



➤ INAE Vision 2020-2025

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INAE VISION

To be the premier Engineering Academy of the World providing timely inputs to the national and international policy makers, and to extend appropriate assistance in developing engineered solutions for the challenging problems facing contemporary societies and the humanity as a whole.

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INAE Mission

To serve professionals in building and institutionalizing engineering and technological excellence in education, research and industry in India and support advancement of engineering profession globally

Technology Roadmap

We are living in exciting times. We will have to contend with the profound transformation of our society and our industry, because of two revolutions in the making – namely, the digital revolution and the impending transition to fossil fuel free energy globally.

The digital revolution is rapidly transforming the very nature of industrial enterprise today. Many disruptive transformations are maturing rapidly because of the advent of cloud computing and internet of things (IoT) and due to major advances and breakthroughs being made on several fronts such as artificial intelligence (AI) including machine learning (ML) and big data analytics, robotics, autonomy, drones, 3D printing, advance sensors and 5G technologies.

Another revolution in the making is the exciting possibility of fossil fuel-free generation of electricity in the coming decade. The availability of electricity based on renewable sources such as sun, wind and biomass, will cause a major disruption as well as an opportunity for creating a cleaner world, since use of fossil fuels (coal, oil or natural gas) currently, creates deleterious environmental consequences which need urgent attention.

While both these revolutions will cause major disruptions in how we live and work, the transition to the new world in the making is contingent upon the availability of new sources of critical raw materials.

Both digital hardware and generation of electricity from renewables (including the technological challenges associated with energy storage) require a host of new metals and materials for which the new value chains (also the appropriate global supply chains) will have to be established. Innovative processes for extraction of minerals and metals as well as recycling, which are more energy efficient and environment-friendly will have to be developed to produce these critical elements.

To facilitate this global transition, we need to create human resources with high level of domain expertise in different facets of engineering as well as the much needed engineering skill sets needed to deal with the problems of scalability, uncertainty, reliability, complexity, system engineering, ability to deal with variability and yet manufacture products and create solutions of uniform and reproducible quality, capability to design, develop and optimize engineering systems for a given set of inputs and for a desirable set of assured outputs of consistent quality.

Our engineering education has to be appropriately re-engineered so as to equip our future leaders with not only the domain expertise but also the skillsets to innovate continuously and consistently in the face of constant change and dynamic transformations. The human ingenuity and the preparing the well-trained minds, will be critical ingredients in responding to the challenges ahead.

It in this context, INAE has come up with the following areas for our focused attention in the next five years. We believe that these efforts will assist us in facilitating the smooth transition to the new world in the making.

1. Accelerated Discovery, Development and Deployment of Novel Materials, particularly for strategic sectors like Defense, Atomic Energy and Space.

We have an urgent need of materials (metals, alloys as well as composites) development for the following sectors – auto sector (both electric vehicles as well as IC engines based vehicles), aerospace, ultra-supercritical power plants, nuclear power plants, renewable energy sector (novel PV materials, rare earth magnets, battery materials for both large scale energy storage as well as for electric vehicles and other electronic appliances, thermoelectric materials for converting low temperature heat into electricity), novel sensors for healthcare industry, materials for the defense applications and space applications, to name a few.

These materials will have to be engineered for India-specific applications. That means one must consider during the process of design & development itself, the kind of natural resources we have and the kind of supply chains we will be able to establish to source the starting raw materials, considering the complex geo-political scenario and vulnerabilities associated with dependence on raw materials from abroad.

The other important consideration is the speed of development. In order to remain globally competitive in this domain, we must leverage the state of the art digital platforms (equipped with advanced modeling, simulation, data analytics and knowledge engineering tools) for accelerating the development cycle from conception to deployment in actual applications as well as the entire life cycle (cradle to cradle or cradle to grave in some cases), that is, even for the structural health monitoring of the structures where these materials will be deployed.

Another important consideration is the environmental impact of these materials, that is, we must undertake a life cycle analysis, both with respect to the environmental footprint as well as the energy efficiency (actual consumption as compared to the thermodynamic energy needed to accomplish the particular task), for every developmental effort.

It is now well established that integrated computational materials engineering (ICME) approach can help accelerate the materials development cycle.

INAE will work towards coming up with a national strategy to establish and institutionalize the ICME based approach for all material development efforts. The digital platform, thus created, must be equipped with knowledge engineering capabilities so that it can not only act as a knowledge repository of all past efforts made thus far but also continues to update the knowledge going forward.

2. Strategies for Energy Transition to Fossil Fuels free Renewable Energy Sources

It is inevitable that India, like several other nations of the world, will move away from fossil fuels as a source of energy. While we have made some headway in developing renewable energy sources like solar and wind, the necessary infrastructure to support the energy transition does not exist at the present time.

INAE plans to create an interdisciplinary expert group to study the whole energy transition comprehensively and holistically, keeping in mind the challenges inherent in such a massive transformation.

INAE will focus on the following important sectors which will be disrupted in the immediate future and/or the areas of concern which we require a strategy for, urgently to facilitate the transition

- Large scale energy storage solutions - Solutions other than Lithium Ion Batteries which do not seem to be appropriate for a country like India for a variety of reasons including the fact that we do not have the basic raw materials - Liquid Metal Flow batteries (for example, Vanadium Flow Batteries) is another attractive option which must be explored.
- Electricity Grid Infrastructure - current grid will not be able to cater to intermittent and distributed electricity inputs; the concept of smart grids which is adequately robust to cater to both supply side challenges (renewable energy sources) as well as demand management (dynamic pricing to take care of its peak loads).
- Transportation (electric mobility, both for people as well as for goods).
- Mining, Mineral Processing and Extractive Metallurgy Industry (which currently depends totally on fossil fuels not only as a source of heat but also as a reductant to convert metal oxides to metals).
- Recycling of waste by-products including municipal waste, tailings and smelter slags including steel slag, red mud and spent pot lining, electronic waste and hospital waste.
- Supply chains for raw materials needed for the transition - sourcing strategies from other geographies, urban mining, deep sea mining and space mining.
- Finding alternative technology options for the manufacture of steel and cement to reduce the environmental foot-print - currently these two materials which will continue to remain the backbone of the Indian economy for the foreseeable future and the consumption is likely to increase by an order of magnitude in the coming decade.
- Waste-water treatment and recycling.
- Water purification technologies including desalination

3. Excellence in Engineering Education

Several groups including other academies globally, are working on the new curricula for engineering education so that our young emerging leaders are adequately equipped with necessary engineering skill sets to face the challenges in the coming decades.

Various deliberations within India as well as abroad have emphasised the need of providing hands-on design experience, problem solving skills and exposure to the systems engineering concepts, tools and technologies to the engineering students. The curricula also need to be updated with the advancements in digital technologies.

All engineers must be familiar with the sustainability paradigm and must be able to do life cycle analysis for every engineering product. They must be equipped with knowledge and the experience with various digital platforms and modelling tools such as computational materials engineering (all the way from atomistic scale to macroscopic scale), computational fluid dynamics, structural analysis tools, life cycle analysis modelling tools, engineering scale up, robust design methodologies to take care of uncertainty and complexity, machine learning and data analytics tools and algorithms, multi-objective and multi-variate optimization tools and technologies.

It is important that the professional ethics is part of the engineering course curricula. A multi-disciplinary systems perspective to all engineers will certainly broaden their horizons – much needed to face the emerging world scenario. Good communication skills and ability to work in teams, are also prerequisites for engineers to succeed in the real life.

All engineers must possess basic IT skillsets and it is a given since digital technologies are transforming every aspect of our lives.

A multidisciplinary INAE Expert Group will critically examine the current status of engineering education, identify gap areas and strive to fill those gaps with appropriate action plans

4. World Class Infrastructure

INAE will come up with an action plan in consultation with all stake- holders to upgrade our national infrastructure within next few years. This will include

- Requirements, technology options and the investments needed to create a few smart cities in the country - including mobility, healthcare facilities, e-governance, access to affordable housing, utilities (electricity and water), waste collection, processing and recycle, education, communication, maintenance of infrastructural facilities, disaster management infrastructure including extreme events (for example, excessive rain and floods) etc.
- Requirements, technology options and the investments needed to create a rural infrastructure so that they can enjoy access to certain basic amenities where they are located - digital connectivity for example can provide them with access to healthcare, online education, information dissemination, financial inclusion, logistics warehousing and agriculture and farm productivity with engineering focus etc.

5. Cyber-physical Systems

Globally innovations are taking place at the interface of digital technologies and domain expertise. For example, manufacturing is being transformed as a consequence of the following - robotics and automation, Internet of Things (IoT), cloud computing, 3D printing, AI, machine learning and data analytics (Digital Twins), structural health monitoring of built structures and engineered products, drones, autonomy, data analytics based predictive asset maintenance systems, blockchain technology to facilitate complete traceability of the products, digital platforms for integrated design, development, deployment and monitoring of materials and products and knowledge engineering platforms for capturing, retaining and context sensitive retrieval of knowledge to solve challenging problems.

Similarly leveraging the advanced digital technologies, the infrastructure available in a given locality or a city can be upgraded for easy accessibility – for example, healthcare facilities, e-governance, utilities (electricity and water)

It is now possible to make most of healthcare facilities available to the citizens at their place of residence (particularly important for senior citizens living alone) through the intervention of digital connectivity, sensors and IoT solutions. Provision of healthcare and affordable Medicare facilities through technological interventions is a key focus area.

INAE will select certain areas for focussed attention during the next five years and develop strategies to create infrastructure to facilitate digital transformation for achieving a set of desirable objectives for example, higher productivity, higher efficiency, better quality of life and better quality of products, reduced cost of services, higher safety of workers, etc.

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ACADEMY ACTIVITIES

Academy News (Covering period from May 1, 2024 to September 30, 2024)

Joint activities with ANRF (erstwhile SERB), DST

I. ANRF (erstwhile SERB), DST-INAE Digital Gaming Research Initiative

The ANRF (erstwhile SERB), DST-INAE Online and Digital Gaming Research Initiative was launched at the behest of DST as a unique program to leverage Digital Gaming Research and Industry in India and to achieve self-reliance in advanced Augmented Reality (AR)/ Virtual Reality (VR) technologies to create indigenous gaming platforms for a number of applications ranging from education to leisure with the backdrop of Indian Ethos, for desktop and hand-held devices. This initiative is in line with national priorities. The initiative launched to leverage Digital Gaming Research and promote such Industry in India is progressing well. The research work by the selected Principal Investigators and Project Teams are progressing satisfactorily. It was recently suggested by the Project Managing and Coordinating Committee (PMAC) to conduct a review meeting of the projects twice a year to monitor progress effectively. In this context, the review meeting is being held in-person in November 2024, wherein project PIs would be invited to present their work progress before the PMAC.

II. INAE -SERB Abdul Kalam Technology Innovation National Fellowship

The ANRF (erstwhile SERB), DST – INAE Abdul Kalam Technology Innovation National Fellowship launched in 2017 is a flagship initiative of INAE, funded by SERB (DST), to recognize, encourage and support translational research by individuals working in various capacities of engineering profession in public funded institutions in the country. Ten new Kalam Fellows were selected last year on 29-30th August 2023. Altogether, 57 professionals have been conferred this fellowship so far. At present, 43 fellows are on the roll. Several of the translational research projects pursued by these Kalam Fellows have reached the stage of technology transfer and creation of start-ups including filing up of over 91 patents and setting up of a few technology ventures. The work by incumbent Fellows is progressing well in terms of meeting the objectives contained in the selected project proposals. The Fellows selected in the year 2023-24 are presently working on the following research proposals viz “Minimally Invasive Real-Time BCI System for Motor Neurorehabilitation Using Machine Learning Co-Processor Chip”; “Neonatal Hearing Screening System Development and Validation”; “Transcutaneous Energy Transfer System for Implantable Medical Devices”; “AI powered Virtual Reality device for fast and accurate diagnosis of visual field defects and impairment in 3D Motion perception”; “Electric Vehicle (EV) agnostic, solar photovoltaic (PV) supportive, cyber secured, bidirectional, single gun charger”; “Development of composite structures for the application in hydrogen storage and distribution integrated with sensor”; “To develop a high-throughput platform for accelerating the discovery for materials”; “Chemically Engineered Thermostable Human Insulin for Diabetic Patients”; “Point-of-Care Blood Cell Counter” and “In silico tools for modelling hemodynamics constituents and the responses of vascular walls”.

INAE Events

I. National Technology Day Celebrations by INAE - Panel Discussion on “AI/ML: Imperatives, Opportunities and Threats” held on 11th May 2024 (Saturday) in virtual mode.

To commemorate the National Technology Day a Panel Discussion on “AI/ML: Imperatives, Opportunities and Threats” was held on 11th May 2024 (Saturday) in virtual mode. The following Panelists participated viz Dr Manish Gupta, Director, Google Research India, Bengaluru; Dr Anand Deshpande, Founder Chairman and Managing Director, Persistent Systems, Pune; Dr Rohini Srivathsa, Chief Technical Officer, Microsoft India and South Asia; Mr R. Chandrashekhara, Former Secretary, Department of IT and Dept of Telecom; Former President, NASSCOM, Chairperson, Centre for Digital Future; Dr Shubhashis Gangopadhyay, Vice Chairperson, Centre for The Digital Future (CDF) &

Founding Dean of Indian School of Public Policy, Economics, Law & Economics, Policy Praxis Lab and Prof Vineeth N Balasubramanian, Department of Computer Science and Engineering, IIT Hyderabad. Prof. Indranil Manna, President, INAE and Vice-Chancellor, BIT, Mesra delivered the Welcome Address. The event was moderated by Prof. UB Desai, Vice-President, INAE, Professor Emeritus and Former Director, IIT Hyderabad.

