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INAE VISION 2020-2025

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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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

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 April 1, 2023 to December 31, 2023)

Joint Activities with Science and Engineering Research Board (SERB)

I. SERB-INAE Collaborative Initiative in Engineering

INAE jointly with SERB had taken an initiative last year to conduct various events under SERB-INAE Collaborative Initiative in Engineering. As an outcome, the following four initiatives under the umbrella of 'Collaborative Initiative in Engineering' were undertaken.

- SERB-INAE Conclaves on *Atmanirbhar* Technologies - Engineering Secured Future
- SERB-INAE Woman Engineers Program
- SERB-INAE Outreach Programs for NE, J&K and Ladakh
- SERB-INAE Innovation Hackathon

INAE has received a tremendous response and the initiative has progressed well with the conduct of events efficiently under all the four verticals given above. The events/programs organized during the period April to December 2023 are given below:

a) SERB-INAE Conclaves on *Atmanirbhar* Technologies - Engineering Secured Future

(i) The 17th National Frontiers of Engineering (NatFoE-23) Symposium

The Symposium on National Frontiers of Engineering (NatFoE) is one of the flagship events of INAE since 2006. The main objective of the event is to encourage Young Engineers (ages ~27-45) from industry, universities, and R&D labs to discuss leading-edge research and technical work across a range of engineering fields. The 17th National Frontiers of Engineering (NatFoE-23) symposium was organized by INAE in collaboration with Birla Institute of Technology Mesra under the aegis of INAE-SERB conclave on *Atmanirbhar* Technologies- Engineering Secured Future during June 24-25, 2023. This annual flagship event of INAE was attended by young researchers across various academic institutions, R&D laboratories and industries as speakers and participants. The Inaugural Session was presided over by Prof Indranil Manna, President, INAE. During the Inaugural Session, Prof C Jeganathan, Co-ordinator, NatFoE-23 & Dean RIE, BIT Mesra delivered the Welcome Address and explained the objectives of the symposium. Shri Jayant Sinha, Member of Parliament, Lok Sabha graced the occasion as the Chief Guest. He enthused and motivated the august audience of young engineers for achieving great heights in their endeavours. He also delivered a talk on "Getting to the Green Frontier: A Net-Zero Development Model for India" wherein he interacted with the students on the Green Frontier Model and laid down the challenges that might occur in the near future due to climate change. Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE expressed his heartfelt gratitude and regards to all the dignitaries, coordinators of the event and SERB.



Chief Guest, Shri Jayant Sinha being felicitated by Prof Indranil Manna, President, INAE



Inaugural Session in Progress

There were technical sessions on four thematic areas in the symposium and each session had one plenary talk and three keynote talks by experts from the relevant disciplines. All the technical sessions were conducted by the respective theme conveners. Four themes covered during the event were (i) Mining Technology -Mastering Depth & Exploration (ii) AI, GPT & Robotics - Technology of Future (iii) Smart Water Harvesting & Cleaning - Engineering Water (iv) Embracing Futuristic Technologies to make Engineering Education Alluring. In addition, a special session on Azadi ka Amrit Mahotsav was organized to commemorate the seventy-fifth year of Indian independence and the achievements of the country during this period. There was total 20 presentations by domain experts in the thematic areas and Plenary Talks by eminent speakers during the Symposium.



Prof T. Pradeep, IIT Madras presenting a memento to a speaker

The Plenary talk of the first session on Mining Technology -Mastering Depth & Exploration was given by Prof. Arvind Kumar Mishra, Director of CSIR-Central Institute of Mining and Fuel Research, Dhanbad (CIMFR). His talk was on “Emerging Trends of Exploration and Extraction Technologies for Deep-Seated Coal Deposits.” Dr Debasis Bandhopadhyay, CMPDI (HQ), Ranchi, Dr PS Paul, IIT (ISM), Dr Siddhartha Roy, CMPDIL (HQ), Ranchi were the invited speakers of this session. The Azadi talk was delivered by Prof. Jayanta Bhattacharya, IIT Kharagpur. The second session on AI, GPT & Robotics - Technology of Future was graced by Dr Manish Gupta, Director, Google Research as plenary speaker. The topic of his talk was “What an Amazing Time to be an AI Researcher. Dr. Swagatam Das, Indian Statistical Institute, Kolkata, Dr Anuj Kumar Sharma, AKTU Lucknow, Mr Gopi Krishna Nuti, Autodesk, Bangalore were the invited speakers of this session. The on the theme of Azadi ka Amrit Mahotsav in this session was delivered by Mr Joy Mustafi, MUST Research, Hyderabad.

The plenary talk on Smart Water Harvesting & Cleaning - Engineering Water was delivered by Prof T. Pradeep, IIT Madras as a plenary speaker. The topic of his talk was “Affordable Clean Water Using Advanced Materials.” Prof VC Srivastava, IIT Roorkee, Dr J Rajesh Banu, Central University of Tamil Nadu, Dr Pradip P Kalbar, IIT Bombay delivered the invited talks in this session. The talk on the theme of Azadi ka Amrit Mahotsav was given by Dr (Mrs) Indira Khurana, Director Research at the Safai Karmachari Andolan and Vice Chairperson of NGO Tarun Bharat Sangh. The Plenary talk of the session on Embracing Futuristic Technologies to make Engineering Education Alluring was given by Dr Rajeev Shorey, IIT Delhi as a plenary speaker. Dr Shorey spoke about about “Recent Investigations in the Intersection of Machine Learning and Edge Computing.” Dr. Tapan K. Gandhi, IIT Delhi, Dr. Kaushal Kumar Bhagat, IIT Kharagpur and Dr. Manjira Sinha IIT Kharagpur were the invited speakers of this session. Another talk on the theme of Azadi ka Amrit Mahotsav was given by Dr. T V Bharat, IIT Guwahati.



Dr Manish Gupta, Director, Google Research delivering plenary talk



Participants attending the second plenary talk

A large number of Research Scholars and Faculty Members of BIT Mesra also attended the Symposium and helped towards the organization of the symposium. Through this symposium, participants got the opportunity to form connections and opportunity to engage with successful alumni, faculty, and professionals with vast experience and professional standing. The symposium provided participants and students alike access to knowledge and insights that helped them in their professional journeys as engineering professionals and students.

