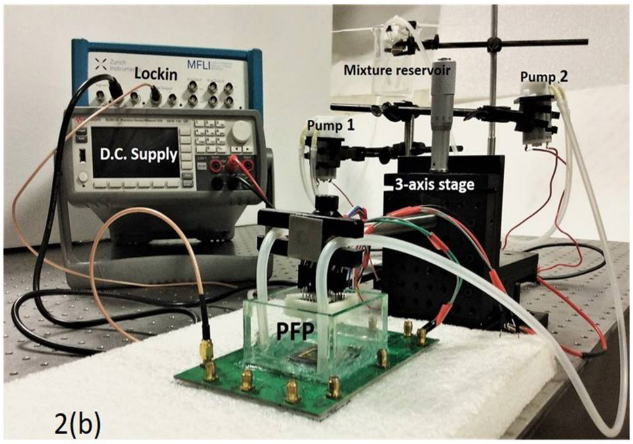


Fig. 2(a) Schematic of the PFP Sysytem. (b) Macro Experimental set up for online condition monitoring of fluids

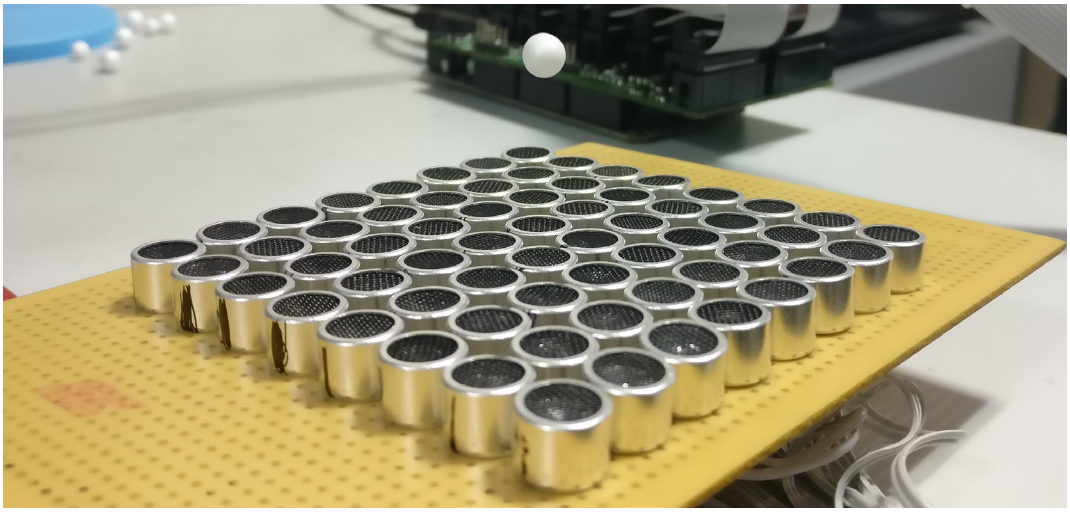
call PMUT-Fluid-PMUT system or PFP. Results obtained from the PFP system indicate that PMUTs can continuously sense density with reasonably high sensitivity and hence are suitable candidates for online condition monitoring of various fluids.

Focussed Ultrasound using Phased Arrays

Harshvardhan Gupta and Rudra Pratap

Ultrasound, like audible sound, is a mechanical pressure wave that results from the back and forth vibration of the particles of the medium through which the sound wave is travelling. High intensity focused ultrasound, or HIFU for short, is a technology that uses ultrasound to destroy cancerous tumour cells by focussing ultrasound to a small volume.

This technology uses arrays of ultrasound transducers to focus and steer ultrasound electronically by modulating the phase of the signal to each transducer element in the array. This system is called a phased array. Ultrasound phased arrays can also be used to levitate and manipulate matter in a technique called acoustophoresis, as in the case of this 8x8 array of 40 kHz transducers keeping a thermocol bead suspended in mid-air (figure). The technique is gentle, involves no contact and exerts minimal force, which makes it viable for live biological samples.



At the MEMS Lab in CeNSE, researchers are exploring the miniaturization of these technologies using PMUTs fabricated at the Centre. These PMUTs range from a millimetre to a hundredth of a millimetre in size and can be fabricated in large arrays. Potential applications of these devices and the phased-array technique include trapping and moving micro beads, sorting of cells in blood, detection of cancer cells, among many others.

FACILITY UPDATES

ADVANCED IC AND PACKAGING LAB

M.M. Nayak

Packaging of microelectronics is the science and art of establishing interconnections for MEMS and IC devices. MEMS is a relatively new field which is tied closely to the IC micro-fabrication process. All packaging applications can be summed up in three terms: performance, reliability and cost.

The Packaging lab at CeNSE houses equipment and tools that enable packaging of various MEMS and IC devices. The lab has facilities for wafer dicing, die attaching, ball/wedge bonding, laser welding, helium leak detection, soldering, moisture-proofing, laser engraving, 3D printing, as well as a probe station, a hot & cold chamber, and a high magnification microscope, for the assembly, packaging and testing of MEMS and ICs. It also has facilities for low/high pressure calibration and acoustic calibration (with data acquisition systems) for performance studies and characterization of various sensors/ transducers. As one of the support facilities at CeNSE, the packaging lab has all that is needed to build a packaged device from the wafer, and is serving a diverse community of faculty, students (graduate and undergraduate), industry and start-ups.