II. National Engineers Day 2024 Celebrations by INAE

Celebrations by INAE Headquarters - Online Distinguished Lectures focused on the theme “Engineering Innovations in Medicine: Pioneering Advances at the Intersection of Technology and Healthcare”.

National Engineers Day is celebrated all over the nation on 15th September every year to honour the birth anniversary of Bharat Ratna Dr M Visvesvaraya and to highlight the pivotal role of engineering and technology in national development. To commemorate this occasion, Indian National Academy of Engineering (INAE) celebrated National Engineers Day on 15th September 2024 (Sunday) morning in virtual mode. The online event comprising distinguished lectures focused on the theme “Engineering Innovations in Medicine: Pioneering Advances at the Intersection of Technology and Healthcare”. The celebration commenced with a Welcome Address by Prof Indranil Manna, President, INAE, who emphasized the importance of engineering innovations in transforming healthcare. Following this, Dr SK Sarin, Director, Institute of Liver and Biliary Sciences (ILBS), President, National Academy of Medical Sciences and the Chief Guest of the event delivered the Opening Remarks. His insightful talk, particularly on Personalized Medicine, addressed key topics such as "Polygenic Risk Assessment DT4H, HGP2" and "Organ Regeneration Banking," inspiring attendees with the potential of these advanced medical technologies.

Thereafter, Prof Suman Chakraborty, FNAE, Institute Chair Professor, Sir JC Bose National Fellow, Former Dean R&D and Head, School of Medical Science & Technology, IIT Kharagpur made a presentation on “Community Transformation via Democratized Diagnostic Technologies for the Underserved.” He showcased his innovative development of ultra-low-cost diagnostic technologies aimed at enhancing disease detection in resource-limited settings. His work includes nucleic acid-based rapid tests and smartphone-based screenings, which empower community health workers and marginalized women, fostering socio-economic transformation and promoting gender parity.

Prof Rohit Srivastava, FNAE, Himanshu Patel Chair Professor in Applied Biosciences and Former Head of Department of Biosciences and Bioengineering, IIT Bombay then spoke on “Affordable Healthcare Technologies for India”. He shared insights from his research on biosensors and point-of-care diagnostic technologies designed for rural and maternal healthcare. Prof Srivastava highlighted four commercialized devices: the SYNC Bluetooth integrated glucometer for diabetes management, UChek for routine urine analysis, TouchHb for non-invasive haemoglobin detection, and CareMother, a smartphone platform connecting doctors and pregnant women to monitor high-risk pregnancies in rural areas.

The session was concluded with closing remarks and expression of gratitude to all speakers and participants, reiterating the significance of engineering in advancing healthcare solutions. The event successfully brought together leading experts to discuss the transformative impact of engineering innovations in the healthcare sector. The insights shared during the session underscored the importance of collaboration between engineering and medical fields to address healthcare challenges in India, particularly for underserved populations. National Engineers Day 2024 was a celebration of creativity, innovation, and the commitment of engineers to enhance the quality of life through technology. The event was well attended online and appreciated by all participants and delegates.



Welcome Address by Prof Indranil Manna, President, INAE



Opening Remarks by Chief Guest -Dr SK Sarin



Prof Suman Chakraborty, FNAE giving his talk



Prof Rohit Srivastava, FNAE giving presentation

III. Engineers Conclave 2024

Engineers Conclave 2024 (EC-2024), an annual mega event organized by the Indian National Academy of Engineering (INAE) jointly with major engineering institutions of the country, was organized together with Defence Research and Development Organization (DRDO) on September 26-27, 2024 at the prestigious Defence Research and Development Laboratory in Hyderabad. Prof Indranil Manna, President, INAE and Vice-Chancellor, Birla Institute of Technology (BIT), Mesra, Ranchi and Dr. Samir V Kamat, Secretary DDR&D and Chairman DRDO, Ministry of Defence, Govt. of India were the Co-Chairs of Engineers Conclave 2024. Dr. Jaiteerth R Joshi, Program Director, DRDL, Hyderabad is the Convener of EC-2024. This year's Engineers Conclave was a grand celebration of engineering excellence, knowledge sharing, and collaboration showcasing the R&D success stories of DRDO and Industry for Defence Applications. With the two themes focusing on “Additive Manufacturing for Defence Applications” coordinated by Dr G Madhusudhan Reddy, Former Outstanding Scientist and Director, DMRL, Hyderabad and “Defence Manufacturing Technologies,” coordinated by Shri Jitendra J Jadhav, Director General, Aeronautical Development Agency, Bengaluru, which were chosen keeping in view the current national priorities and interests; the event brought together engineers, scientists, researchers, and industry leaders to explore and discuss cutting-edge technologies and advance the state-of art in terms of indigenization in chosen areas.

The Engineers Conclave 2024 was the eleventh such conclave and commenced with an Inaugural Session on September 26, 2024 at DRDL. The event witnessed a galaxy of eminent luminaries who graced the occasion with their wisdom and insights. The Inaugural Session begun with a warm Welcome Address by Shri U Raja Babu, Director General – Missiles and Strategic Systems (DGMSS) followed by a Presidential Address by Prof. Indranil Manna, President, INAE who presented a brief background of INAE and the Engineers Conclave. The Guest of Honour - Dr. Samir V Kamat, Secretary DDR&D and Chairman DRDO, Ministry of Defence, Govt. of India highlighted pertinent issues in his address followed by the release of the Conclave Souvenir. The Inaugural Session was graced by the Chief Guest

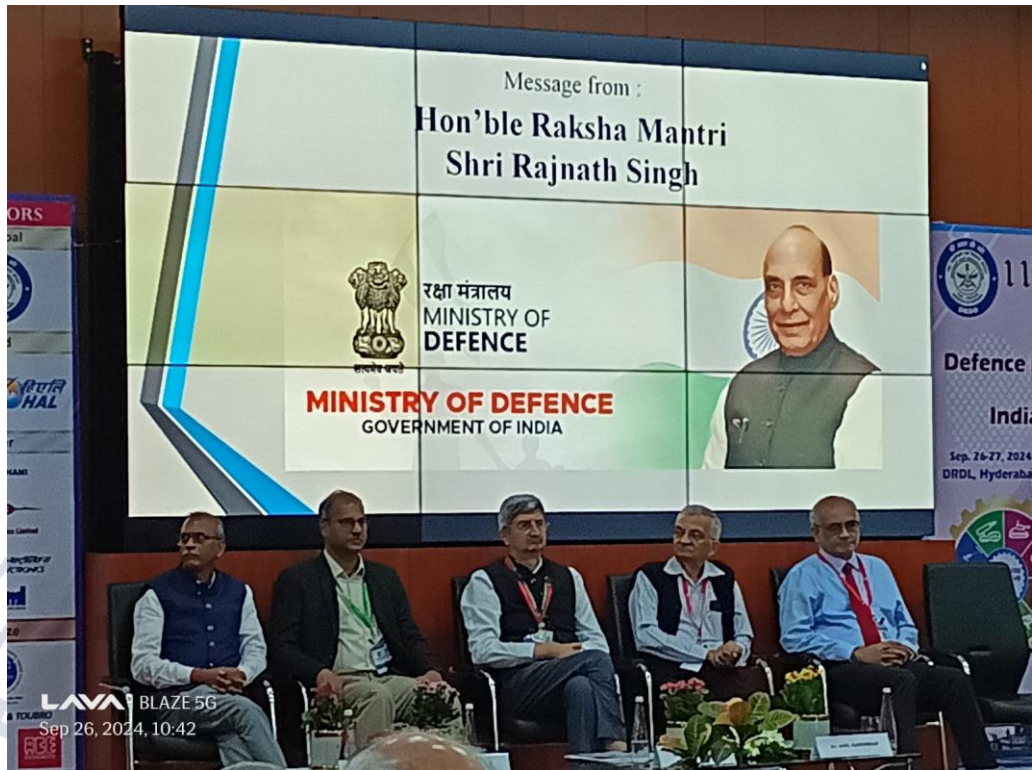
- Dr. Anil Kakodkar, Former President, INAE; Chancellor, Homi Bhabha National Institute; Member, AEC; Chairman, Rajiv Gandhi Science & Technology Commission, Govt. of Maharashtra; Former Chairman, AEC. The Hon'ble Raksha Mantri Shri Rajnath Singh Ji sent a Message conveying good wishes for the Conclave which was projected on the screen during the Inaugural Session.



Inaugural Session in Progress



Inaugural Session of Engineers Conclave 2024



Message by Hon 'ble Raksha Mantri Shri Rajnath Singh



Valedictory Session in progress

The event featured plenary speakers, technical sessions, and networking opportunities, providing a platform for visionaries and innovators to shape the future of engineering in chosen themes of interest. The event highlights included Parallel Technical Sessions on both the themes which provided an opportunity for the delegates to gain knowledge of the latest technological developments, gap areas and promises for future growth on both themes. The Chairman of the Valedictory Session: Dr. G. Satheesh Reddy, Former Scientific Advisor to Raksha Mantri & Former Secretary DD R&D and Chairman

DRDO highlighted the salient outcomes of the Conclave. The Co-Chair, Valedictory Session was Shri G. A. Srinivasa Murthy, DS and Director, Defence Research & Development Laboratory (DRDL) who touched upon the tangible deliverables emanated from the deliberations. The Summing up of Technical Sessions of two Themes by respective Coordinators highlighted all the vital issues discussed and deliberated with a view to bring out actionable recommendations to serve as inputs for policy formulation and to advance the concerned areas. As envisaged, the Engineers Conclave 2024 met the envisaged objectives of providing a common platform for the best engineering minds from R&D organizations, Academic Institutions and industry to share knowledge and innovative ideas with a view to arrive at actionable recommendations to be forwarded to the concerned stakeholders from the Government Departments/agencies and other organizations for the progress of the two themes and advancement of state-of-the-art indigenous technologies in allied areas, thereby paving the way for further technological advancement of the Nation.

Local Chapter Activities and Webinar Series held during May 2024 to September 2024

The following Webinars/activities/meetings/Technical Lectures were conducted during May to September 2024 by INAE and Local Chapters.

INAE Bhubaneswar Chapter

- (i) 35th Distinguished Lecture Lecture- 35 of INAE Distinguished Lecture Series jointly organised by INAE Bhubaneswar Chapter, SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Dipti Ranjan Sahoo, Associate Dean (Infrastructure), Professor of Structural Engineering, Department of Civil Engineering, Indian Institute of Technology Delhi on 9th May, 2024 on "Anti-seismic devices for earthquake resilient infrastructure" held online.
- (ii) 36th Lecture of the INAE Distinguished Lecture Series jointly organised by INAE Bhubaneswar Chapter, SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Partha P. Chakrabarti, Dept of Computer Science and Engineering, Indian Institute of Technology Kharagpur on the topic "Artificial Intelligence - Emerging Face of Scientific, Industrial and Social Revolution: Challenges and Opportunities for India" on 17th May 2024 in virtual mode.

Key Points: This talk provided a glimpse of modern Artificial Intelligence and Machine Learning (AI/ML) and showcased its power and scope in solving scientific, industrial and social problems in a new way. It also highlighted the dangers of using AI/ML in an inappropriate manner and the precautions to be taken. Finally, the talk presented the challenges and opportunities that it offers for a country like India and its aspirations.

You tube Video Recording Link : <https://youtu.be/MKkxe05Giqs>

People Participated: 65

- (iii) 37th Distinguished Lecture of INAE Distinguished Lecture Series was jointly organised by INAE Bhubaneswar Chapter, SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Venkatesh Kodur, University Distinguished Professor and Director, Michigan State University, USA on 18th July, 2024 on "World Trade Center Building Disaster: Stimulus for Fire Safety Innovation" in virtual mode.

Key Points: Fire represents one of the most severe environmental hazards to which buildings and built infrastructure is subjected to, and thus provision of appropriate fire safety measures is a major requirement in building design. Fires can threaten life safety and also can lead to significant economic and public losses. The magnitude of fire problem is getting worse in recent

years, especially in countries like India, due to increasing urbanization, higher fuel loads in buildings, innovative structural and architectural concepts, and the use of high performing construction materials with poor fire resistance properties. However, much of the fire safety design provisions in current building codes and standards are based on outdated prescriptive based methodologies that may not be fully applicable to current design scenarios.

The September 11th World Trade Center (WTC) disaster, in which fires played a major devastating role in the loss of life and the destruction of numerous buildings around Ground Zero, offers an ideal case study to highlight the drawbacks in the current fire safety provisions, and to explore innovative strategies for enhanced fire safety in buildings. This 9-11 terrorist incident was the worst building disaster in history resulting in the largest loss of life from building collapses in North America. Following the disaster, the Federal Emergency Management Agency (FEMA), the American Society of Civil Engineers (ASCE), the City of New York, and several other federal agencies and organizations established a high-profile "Experts Team" to investigate the collapse and damage to the buildings around Ground Zero. This 'Building Performance Assessment Team' (BPAT) investigation comprised of site visits to Ground Zero, forensic survey of the WTC site, land-fill, and steel recycling centres, review of videotape records and eyewitness accounts, interviews with building design teams, and analysis using computer models. Based on this information, the team produced a detailed report with a number of recommendations for achieving enhanced fire safety in buildings, and this investigation report was submitted to US Congress. The lessons learned from this investigation offer a unique opportunity to develop innovative strategies and technologies for minimizing the adverse impact of fire hazard in built infrastructure.

In the first part of the presentation, an overview of the results from the building performance investigation of the WTC disaster was presented. The overall damage to the buildings and infrastructure in "Ground Zero" area was reviewed and discussed. The devastating role of fires and the combined failure of all three levels of fire defense mechanisms that led to collapse of the Twin Towers and other buildings were explained. The conclusions and recommendations, documented in the FEMA and National Institute of Standards Technology (NIST) reports, were summarized. In the second part of the presentation, fire performance problems in modern buildings and infrastructure were discussed and the drawbacks in current fire safety design provisions were highlighted. The various innovations and technologies that are needed to address fire safety issues in modern buildings and infrastructure were highlighted. In addition, some of the recent changes being implemented in the US codes and standards for enhanced fire safety in buildings were outlined.