National Competition on Innovation in Manufacturing Practices (IMP 2023)

Innovation in Manufacturing Processes (IMP) – 2023 conducted by INAE and BIT Mesra under the aegis of SERB-INAIE Conclave on *Atmanirbhar* Technologies- Engineering Secured Future on June 26, 2023, is a national level project competition open to all engineering students and practitioners with the endeavour to engage with the engineering youth of the country. The Innovation in Manufacturing Processes (IMP) – 2023 was dovetailed with the 17th National Frontiers of Engineering (NatFoE-23) Symposium. In addition to undergraduate and postgraduates (Master's students) categories, start-ups were also invited scholars to showcase their project work related to innovations in manufacturing sector. The students participated from various eminent institutions such as NIT Rourkela, NIT Patna, NIT Jamshedpur, IIT (ISM), Dhanbad, IEST Shibpur, IIT Guwahati, RCC Institute of Technology, Kolkata, Rai University, Sido Kanhu Murmu University, Dumka, BIT Polytechnic and BIT Mesra. The competition received an overwhelming response with a registration of total 62 teams. Entries were invited in the form of three-minute video (mp4) of the functioning model process, operations and a description of 250 words write-up document. Out of all these entries, 16 entries were shortlisted for the final pitching in front of the Jury members. The Pitching session included many innovative ideas in areas such as Drilling Technology, Sustainable E.V. development, and Sustainable biodegradable paper packaging from waste material. A total of six prizes, three winners and three runner-up prizes of Rs 40,000 and Rs 20,000 respectively in the undergraduate, postgraduate and Start-ups/PhD categories were conferred.

The Chief Guest at the Inaugural ceremony of IMP-2023 was Prof Sivaji Chakravorti, Vice President, INAE, and the Guest of Honour cum Jury members were Dr. Hariharan, Former General Manager, HRD - MTI SAIL Ranchi, Dr. P.K. Chatterjee Former Chief General Manager, MECON Ltd., Ranchi and Mr. M.K. Gupta, Principal, Jharkhand Tool Room, Govt of Jharkhand. The session began with the Welcome Address by Dr. C. Jeganathan, Coordinator of IMP-23 & Dean of Research, Innovation and Entrepreneurship, BIT Mesra. He welcomed the dignitaries and briefed about the competition and about the details of various participating institutions. The jury members of IMP-2023 addressed the gatherings and stressed about the need for Innovation in India's Manufacturing Industry. Prof Sivaji Chakravorti highlighted the importance of IMP as an opportunity for young engineers and entrepreneurs in this national level project competition. Prof Indranil Manna, President, INAE & Vice Chancellor, BIT Mesra also addressed the audience with pertinent information about India's glorious past in the field of manufacturing and emphasized the need for sustaining the GDP through manufacturing industry since

it can serve to strengthen national security, provide job opportunities, and stimulate the growth of a sustainable economy. Prof Indranil Manna presented Memento as a token of gratitude to Chief Guest and jury members. Dr. Richa Pandey, Assistant Professor, BIT Mesra proposed the vote of thanks.



Prof Sivaji, Chakravorti, Chief Guest delivering inaugural address



Students projecting their ideas at IMP2023



Participants/Winners with Jury members of IMP 2023

Shri N. C. Agrawal, CEO of Meditron, Ranchi, was the Chief guest of the valedictory function. Shri N.C Agarwal addressed the gathering with his experience in the entrepreneurial journey, and motivated and congratulated all the participants. In the Undergraduate category, first prize was awarded to Ankit Niraj Pandey and Team from Parul University, Gujarat for their Project on “Drilling Technology”, and the second prize was awarded to Bogi Manish Kumar and Team from IIT(ISM) Dhanbad for their project on “AI Chat/GPT and Robotics”. In the Post-Graduate Category, the first prize was awarded to Pranjal Pandey and Team from BIT Mesra for his project on 'AI, Chat/GPT and Robotics', and the second prize was awarded to Ms. Nistha Mukhopadhyay and Team from BIT Mesra for their project on “Biodegradable Packaging Paper from Waste Material.” In the final category comprising of Start-ups/PhD the first prize was awarded to Piyali Mukherjee and Team from IIST Shibpur, Kolkata for their project on “Healthcare Diagnostics”, and the joint-second prize was shared between Akanksha Kumari and Team, BIT Mesra and Sweta Satpathy and Team BIT Mesra for their projects on “Key Intervention to Solve Micronutrient Deficiencies” and “High-Speed Non-Invasive, Biomechanical Profiling for Medical Purposes” respectively.

b) SERB-INAE Woman Engineers Program

(i) Two-days Symposium for Young Women Engineers

INAE and SERB jointly organized a **two-days Symposium for Young Women Engineers during November 20-21, 2023 at Tezpur University, Assam**. The topic of the Symposium was “Technologies for sustainable developments in North-Eastern Region”. Young women engineers (< 45 years of age) from engineering and technological Institutions/Universities covering all the states of North-Eastern region (NER) participated in this symposium. The symposium featured eight distinguished scientists and deliberated on areas covering two themes namely, ‘High-value Agri-based products’ and ‘Rejuvenation of natural resources’. Further, the symposium featured group activity by participants on problems and solutions that are pertinent to the people of north-east. The inaugural function was graced by Prof. Shambhu Nath Singh, Vice-Chancellor of Tezpur University and he emphasized the women’s contribution in science and technology for the growth of nation. Altogether 30 young women engineers covering the states of Northeast participated in the symposium. Dr. Sharmila Mande, FNAE and coordinator of the Symposium further emphasized that the event provided a dynamic platform for young women engineers to explore innovative solutions in addressing regional problems that are important for sustainable development of north-eastern region. The two-day deliberations by the domain specific expert scientist provided knowledge on emerging and advanced technologies and the implementation of the similar research work by the participants in the North-Eastern states of India.



Group Photograph of Participants



Session in Progress

c) SERB-INAE Outreach Programs for NE, J&K and Ladakh

(i) Two-Day SERB-INAE Workshop on “Entrepreneurship and Skill Development with Special Reference to Startups” held on 17-18 July 2023 at University of Ladakh

With the aim to inculcate an entrepreneurial spirit among the participants and motivate them to become successful entrepreneurs, INAE organized a two-day workshop on “Entrepreneurship and Skill Development with Special Reference to Start-ups” jointly with the University of Ladakh on July 17- 18, 2023 at Leh. On the inaugural day, about 70 students from Elizer Joldan Memorial College, Leh Industrial Training Institute Leh, and the University of Ladakh participated in the workshop. During the event, Prof. SK Mehta, Vice-Chancellor University of Ladakh and Prof. Indranil Manna, President INAE were the Chief Guests. While addressing the participants, Prof. Indranil Manna advised students to take the maximum inputs from the two-day workshop and come up with new innovative ideas to solve certain unmet gaps in the market. He also expressed the intention to further collaborate with the university for future courses of action. Prof. SK Mehta also guided students to develop entrepreneurial traits to become successful entrepreneurs in the near future. Later, Mr. Abhishek from the Department of Industries and Commerce, UT Ladakh acquainted the students with various government incentives and schemes for entrepreneurship development in Ladakh and advised students to avail the benefits. Ms. Stanzin Minglak, Co- founder Lena Ladakh spoke at length about how to become successful female entrepreneurs. Next speaker, Mr. Nawang Phuntsog, Founder Nomadic Mills talked at length about community-based entrepreneurship and the importance of giving something back to the community.