AUTOMATIC DICING MACHINE

WIRE BONDER

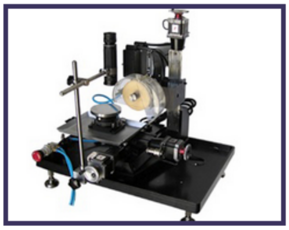
LASER WELDING SYSTEM

DEAD WEIGHT PRESSURE CALIBRATOR

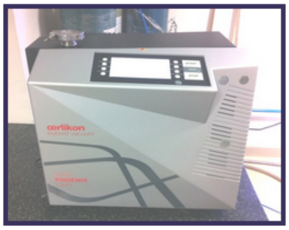
PRESSURE CALIBRATOR (PNEUMATIC)

PARYLENE DEPOSITION SYSTEM

CLIMATE CHAMBER



SEMI-AUTOMATIC DICING



HELIUM LEAK DETECTOR

Recently, the Pakaging Lab acquired two more valuable tools:

1) **Pneumatic Modular Pressure Controller /Calibrator** (Model - 6270A): This tool provides a robust and reliable way to simplify the task of pneumatic pressure calibration. This Calibrator has three sensors installed, and expandable up to five sensors, in a single chassis simultaneously, with an uncertainty of 0.01% of reading from 30% to 100% of the module's span. Other features include:

• Ranges:

o Sensor 1: -1 bar to 200 barG

o Sensor 2: 7 barA

o Sensor 3: -1 to 2 barG

• Operating Medium: Nitrogen.

• Controller with both control and measure capability.

• Communication Port: RS232, IEEE and/ or USB.

• Operating ambient temperature: 20 to 35 ° C

• Power Supply: 220 V, 50 Hz.

• Control Precision: 10 ppm

2) **Plasma Cleaner** (Model – PDC 002 HP): a benchtop plasma instrument extensively used for nanoscale surface cleaning and surface activation. This unit features:

• Adjustable RF power settings (Low, Medium, High)

• Maximum RF power of 30W

• 6 diameter x 6.5 length Pyrex chamber

• Hinged door with viewing window

• Active fan cooling

• Integral switch for a vacuum pump

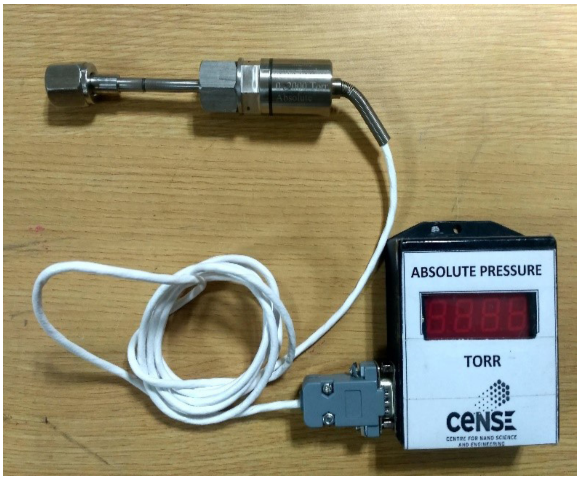
• 1/8 NPT metering valve to qualitatively control gas flow and chamber pressure

• 1/8 NPT 3-way valve to quickly switch from introducing gas, venting and isolating the chamber.

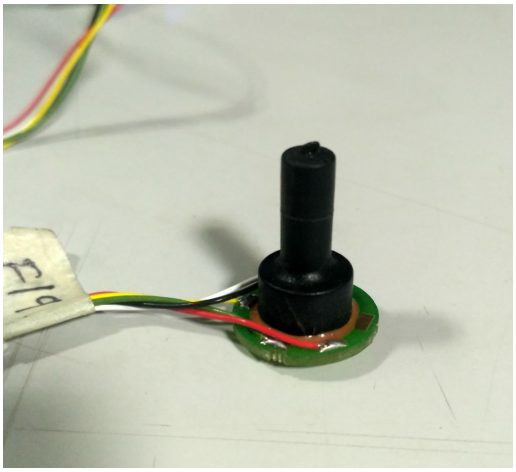
With a repository of such powerful tools, the Packaging lab at CeNSE has undertaken and successfully delivered multiple projects since its inception. Here is a report on projects-current and recently completed:

Title	Status	Total Deliverables	Delivered
HAL – Helicopter Division, Bangalore throough IISc Start-up i2n Industries			
Altitude Sensor (0 -1 barA)	On going	30	8
Air speed sensor (0 -140 mbarD)	On going	30	8
Development of Oxygen pressure sensors for ULH (0 - 200 barG)	On going	04	-
LPSC - ISRO Projects			
Integrated Pressure, Temperature and humidity sensors	On going	05	-
Oil filled Pressure sensors Capsule 5 bar,15 bar, 30 bar, 50 bar,100 bar, 200 bar & 400 bar	On going	7 Ranges x 3 Nos = 21	-
Hight Temperature Pressure sensors (0 -100 barG)	On going	05	-
Quartz Resonant Pressure Sensors (0 -30 barG) & (0 - 300 barG)	On going	2 Ranges x 5 Nos = 10	-