People Participated: 48

- (iv) 38th Lecture of the INAE Distinguished Lecture Series was jointly organised by INAE Bhubaneswar Chapter, SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by Prof. Radhakant Padhi, Professor, Indian Institute of Science, Bangalore on the "Autopilot Inspired Artificial Pancreas for Type-1 Diabetic Patients of India" on 19th July, 2024 in virtual mode.

Key Points: Type-1 diabetic patients have pancreatic failure and are incapable of secreting any insulin to the blood plasma. Hence, if untreated, they cannot live for long time. The current practice, which is largely followed in the world, is through daily multiple insulin injections. Unfortunately, however, besides being a painful practice, it normally leads to gross inaccuracies, thereby not being able to harvest the full potential of insulin. Fortunately, commercially available insulin pumps are now available which can be programmed to deliver the desired amount of insulin in a very slow rate. However, because they operate continuously for a long time, inaccuracies in manual programming also leads to inaccuracies leading to glucose excursions

beyond the desired limits. To address this issue, the current approach in the world is to develop a robust closed-loop feedback system, called artificial pancreas, wherein a small amount of insulin is continuously infused into the patient's body through the subcutaneous route by an insulin pump, depending on the situation of the patient as sensed by a subcutaneous CGM sensor.

This talk gave an overview of the Artificial Pancreas (AP) concept, followed by the specific activities being carried out by the speaker at the Indian Institute of Science, in collaboration with MS Ramaiah Medical College, in Bangalore, towards the development of an effective artificial pancreas system for Type-1 diabetic patients of India. A large part of this research has been inspired by the speaker's experience in designing AP (auto-pilot) systems for aerospace systems. From a modest beginning in 2017, substantial progress has been made in both back-end and front-end developments, leading to successful lab testing followed by clinical trials under controlled environment. The current status of this research as well as the future plan of action towards realizing this dream were outlined in this talk.

People Participated: 96

- (v) 39th Lecture of the INAE Distinguished Lecture Series was jointly organised by INAE Bhubaneswar Chapter, SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar, NISER Bhubaneswar and IEEE Bhubaneswar Sub-section and delivered by 39th Distinguished Lecture by INAE Bhubaneswar Chapter on "Human-Centric Manufacturing - a new era" by Prof. Surjya K. Pal, Professor, IIT Kharagpur on 30th September 2024 in virtual mode.

INAE Bangalore Chapter

- (i) **One-day Workshop on "EcoDrive: Accelerating Sustainable Electric Mobility" on May 11, 2024 as part of Technology Day Celebrations of INAE Bangalore Chapter**

One-day Workshop on "EcoDrive: Accelerating Sustainable Electric Mobility" was organized by INAE Bangalore Chapter and Dayananda Sagar University (DSU) on May 11, 2024 at Devarakaggalahalli, Karnataka. A student competition participated by teams from several colleges was also held. The following talks were held at the event:

- (i) Prof. S Sampath, Professor, Inorganic and Physical Chemistry, IISc, Bangalore delivered a talk on batteries.
- (ii) Dr L Venkatakrishnan, Chief Scientist, National Aerospace Laboratories, Bangalore delivered a talk on the topic: "Towards Perpetual Flight: A Solar Electric High-Altitude Aircraft".
- (iii) Dr Ganesh Murthy CNS, Principal Engineer Daimler Truck Innovation Centre, India, Bangalore delivered a talk on the topic: "Electric Vehicles: Systems, Architecture, Implementation, Testing and Data Analysis".
- (ii) **The third Professor Roddam Narasimha Memorial Lecture** was jointly organised by CSIR-NAL and INAE Bangalore Chapter on "Complex system approach to investigate and mitigate combustion instability in turbulent combustors" on 22nd July 2024 and delivered by Prof RI Sujith, IIT Madras.

INAE Delhi Chapter

- (i) Information Session on INAE Individual Membership organized by INAE Delhi Chapter on 19th September 2024 at IIT Delhi.
- (ii) Seminar organized by INAE Delhi Chapter on "Concepts for Frequency Sweep and Efficient Repeated Analysis in the context of Vibroacoustic Optimization and Uncertainty Quantification" by Professor Subodh V. Modak, Director of the International Institute of Acoustics and Vibrations, Technical University of Munich on 30th September 2024 in virtual mode.

INAE Kolkata Chapter

Celebration of National Engineers Day by INAE Kolkata Chapter

INAE Kolkata Chapter in association with the Academy of Technology (AoT), Adisaptagram, Hooghly, West Bengal, celebrated Engineers' Day 2024 on September 15, 2024 by organizing a thematic lecture and a talk on experiential learning at AoT. Prof. Sankar K Pal, the Founder Member of the INAE Kolkata Chapter, delivered this year's Engineers' Day Lecture. The talk, titled "Machine Intelligence and Data Science: Why and How?" was aimed at enlightening the budding engineers with an overarching perspective of the rapidly emerging role of AI in today's engineering landscape. This talk was followed by a lecture on "Spark Your Creativity: Blend Hardware with Innovative Programming" by Dr. Souvick Chatterjee of Mathworks. The event was attended by INAE Fellows, faculty and engineering students from Kolkata.

INAE Kanpur Chapter

(i) Materials Camp at IIT Kanpur (May 3-6, 2024)

The Materials Camp at IIT Kanpur was held from May 3-6, 2024, in collaboration with the ASM International Kanpur Chapter, INAE Kanpur Chapter, and IIM Kanpur Chapter. This camp brought together students for an immersive experience featuring hands-on workshops, interactive lectures, and collaborative projects. Attendees explored the latest advancements in materials research and their practical applications through real-world problem-solving activities. The collaboration with INAE emphasized the importance of bridging academic research with industry needs, promoting knowledge exchange, and preparing participants for future technological challenges. This event not only enhanced technical skills but also fostered networking and collaboration among the next generation of engineers and scientists. A total of 37 students and 8 faculty members participated in the workshop.



(ii) Virtual Lab Workshop at IIT Kanpur

The Virtual Lab Workshop at IIT Kanpur was held on May 5, 2024, in collaboration with the ASM International Kanpur Chapter, INAE Kanpur Chapter, and IIM Kanpur Chapter and Materials Science and Engineering, IIT Kanpur. This workshop aimed to demonstrate the cutting-edge applications of virtual reality in enhancing the educational experience for science and engineering students. Participants engaged in hands-on sessions where they navigated through VR simulations. A total of 37 students and 8 faculty members participated in the workshop. Expert speakers from IIT Kanpur shared insights on the latest VR technologies, best practices for integration into academic curricula, and the potential of VR to revolutionize traditional laboratory education. This collaborative event underscored the commitment to leveraging advanced technologies to improve learning outcomes and prepare students for future challenges in the technological landscape.



Virtual Lab Workshop at IIT Kanpur



INAE Forums

I. Meeting of INAE Forum on Engineering Interventions for Disaster Mitigation held on June 22, 2024 in virtual mode chaired by Prof DN Singh, IIT Bombay, Mumbai. During the said meeting the following points were deliberated viz. "Climate Resilient Infrastructure Landscape: Are We Ready with Engineering Solutions?", by Prof. SS Chakraborty; Alternate Perspective for Strategic Framework: A Shift Towards Societal Resilience - A Strategic Framework for Engineering Interventions in Disaster Mitigation, proposed by Prof. Nagesh R. Iyer; white paper on the man-made and unforced disasters in the built habitat, by Ms Alpa Sheth; Need for a Sharp Focus and SOPs for Specific Engineering Interventions for Disaster Mitigation, by Prof. N. Raghavan; Climate change and the enhancement in frequencies/intensities of natural disasters, by Prof. U. C. Mohanty; Increasing flood frequencies under climate change and Digital Twin for Floods in Bangalore city, by Prof. P. P. Mujumdar and Disaster management and economic development, by Dr. B.C. Roy. The progress on above reports/white papers were reviewed in the meeting.

II. Meetings of INAE Forum on Civil Infrastructure

The Forum had undertaken a study on “Sustainability of the Built Environment”, so as to prepare a report with recommendations on policies and actions required for sustainability in respect of civil infrastructure. The issues being addressed include sustainability at all stages, like functional design, detailed engineering, selection of materials, construction methodology, construction management; Recyclability and use of waste materials in the building and construction sector. During the meeting on July 12, 2024, the draft structure of contents of the report and the work in progress was reviewed. It was highlighted that three groups of materials were discussed, viz. (i) those materials which are already established by research and practice and codal provision etc exists, (ii) materials that are researched and found very promising, but codal provisions are yet not available, (iii) the future materials that are in plan for research and testing. Various aspects of recommendations were discussed such as policy incentives to promote sustainable materials, durability of structures, construction practices and skill development which are being actively pursued by the Members of the Forum. During the meeting on August 22, 2024 the draft Chapters prepared by the Members were discussed for comments and suggestions before finalization. The issue of demand and supply status of materials shall also be incorporated in the report suitably. During the online meeting on September 12, 2024 the draft Chapters prepared by the Members were reviewed.

Joint Initiatives with DST

I. India-Taiwan Programme of Cooperation in Science & Technology

International Cooperation Division (ICD), DST entrusted INAE to implement India-Taiwan joint program from 2023 onwards. This cooperation is being coordinated by National Science and Technology Council (NSTC) from Taiwan’s side. It is a joint program of cooperation between India and Taiwan and a joint call for proposal is launched every year. In this regard, a MoU was signed between INAE and ICD, DST on May 15, 2023 in presence of the Secretary, DST, and the President, INAE wherein it was discussed to launch a call for proposal (CFP) for the projects to be implemented from 2024 onwards and to implement the eleven approved projects for year 2023. For this year, a call for proposals was launched on June 1, 2024 with last date as July 31, 2024. The priority areas for R&D projects are Artificial Intelligence, IoT (Internet of Things), Big Data, Cyber Security; Biotechnology, Healthcare including Functional Genomics, Drug Development and Biomedical Devices; Agriculture and Food Sciences; Green Energy Technology/ Renewable Energy (solar energy and bioenergy)/ Clean Energy; Semiconductor & Communication; Aerospace Technology and Manufacturing Technologies. A total of 165 eligible proposals have been received. Expert evaluation of the above proposals is ongoing in September 2024 by domain experts from Project Evaluation Committee for selection of projects.

II. Vaishvik Bharatiya Vaigyanik (VAIBHAV) Fellowship

A Memorandum of Understanding (MOU) was signed between DST and INAE for implementation of Vaishvik Bharatiya Vaigyanik (VAIBHAV) Fellowship on July 15, 2024. The background is as follows. International Cooperation Division (ICD) of the Department of Science & Technology deals with International Scientific and Technological Affairs including the negotiations and implementation of Scientific, Technological and Innovation (STI) Cooperation Agreements and is responsible for the implementation of scientific and technological activities with various international counterpart organizations. The co-operations are sought under bilateral, multilateral or regional framework modes for facilitating and strengthening interactions among governments, academia, institutions and industries in areas of mutual interest. This initiative is pursuant to Government of India VAIBHAV Summit organized in October 2020 to connect Indian STEMM diaspora with Indian Institutions. In this connection, the Government has taken a step further to shape and implement the VAIBHAV programme and announced VAIBHAV Fellowship Call-2023 in June 2023 as a first step and the results were announced on 23 Jan 2024. On the same day, the 2nd cycle of 1st year Call of VAIBHAV Fellowships

was announced which get closed on 31 March 2024. DST has assigned INAE to administer and implement VAIBHAV Fellowship. The Roles and Responsibilities of INAE on behalf of the Department of Science & Technology will be to extend financial support to VAIBHAV fellows, depending on rules and regulations as laid out by DST.

Joint Consultative Committees

A Meeting of the **DRDO-INAE Consultative Committee** was held on September 26, 2024 at DRDL, Hyderabad in physical mode wherein the Agenda points included Membership of INAE; Nomination of DRDO Scientists for INAE Fellowship and Young Engineers for Young Associates and DRDO- INAE joint programs

International Affairs

I. CAETS 2024 Annual Meeting

CAETS Annual Meeting was held in Helsinki, Finland from July 1-3, 2024 in which INAE Delegation led by Prof Indranil Manna President, INAE participated. Prof Indranil Manna made presentations to the CAETS Board of Directors and CAETS Council to inform them about the progress and recommendations made by the CAETS Engineering Education Working Group (EEWG) Co-Chaired by President, INAE and the efforts were much appreciated. The EEWG meeting was also held on July 1, 2024 in hybrid mode. Some of the recommendations and suggestions are as follows: Engineering education (EE) must have inbuilt components of flexibility and inter-disciplinarity to converge on a system engineering approach; Need for adult education through refresher courses; Emphasis on design and problem-solving ability in the curriculum; Accreditation should not make teaching very rigid and strait-jacketed and EEWG should collaborate with the Working Group on AI. The CAETS Communication Committee meeting was also held on July 1, 2024 in hybrid mode which has representation from INAE Fellowship. The theme of CAETS 2024 conference was Carbon Neutral Technologies and Society, that is, carbon neutral society, its prerequisites, and technical solutions and the presentations made by the international experts were informative and rich in technical content. The meeting was a success in meeting the objectives and the contributions of INAE in CAETS Working Groups and important meetings were well appreciated.