In the afternoon session, Ms. Rigzin Wangmo Lachic, encouraged participants to think out of the box and shared her experience in entrepreneurship. Later, Mr. Stanzin Jordan Co-founder Ladakh Basket spoke about the opportunities available to the youths in the Agri sector and asked students to be interns in their start-up.

On the second day, Dr. Debasis Chatterji, Founder Confiscore.com took two sessions on design thinking for innovation and gave tasks to the participants. He talked about the relevance of design thinking in today's environment and shared examples of the application of design thinking in solving certain societal problems. In the afternoon session, Ms. Rigzin Angmo, Co- Founder, Nima Goss familiarized the participants with the entrepreneurship process and the traits one needs to develop in order to become an entrepreneur. Later in the valedictory session, Prof. Sivaji Chakravorti, Vice-President INAE, and Prof. AK Sharma, Registrar University of Ladakh were the chief guests. While addressing the gathering, Prof. Sivaji shared some anecdotes of successful innovators and advised students to become innovators. Prof. AK Sharma advised students to broaden their horizons and engage in entrepreneurship at early stages of life even during their studies to make themselves self-dependent. At the end of the event, Dr. Mohd Rafee proposed the vote of thanks. The event was an astounding success in meeting the objectives.



Workshop Proceedings in Progress



Group photograph of Students attending the Workshop

(ii) Workshop on “Self-employment through Entrepreneurship - The path for Self-reliant India”

SERB and INAE jointly organized three-days' workshop on “Self-employment through Entrepreneurship – The path for Self-reliant India” in association with NIT Silchar during July 26-28, 2023. The primary objectives of the workshop were to make the participants aware of recent trends and future aspects of being an entrepreneur, to identify the possible sectors for becoming an entrepreneur and to motivate people representing different sections of society, including SC, ST, EWS, women, the differently abled, and Ex-servicemen to consider entrepreneurship as one of their career options in the light of NEP 2020 to making India self-reliant – *Atmanirbhar Bharat*. The program was widely circulated, and a total of 89 participants registered and 52 attended the program from different institutes like Polytechnique College, Government Engineering College, Private College from West Bengal, NERIST, NIT Silchar and Assam Pollution Control Board. Lecture sessions by experts, hands-on training sessions were scheduled during the event wherein lecture sessions were related to recent trends in entrepreneurship and product development, the future of entrepreneurship, and funding schemes provided by the government. The participants conducted experiments on the wind turbine, 3-D printing, product development using natural resource-based composite materials, and solar photovoltaics. The event was an astounding success in meeting the laid down objectives.



Participants of the Workshop at NIT Silchar



Hands-on training sessions

d) SERB-INAE Innovation Hackathon

(i) **INAE Youth Conclave 2023:** The **INAE Youth Conclave 2023** was held under the aegis of SERB-INAE Innovation Hackathon during November 3-4, 2023 at GITAM University, Vishakhapatnam. The theme of the conclave "Innovation and Technology for Global Challenges," highlighted the importance of technological advancements in addressing pressing global issues. The conclave focused on six key areas, each with profound implications for global problem-solving: 1. AI in Healthcare, 2. Space & Robotics, 3. Green Energy and Storage, 4. Circular manufacturing, 5. Biomedical Engineering and Devices, 6. Smart City & Urban Planning. The conclave featured a series of engaging events that fostered innovation, knowledge sharing, and entrepreneurial spirit. These events included Ideathon, Poster Presentation, Model/Project Exhibition, Start-Up Showcase. In each of these events, participants came from different states had the opportunity to compete for prizes, with the top three performers in each category receiving cash awards. The 1st prize winner received Rs 25,000, the 2nd prize winner received Rs 15,000, and 3rd prize winner received Rs 10,000. An inspiring inclusion in the event was the provision of exclusive prizes for women-only teams, with a cash award of Rs 10,000 in each event to promote gender diversity and inclusivity.



Dignitaries lighting the lamp in the inaugural ceremony



Students exhibiting their models



Prof. Sivaji Chakravorti, Vice-President, INAE and Prof DR Prasada Raju, Coordinator of the event interacting with the participants

All these events were outstanding successes with overwhelming participation and unprecedented enthusiasm. Each event was well appreciated by all the stakeholders from Academic institutions, R&D Organization and Industry. The success of these initiatives shall lead to future programs of engineering importance to the nation producing unique impact and meaningful outcome. To view the report of the INAE Youth Conclave 2023 [click here...](#)

II. SERB-INAЕ Digital Gaming Research Initiative

The SERB-INAЕ 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. A call for well-defined proposals on the following thematic areas concerning online and digital games were invited through INAE Website and was also published in national dailies, besides forwarding to INAE Fellows, Young Associates, Directors of IITs, NITs and CFTIs and AICTE for further distribution.

- (a) Category (I): R&D in Learning, Educational, and Leisure Online Gaming Platforms**
- (b) Category (II): Immersive Game Prototypes, with a focus on Indian Culture & Values**
- (c) Category (III): Collaborative Technical Design Process: Creation of SERB Game Labs**

Forty-three proposals were received which would be selection for execution shortly based on the merit of the proposal and guidelines thereof. The number of proposals received under each category are as given below:

- Category (I): R&D in Learning, Educational, and Leisure Online Gaming Platforms --17 proposals
- Category (II): Immersive Game Prototypes, with a focus on Indian Culture & Values—15 proposals
- Category (III): Collaborative Technical Design Process: Creation of SERB Game Labs—11 proposals

Out of total 43 proposals received, twelve proposals were provisionally ineligible and one duplicate proposal was received. A meeting of Program Management Advisory Committee (PMAC) for SERB-INAЕ Online and Digital Gaming Research Initiative was convened on April 6, 2023 in hybrid mode. 23 proposals were shortlisted by the concerned experts from SERB and INAE for presentation before the Program Management Advisory Committee during the meeting held on May 26- 27, 2023 at New Delhi in hybrid mode. The experts recommended thirteen deserving proposals for consideration of selection

III. INAE -SERB, DST Abdul Kalam Technology Innovation National Fellowship

Indian National Academy of Engineering (INAE) and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) had launched the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship in the year 2017 to recognize, encourage and support translational research by Individuals working in various capacities of engineering profession, in public funded institutions in the country. As per the guidelines of the fellowship, the duration of the Fellowship will be initially for three years, extendable by up to two more years depending on the performance. The fellowship can be held for a maximum of 5 years. All fellowships are reviewed on completion of three years, and if the progress is found to be in line with the proposal, an extension of additional two years is granted to the fellow. The last date for the receipt of new nominations for this year was July 16, 2023. The performance of six fellowships completing their tenure of three years on September 30, 2023 was reviewed by the Search Cum Selection Expert Committee (SSEC) during its meeting held on August 1, 2023 in hybrid mode. After detailed deliberations, based on the degree of translational research leading to deployable technology as indicated in the proposals received; the Committee shortlisted 25 nominees who made a presentation of their proposal before the Search cum Selection Expert Committee on August 29, 2023. Based on the presentations, the Committee selected ten nominees to be conferred as Abdul Kalam fellows for Financial Year 2023-24.