Title	Status	Total Deliverables	Delivered
Start-up Projects			
Green Propellant Compatibility Test (0 -100 mbarG) M/s. Bellatrix	On going	20	06
Air Duct Sensor (0 -140 mbarD) M/s. Impact Engineering Pvt Ltd	Sample	06	06
Train Engine – Brake Pneumatic Pressure Sensor (0 – 6 barG) M/s. Lab to Market	Sample	06	01
IISc Internal Projects			
Vacuum sensor (0 -2000 Torr), Prof. Sushobhan Avasthi, CeNSE	Completed	02	02
Vacuum sensor (0 -1200 mbar), Prof. Srinivasan Raghavan, CeNSE	On going	01	-
Pressure Controller (0 -2 barA), Prof. Sushobhan Avasthi, CeNSE	On going	02	-



(0-2000 Torr) Vacuum Sensor



Air Duct Sensor (0-140mbar D)

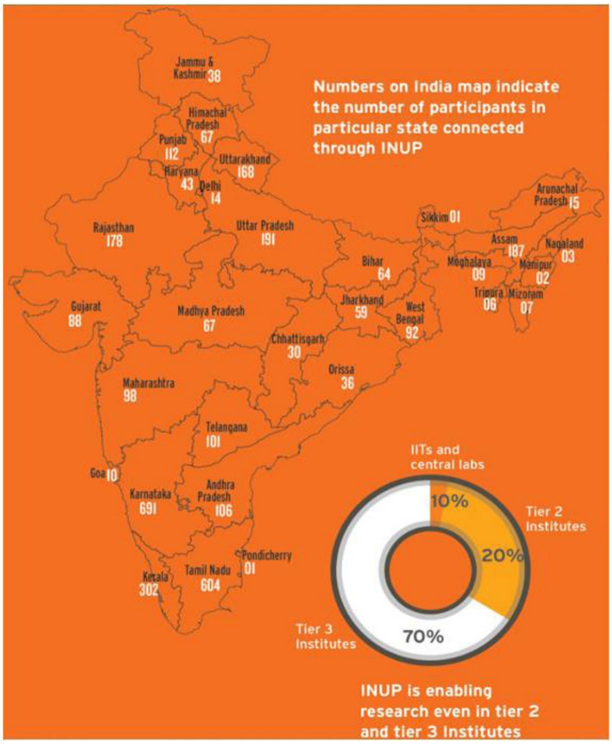
Packaged Pressure Transducer (0-1bar A and 0-140mbar D) - Delivered (16nos) to HAL, Helicopter Division

OUTREACH

INDIAN NANOELECTRONICS USERS PROGRAM

The Indian Nanoelectronics Users' Program (INUP) is a unique initiative originally conceived and supported by the Ministry of Electronics and Information Technology (MeitY). The program is an integral part of the larger effort of establishing Centres for Excellence in Nanoelectronics (CEN). CENs, built at great expense and staffed with teams of technical experts serve as National Centers. These facilities are open to aspiring academic researchers from around the country and have been instrumental in creating human resources in the area of Nanoelectronics. Through INUP, both IISc, Bangalore and IIT Bombay – tasked with the responsibility to implement this program – continue to inculcate a spirit of collaboration among researchers, and help efficient utilization of national resources by bringing in researchers from all over the country.

INUP Outreach



The vision of the program is to intiate R&D efforts in academic institutions around the country and develop trained technical manpower. INUP organizes and conducts workshops and hands-on training programs for wide dissemination of knowledge in the field of nanoscience and engineering. The INUP experience has resulted in a new initiative I-STEP, International Scientific and Technological Education Program, supported by the Ministry of External Affairs and the Deptartment of Science and Technology (DST), to train international researchers.

INUP provides three levels of training – Familiarization workshops (level 1 – designed to provide an overview of the cutting-edge research in the area of nanoscience and technology), hands-on training (level 2 – provides participants practical training on state-of-the-art nanofabrication and characterization tools) and project work at CeNSE (level 3 – where researchers are encouraged to submit research proposals that can be executed at CeNSE). To lower the barriers for doing research, participants are provided full technical and financial support during training and execution of the research project. The program is also designed to elicit collaboration among participants through sharing of resources available in their own institutions. Since its inception in 2008, INUP has received exceptional positive feedback from its participants as well as funding agencies. INUP is now connected to over 700 academic institutes around the country. The last of the MeitY supported INUP Phase II hands-on training program was conducted from 12 to 22 February, 2019, and had nearly 25 participants from academic institutions all over the country.