II. 7th INAE-NAEK Workshop on "Current Status and Cooperation Plan of the Satellites for Observing the Earth" held on August 19-20, 2024

The 7th INAE-NAEK Workshop on "Current Status and Cooperation Plan of the Satellites for Observing the Earth," held online from August 19-20, 2024, successfully gathered leading experts from India and South Korea to discuss the latest advancements in satellite technology and explore avenues for international collaboration. The workshop opened with welcome addresses by Prof. Indranil Manna, President INAE, and Dr. Kinam Kim, President of NAEK, setting the tone for two days of engaging discussions on the importance of satellite technology in addressing global challenges. Prof Indranil Manna highlighted the wide-ranging scope of applications of remote sensing satellites. He recalled that the two academies have been collaborating steadily for several years and proposed developing further collaborations among the two countries such as joint student supervision or exchange programs. Dr Kinam Kim highlighted the technological feasibility of cooperation among the countries in the Aerospace sector and expressed his confidence that fruitful collaborations would materialize between the two countries.



The keynote speeches provided deep insights into the benefits of observing Earth from space and the status of satellite development worldwide, with a particular focus on climate monitoring. The Keynote speech by Dr Shailesh Nayak, Director, National Institute of Advanced Studies (NIAS), Bengaluru & Chancellor, TERI School of Advanced Studies, Delhi highlighted the importance of standardisation of sensor specifications, use of satellite image analytics and the necessity of developing models combining satellite information and physical models for coastal zone management, hazard assessment and climate study and the Indian efforts in this regard. The keynote speaker from Korea, Dr. Joojin Lee, Chair, Advisory Committee on Science and Technology Diplomacy, Previous President of Korea Aerospace Research Institute (KARI) gave an overview of the global trends in satellite development as well as the status of Earth observation and climate monitoring and summarised the efforts of KASA and KARI in developing satellites for climate monitoring mission and upcoming missions such as Luna Lander and Mars Lander.

The technical sessions that followed were chaired by esteemed professionals from both countries and covered a wide range of topics, including the development of core technologies for satellite image utilization, AI technology applications, and policy frameworks for accessing and utilizing satellite data in the private sector. Dr BN Suresh, FNAE, Former President, INAE & Chancellor, Indian Institute of Space Science & Technology (IIST) and Honorary Distinguished Professor, ISRO Headquarters, Bengaluru and Prof. Jai-ick Yoh, Department of Aerospace Engineering, Seoul National University acted as the session chairs on the first day while Prof. RI Sujith, FNAE, Department of Aerospace Engineering, Indian Institute of Technology Madras and Dr. Changjin Lee, Research Fellow, Korea Association for Space Technology Promotion were the session chairs on the second day of the workshop.



The first day of the technical sessions commenced with Dr. Taegyun Jeon, CEO & Founder, SI Analytics who briefed about the space partnership between India and Korea exploring the joint satellite applications. The potential and realized benefits of a strategic partnership in space exploration and satellite technology were dwelt upon and key areas such as historical and current collaborations, technological synergies, joint satellite applications, and the economic and social impacts were discussed. The second speaker, Dr Nilesh Desai, Distinguished Scientist and Director, Space Applications Centre, ISRO, Ahmedabad discussed India's Spaceborne payloads and associated technologies for product generation. The future trends in various space technologies, which are fed into the design and realisation of space-borne advanced remote sensing payloads and instrumentations for various Electro-optical and Microwave remote sensing satellite missions were touched upon. The various indigenous space and ground segment technologies and their applications for satellite product generation for earth observation and societal benefits were also elucidated.

The third speaker, Dr. Young-Je Park, CRO, TelePIX demonstrated the importance of leveraging high-resolution optical imagery to address coastal water issues. His presentation explored the importance of satellites in addressing critical coastal ocean issues in Korea such as harmful algal blooms (HABs), floating algae, and floating marine debris. The uncertainties in the satellite products, lack of timely satellite data or insufficient spatial and temporal resolutions were discussed and an integrated approach utilizing both high-resolution satellite imagery and high-frequency images from geostationary ocean colour sensor was proposed to effectively monitor and manage these coastal ocean issues.



Mr Suyash Singh, CEO & Co-founder, GalaxEye Space, Bengaluru spoke about bringing consistency in satellite imaging world through Drishti satellite (Multi-Sensor Satellite). His talk included the inconsistencies observed in satellite imagery and the adoption of Multi-sensor satellites in overcoming them for widespread commercial adoption. He stated that Generative AI is the way forward towards consistent, highly available and easily interpretable imagery.



The technical sessions on the second day commenced with Dr. Il-Seok Oh, Vice President, Korean Academy of Space Security who summarised the law and policy that are being utilized for satellite data and images in Korea. He highlighted the increased utilization of satellites by Korean government ministries and agencies and the promotion of legislation and policies to meet specialized and diverse demands for satellite information and to prevent inefficiencies in satellite operations operated by diverse governmental and public stakeholders. He dwelt upon the concepts of openness and security of satellite information and emphasised that sustainable growth emerged due to the paradigm shift from the concept of “growth of people” to “growth with people” to solve the global problems.

The second speaker, Mr Ganesh Mohan, Assistant Director, Indian National Space Promotion and Authorisation Centre (IN-SPACe), Department of Space, Government of India, Ahmedabad addressed the audience on behalf of Shri Vinod Kumar, Director, IN-SPACe. He briefed about the role of IN-SPACe under Department of Space (DOS), to promote, enable, authorize and supervise Non-Government Entities (NGEs) and academia to undertake space related activities. He also stated that IN-SPACe acts as a bridge, connecting user needs with private companies and ISRO's technical expertise. This talk delved into how IN-SPACe, is translating Government of India's vision into reality. The third speaker, Dr Tae-Byeong Chae, Executive Director, National Satellite Operation & Application Center, Korea Aerospace Research Institute (KARI), shared information on satellite data distribution policy & utilization in Korea. He mentioned the initiatives undertaken by Korean Government to organize a national satellite information utilization council to provide satellite data for public purposes. The fourth speaker, Mr Prateep Basu, Chief Executive Officer, Satsure, Bengaluru, gave a talk on the Earth Observation: The Commercialisation Paradigm from Imagery to Intelligence. He briefed regarding the software and analytical applications built using Earth Observation data that bridges advanced space technology with practical, real-world needs, supporting industries such as agriculture, disaster management, environmental monitoring, and defense. The shift from imagery to insights, transforming the Earth observation industry, making satellite data more valuable and integral to solving real-world challenges was also highlighted.

The fifth speaker, Dr Hyo Jin Yang, Senior Researcher, National Land Satellite Center of Ministry of Land, Infrastructure and Transport spoke about the first satellite mission for public application and service in South Korea, CAS500-1/2. In her presentation, she shared the status of satellite operation, research and development for the utilization of products, and also about the achievements on data utilization and distribution since October, 2021. The last speaker for the session, Dr Saptarshi Mondal, Manager, Vassar Labs, Hyderabad spoke in the session on behalf of Mr Nikhilesh Kumar, Co-founder & CEO, Vassar Labs, Hyderabad. He touched upon cloud-based processing and analytical platform for agriculture, water, urban, and forest Monitoring using EO data. The adoption of cloud based automated satellite data processing and analytical platforms was proposed to be a possible solution for the challenges in operational monitoring using satellite data. He demonstrated the fieldWISE, aquaWISE and cityWISE platform developed for the monitoring agriculture, water and urban landscape changes. He stated that the WISE platform significantly enhances the efficiency and effectiveness of monitoring and management processes across various domains.

Throughout the workshop, experts presented on various aspects of satellite technology, such as the commercialization of earth observation data, the role of public satellite missions, and the development of cloud-based platforms for processing environmental data. The sessions underscored the critical role that satellite technology plays in fields like climate monitoring, agriculture, and urban planning. The event concluded with a series of productive Q&A sessions and closing remarks from the session chairs, reinforcing the importance of continued cooperation between India and South Korea. The workshop not only facilitated the exchange of innovative ideas but also laid the groundwork for future collaboration, highlighting the shared commitment of both countries to advancing satellite technology for the benefit of humanity.

III. CAETS Engineering Education Working Group

The CAETS Engineering Education Working Group (EEWG) has been created to help CAETS in contributing to continuous improvement and modernization of engineering education and practice internationally and promoting ethics in engineering education, research and practice. Prof Indranil Manna, President, INAE, has been entrusted with the responsibility to Chair the Working Group along with Vice-Chair Dr Katherine Frase of USA-NAE at the behest of CAETS. Representatives from twenty-two-member countries are the members of this Working Group. Several meetings of the CAETS EEWG, comprising of representatives from 22 Member Academies, have been organized so far. The Seventh CAETS Engineering Education Working Group Meeting co-Chaired by Prof Indranil Manna, President, INAE and Dr Katherine Frase, US, NAE was held on August 20, 2024 over WebEx to discuss country-specific details pertaining to Intellectual Property Rights (IPR) related issues (e.g., protection, sharing, cost, rate of translation, efficacy, etc.) and Accreditation of teaching course-curriculum and processes - the need for global cooperation and uniform standards. The representatives from the Member Academies of CAETS presented an abstract on each country specific inputs. The information and status of each of the member countries enabled the Members to appreciate the status, lacunae, good practices, and advantages better to be included in the report under preparation by the Working Group.

IV. CAETS Communication Committee

The CAETS Communication Committee was constituted with an objective of the Committee is to develop and maintain a CAETS Style Guide that sets content and style guidelines and defines templates for all CAETS Communications (statements, reports, videos, website, etc.). The committee also supports review of draft documents. Prof Amit Agrawal, IIT Bombay, FNAE is INAE representative at the CAETS Communication Committee and participated in the meeting held on June 11, 2024 in virtual mode. The Agenda of the meeting was to review the submissions for the Communications Prize by the judges and for the Members to provide Academy style guides for reports prepared by CAETS. The contributions by INAE Representatives in CAETS Committee meetings are always well appreciated.

Election of Fellows, Foreign Fellows and Young Associates

Nominations for Fellowship, Foreign Fellowship and Young Associates were invited in January 2024 with last date of April 15, 2024. A total of 369 valid nominations for Fellowship (134 New and 235 carried forward from 2022 and 2023) and 25 valid nominations for Foreign Fellowship (10 New and 15 carried forward) were considered by the Sectional Committees during their meetings from May 15, 2024 to May 31, 2024 to shortlist nominees for “Peer Review” and identify suitable domain experts to carry out the review. Based on the recommendations of the Sectional Committees during their meetings held in the months of July/Aug 2024 over WebEx, the Conveners of all Sectional Committees made presentations to the Council on the nominations recommended for Election of Fellows. The details of nominees elected as Fellows/Foreign Fellows have been uploaded on INAE website and can be viewed at the link <https://www.inae.in/nomination-information/>

INAE Young Associate

The INAE Governing Council, during its 146th Meeting on March 27, 2023 instituted an “INAE Young Associate” recognition in lieu of the erstwhile INAE Young Engineer Award with no prize money and similar guidelines due to directives from DST to suspend awards. Accordingly, nominations were invited from INAE Fellows; Directors of IITs, NITs and VC of Central Universities; and Heads of R&D organizations and Industry. Out of a total of 110 nominations considered, 46 were shortlisted by the Sectional Committees during their meetings held between 15th to 31st May 2024 for making presentation before the Selection Committee for Young Associate. Twenty nine candidates for INAE Young Associate 2024 were recommended by Selection Committee for Young Associate during meetings held on 8th and 9th August 2024 as per details given at the link <https://www.inae.in/young-criteria/>

INAE Publications

Transactions of Indian National Academy of Engineering – An International Journal of Engineering and Technology”

INAE is currently publishing a Journal named “Transactions of Indian National Academy of Engineering – International Journal of Engineering and Technology” published by M/s Springer which was earlier named INAE Letters. **Transactions of INAE Volume 9, Issue 2, June 2024 and Issue 3, September 2024** were published through Springer Publishers during the period May to September 2024.

Donations to INAE Corpus Fund

Prof Indranil Manna, President, INAE has written several letters addressed to the Fellowship wherein he recalled that the Department of Science and Technology (DST), as directed by the Department of Expenditure, Government of India (GoI) is in the process of disengaging itself from the activities of INAE including providing the annual financial support w.e.f. 01st April 2025. To address the issue of sustainability of INAE, several meetings were held with high level Government officials, former Presidents and senior Fellows of INAE, and industry leaders in the two years since the formal letter from DST (dated 6.5.22) was served to INAE about disengagement. While efforts had been made to impress upon the Government that INAE is essential to realize the country’s agenda on engineering and technology, it had become amply clear that INAE must undertake a serious effort to generate an adequate Corpus Fund and attain financial self-sufficiency.

INAE has worked out a strategy to generate a Corpus Fund of Rs 100 crores to ensure its sustainability with financial and functional autonomy seeking contributions from (i) Corporate Donations/Membership; (ii) Institutional Membership (Academic and R&D institutions); (iii) Individual Donations/Membership; (iv) Corporate Social Responsibility (CSR); (v) Government/ Projects; and (vi) Publications. Many of our esteemed Fellows have already contributed to this cause, voluntarily and with alacrity. INAE gratefully acknowledges their contributions to bolster our collective efforts and resolution. The details for forwarding of donations and tax benefits to donors are given below:

Bank Details for receipt of donation to INAE:

Name of beneficiary: **INAE Corpus Fund**

Account Number: **41790835603**

Bank Address: **Jawaharlal Nehru University, New Mehrauli Road, New Delhi**

Type of Account: **Savings**

IFSC: **SBIN0001624**

Tax benefits for donors

The contribution to the **INAE Corpus Fund** qualifies to be considered under the category of donation and is eligible for 50% tax deduction under section 80G. The donors will get a receipt and the 80G certificate within a fortnight.