INAE Events

37th Foundation Day Function of INAE

The Indian National Academy of Engineering (INAE), founded on April 20, 1987 is an autonomous professional body partly supported by grant-in-aid from the Department of Science & Technology, Government of India. The 37th Foundation Day Function of Indian National Academy of Engineering (INAE) was held on 20th April 2023 (Thursday) at R&I Park, IIT Delhi in hybrid mode. The function commenced with a Welcome Address and short brief on INAE delivered by Lt Col Shobhit Rai (Retd), Officiating Executive Director, INAE followed by an Address by Prof Indranil Manna, President, INAE and Vice-Chancellor, BIT Mesra wherein he presented the major activities during the last one year. The Guest of Honour, Prof Rangan Banerjee, FNAE, Director, IIT Delhi then gave a thought-provoking talk on “The Challenge of Net Zero and India’s Energy Transition” during which he covered the challenges and opportunities provided by this transition and focussed on the need for targeted and co-ordinated research and innovation to enable the sustainable growth of the Indian energy sector. This was followed by an enlightening address on “Climate Change and India’s Pathway” by the Chief Guest, Dr VK Saraswat, FNAE, Member, NITI Aayog who spelt out the national priorities in the field of India’s Energy Security covering all aspects about the transition to new and green energy technologies. He spoke about the Hydrogen Economy and the need to change to more environment- friendly ways to manufacture hydrogen on a large scale for deployment at national level, as a major source of energy. He also touched upon the introduction of electric vehicles and the infrastructure required for deployment on a large scale. The effect of greenhouse gases on climate change and mitigation of global warming by carbon capture and sequestration were emphasized during his address. His talk was a comprehensive delivery on the future path for India to strive towards Net Zero, reduce greenhouse gas emission and mitigate the effects of climate change for sustainable development of the economy. The Function was attended by about 60 INAE Fellows, Young Associates and Research Scholars of IIT Delhi in person 150 INAE Fellows, Young Associates and Invitees online and was an outstanding success.



Dr VK Saraswat welcomed by President, INAE



Prof Indranil Manna, delivering Address



Prof Rangan Banerjee delivering Talk



Dr VK Saraswat Delivering his Address

National Technology Day celebration by INAE on 11th May 2023

INAE celebrated the National Technology Day on 11th May 2023 wherein Mr. MV Kotwal, FNAE, Ex-Member of the L&T Board & President Heavy Engineering delivered a special Talk online on “Technology – A Prime Mover for Growth”. Prof. Indranil Manna, President, INAE delivered the Presidential Address. In his talk Mr MV Kotwal highlighted that every aspect of life is dependent upon technology and exponential growth has occurred not only in per capita GDP but also in human health & longevity as well as Education, Commerce, Construction, Infrastructure, Mobility, Exploration, Process Design, Manufacturing, Communication, Defence and almost every other area. He illustrated some outstanding technological achievements that have made a landmark change in the lives of man in recent times. Over 80 participants attended the talk which was well appreciated.

Panel Discussion on CAETS Energy Report 2022 - “Buildings and Smart Cities” held on 27th May 2023

INAE organized an online Panel Discussion on CAETS Energy Report 2022 - “Buildings and Smart Cities” on 27th May 2023 (Saturday) wherein the following five persons played a leading role viz Dr. Yves Bamberger, Vice-President, French Academy of Engineering and Chairman, Energy Committee of CAETS presented the CAETS Energy Report 2022; Prof. Indranil Manna, FNAE, President, INAE and Vice-Chancellor, BIT, Mesra delivered the Presidential Address; Dr. Ajay Mathur, FNAE, Chairman, INAE Forum on Energy; Director-General, International Solar Alliance (ISA), Gurugram delivered Welcome Note; Dr. Bibek Bandyopadhyay, FNAE, Senior Advisor, International Institute of Energy Conservation, New Delhi made a brief supplementary presentation on “Buildings” and the concluding remarks were delivered by Mr. Pradeep Chaturvedi, FNAE, Vice-President, World Environment Foundation, New Delhi. The CAETS 2022 Energy Report on “Towards Low-GHG Emissions from Energy use in Selected Sectors” was released during the CAETS 2022 Annual Meetings and International Conference on “Engineering a better world: Breakthrough Technologies for Healthcare” hosted by the National Academy of Technologies of France (NATF) in Versailles, near Paris, France on September 27-28, 2022. During the event, the contributions of INAE Fellows in preparation of the said report was highly appreciated.

National Engineers Day Celebrations on September 15, 2023

INAE celebrates the “National Engineers Day” every year on 15th September. To commemorate the occasion, INAE organized a Panel Discussion on “Cyber Security and Cyber-Physical Systems” on National Engineers Day 2023 i.e. 15th September 2023 (Friday) over WebEx. The following eminent experts in the subject domain participated as Panelists: Dr. Ajay Kumar, *FNAE*, Former Defence Secretary, Ministry of Defence, Government of India; Mr. K Ananth Krishnan, *FNAE*, Formerly Executive Vice President and Chief Technology Officer, TCS; Prof. Manindra Agrawal, *FNAE*, Project Director, C3i (cybersecurity and cybersecurity for Cyber-Physical Systems) Innovation Hub and Professor, Department of Computer Science & Engg., IIT Kanpur and Prof. P. Rajalakshmi, Director, NMICPS TiHAN Foundation Technology Innovation Hub on Autonomous Navigation and Data Acquisition Systems (UAVs, ROVs etc.) at IIT Hyderabad and Professor, Department of Electrical Engineering, IIT Hyderabad. Prof. Anurag Kumar, *FNAE*, Former Director, Indian Institute of Science Bangalore steered the panel discussion as the Coordinator. Prof. Indranil Manna, President, INAE also addressed the audience online on vital issues being addressed in the Panel Discussion meeting. The presentations were followed by a lively Q&A session in which the panelists addressed a plethora of queries on relevant issues pertaining to Cyber Security and Cyber-Physical Systems which have assumed importance in the present context. The topic of Industry 4.0 and its implementation in Indian industry was also touched upon. Over 60 Fellows, Young Associates, faculty and researchers attended the Panel Discussion meeting online.