The next set of training programs, supported by MHRD, will be formally launched in May, starting with the Basic Training Program in Nano Science and Technology (14 to 16 May, 2019) followed by the Advanced Training Programs on Nanofabrication and Characterization Techniques later in the year. Both the courses are designed to equip participants with the latest information on nanoscale research and enable them to use the state-of-the-art tools for device fabrication and testing. Regular updates on all upcoming events will be posted on INUP website: www.inup.cense.iisc.ac.in/

ALUMNI PROFILE

For this issue, PressCeNSE got in touch with **Dr. Venkatesh Kadbur Prabhakar Rao** who did his PhD thesis research at our Centre, working with Prof. Rudra Pratap and Prof. Navakanta Bhat. He graduated in 2017 and is currently an Assistant Professor in the Department of Mechanical Engineering at the Birla Institute of Technology and Science, Pilani, Rajasthan.

He shared some details of his work at CeNSE and current projects.

1) Can you tell us about what you are currently working on?

Our lab is currently working to develop an experimental platform to measure the mechanics of micromechanical structures and biological cells.

[To know more, please visit www.bits-pilani.ac.in/pilani/venkateshkprao/Profile].

2) Describe your work as a PhD student at CeNSE.

Back when I started working for my PhD, experimental vibration analysis of mechanical structures was a well-established field; plenty of literature was readily available on macro-scale structures in the fields of civil, mechanical, and aerospace engineering. But the study of vibrations of micro-scale structures such as MEMS, liquid droplets, and biological cells was relatively new. For such structures, the amplitudes of vibration are typically in the nanometer or sub-nanometer range and the frequencies are in the kHz to MHz range, depending on the dimensions of the structure. In our study, we used a scanning Laser Doppler Vibrometer (LDV) to measure the vibrations of micro-scale objects such as MEMS structures, micro droplets and biological cells. The vibrometer can capture frequency response up to 24 MHz with picometer displacement resolution.

First, we presented the study of the dynamics of a 2-D micromechanical structure - a MEMS electrothermal actuator. The structure was realized using the SOI MUMPs process from MEMSCAP. The fabricated device was tested for its dynamic performance characteristics using the LDV. In our experiments, we could capture up to 50 out-of-plane modes of vibration - an unprecedented capture - with a single excitation. Subsequent FEM-based numerical simulations confirmed that the captured modes were indeed what the experiments indicated, and the measured frequencies were found to be within 5% of the theoretically predicted ones. Subsequently we studied the dynamics of a 3-D micro-droplet to show how adhesion to the substrate modulates the natural frequency of the droplet. Adhesion properties of droplets are decided by the degree of wettability that is generally measured by the contact angle between the substrate and the droplet. In this work, we were able to capture 10 modes of vibration of a mercury droplet on different substrates and measure the corresponding frequencies experimentally. We verified these frequencies with analytical calculations and found that all the measured frequencies were within 6% of the theoretically predicted values. We also showed that, considering any two pairs of natural frequencies, we can calculate the surface tension and the contact angle, thus providing a new method for measuring adhesion of a droplet on an unknown surface.

Lastly, we presented a study of vibrations of biological cells. Our first study was that of single muscle fibres taken from *Drosophila*. Muscle fibres with different pathological conditions were held in two structural configurations - as a fixed-fixed beam and a cantilever beam - and their vibration signatures analysed. We found that there was significant reduction in natural frequency of the diseased fibres. Among the diseased fibres, we could confidently classify the myopathies into nemaline and cardiac types based on the natural frequency of single fibres. We have noticed that the elastic modulus of the muscle which decides the natural frequency is dictated by the myosin expression levels. Our last example was a study of the vibration signatures of cancer cells, where we measured the natural frequencies of normal and certain cancerous cells, and showed that we can distinguish the two based on their natural frequencies. We found that the natural frequency of cancerous cells is approximately half of that of normal cells. Within the cancerous cells, we were able to distinguish epithelial cancer cells and mesenchymal cancer cells based on their natural frequency values. This mechanical assay based on vibration response corroborated results from the biochemical assays such as Western blots and PCR, thus opening a new technique of mechano-diagnostics.

3) How did the work you did at CeNSE prepare you for your current role?

My present research effort is indeed in the same field that I had worked in during my PhD. As a student at CeNSE, I learned how to handle micromechanical structures and cells, played with biological samples, developed an orthogonal diagnostic tool – mechano-diagnosis. The experience I gained during my PhD research is now helping me in establishing my lab and setting up the experimental tools for measuring the response of MEMS devices and cells.

4) How would you describe your experience as a student at CeNSE?

IISc is heaven on earth. I was associated with both my advisors since before the inception of CeNSE. I had witnessed the complete transformation of CeNSE from an idea to a state-of-the-art facility. Prof. Rudra Pratap is my inspiration; he will never bind his students within borders. He always let us think out of the box. During one of my interactions with him in the early days of my PhD, he said, “We should lead tomorrow’s technology. If Hodgkin and Huxley had not done the experiments on squid giant axon, we would have not had electrophysiology”. Later we showed with our expertise how we can come up with an orthogonal diagnosis technique. The dream came true after the Biological Sciences faculty joined hands with us. My next goal would be to develop a Lab-on-Chip device for the same.