INAE is extremely grateful to all Fellows who have generously contributed to the INAE Corpus Fund and welcomes further contributions/donations from Fellows, Young Associates, Awardees; Industry Leaders and Industry Houses etc with a view to achieving self-sufficiency in functioning in the near future. A donor wall containing names of Fellows who have generously donated is posted on INAE website at the link <https://www.inae.in/donor-wall/>

Categories of Memberships Introduced in INAE

INAE Membership was introduced to embrace a wider reach and participation of engineering community, which shall be accorded to working professionals in engineering in the industry, R&D or academic institutions, engineering services, entrepreneurship firms, and government/private agencies. After a duly approved process, Individual Membership will be awarded to aspiring mid-career to senior engineering professionals, to give them a fillip for their future professional journeys who still have milestones to achieve in their career path, before they attain the gold standards to be elected as Fellows of INAE. Individual Membership entails a yearly fee and is as per timelines. The Fellowship retains the premier Gold Standard and the Membership category is independent and by no means affects the prestige of the Fellowship category. An appeal has been made to all Fellows to support these initiatives and help facilitate a greater number of Memberships in all three categories – Institutional, Corporate and Individual Memberships. INAE Fellows have been requested to help facilitate forwarding of nominations for Memberships in all three categories – Institutional, Corporate and Individual Memberships.

Important Meetings held during May to September 2024

May 2024

- i. Meeting of Program Management and Advisory Committee (PMAC) on SERB-INAE Online and Digital Gaming Research Initiative held on May 2, 2024 over WebEx.
- ii. 5th Meeting of the CAETS Engineering Education Working Group (EEWG) held on May 9, 2024 over WebEx
- iii. Meetings of Conveners of 10 Sectional Committees with President and Vice-President, (Fellowship, Awards and Corporate Communication) on May 14, 2024 over WebEx.
- iv. First Meetings of 10 INAE Sectional Committees from May 15, 2024 to May 31, 2024 to shortlist nominees for Peer Review for Fellowship and Foreign Fellowship 2024 and INAE Young Associates 2024.
- v. Meeting of Action Group of Forum on Civil Infrastructure held on May 15, 2024 over WebEx.
- vi. Meeting to plan conduct of Engineers Conclave 2024 on May 21, 2024 over WebEx.
- vii. ISRO-INAE Consultative Committee Meeting at ISRO Headquarters, Bengaluru on May 22, 2024 in hybrid mode.
- viii. Annual Meeting of Kharagpur Local Chapter on May 24, 2024 at IIT Kharagpur in hybrid mode.

June 2024

- i. 48th Apex Committee Meeting on June 6, 2024 over WebEx
- ii. Meeting to plan conduct of Engineers Conclave 2024 on June 10, 2024 over WebEx
- iii. Progress on Financial autonomy of INAE- Meeting of INAE Chapters with President INAE on June 18, 2024 over WebEx
- iv. 41st Finance Committee Meeting on June 19, 2024 in hybrid mode
- v. Meeting of the Advisory Committee for update on generation of INAE Corpus Fund and Way Forward held on June 20, 2024 over WebEx
- vi. Meeting to Plan the conduct of Engineers Conclave -2024 held on June 25, 2024 over WebEx
- vii. 151st INAE Governing Council Meeting on June 28, 2024 in hybrid mode
- viii. 36th Annual General Meeting of Fellows held on June 28, 2024 over WebEx

July 2024

- i. Online Meeting of Conveners of Sectional Committees with President, INAE on July 12, 2024
- ii. Preliminary Meeting to discuss Nomination for Fellowship 2024 on July 17, 2024 over WebEx
- iii. Online Meeting to discuss Individual Membership on July 22, 2024
- iv. Meetings of 10 Sectional Committees from July 18-31, 2024 to discuss and recommend nominations for Fellowship and Foreign Fellowship 2024 for consideration of the Governing Council for final selection of Fellows during its next meeting on August 23, 2024.

August 2024

- i. Second Online Meeting of Sectional Committee X (Interdisciplinary and Special Engineering Fields and leadership in Academia, R&D and Industry) on August 5, 2024.
- ii. Fifth online meeting to plan conduct of Engineers Conclave 2024 on August 6, 2024.
- iii. Online Meetings of Selection Committee for INAE Young Associate 2024 held on August 8-9, 2024
- iv. Second online Meeting of Individual Membership Committee on August 13, 2024.
- v. Selection Committee Meeting for nominees to be elected for fellowship under Rule 37 (g) on August 14, 2024 over WebEx
- vi. Selection Committee Meeting for nominees to be elected as Foreign Fellows on August 14, 2024 over WebEx
- vii. Online Meeting of INAE Publication Committee on August 21, 2024
- viii. 152nd Meeting of INAE Governing Council held on August 23, 2024 at New Delhi in hybrid mode.
- ix. Special General Meeting of Fellows held on August 23, 2024 at New Delhi in virtual/hybrid mode.
- x. Online meeting to plan conduct of Engineers Conclave 2024 held on August 27, 2024.

September 2024

- i. Online meeting to plan conduct of Engineers Conclave 2024 held on September 9, 2024.
- ii. Information Session on Individual Membership of INAE held on September 19, 2024 at Department of Civil Engineering, Indian Institute of Technology (IIT) Delhi in hybrid mode

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INTERNATIONAL/NATIONAL CONFERENCES/SEMINARS BEING ORGANIZED BY IITS/OTHER INSTITUTIONS

3rd International Conference & Exposition on Mechanical, Material and Manufacturing Technology - online and in-person on 24th to 26th October 2024 at Hyderabad, Telangana
<https://conferencealerts.com/show-event?id=263887>

12th International Conference on the Internet of Everything, Microwave, Embedded, Communication, and Networks - online and in-person on 24th to 26th October 2024 at Jaipur, Rajasthan
<https://conferencealerts.com/show-event?id=264084>

3rd International Conference on Automation, Signal Processing, Instrumentation and Control iCASIC 2024 - in person on 7th to 8th November 2024 at Vellore, Tamil Nadu
<https://conferencealerts.com/show-event?id=263470>

2nd International Conference on Devices, Intelligent System & Communications - online and in-person on 8th to 9th November 2024 at Hyderabad, Telangana
<https://conferencealerts.com/show-event?id=265595>

3rd International Conference on PCEMS 2024 – in person on 11th to 12th November 2024 at Nagpur, Maharashtra
<https://conferencealerts.com/show-event?id=260314>

6th International Conference on Artificial Intelligence and Speech Technology (AIST2024) - online and in-person on 13th to 14th November 2024 at Delhi
<https://conferencealerts.com/show-event?id=261317>

International Conference on Smart Systems for Integrated Computing and Communication - online and in-person on 15th to 16th November 2024 at Coimbatore
<https://conferencealerts.com/show-event?id=264249>

International Conference on Interdisciplinary Research in Science, Engineering and Technology (ICIRSET - 24) - online and in-person on 22nd to 23rd November 2024 at Mumbai
<https://conferencealerts.com/show-event?id=264693>

EEE Electron Devices Kolkata Conference (EDKCON 2024) - online and in-person on 23rd to 24th November 2024 at Kolkata, West Bengal
<https://conferencealerts.com/show-event?id=263583>

International Conference on Innovations in Communication and Informatics (ICICI 2024) - online and in-person on 28th to 30th November 2024 at Hyderabad, Telangana
<https://conferencealerts.com/show-event?id=263969>

4th International Conference on Cognitive & Intelligent Computing (ICCIC-2024) on - online and in-person on 29th to 30th November 2024 at Hyderabad, Telangana
<https://conferencealerts.com/show-event?id=263944>

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Honours and Awards
(covering the period May 2024 to September 2024)

| | |
|---|---|
| 1 | Dr N Subramanian, FNAE, Consulting Engineer, Former Proprietor and Chief Executive, Computer Design Consultants, Chennai has been honoured with the ASCE 2024 Edmund Friedman Professional Recognition award for “exemplary conduct and services in the field of Civil Engineering, delivering vital and enduring projects, and for commitment to engineering education and helping young engineers from diverse backgrounds, and outstanding community leadership and philanthropy”. |
| 2 | Prof. Rohit Srivastava, FNAE, Hemant Patel Chair Professor in Applied Biosciences and Former Head of Department of Biosciences and Bioengineering, IIT Bombay has been awarded the prestigious 'Rashtriya Vigyan Puraskar - Vigyan Shri' by the Government of India on August 22, 2024. The award was presented by the Hon'ble President of India, Smt. Droupadi Murmu, in recognition of his exceptional contributions to science and technology, particularly in the field of Technology and Innovation. |
| 3 | Prof. Bhim Singh, FNAE, IIT Delhi has been honoured with Rashtriya Vigyan Puraskar 2024 - Vigyan Shri presented by the Hon'ble President of India, Smt. Droupadi Murmu on August 22, 2024 for his work in advancing power electronics for renewable energy sources and e-mobility |
| 4 | Dr. Avesh Kumar Tyagi, FNAE, Director, Chemistry Group, Bhabha Atomic Research Centre (BARC), Mumbai has been honoured with Rashtriya Vigyan Puraskar 2024 - Vigyan Shri presented by the Hon'ble President of India, Smt. Droupadi Murmu on August 22, 2024 for his contribution in the field of atomic energy. |
| 5 | Prof Mahesh C Tandon, FNAE, Chairman, Tandon Consultants Pvt., New Delhi has been conferred Lifetime Achievement Award by “Civil Engineering & Construction Review”. |
| 6 | Dr Sanak Mishra, former President, INAE and Member of the Governing Board of the Steel Research & Technology Mission of India; Formerly Managing Director, Rourkela Steel Plant and Director, Steel Authority of India Ltd. (SAIL); Vice-President, ArcelorMittal and CEO India Projects; Secretary General, Indian Steel Association; President, Indian Institute of Metals chaired one of the 14 Task Forces, i.e. on the use of Biochar as a reductant in the primary stage of ironmaking. Last year, the Ministry of Steel had constituted 14 Task Forces to address the urgency of decarbonisation of the Indian steel industry. Based on the reports submitted by the 14 Task Forces, the Ministry of Steel prepared a consolidated and comprehensive position paper titled “Greening the Steel Sector in India; Road Map and Action Plan”. The document was released by the Hon’ble Minister of Steel, Shri HD Kumaraswamy in an event organized by the Steel Ministry on September 10, 2024 at the India International Centre, New Delhi. On this occasion the Dr Sanak Mishra, FNAE and other Chairmen of the Task Forces, were felicitated by the Hon’ble Minister. |

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NEWS OF FELLOWS
(covering the period May 2024 to September 2024)

| | |
|----|--|
| 1, | Prof. Dr. S.N.Mukhopadhyay, FNAE, Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERG, IIT Delhi with wife Mrs Sakuntala jointly has contributed a hand written article in Bangla medium on "Amader Anander o Goa Bhramaner Katokatha" in ABHIDHA 2024 Magazine of BUS , I.I.T. Delhi in Barsobaran Issue, 2024, p4-11 which has been highlighted in May Newsletter of C.R. Park. He is also Life Member of C.R. Park KMS and along with his wife Mrs Sakuntala has written their biography book "Anande Jeebansrote" in Bangla medium printed by SR Print Studio, New Delhi associated with KMS New Delhi in September 2024. |
| 2. | Prof Sandeep Verma, FNAE Professor of Chemistry, IIT Kanpur and his team have developed an indigenous solution for diabetes viz synthetic insulin that offer high thermal stability. |
| 3. | Mr Jitendra J Jadhav, FNAE has been appointed as the new Director General of Aeronautical Development Agency (ADA). |
| 4. | Dr Rajeev Shorey, FNAE, former CEO of the University of Queensland - IIT Delhi Academy of Research (UQIDAR) at IIT Delhi took charge as the Director of the Indian Institute of Information Technology (IIIT), Surat, Gujarat on the 12th June 2024. |

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INAE ON FACEBOOK AND TWITTER

INAE has created a Facebook and Twitter Account to post the news of recent INAE activities in the Social Media. The same can be viewed at the link below.