Indian National Academy of Engineering

National Engineers Day Celebrations by INAE



Panel Discussion on “Cyber Security and Cyber Physical Systems”

on 15th September 2023 from 4.30 PM to 6.00 PM over WebEx

Distinguished Panelists:

 <p>Dr. Ajay Kumar, <i>FNAE</i>, Former Defence Secretary, Ministry of Defence, Government of India</p>	 <p>Mr. K Ananth Krishnan, <i>FNAE</i>, Formerly Executive Vice President and Chief Technology Officer, TCS</p>
 <p>Prof. Manindra Agrawal, <i>FNAE</i>, Project Director, C3i (cybersecurity and cybersecurity for Cyber-Physical Systems) Innovation Hub and Professor, IIT Kanpur</p>	 <p>Prof. P. Rajalakshmi, Director, NMICPS TiHAN Foundation Technology Innovation Hub on Autonomous Navigation and Data Acquisition Systems (UAVs, ROVs etc.) at IIT Hyderabad</p>

<h4>Welcome Address :</h4>  <p>Prof. Indranil Manna, <i>FNAE</i>, President, INAE and Vice-Chancellor, BIT Mesra</p>	<h4>Program Coordinated by :</h4>  <p>Prof. Anurag Kumar, <i>FNAE</i>, Former Director, IISc Bangalore</p>
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Engineers Conclave 2023

Engineers Conclave 2023 (EC-2023), an annual mega event organized by INAE jointly with major engineering institutions of the country, was organized from October 5th-7th, 2023 at the prestigious Raja Ramanna Centre for Advanced Technology (RRCAT) in Indore, India. The event was overall coordinated by RRCAT and jointly organized by INAE and UGC-DAE- Consortium for Scientific Research (CSR), Indore, with the DAVV and IIT Indore as the partner institutes. This year's Engineers Conclave was a grand celebration of engineering excellence, knowledge sharing, and collaboration.

With the two themes focusing on " Laser Technologies for Emerging Engineering Challenges" and "Engineering and Technology for Clean and Green India @2047," the event aimed to bring together engineers, scientists, researchers, and industry leaders to explore and discuss cutting-edge technologies and sustainable solutions.

The Engineers Conclave 2023 started with an Inaugural Session on October 5th, 2023, at the RRCAT. The event witnessed a galaxy of eminent luminaries who graced the occasion with their wisdom and insights. The Inaugural Session commenced with a warm Welcome Address by Dr. A.J. Pal, Director, UGC-DAE-CSR, Indore. His Welcome Address promised to set the tone for a gathering of visionaries, researchers and innovators. Following Dr. Pal's welcome, the audience had the privilege of listening to an enlightening Presidential Address by Prof. Indranil Manna, President, INAE. A Distinguished Guest Dr. K.N. Vyas, Former Chairman, Atomic Energy Commission (AEC) and Secretary, Department of Atomic Energy (DAE) & Former Director, Bhabha Atomic Research Centre (BARC) then took the stage. Dr. Vyas's address offered valuable perspectives on pertinent engineering issues, enriching the audience's understanding of the challenges and opportunities in today's engineering landscape. The event was further graced by an eminent Distinguished Guest, Dr. Anil Kakodkar, Chancellor, Homi Bhabha National Institute, Member, AEC and Chairman, Rajiv Gandhi Science & Technology Commission, Govt. of Maharashtra. Dr Kakodkar's eloquent and inspiring address made a profound impact on the audience by sharing his view points on important issues related to the Conclave. The Chief Guest for the Inaugural Session was Prof. M Jagadesh Kumar, Chairman, UGC who is a renowned personality in the domain of Nanoelectronic Devices, Nanoscale Device modelling and simulation, Innovative Device Design, and Power semiconductor devices. Prof Kumar highlighted key issues for the advancement of the thematic areas of the Conclave with his deep insight and vision. His presence emphasized the significance of Engineers Conclave 2023, as a premier platform for knowledge exchange and collaboration. His address was informative and insightful and inspired the august audience. This Inaugural Session was a unique opportunity for participants and delegates to gain insights and inspiration from some of the brightest and most eminent minds in the engineering field.



Panel Discussion in Progress



Release of Abstract Booklet

The event highlights were the Plenary Sessions. These sessions at EC-2023 offered attendees and delegates the opportunity to gain valuable insights and inspiration from esteemed experts. The plenary speakers addressed critical topics and emerging trends in engineering, providing attendees with a deeper understanding of the challenges and opportunities in today's rapidly evolving world. The Keynote Speakers were an impressive line-up of keynote speakers, including renowned domain experts from Academia, Industry and R&D. These thought leaders shared their insights on the latest advancements in their respective fields. The Technical Sessions featured a series of parallel technical sessions covering a wide range of topics, from artificial intelligence and robotics to renewable energy and environmental engineering. Attendees had the opportunity to deepen their knowledge and engage in meaningful discussions. The deliberations were aimed at arriving at actionable recommendations in terms of

engineering interventions for advancing the growth of engineering and technology in chosen thematic areas. Engineers Conclave hosted interactive exhibition showcasing the latest engineering innovations, products, and services. Attendees could explore hands-on experiences and network with industry professionals. The event provided a platform for networking and collaboration. Engineers, researchers, and industry experts can connect, exchange ideas, and build meaningful relationships for future collaborative projects and initiatives in niche areas of engineering interest. Actionable recommendations are being compiled which shall be forwarded and progressed with concerned stakeholders from government departments/Agencies and Industry.