5) Based on your experiences do you have any career advice for our students?

Advisors are the best role models for a student. We can follow in their footsteps.

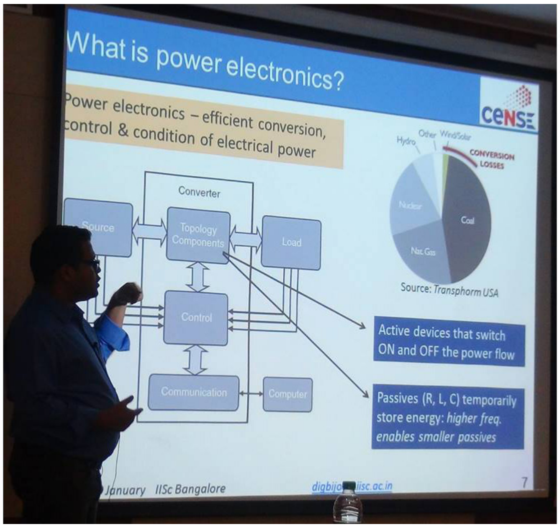
[*If you are interested in knowing more about his work or would like to discuss career options, you can write to Dr. Rao at*: **venkateshkp.rao@pilani.bits-pilani.ac.in**].

EVENTS

INTRODUCTORY TRAINING COURSE ON NANOFABRICATION TECHNOLOGIES

14 January – 01 February

An Introductory Training Course on Nanofabrication Technologies was organized by our Center under the International Scientific and Technological Education Program (I-STEP), supported by the ITEC division, Ministry of External Affairs, GoI. This course had 30 participants from 14 countries. The event was inaugurated by Prof. Navakanta Bhat, Chair, CeNSE, who presented an overview of the research and facilities at CeNSE and encouraged participants to utilize the opportunity provided by the Course.

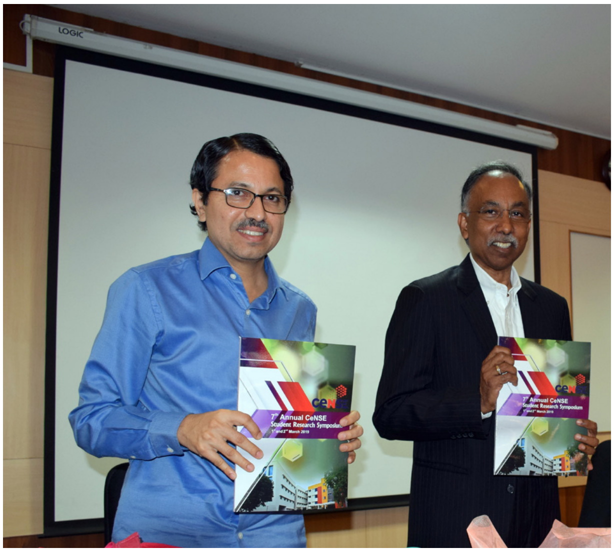


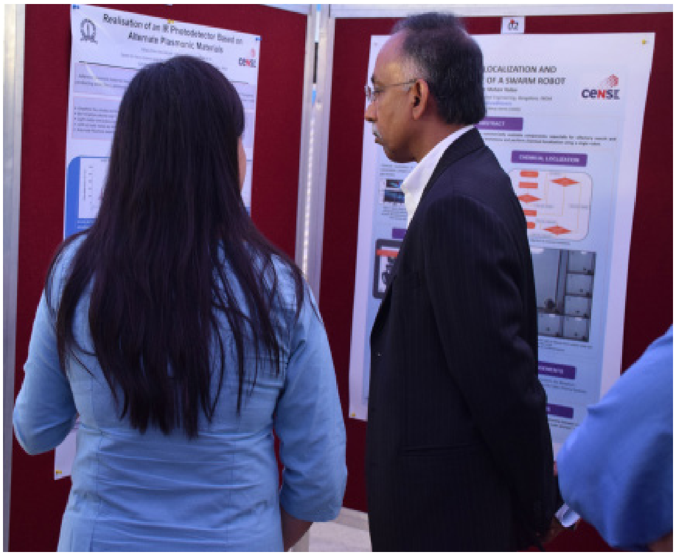
The course structure had various modules with thorough introductory lectures by CeNSE faculty members and technical staff on the preparation/fabrication and characterization of nanoscale materials, followed by practical training sessions. The staff of the NNfC and MNCF worked together to provide excellent hands-on training to the participants. The Course was organized by Dr. Sanjeev Kumar Shrivastava (Coordinator of ITEC programs at IISc) and Prof. S.A. Shivashankar, and able assistance was provided by Ms. L. Radhika, Ms. G. Sangeetha, Mr. N. Pandey and Mr. N.S. Manjunatha. During the feed back session at the end of the course, participants said that the valuable opportunity helped them realize the benefits of collaborating with researchers at CeNSE and how the excellent facilities at CeNSE could help them in their research.