(a) Facebook -link <https://www.facebook.com/inaehq1>

(b) Twitter handle link <https://twitter.com/inaehq1>

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Obituaries

Dr. CR Prasad

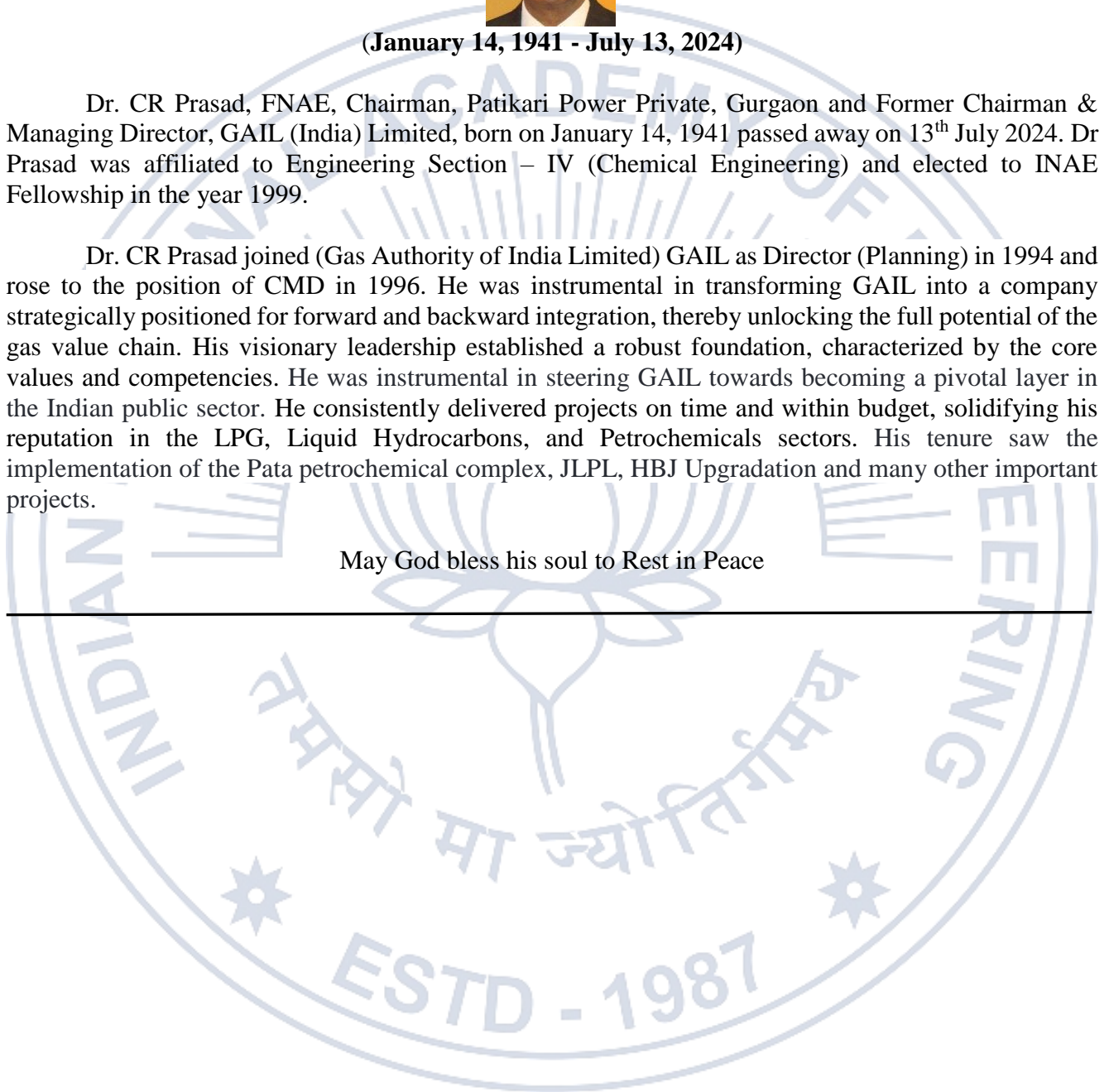


(January 14, 1941 - July 13, 2024)

Dr. CR Prasad, FNAE, Chairman, Patikari Power Private, Gurgaon and Former Chairman & Managing Director, GAIL (India) Limited, born on January 14, 1941 passed away on 13th July 2024. Dr Prasad was affiliated to Engineering Section – IV (Chemical Engineering) and elected to INAE Fellowship in the year 1999.

Dr. CR Prasad joined (Gas Authority of India Limited) GAIL as Director (Planning) in 1994 and rose to the position of CMD in 1996. He was instrumental in transforming GAIL into a company strategically positioned for forward and backward integration, thereby unlocking the full potential of the gas value chain. His visionary leadership established a robust foundation, characterized by the core values and competencies. He was instrumental in steering GAIL towards becoming a pivotal layer in the Indian public sector. He consistently delivered projects on time and within budget, solidifying his reputation in the LPG, Liquid Hydrocarbons, and Petrochemicals sectors. His tenure saw the implementation of the Pata petrochemical complex, JLPL, HBJ Upgradation and many other important projects.

May God bless his soul to Rest in Peace



Dr. MS Valiathan

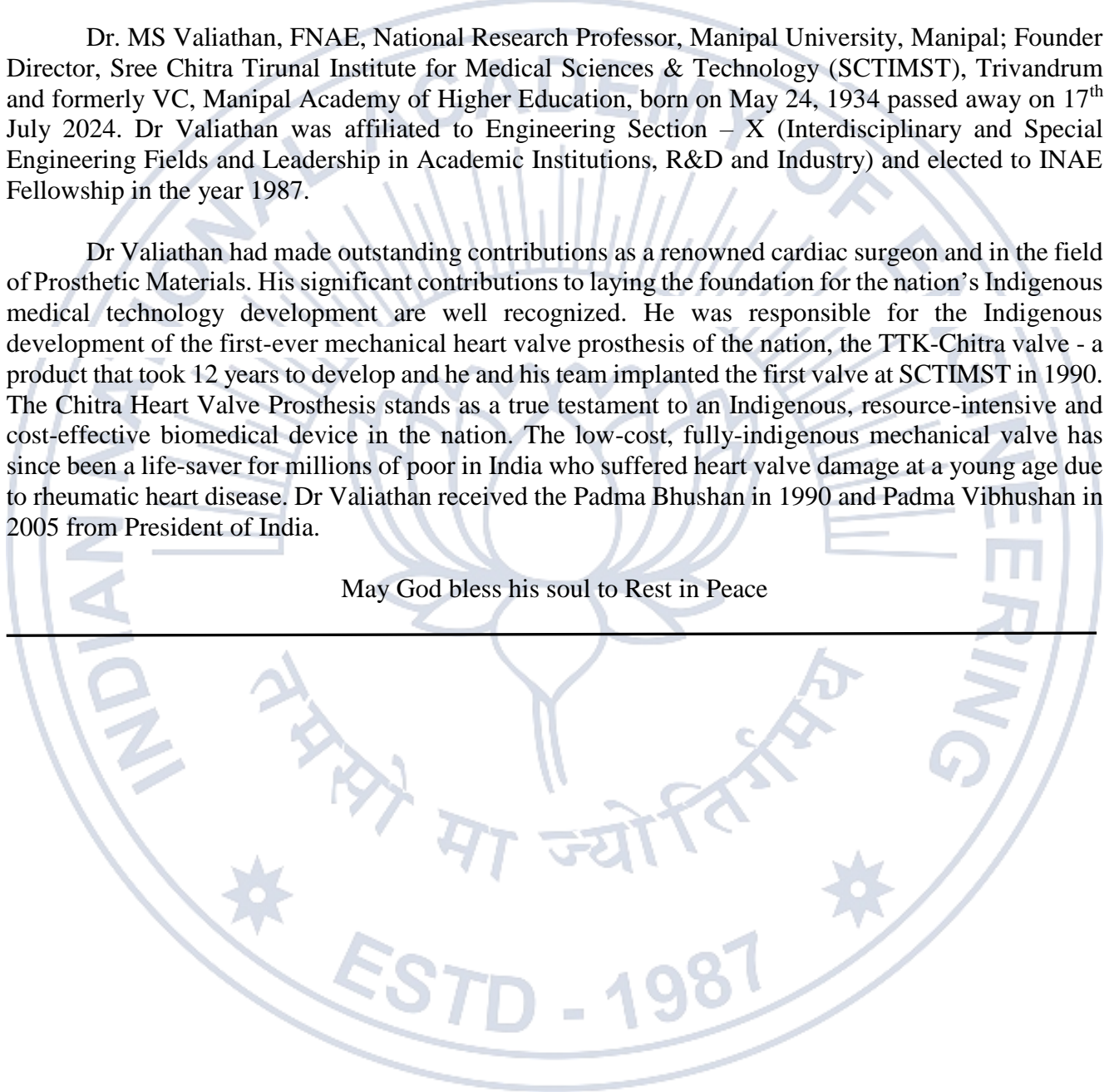


(May 24, 1934 - 17th July 2024)

Dr. MS Valiathan, FNAE, National Research Professor, Manipal University, Manipal; Founder Director, Sree Chitra Tirunal Institute for Medical Sciences & Technology (SCTIMST), Trivandrum and formerly VC, Manipal Academy of Higher Education, born on May 24, 1934 passed away on 17th July 2024. Dr Valiathan was affiliated to Engineering Section – X (Interdisciplinary and Special Engineering Fields and Leadership in Academic Institutions, R&D and Industry) and elected to INAE Fellowship in the year 1987.

Dr Valiathan had made outstanding contributions as a renowned cardiac surgeon and in the field of Prosthetic Materials. His significant contributions to laying the foundation for the nation's Indigenous medical technology development are well recognized. He was responsible for the Indigenous development of the first-ever mechanical heart valve prosthesis of the nation, the TTK-Chitra valve - a product that took 12 years to develop and he and his team implanted the first valve at SCTIMST in 1990. The Chitra Heart Valve Prosthesis stands as a true testament to an Indigenous, resource-intensive and cost-effective biomedical device in the nation. The low-cost, fully-indigenous mechanical valve has since been a life-saver for millions of poor in India who suffered heart valve damage at a young age due to rheumatic heart disease. Dr Valiathan received the Padma Bhushan in 1990 and Padma Vibhushan in 2005 from President of India.

May God bless his soul to Rest in Peace



Dr. Ram Narain Agarwal



(July 24, 1941– August 15, 2024)

Dr RN Agarwal, FNAE, Formerly Director, Advanced Systems Laboratory and Programme Director (AGNI), Defence Research & Development Laboratory (DRDO), Hyderabad born on July 24, 1941 passed away on August 15, 2024. Dr Agarwal was affiliated to Engineering Section – VII (Aerospace Engineering) and elected to INAE Fellowship in the year 2000.

Dr Agarwal had made outstanding contributions to the fields of Aero-Missiles, Re-entry and made significant contributions to the Agni missile program, launched in 1983, and served as its first program director. He was instrumental in India's Agni missile development programme right from its inception in 1983 till 2005. He inspired the team to successfully test the Technology demonstrator missile in May 1989. Thereafter, various versions of the missile were developed and inducted into the defence forces. Today, Agni V, the nuclear-capable, intermediate-range ballistic missile has the capability to strike targets beyond 5000 kms. Dr Agarwal retired as the founder and director of the Advanced Systems Laboratory (ASL), Hyderabad in 2005. Dr Agarwal played a key role in establishing the re-entry technology, all composite heat shield, onboard propulsion system, guidance and control etc for missiles during a distinguished tenure of 22 years. He was conferred the Padma Shri in 1990 and Padma Bhushan in 2000 by the President of India.

May God bless his soul to Rest in Peace

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. New imaging technique brings us closer to simplified, low-cost agricultural quality assessment

Hyperspectral imaging is a useful technique for analyzing the chemical composition of food and agricultural products. However, it is a costly and complicated procedure, which limits its practical application. A team of University of Illinois Urbana-Champaign researchers has developed a method to reconstruct hyperspectral images from standard (Red, Green, Blue) RGB images using deep machine learning. This technique can greatly simplify the analytical process and potentially revolutionize product assessment in the agricultural industry. The researchers tested their method by analyzing the chemical composition of sweet potatoes. They focused on soluble solid content in one study and dry matter in a second study -- important features that influence the taste, nutritional value, marketability, and processing suitability of sweet potatoes. Using deep learning models, they converted the information from RGB images into hyperspectral images. "With RGB images, you can only detect visible attributes like color, shape, size, and external defects; you can't detect any chemical parameters. In RGB images you have wavelengths from 400 to 700 nanometers, and three channels -- red, green, and blue. But with hyperspectral images you have many channels and wavelengths from 700 to 1000 nm. With deep learning methods, we can map and reconstruct that range so we now can detect the chemical attributes from RGB images," said Mohammed Kamruzzaman, assistant professor in ABE and corresponding author on both papers. Hyperspectral imaging captures a detailed spectral signature at spatial locations across hundreds of narrow bands, combining to form hypercubes. Applying cutting-edge deep learning-based algorithms, Kamruzzaman and Ahmed were able to create a model to reconstruct the hypercubes from RGB images to provide the relevant information for product analysis. They calibrated the spectral model with reconstructed hyperspectral images of sweet potatoes, achieving over 70% accuracy in predicting soluble solid content and 88% accuracy in dry matter content, marking a significant improvement over previous studies. In a third paper, the research team applied deep learning methods to reconstruct hyperspectral images for predicting chick embryo mortality, which has applications for the egg and hatchery industry. They explored different techniques and made recommendations for the most accurate approach. "Our results show great promise for revolutionizing agricultural product quality assessment. By reconstructing detailed chemical information from simple RGB images, we're opening new possibilities for affordable, accessible analysis. While challenges remain in scaling this technology for industrial use, the potential to transform quality control across the agricultural sector makes this a truly exciting endeavor," Kamruzzaman concluded.

Source <https://www.sciencedaily.com/releases/2024/09/240930160206.htm>

ESTD - 1987

Computer Engineering and Information Technology

2. New security protocol shields data from attackers during cloud-based computation

Deep-learning models are being used in many fields, from health care diagnostics to financial forecasting. However, these models are so computationally intensive that they require the use of powerful cloud-based servers. This reliance on cloud computing poses significant security risks, particularly in areas like health care, where hospitals may be hesitant to use AI tools to analyze confidential patient data due to privacy concerns. To tackle this pressing issue, MIT researchers have developed a security protocol that leverages the quantum properties of light to guarantee that data sent to and from a cloud server remain secure during deep-learning computations. By encoding data into the laser light used in fiber optic communications systems, the protocol exploits the fundamental principles of quantum mechanics, making it impossible for attackers to copy or intercept the information without detection. Moreover, the technique guarantees security without compromising the accuracy of the deep-learning models. In tests, the researcher demonstrated that their protocol could maintain 96 percent accuracy while ensuring robust security measures. The cloud-based computation scenario the researchers focused on involves two parties -- a client that has confidential data, like medical images, and a central server that controls a deep learning model. The client wants to use the deep-learning model to make a prediction, such as whether a patient has cancer based on medical images, without revealing information about the patient. In this scenario, sensitive data must be sent to generate a prediction. However, during the process the patient data must remain secure. Also, the server does not want to reveal any parts of the proprietary model that a company like OpenAI spent years and millions of dollars building. In digital computation, a bad actor could easily copy the data sent from the server or the client. Quantum information, on the other hand, cannot be perfectly copied. The researchers leverage this property, known as the no-cloning principle, in their security protocol. For the researchers' protocol, the server encodes the weights of a deep neural network into an optical field using laser light. A neural network is a deep-learning model that consists of layers of interconnected nodes, or neurons, that perform computation on data. The weights are the components of the model that do the mathematical operations on each input, one layer at a time. The output of one layer is fed into the next layer until the final layer generates a prediction. The server transmits the network's weights to the client, which implements operations to get a result based on their private data. The data remain shielded from the server. At the same time, the security protocol allows the client to measure only one result, and it prevents the client from copying the weights because of the quantum nature of light. Once the client feeds the first result into the next layer, the protocol is designed to cancel out the first layer so the client can't learn anything else about the model. Instead of measuring all the incoming light from the server, the client only measures the light that is necessary to run the deep neural network and feed the result into the next layer. Then the client sends the residual light back to the server for security checks. Due to the no-cloning theorem, the client unavoidably applies tiny errors to the model while measuring its result. When the server receives the residual light from the client, the server can measure these errors to determine if any information was leaked. Importantly, this residual light is proven to not reveal the client data. Modern telecommunications equipment typically relies on optical fibers to transfer information because of the need to support massive bandwidth over long distances. Because this equipment already incorporates optical lasers, the researchers can encode data into light for their security protocol without any special hardware. When they tested their approach, the researchers found that it could guarantee security for server and client while enabling the deep neural network to achieve 96 percent accuracy. The tiny bit of information about the model that leaks when the client performs operations amounts to less than 10 percent of what an adversary would need to recover any hidden information. Working in the other direction, a malicious server could only obtain about 1 percent of the information it would need to steal the client's data.