Brainstorming Session on ‘Innovative Pathways for Hydrogen Development’ jointly organized by INAE Delhi Chapter, International Solar Alliance (ISA) and INAE Forum on Energy held on November 17, 2023 at India International Centre, New Delhi. Dr Kirit Parikh, Former Chairman, IRADe and Member, Planning Commission was the Guest of Honour. Green Hydrogen (GH₂), i.e., hydrogen made using zero-carbon emission processes, is emerging as a major option for replacing fossil fuels in non-electricity applications in all net-zero scenarios. In the move towards a net-zero carbon world, solar, wind, biomass, hydro, and nuclear (or green) electricity, complemented by electricity storage, is already emerging as a cost-effective and carbon-free option. GH₂, on the other hand, still requires technological and commercial development to be cost-competitive with fossil fuels used in sectors such as long-distance transport, steel, petrochemicals, etc., or for supplying heat in industrial applications. The ISA has launched a Green Hydrogen Innovation Centre (GHIC), during the current G-20 presidency, to provide up-to-date information on policies, technologies and initiatives on GH₂ production, transport and utilization, as well as to provide certified training for GH₂ management, and to link GH₂ developers and financiers. An ISA and INAE partnership could *inter alia* explore engineering challenges in: Upgradation of electrolyzer technology; Development of GH₂ production technology using heat from nuclear-reactors and concentrated solar power; Options for GH₂ production using intermittent sources of green electricity; Utilization of hydrogen for the production of steel and petrochemicals; Utilization of hydrogen for the cost-effective production of industrial heat; Transportation of hydrogen as ammonia, urea, methanol, etc. The possible INAE-ISA partnership on GH₂ was discussed at brainstorming meet.



Brainstorming Session in Progress at New Delhi

INAE Annual Convention 2023

The Indian National Academy of Engineering (INAE) organized its Annual Convention 2023 on December 9-11, 2023 at Siksha 'O' Anusandhan University, Bhubaneswar in association with Siksha 'O' Anusandhan University, Bhubaneswar; Indian Institute of Technology (IIT) Bhubaneswar; CSIR-Institute of Minerals and Materials Technology (IMMT) Bhubaneswar and INAE Bhubaneswar Chapter. The INAE Annual Convention 2023 was a mega event attended by Fellows, Foreign Fellows, Young Associates and Invitees and this year, there was an overwhelming attendance at Bhubaneswar, which has rich cultural heritage and famous historic temples. The convention commenced with the Inaugural Session on December 9, 2023 wherein the Welcome Address was delivered by Prof Damodar Acharya, FNAE, Chairman, Advisory Board, SOA University, Bhubaneswar and Prof PK Nanda, Vice-Chancellor, SOA University. Prof Indranil Manna, President, INAE and Vice Chancellor, Birla Institute of Technology (BIT), Mesra and former Director, IIT Kanpur delivered the Presidential Address and gave an overview of INAE highlighting the major ongoing and forthcoming technical activities undertaken with the objective of fostering the growth of engineering & technology and enhancement of engineering education in the country. He highlighted that in view of the Prime Minister's vision of an *Atmanirbhar* Bharat by 2047, technological self-reliance is an absolute necessity in all sectors including energy, habitat, transportation, defence and communication etc. He also mentioned that the Academy being a pool of most eminent engineering professionals can play a vital role in the technological progress of the nation. For example, in the thematic area of energy, the average per capita consumption of energy in the country needs enhancement. Prof Manna highlighted that India having the largest population in the world and being a young and aspiring nation requires the widescale deployment of green renewable energy technologies to meet the increasing demand for power and energy. In addition, to achieve further technological progress and advancement in the country and increase the Human Development Index in terms of health, education and living standards as a function of per capita energy consumption, there is a need to create engineering professionals from grassroot level itself to improve the quality of living. INAE can play an important role in these areas by promoting the cause of engineering and technology.

Mr. TV Narendran, FNAE, CEO and Managing Director of Tata Steel Limited, was the Chief Guest of the event and delivered the Inaugural Lecture. Mr Narendran is also currently on the Board of Tata Steel Limited and the Chairman of Tata Steel Europe. He spoke of the vital role of steel industry in the economic development of a nation. He brought out that India is the second largest producer of steel in the world, but it has a carbon footprint and there is a need to deploy greener technologies for sustainability. He spoke on the current challenges, futuristic technologies and role of interdisciplinary areas in development of greener technologies for the future of the steel manufacturing industry in the country. He emphasized that green hydrogen is key to decarbonising India's steel industry. He said that India is blessed with wealth of Iron ore and geological richness which can be leveraged for growth of the steel industry by adding steel capacity, which is pervasive requirement for other industries and growth of GDP in the nation. There is a need to find India-centric futuristic solutions to overcome technological and operational challenges for sustainability in the steel manufacturing process. He also touched upon other themes of importance such as the manufacturing industry, digitization and the contributions of the engineering fraternity in this regard. He expressed that attracting young engineering talent to core engineering areas is essential since many engineers choose other areas. Also, the industry professionals and academicians should work together to enhance the R&D activities on a larger scale and stronger capital goods industry is desirable for progress. Mr Narendran expressed that multidisciplinary activities is the need of the hour and INAE can play an active and holistic role in this regard.



*Chief Guest Mr TV Narendran, FNAE, CEO & Managing Director, Tata Steel Limited
Delivering Inaugural Talk*

A Book on “Diverse Space Applications” authored by Dr. BN Suresh, FNAE, Former President, INAE & Chancellor, Indian Institute of Space Science & Technology (IIST), Thiruvananthapuram was released which is a compilation meant to showcase the contributions of Indian Space program towards National development. The event features several important meetings wherein INAE Fellows participated such as the Governing Council Meeting, Annual General Meeting featuring a Brainstorming Session on pertinent issues for the way forward for the Academy and a Special General Meeting of Fellows wherein amendments to Rules & Regulations were deliberated. Forty-eight Fellows and five Foreign Fellows were elected this year. Some of the eminent luminaries inducted as Fellows during the Annual General Meeting of Fellows include Mr. Satya Narayana Nadella, Chairman and Chief Executive Officer of Microsoft; Mr. Sunil Bharti Mittal, Founder and Chairperson of Bharti Enterprises; Mr. K. Krithivasan, Chief Executive Officer and Managing Director of Tata Consultancy Services (TCS); Prof. TG Sitharam, Chairman, All India Council of Technical Education (AICTE), New Delhi; Mr. Ajai Chowdhry, Co-Founder- HCL, Chairman – EPIC Foundation; Mr. Girish Arun Wagh, Executive Director, Tata Motors Ltd., Mumbai; Dr. Pramod Madhukar Chaudhari, Executive Chairman, Praj Industries Ltd., Pune; Mr. Chander Prakash Gurnani, MD and CEO, Tech Mahindra; Dr. Tapan Sahoo, Executive Director (Engineering), Maruti Suzuki India Limited, Gurgaon; Mr. Sreenivas Subramoney, Intel Fellow, Director of Processor Architecture, Intel Corporation, Bengaluru; Dr. Kanakasabapathi Subramanian, Senior Vice President, Product Development, Ashok Leyland Ltd., Chennai and Prof. Indumathi M Nambi, Professor in Environmental Engineering, Department of Civil Engineering, Indian Institute of Technology Madras, Chennai . Other prominent newly inducted Fellows are Dr. M. Ravichandran, Secretary to the Govt. of India, Ministry of Earth Sciences; and Dr. Purnendu Chatterjee, Founder and Chairman of The Chatterjee Group (TCG). The newly elected Fellows, Foreign Fellows and Young Associates of INAE were inducted during the Annual General Meeting and they were presented their Fellowship/ Young Associateship Certificates accordingly. They also made brief Technical Presentations on their most significant scientific/ engineering contributions which shall be of interest for all delegates. The list of newly elected Fellows, Foreign Fellows and Young Associates can be viewed by [clicking here....](#)