ANNUAL STUDENT RESEARCH SYMPOSIUM

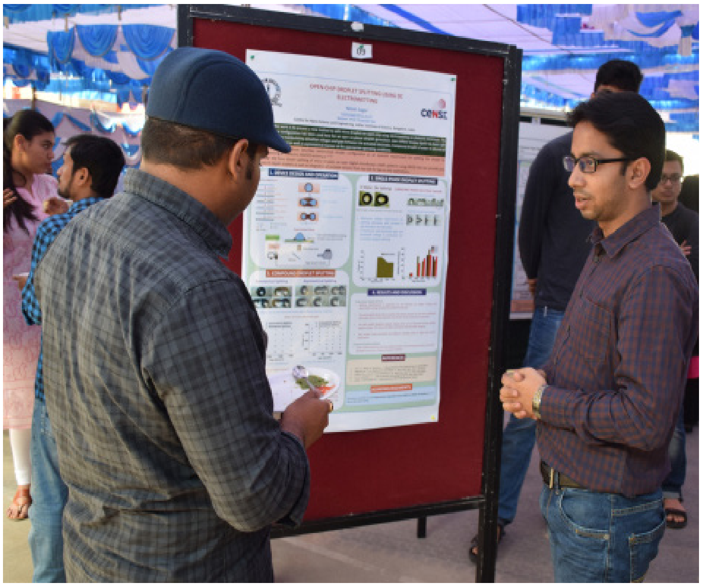
01 March - 02 March

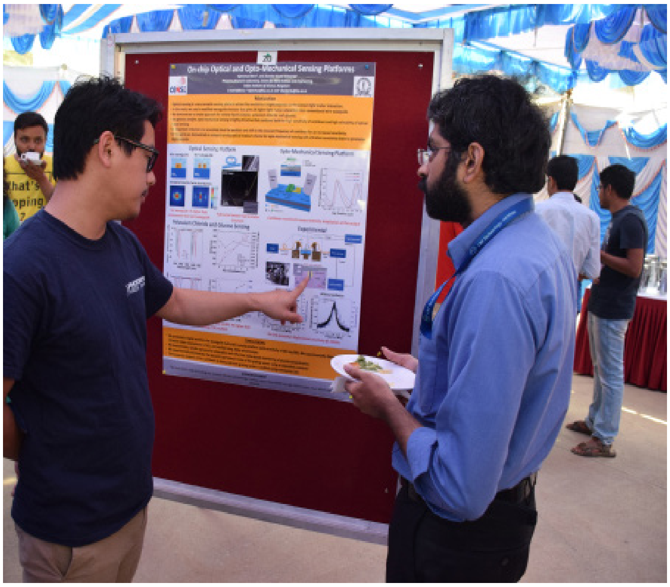
The CeNSE annual student research symposium is a forum that showcases outstanding student scholarship and research by students at our center. The VII annual symposium in March 2019 provided a venue for students to share their research with the academic community, peers and the greater community through poster displays as well as oral and multimedia presentations. Open to all graduate students, the Symposium aligns with CeNSE's spirit of promoting interdisciplinary research and collaboration, which in turn instills in our students the importance of exploring issues from multiple perspectives.



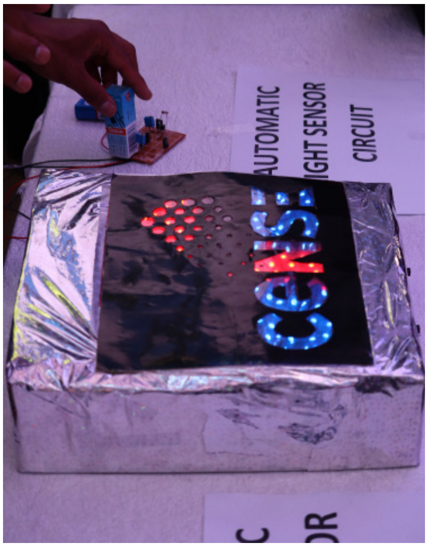


This year's symposium was inaugurated by Shri SD Shibulal, Co-founder and former CEO, Infosys and featured presentations by CeNSE's Industry Affiliates. At the end of day two, winners were awarded prizes in two categories: research excellence and best poster. While Pallavi Dasgupta, Priyanka Suri and Sandeep Vura won the 'Research Excellence' awards, Nayana Remesh, Sai Saraswathi Yarajena and Viphretuo Mere won the awards for 'Best Poster'.