Source <https://www.sciencedaily.com/releases/2024/10/241001142659.htm>

Mechanical Engineering

3. Helping robots zero in on the objects that matter

Imagine having to straighten up a messy kitchen, starting with a counter littered with sauce packets. If your goal is to wipe the counter clean, you might sweep up the packets as a group. If, however, you wanted to first pick out the mustard packets before throwing the rest away, you would sort more discriminately, by sauce type. MIT engineers have developed a method that enables robots to make similarly intuitive, task-relevant decisions. The team's new approach, named Clio, enables a robot to identify the parts of a scene that matter, given the tasks at hand. With Clio, a robot takes in a list of tasks described in natural language and, based on those tasks, it then determines the level of granularity required to interpret its surroundings and "remember" only the parts of a scene that are relevant. In real experiments ranging from a cluttered cubicle to a five-story building on MIT's campus, the team used Clio to automatically segment a scene at different levels of granularity, based on a set of tasks specified in natural-language prompts such as "move rack of magazines" and "get first aid kit." The team also ran Clio in real-time on a quadruped robot. As the robot explored an office building, Clio identified and mapped only those parts of the scene that related to the robot's tasks (such as retrieving a dog toy while ignoring piles of office supplies), allowing the robot to grasp the objects of interest. Clio is named after the Greek muse of history, for its ability to identify and remember only the elements that matter for a given task. The researchers envision that Clio would be useful in many situations and environments in which a robot would have to quickly survey and make sense of its surroundings in the context of its given task. Huge advances in the fields of computer vision and natural language processing have enabled robots to identify objects in their surroundings. But until recently, robots were only able to do so in "closed-set" scenarios, where they are programmed to work in a carefully curated and controlled environment, with a finite number of objects that the robot has been pretrained to recognize. In recent years, researchers have taken a more "open" approach to enable robots to recognize objects in more realistic settings. In the field of open-set recognition, researchers have leveraged deep-learning tools to build neural networks that can process billions of images from the internet, along with each image's associated text. From millions of image-text pairs, a neural network learns from, then identifies, those segments in a scene that are characteristic of certain terms, such as a dog. A robot can then apply that neural network to spot a dog in a totally new scene. From millions of image-text pairs, a neural network learns from, then identifies, those segments in a scene that are characteristic of certain terms, such as a dog. A robot can then apply that neural network to spot a dog in a totally new scene. But a challenge still remains as to how to parse a scene in a useful way that is relevant for a particular task. With Clio, the MIT team aimed to enable robots to interpret their surroundings with a level of granularity that can be automatically tuned to the tasks at hand. For instance, given a task of moving a stack of books to a shelf, the robot should be able to determine that the entire stack of books is the task-relevant object. Likewise, if the task were to move only the green book from the rest of the stack, the robot should distinguish the green book as a single target object and disregard the rest of the scene -- including the other books in the stack. The team's approach combines state-of-the-art computer vision and large language models comprising neural networks that make connections among millions of open-source images and semantic text. They also incorporate mapping tools that automatically split an image into many small segments, which can be fed into the neural network to determine if certain segments are semantically similar. The researchers then leverage an idea from classic information theory called the "information bottleneck," which they use to compress a number of image segments in a way that picks out and stores segments that are semantically most relevant to a given task. Going forward, the team plans to adapt Clio to be able to handle higher-level tasks and build upon recent advances in photorealistic visual scene representations.

Chemical Engineering

4. Fluoride-free batteries: Safeguarding the environment and enhancing performance

A research team led by Professor Soojin Park and Seoha Nam from the Department of Chemistry at POSTECH, in partnership with Hansol Chemical's Battery materials R&D center, has developed a new fluorine-free binder and electrolyte designed to advance eco-friendly, high-performance battery technology. As environmental concerns intensify, the importance of sustainable materials in battery technology is growing. Traditional lithium batteries rely on fluorinated compounds such as polyvinylidene fluoride (PVDF) binders and lithium hexafluorophosphate (LiPF₆, LP) salts. However, this "PVDF-LP" system releases highly toxic hydrogen fluoride (HF), which reduces battery performance and lifespan. Furthermore, PVDF is non-biodegradable, and with the European Union (EU) tightening regulations on PFAS, a ban on these substances is expected by 2026. Researchers from POSTECH and Hansol Chemical have designed a non-fluorinated battery system to comply with upcoming environmental regulations and enhance battery performance. They created a lithium perchlorate (LiClO₄, LC)-based electrolyte to replace fluorinated LP electrolytes along with a non-fluorinated aromatic polyamide (APA) binder using Hansol Chemical's proprietary technology. This innovative "APA-LC" system is entirely free of fluorinated compounds. The "APA binder" reinforces the bonding between the cathode's active material and the aluminum current collector, preventing electrode corrosion in the electrolyte and significantly extending battery life. Additionally, the "LC system," enriched with lithium chloride (LiCl) and lithium oxide (Li₂O), lowers the energy barrier at the interface to promote ion migration, leading to faster lithium diffusion and superior output performance compared to the existing LP system. Overall, the APA-LC system exhibited greater oxidation stability than the conventional PVDF-LP system and maintained 20% higher capacity retention after 200 cycles at a rapid charge/discharge rate of 1 C, within the 2.8-4.3 V range in a coin cell test. The research team applied the APA-LC system to produce a high-capacity 1.5 Ah (ampere-hour) pouch cell. The cell maintained excellent discharge capacity and demonstrated strong performance during fast-charging trials. This marks the world's first successful demonstration of a battery system that is entirely scalable and practical, made entirely from non-fluorinated materials, without any fluorinated compounds. They haven't just replaced fluorinated systems; but proven high-capacity retention and outstanding stability. Their solution will advance the sustainability of the battery industry, facilitating the shift to non-fluorinated battery systems while ensuring environmental compliance.

Source <https://www.sciencedaily.com/releases/2024/09/240926131910.htm>



Electrical Engineering

5. New organic thermoelectric device that can harvest energy at room temperature

Researchers have developed a new organic thermoelectric device that can harvest energy from ambient temperature. While thermoelectric devices have several uses today, hurdles still exist to their full utilization. By combining the unique abilities of organic materials, the team succeeded in developing a framework for thermoelectric power generation at room temperature without any temperature gradient. Thermoelectric devices, or thermoelectric generators, are a series of energy-generating materials that can convert heat into electricity so long as there is a temperature gradient -- where one side of the device is hot and the other side is cool. Such devices have been a significant focus of research and development for their potential utility in harvesting waste heat from other energy-generating methods. Perhaps the most well-known use of thermoelectric generators is in space probes such as the Mars Curiosity rover or the Voyager probe. These machines are powered by radioisotope thermoelectric generators, where the heat generated from radioactive isotopes provides the temperature gradient for the thermoelectric devices to power their instruments. However, due to issues including high production cost, use of hazardous materials, low energy efficiency, and the necessity of relatively high temperatures, thermoelectric devices remain underutilized today. Researchers were investigating ways to make a thermoelectric device that could harvest energy from ambient temperature. Our lab focuses on the utility and application of organic compounds, and many organic compounds have unique properties where they can easily transfer energy between each other." explains Professor Chihaya Adachi of Kyushu University's Center for Organic Photonics and Electronics Research (OPERA) who led the study. "A good example of the power of organic compounds can be found in OLEDs or organic solar cells." The key was to find compounds that work well as charge transfer interfaces, meaning that they can easily transfer electrons between each other. After testing various materials, the team found two viable compounds: copper phthalocyanine (CuPc) and copper hexadecafluoro phthalocyanine (F₁₆CuPc). "To improve the thermoelectric property of this new interface, we also incorporated fullerenes and BCP," continues Adachi. "These are known to be good facilitators of electron transport. Adding these compounds together significantly enhanced the device's power. In the end, we had an optimized device with a 180 nm layer of CuPc, 320 nm of F₁₆CuPc, 20 nm of fullerene, and 20 nm of BCP." The optimized device had an open-circuit voltage of 384 mV, a short-circuit current density of 1.1 μA/cm², and a maximum output of 94 nW/cm². Moreover, all these results were achieved at room temperature without the use of a temperature gradient. There have been considerable advances in the development of thermoelectric devices, and our new proposed organic device will certainly help move things forward," concludes Adachi. "We would like to continue working on this new device and see if we can optimize it further with different materials. We can even likely achieve a higher current density if we increase the device's area, which is unusual even for organic materials. It just goes to show that organic materials hold amazing potential."

Source <https://www.sciencedaily.com/releases/2024/09/240919115027.htm>

ESTD - 1987

Electronics and Communication Engineering

6. Shrinking AR displays into eyeglasses to expand their use

Augmented reality (AR) takes digital images and superimposes them onto real-world views. But AR is more than a new way to play video games; it could transform surgery and self-driving cars. To make the technology easier to integrate into common personal devices, researchers reported how to combine two optical technologies into a single, high-resolution AR display. In an eyeglasses prototype, the researchers enhanced image quality with a computer algorithm that removed distortions. AR systems, like those in bulky goggles and automobile head-up displays, require portable optical components. But shrinking the typical four-lens AR system to the size of eyeglasses or smaller typically lowers the quality of the computer-generated image and reduces the field of view. Youguang Ma and colleagues may have found a solution for condensing the technology. They combined two optical technologies -- a metasurface and a refractive lens -- with a microLED screen (containing arrays of tiny green LEDs for projecting images) to create a compact, single-lens hybrid AR design. Their display's metasurface is an ultrathin, lightweight silicon nitride film etched with a pattern. The pattern shapes and focuses light from the green microLEDs. Then, a black-and-green image forms on a refractive lens made from a synthetic polymer, which refines the image by sharpening and reducing aberrations in the light. The final image is projected out of the system and superimposed onto an object or screen. To further enhance the resolution of the projected image, Ma and the team used computer algorithms to identify minor imperfections in the optical system and correct them before light leaves the microLED. The researchers integrated the hybrid AR display into a pair of eyeglasses and tested the prototype's performance with computer image enhancement. Projected images from the one-lens hybrid system had less than 2% distortion across a 30° field of view -- image quality that's on par with current commercial AR platforms with four lenses. The researchers then confirmed that their computer preprocessing algorithm improved a reprojected AR picture of a red panda. The reprojected red panda was 74.3% structurally similar to the original image -- a 4% improvement from the uncorrected projection of the image. With additional development, the researchers say the platform could extend from green to full color and enable a new generation of mainstream AR glasses.