The Annual Convention provided a golden opportunity for networking amongst Fellows and Young Associates and was a memorable event and is eagerly awaited by all concerned every year. The other technical highlights of the INAE Annual Convention 2023 were the First Panel Discussion on “New Tech industry”; Brief Presentations on Technical Report by Conveners, Sectional Committees; Special Talk on "Chandrayaan 3: The Mission and its Accomplishments" by Mr. S Somanath, Chairman, Space Commission, Chairman, ISRO and Secretary, Department of Space; Plenary Talk on “Green Hydrogen” by Prof. GD Yadav, FNAE, Emeritus Professor of Eminence, ICT and JC Bose National Fellow, Institute of Chemical Technology, Mumbai and Second Panel Discussion on “Artificial Intelligence in Industry 4.0 and Sustainability”. The Cultural Programme - Performance on Evolution of Odissi Dance;

Audio-Visual Presentation on Culture & Heritage of Odisha and Local Excursion tour to heritage sites in Bhubaneswar enthralled all the participants and delegates. The cultural events conducted also delighted the august audience.

Selected Photographs of Inaugural Session



Inaugural Session: L to R: Lt Col Shobhit Rai, Prof Indranil Manna, Mr TV Narendran, Prof Damodar Acharya and Prof PK Nanda



Release of Book on "Diverse Space Applications" by Dr BN Suresh, former President, INAE

For photographs of Induction Ceremony during Annual General Meeting of Fellows, Please [click Here](#)

Some Glimpses of Technical Sessions in Progress



Panel Discussion on "Artificial Intelligence in Industry 4.0 and Sustainability"



Presentations on Technical Report by Conveners, Sectional Committees



Technical Presentation in Progress



Glimpses of Audience

Local Chapter Activities and Webinar Series held during April 2023 to December 2023

The following Webinars/activities/meetings/Technical Lectures were conducted during April to December 2023 by INAE and Local Chapters.

INAE Mumbai Chapter

(i) INAE Mumbai Chapter organized a Webinar on **“Indigenisation of On-Power Fuel Handling Equipment for Pressurised Heavy Water Reactors”** by Mr. A Sanatkumar, FNAE, Formerly Distinguished Scientist and Sr. Executive Director (OP&TT), NPCIL, Mumbai held on April 1, 2023.

The summary of the talk is as follows: Nuclear Power Plants (NPPs) utilising Pressurised Heavy Water Reactors (PHWR), based on Canada’s CANDU technology, have been further evolved and developed in India. PHWRs use Natural Uranium as nuclear fuel and hence need to be endowed with ability to refuel even as they are producing energy. This essential feature is termed as ‘on-power’ (or ‘on-load’) refuelling, which has the following advantages:

- Continued safe operation over long periods of time without need for plant shut down for refuelling, thereby enabling the power plant to economically clock high-Capacity factors (in the talk, examples of such performance by some of our PHWR plants were cited);
- Remove spent fuel bundles from the reactor core thereby increasing neutron economy;
- ability to remove defective fuel bundles if any, from the core thereby reducing manrem load on the operators;
- reposition the fuel bundles in the core as required to achieve optimum energy output from them.

All of the above activities are carried out without a need for reactor shutdown. On-Power Refuelling is a highly complex, multi-disciplinary, robotic system. In view of the high technology involved, it is necessary for our country to be self-reliant in this area. Beginning with the completely imported RAPS 1 in early 1970s, over the years DAE has developed, indigenised, innovated where required, evolved and built several PHWR models comprising of sixteen numbers of 220 MWe, and two numbers of 540 MWe capacities. At present six numbers of 700 MWe reactors are under construction/commissioning while pre-project activities are on-hand towards construction of ten numbers of 700 MWe NPPs in Fleet Mode.

Evolution, innovation and indigenisation of PHWR on-power Fuel Handling Systems (FHS) are driven by

- necessary changes called for in plant layouts in NPPs built at different project sites to suit site conditions which in turn mandate corresponding changes in the design and implementation of FHS;

- difficulties experienced in import of some specialised raw materials and proprietary Standard Components due to technology control sanctions imposed;
- Operations feedback received from previously built NPPs;
- Need to establish adequate supply chains to cater to spares requirements considering these NPPs have a productive life time of at least 40 years (with possible life-extension at a future date).

During the talk, several examples of successful evolution, innovation and localisation in FHS were discussed. As at present 100 % indigenisation has been achieved in the areas of conceptual and detail design of the components required for the FHS, stress analysis, testing, construction, quality control, commissioning, operation and maintenance, trouble shooting and safety evaluation. In the latest 700 MWe project, in the area of manufacture, it is estimated that nearly 90% indigenisation has been achieved with respect to the mechanical components. Only some proprietary components and special raw materials not manufactured in India are imported.

The talk gave a few typical examples of several agencies who have, over the years, successfully collaborated with NPCIL to progressively implement indigenous Fuel Handling Systems from RAPS 2 onwards. On the basis of experience in indigenous implementation, it is felt that since a majority of equipment in the FHS do not need bulk manufacture, but need only a few numbers each, Private Sector agencies are unwilling to take up development and manufacture of these items in their shops/factories. Moreover, most often, all the equipment required for the complete manufacture of a part is not available under one roof, and they have to be processed via several job-subcontracts with agencies having the required machine tool / manufacturing equipment for the specific manufacturing operation. They are generally risk-averse to undertake this type of high-tech manufacture which also requires entering into multiple subcontracts with different private and public sector agencies. It is felt that to speed up indigenisation, purchase procedures must have some scope for mitigating potential and capable manufacturers' risks to some extent. Even so, since about the year 2000, there has been a good amount of improvement in the availability of precision manufacturing infrastructure in our country, which is why it has been possible to enhance manufacturing localisation in the 700 MWe Projects considerably. In some cases, it may be feasible to workout alternative designs and concepts in order to suit infrastructure that *is* available in our country and yet without compromising safety or the design intent. This has been followed wherever it was felt that it would be advantageous.