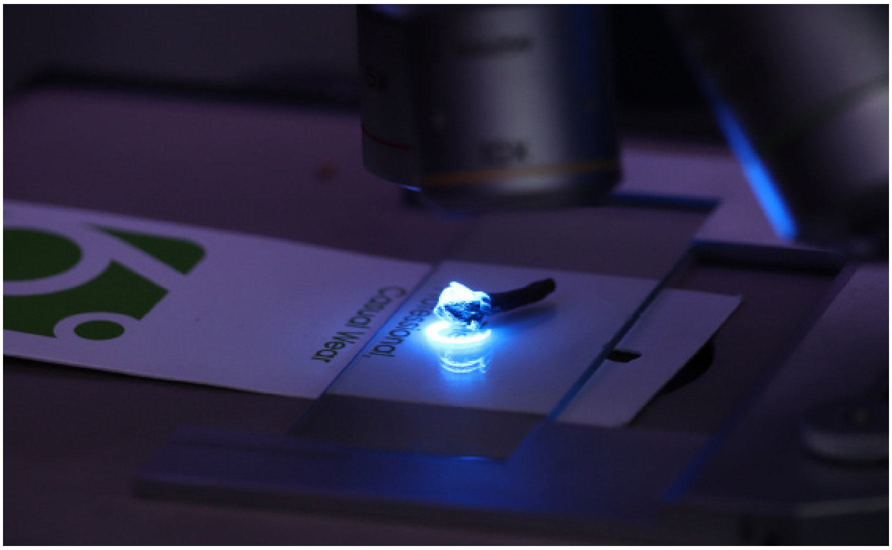
OPEN DAY
23 March

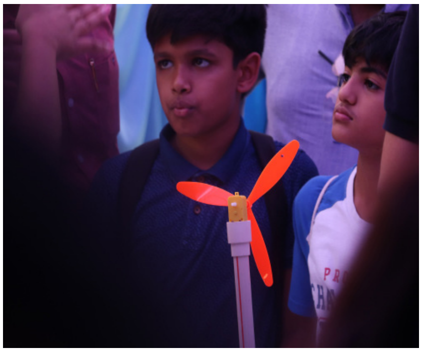


This annual event sees IISc open its doors to the general public. A wide variety of audience – from school kids to professors – visit, ask about and understand the research culture at the institute. CeNSE, like other departments, tailors various activities to address the curiosity of the visitors. This year, CeNSE organized the following activities for more than 8000 visitors!

• Open Labs: Project and tool demonstrations, posters describing the work done in various laboratories.

• Interactive Demos: A plethora of models related to the research in our department.





The Tradition of Open Day in IISc

Ms. Soumitri Ranganathan's piece based on the archives of the Institute sheds some light on the origins of the Open Day, which can be traced to a report of a review committee, which met on 22 September 1956. The report suggested that "the Institute should have an open week before the annual meeting of the court, during which the Institute may be visited both by members of the Court and the general public". The suggestion found support from J.R.D Tata, the erstwhile President of the Court of IISc. Based on the suggestion, the first Annual Week was organized in March 1957. The Open Days formed part of the Annual Week: besides the general public, industrialists were also specifically invited to visit the Institute on these days. The Open Day brochure brought out in 1972 suggests that the event contributed to improving liaison with Industries and helped promote Industry-Institute collaboration.

The Open days were spread over couple of days initially; this later became a day-long event. It has now become an annual feature in the Institute's calendar. The day-long science and technology carnival is held on a Saturday closest to 3rd March, the birth anniversary of J. N. Tata, the founder of the Institute.

VISITORS TO CeNSE

In the last quarter, we have had many distinguished guests visit our Centre and provide encouraging feedback.

Shri R. Girish, IAS, Director IT&BT, and Managing Director, KITS visited InCeNSE, the Technology Business Incubator at our center.

During their tour of our center in February, Profs. Luici Benedicenti, Chris Diduch, Ting-Ru Yang and Campbell – faculty members from University of New Brunswick, Canada congratulated CeNSE team on building a “world-class integrated facility”.

Dr. Thomas B. Bahder – Program Manager, Physics Division, US Army Research Office, Tokyo, Japan.

Shri S D Shibulal, Co-founder, former CEO and board member, Infosys.

Shri Kris Gopalakrishnan, Co-founder, former CEO and MD, Infosys visited CeNSE in March 2019 and said, “I am impressed with the vision infrastructure and work being done in the CeNSE. Truly one of a kind, world class facility. Wishing the center all the very best.” He also discussed potential business opportunities and intends to follow up on the same.