Source <https://www.sciencedaily.com/releases/2024/09/240925122923.htm>



Aerospace Engineering

7. Chandrayaan-3 detects mysterious tremors on Moon

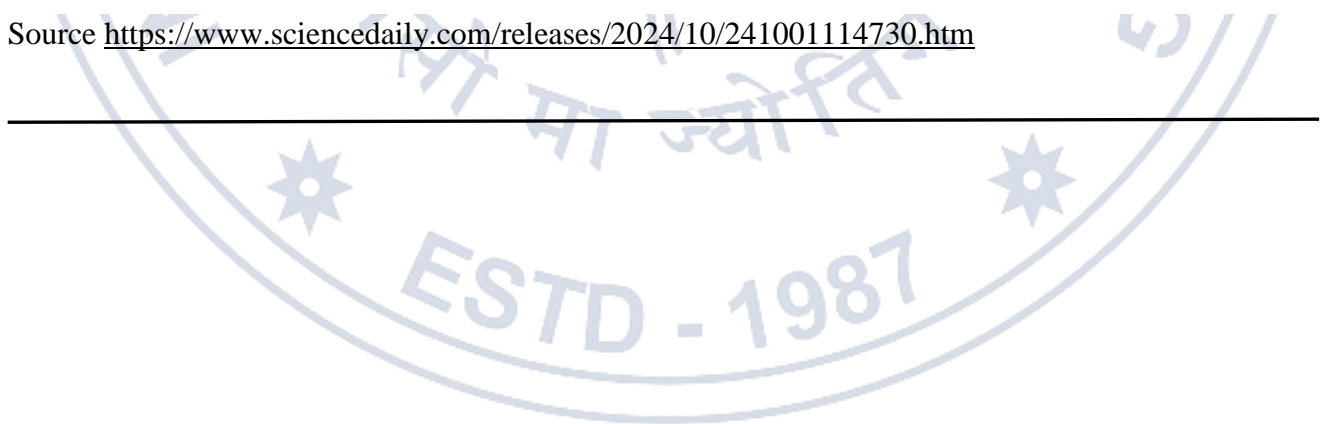
India's Chandrayaan-3 mission has detected over 250 seismic signals in the Moon's south polar region. Among these, 50 distinct signals remain unexplained, suggesting the possibility of Moonquakes. This marks the first time seismic data has been collected from the lunar south pole and the first since the Apollo missions. The Instrument for Lunar Seismic Activity (ILSA), housed aboard the Vikram lander, conducted this experiment at coordinates 69.37° South and 32.32° East, operating continuously for 190 hours between August 24 and September 4, 2023. ILSA is not only the first instrument to record ground vibrations in the Moon's south polar region, but it is also pioneering in its use of sensors crafted through silicon micromachining technology on the lunar surface. The findings from this experiment have been meticulously analysed and published by researchers from the Indian Space Research Organisation (ISRO) in the scientific journal ICARUS. According to the research, out of the more than 250 seismic events recorded, approximately 200 can be linked to known activities, such as the movement of the Pragyan rover or the operation of other scientific instruments. However, around 50 signals remain unexplained, with no clear link to the rover's movements or any other activity. "Further studies are needed to understand what may have caused these uncorrelated events," said KV Sriram, Director of LEOS, told TOI. The most significant signals recorded by ILSA were associated with the navigation of the Pragyan rover. The longest continuous signal recorded lasted 14 minutes, and about 60 signals have been connected to Pragyan's movement, which was controlled remotely. As the rover moved away from ILSA, researchers noted a systematic reduction in the amplitude of the recorded signals. For instance, when the rover was approximately 7 metres from the lander, the peak-to-peak amplitude was around 200 μg (microgravity), which decreased as the distance increased. Chandrayaan-3's mission has provided significant advancements in lunar science, particularly in understanding seismic activity in the Moon's south polar region. The discovery of unexplained seismic events opens new avenues for research and exploration. Continued studies are crucial to uncover the origins of these signals and to further our understanding of the Moon's geological activity. ILSA is not only the first instrument to record ground vibrations in the Moon's south polar region, but it is also pioneering in its use of sensors crafted through silicon micromachining technology on the lunar surface. According to the research, out of the more than 250 seismic events recorded, approximately 200 can be linked to known activities, such as the movement of the Pragyan rover or the operation of other scientific instruments. However, around 50 signals remain unexplained, with no clear link to the rover's movements or any other activity. "Further studies are needed to understand what may have caused these uncorrelated events," said KV Sriram, Director of LEOS, told TOI. The most significant signals recorded by ILSA were associated with the navigation of the Pragyan rover. The longest continuous signal recorded lasted 14 minutes, and about 60 signals have been connected to Pragyan's movement, which was controlled remotely. As the rover moved away from ILSA, researchers noted a systematic reduction in the amplitude of the recorded signals. For instance, when the rover was approximately 7 metres from the lander, the peak-to-peak amplitude was around 200 μg (microgravity), which decreased as the distance increased.

Source <https://www.moneycontrol.com/science/chandrayaan-3-detects-mysterious-tremors-on-moon-are-these-moonquakes-heres-what-scientists-are-saying-article-12818261.html>

8. Squid-inspired fabric for temperature-controlled clothing

Too warm with a jacket on but too cold without it? Athletic apparel brands boast temperature-controlling fabrics that adapt to every climate with lightweight but warm products. Yet, consider a fabric that you can adjust to fit your specific temperature needs. Inspired by the dynamic color-changing properties of squid skin, researchers from the University of California, Irvine developed a method to manufacture a heat-adjusting material that is breathable and washable and can be integrated into flexible fabric. "Squid skin is complex, consisting of multiple layers that work together to manipulate light and change the animal's overall coloration and patterning," said author Alon Gorodetsky. "Some of the layers contain organs called chromatophores, which transition between expanded and contracted states (upon muscle action) to change how the skin transmits and reflects visible light." Instead of manipulating visible light, the team engineered a composite material that operates in the infrared spectrum. As people heat up, they emit some of their heat as invisible, infrared radiation (this is how thermal cameras work). Clothing that manipulates and adapts to this emission and is fitted with thermoregulatory features can finely adjust to the desired temperature of the wearer. The material consists of a polymer covered with copper islands, and stretching it separates the islands and changes how it transmits and reflects infrared light. This innovation creates the possibility of controlling the temperature of a garment. In a prior publication in *APL Bioengineering*, the team modeled their composite material's adaptive infrared properties. Here, they built upon the material to increase its functionality by making it washable, breathable, and integrated into fabric. The team layered a thin film onto the composite to enable easy washing without degradation -- a practical consideration for any fabric. To make the composite material breathable, the team perforated it, producing an array of holes. The resulting product exhibited air and water vapor permeability similar to cotton fabrics. The team then adhered the material to a mesh to demonstrate straightforward fabric integration. Using Fourier transform infrared spectroscopy, the team tested the material's adaptive infrared properties and used a sweating guarded hot plate to test the dynamic thermoregulatory properties. Even with simultaneous thin-film layering, perforations, and fabric integration, the materials' heat-managing performance did not suffer. In addition to the possible applications for the fabric, the manufacturing process the team used to develop the fabric is also full of potential. "The strategies used for endowing our materials with breathability, washability, and fabric compatibility could be translated to several other types of wearable systems, such as washable organic electronics, stretchable e-textiles, and energy-harvesting triboelectric materials," said Gorodetsky.

Source <https://www.sciencedaily.com/releases/2024/10/241001114730.htm>



Energy Engineering

9. Discovery could lead to longer-lasting EV batteries, hasten energy transition

Batteries lose capacity over time, which is why older cellphones run out of power more quickly. This common phenomenon, however, is not completely understood. Now, an international team of researchers, led by an engineer at the University of Colorado Boulder, has revealed the underlying mechanism behind such battery degradation. Their discovery could help scientists to develop better batteries, which would allow electric vehicles to run farther and last longer, while also advancing energy storage technologies that would accelerate the transition to clean energy. Engineers have been working for years on designing lithium-ion batteries -- the most common type of rechargeable batteries -- without cobalt. Cobalt is an expensive rare mineral, and its mining process has been linked to grave environmental and human rights concerns. So far, scientists have tried to use other elements such as nickel and magnesium to replace cobalt in lithium-ion batteries. But these batteries have even higher rates of self-discharge, which is when the battery's internal chemical reactions reduce stored energy and degrade its capacity over time. Because of self-discharge, most EV batteries have a lifespan of seven to 10 years before they need to be replaced. Researcher Toney, who is also a fellow of the Renewable and Sustainable Energy Institute, and his team set out to investigate the cause of self-discharge. In a typical lithium-ion battery, lithium ions, which carry charges, move from one side of the battery, called the anode, to the other side, called the cathode, through a medium called an electrolyte. During this process, the flow of these charged ions forms an electric current that powers electronic devices. Charging the battery reverses the flow of the charged ions and returns them to the anode. Previously, scientists thought batteries self-discharge because not all lithium ions return to the anode when charging, reducing the number of charged ions available to form the current and provide power. Using the Advanced Photon Source, a powerful X-ray machine, at the U.S. Department of Energy's Argonne National Laboratory in Illinois, the research team discovered that hydrogen molecules from the battery's electrolyte would move to cathode and take the spots that lithium ions normally bind to. As a result, lithium ions have fewer places to bind to on the cathode, weakening the electric current and decreasing the battery's capacity. With a better understanding of the self-discharge mechanism, engineers can explore a few ways to prevent the process, such as coating the cathode with a special material to block hydrogen molecules or using a different electrolyte. "Now that we understand what is causing batteries to degrade, we can inform the battery chemistry community on what needs to be improved when designing in batteries," Toney said.

Source <https://www.sciencedaily.com/releases/2024/09/240912142413.htm>



10. Stronger together: miniature robots in convoy for endoscopic surgery

Miniature robots on the millimeter scale often lack the strength to transport instruments for endoscopic microsurgery through the body. Scientists at the German Cancer Research Center (DKFZ) are now combining several millimeter-sized TrainBots into one unit and equipping them with improved "feet." For the first time, the DKFZ team was able to perform an electric surgical procedure on a bile duct obstruction experimentally with a robotic convoy. The list of conceivable applications for miniature robots in medicine is long: from targeted drug application to sensing tasks and surgical procedures. An arsenal of robots has already been developed and tested for this range of tasks, from the nanometer to the centimeter scale. However, the little helpers available today reach their limits in many tasks. For example, in endoscopic microsurgery. The required instruments are often too heavy for a single millimeter-sized robot to carry to its destination. Another common problem is that the robots often have to move by crawling. However, the surfaces of numerous body structures are covered with mucus on which the robots slip and cannot move. A team led by Tian Qiu at the DKFZ in Dresden has now developed a solution for both of these problems: their TrainBot connects several individual robots on the millimeter scale. The units are equipped with improved anti-slip feet. Together, they are able to transport an endoscopic instrument. The TrainBot unit works wireless; a rotating magnetic field simultaneously controls the individual units. The magnetic control enables movements in a plane with the control of rotation. The external actuation and control system is designed for the distances at the human body scale. The Dresden-based DKFZ researchers have already used their robot convoy of three TrainBot units to simulate a surgical procedure. In the case of bile duct cancer, the bile duct often becomes blocked, causing bile to back up, which is a very dangerous situation for those affected. In this case, the occlusion must be opened after an endoscopic diagnosis. To do this, a flexible endoscope is inserted through the mouth into the small intestine and from there into the bile duct. One of the major difficulties here is for the endoscope to navigate around the sharp angle from the small intestine into the bile duct. "This is where the flexible robot convoy can show its strengths," says the project leader Tian Qiu. His team demonstrated it using organs removed from a pig. The robot convoy was able to maneuver an endoscopic instrument for electrical tissue ablation in the bile duct. Once the tip of the wire electrode arrives at the site, electrical voltage is applied and a tissue blockage is gradually removed electrically, a procedure known as "electrocauterization." The wire electrode used was 25 cm long and three and a half times as heavy as a TrainBot unit. "Afterwards, for example, another TrainBot convoy can bring a catheter for fluidic drainage or drug delivery," says researcher Moonkwang Jeong, "After the promising results with the TrainBots in the organ model, we are optimistic that we will be able to develop teams of miniature robots for further tasks in endoscopic surgery."

Source <https://www.sciencedaily.com/releases/2024/10/241001114926.htm>

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ENGINEERING INNOVATION IN INDIA

I. This Insulin Analogue is a Shot in The Arm - Developed by Prof Sandeep Verma, FNAE and Team at IIT Kanpur

Insulin storage and distribution require a stable power supply, which is still erratic in large parts of the country. But a system that solves the problem of end-to-end cold chains for insulin shots is perhaps around the corner. Researchers at the Indian Institute of Technology (IIT) Kanpur have produced an insulin analogue that can stay stable even at high temperatures. The scientists, led by Sandeep Verma, Professor of Chemistry at the institute, have designed and synthesised a modified version of the human insulin with improved heat resistance. Through a minimal modification procedure, they ensured that these novel human insulin analogues would have enhanced stability and resistance to thermal degradation. The team included organic chemists Shantanu Sen and Rafat Ali. They conjugated a phenylalanine amino acid with the side chain amine of B29 lysine of the human insulin. Incorporating this aromatic amino acid at this specific location contributed to enhanced heat resistance (stable even at 65°Celsius), and helped retain its structural integrity for a prolonged duration. While most insulin formulations available in the market require regular refrigeration, a few are stable at ambient temperatures, often found in mid-latitude countries. "At higher temperatures and slightly acidic pH, the hormone becomes aggregated and degraded," says Verma, Professor-in-Charge for the Gangwal School of Medical Sciences and Technology at IIT Kanpur. Insulin doses given to people with diabetes are carefully measured. If an ampule from which the patient draws insulin has 25% aggregates, that much amount of hormone is not available to the patient, making the dosage sub-optimal for blood sugar management, he says. The injection of degraded insulin may cause amyloidosis, a rare group of diseases which leads to the building up of abnormal proteins called amyloid fibrils in tissues and organs, often leading to adverse immune responses. The simplicity of synthesis and scalability make these analogues promising candidates for trials, addressing the challenges of storage and transportation. The highly thermostable insulin variant synthesised by the IIT team can revolutionise safe insulin storage and distribution without expensive cold-chain logistics. This modification method is more effective than previous attempts, offering a prototype for highly thermostable insulin analogues. The simplicity of synthesis and scalability make these analogues promising candidates for clinical trials, addressing the challenges of insulin storage and transportation, says Verma. Verma, who has co-founded a start-up, says the team is keen to work with Indian pharma companies to take this

Source <https://shaastramag.iitm.ac.in/news-brief/insulin-analogue-shot-arm>

II. Army gets first India-made submachine guns

The Indian Army has got the delivery of country's first domestically developed sub-machine guns - ASMI - designed, developed and manufactured in less than three years. ASMI, short for Asmita, which means pride in Sanskrit, has outperformed many renowned international rivals in terms of accuracy and reliability. ASMI weighs under 2.4 kg and is 10-15% lighter than its global competitors. With a price tag of under Rs 1 lakh, the guns are nearly 30% cheaper than the imported ones. ASMI sports a modern design with the use of aluminium and carbon fibre, making a perfect balance between weight and performance. This is a major achievement for Hyderabad-based Lokesh Machines Limited that delivered the order of 550 9x19 mm submachine guns (SMGs) Asmi to the Indian Army. ASMI was developed by the company based on the basic design provided by Armament Research & Development Establishment (ARDE), DRDO Pune and the Indian Army

Source <https://www.moneycontrol.com/news/india/army-gets-first-india-made-submachine-guns-how-asmi-outperforms-israels-uzi-german-mp5-12833163.html>

Note: *Fellows are requested to forward their achievements/achievements of their organization to be featured under the heading “Engineering Innovation in India”.*

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