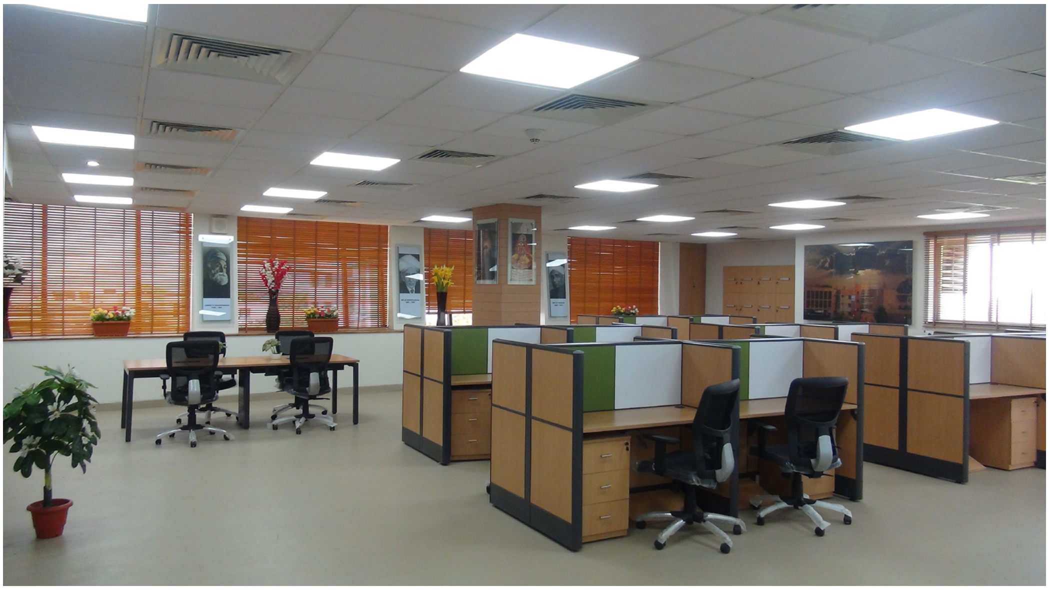
TECHNOLOGY BUSINESS INCUBATOR

A New Initiative at CeNSE

Marati Kalyana Kumar Rao

InCeNSE, the Technology Business Incubator (TBI) at CeNSE is funded by Government of Karnataka to support ideas from entrepreneurs and start-ups (not restricted to those involving IISc affiliates) in the area of nanotechnology. It aims to be a one-stop shop and platform for translating ideas to products, and offers incubatees incomparable support to grow their businesses for different applications, by providing them with access to state-of-the-art lab and fabrication facilities, supported by experienced technologists, as well as the domain knowledge of CeNSE faculty.

InCeNSE started its operations on January 1, 2019, and is currently supporting potential entrepreneurs and and start-ups. The formal inauguration of the TBI is scheduled to happen shortly.



InCeNSE's office space

InCeNSE provides services like technology support and mentorship, IP protection through patent filing support; connection to angel investors, VCs and grant agencies for early-stage investment support, company formation and operations support, business support, together with networking, technical training, and orientation sessions. In addition, infrastructure support with a meeting room, workspace, connectivity through telephone & broadband, and administrative support will also be provided.

InCeNSE provides access to lab facilities at CeNSE for prototype development, including fabrication, characterization, assembly and packaging, and system development. At present, InCeNSE provides help and support to entrepreneurs and start-ups in the broad area of nanotechnology. The scope covers a wide spectrum including, but not limited to, nano materials, devices, sensors and actuators, microfluidics, lab-on-chip devices, drug delivery systems, nano-biotechnology, bio-sensors and biomolecular interactions, neuro-electronics, photonics, lasers, nano IoT.

InCeNSE offers two programs:

Pre-Incubation Program:

- Entrepreneur-in-Residence program gives opportunities to validate product ideas from prototype to market-fit products with feasible business models.

- Infrastructure (workspace, meeting rooms, labs, broadband, telephone, IP support, mentors, etc.) is offered FREE for the first SIX MONTHS.

Incubation Program:

- Aims at the incubation of start-ups, with technology and business support provided to them.
- Infrastructure (workspace, meeting rooms, labs, broadband, telephone, IP support, mentors etc.) is offered FREE for the first TWELVE MONTHS.
- Access to CeNSE facilities provided at special rates, beyond the first year.

How to Get Incubated at InCeNSE?

To get incubated at InCeNSE, share your ideas and business plan with the TBI management, with basic Proof of Concept (PoC) or technology brief, technology and the team. To enable the selection process, please submit your application through www.incubation.cense.iisc.ac.in and then register for either the pre-Incubation or the Incubation program at the above website, or email your proposal to tbi.cense@iisc.ac.in. *We guarantee complete confidentiality in this process*.

Selection Process:

At InCeNSE, the selection process involves two simple stages:

- Initial screening by experts for feasibility check.
- Final selection during discussion and a meeting with InCeNSE.

Mentors:

Experts from different verticals will be mentoring the incubatees in technology implementation, and in taking the business from lab to market. The support and expertise of the mentors will be directed at helping incubatees develop strategies for success in the global market.

Training:

Regular training programs will be conducted with modules on the latest cutting-edge technology, and on business and entrepreneurship, through which experts will help the start-ups and entrepreneurs. Three to four such training programs are planned per year.

Regular updates on new training modules will be posted on the website: www.incubation.cense.iisc.ac.in.

InCeNSE Applications – Progress:

InCeNSE has received good response so far and plans to advertise its programs in leading newspapers. Further, the team plans to reach different platforms using social media and other networking.

At present five applicants are being reviewed for incubation, and preliminary discussions are in progress with twelve other applicants.

[To know more about InCeNSE, please contact Mr. M Kalyana Kumar Rao (maratirao@iisc.ac.in), Technology Manager, InCeNSE. He will be handling all the activities and operations for InCeNSE. He has the M.Tech. degree in Embedded Systems and a post-graduate Diploma in Management. He has worked for Philips, Ikanos, LSI/Avago/Broadcom, Intel, and Kotra (The Commercial Section of the Embassy of South Korea), accumulating 15+years' experience in IT and telecom industries].

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