Talk in Progress

(ii) Talk on “**Amazing Photovoltaics: From Research Curiosity to Technology Reality**” was jointly organized by INAE Mumbai Chapter, PoTIC (Photovoltaic Technology and Innovation Centre) of IIT Bombay, IEEE EDS, and IEEE LMAG on November 8, 2023 and delivered by Dr. Lawrence L. Kazmerski, Foreign Fellow, INAE and Emeritus Research Staff Member of the National Renewable Energy Laboratory (NREL), Fellow, Renewable and Sustainable Energy Institute, University of Colorado, and Distinguished Visiting Professor at Department of Electrical Engineering IIT Bombay.

INAE Chennai Chapter

(i) INAE Chennai Chapter organized an **online Webinar on “Liquid Green Hydrogen: Technology and Application”** on **Saturday, 15th July 2023** over WebEx wherein **Prof. Sunil Kumar Sarangi, FNAE** delivered the talk.

(ii) INAE Chennai Chapter organized a Webinar on **“Asset & PROCESS Integrity Monitoring: A Lab to Market Journey”** on Saturday, 2nd September 2023 over WebEx wherein Prof Krishnan Balasubramaniam, FNAE, Institute Professor, IIT Madras delivered the said lecture. In this presentation, the journey of three technologies, all using ultrasonic guided waves as the fundamental physics of interrogation, from LAB to MARKET, were discussed. The three technologies are: 1. Higher Order Modes Clusters (HOMC) for inspection of hidden region corrosion inspection for Annular Plate of Storage Tanks and Pipe Support Locations. 2. Guided Ultrasonic Monitoring of Pipe Systems (GUMPS) for long term health monitoring of pipes in process industries and 3. Ultrasonic Waveguide based Sensors for measurement of temperature, rheology and levels.

(iii) INAE Chennai Chapter & IIT Madras joint Conference ICOM 2023 (**The 1st Indian Conference on Micro Nano Fluidics -From Soft Matter to Bioengineering**) was held on 29th September - 1st Oct 2023. ICOM 2023 was the first Indian conference on micro nano fluidics that aimed at bringing the entire micro nano fluidics community in India and distinguished researchers around the world to a single platform. It was envisaged that it would be a conference of the highest standard with some of the best researchers in the field as invited speakers, high-quality presentations selected through a rigorous review process, and a strong presence of industry. The conference provided academic researchers and industry professionals working on micro nano fluidics within the country and around the world a platform to discuss some of the most recent research findings and exchange ideas on some of the field's emerging topics. The conference also attempted to examine current challenges and open questions and identify impactful research problems through a panel discussion session that resulted in a draft roadmap for future research.

INAE Bhubaneswar Chapter

(i) The 24th Lecture of the Distinguished Lecture series organized by INAE Bhubaneswar Chapter, jointly with SOA University, IMMT Bhubaneswar and IEEE Bhubaneswar Sub-section on April 18, 2023 on **"Declining Interest in engineering education: quality concerns, causes and suggested policy interventions"** by Professor Prem Vrat, Chairman Board of Governors of Indian Institute of Technology (ISM) Dhanbad.

Prof. Prem Vrat's deliberation covers major imbalances in technical education system such as regional imbalance and branch imbalance. He suggested NEP 2020 has proposed a light but tight philosophy and single regulator under HECL. However quality needs to be nurtured rather than regulated. Myopic viewpoint in present managing institutions which is reflected in short term view of compromising with quality. Some suggestions suggested by him were: 1. Pro-active Industry Involvement in planning, running academic programs; joint project supervision. 2. Explore Implementing NEP-2020 provisions - flexibility, cross subsidizing; Australian Funding model of education. Postpone allocation to a specific branch to second year so that a person may choose based on the interest rather than follow the crowd model. NEP is a good hope if implemented effectively. It attempts to reduce the difference due to public vs. private but on performance and quality. 3. Medical education analogy - attach an Industry with the engineering college like a hospital with a medical college. 4. Broad base UG degrees - general engineering / multi-disciplinary inputs Instead of overspecializing at UG level. 5. Industry sponsored B.Tech program - specific core engineering programme select the person from the pool of applicants and support them throughout: pro-actively guiding about courses; projects to be taken and eventually

they get employed there. Analogous to NCC, in which C-certificate holders could get into defense services directly from campus. A balanced engineering as per demand will be possible through. Prof. discussed two models of Cost of Quality (COQ). 64 people participated in the lecture. You tube Link to the Video : https://youtu.be/VqKyF21_T5E

(ii) The 25th Lecture of the Distinguished Lecture series was organized by INAE Bhubaneswar Chapter, jointly with SOA University, IMMT Bhubaneswar and IEEE Bhubaneswar Sub-section on 11th May 2023" wherein Dr. Jagannath Nayak, Centre for High Energy System and Science, Hyderabad delivered a lecture on **"Lasers or Missiles- Which one to select for Air-Defence Applications"**.

The Key Points covered in the lecture are as follows. The missiles for aerial target engagement and neutralization are well established. But the potential and advantages of a beam weapon with lethal, precise, speed-of-light engagement are numerous and emerging. However, actual system deployed in field and realities need to be considered for any program to succeed. The laser based Directed Energy Weapon (DEW) system offers viable solution as it is fully electric laser due to fibre optic components technology. The system has advantages for operation, deployment including logistic supportability, and cost. Thus, by using Laser, one could enable the Armed forces to address adverse cost-exchange situations, which can occur when engaging inexpensive threats such as unmanned aerial vehicles (UAVs). The ability to accurately point a laser beam is becoming increasingly important. The high-power laser system is composed of several assemblies to carry out multiple functions. The target engagement starts with a cueing sensor to indicate the target location, and then the beam control switches to engagement mode, in which the operator locks the target with electro-optic tracking system (EOTS) integrated on the laser platform. Once the target is locked the EOTS will track the target. Then target is illuminated to carry out fine pointing with micro-radian accuracy through active imaging. Laser beam focusing at the target is assisted by a laser range finder. The fine pointing tracking of the target by high rate camera and associated image processor allows high precision servo control of the Fast Steering Mirror (FSM) for precise pointing of the laser beam on the designated spot of the target engagement and neutralization. This talk addressed the core technological challenges towards development of different types of High-power Laser and Beam control technology. The weapon system for fine pointing of laser beam to the target with micro-radian accuracy to achieve maximum lethality for different types of aerial target was presented. The latest research on layer defence by adaptive hybrid approach, where both lasers and Missiles are used to improve performance of probability of kill was also presented. 58 people participated in the lecture.

(iii) INAE Bhubaneswar Chapter jointly organized with SOA University, CSIR-IMMT Bhubaneswar, IIT Bhubaneswar and IEEE Bhubaneswar Sub-section the Lecture-26 of the Distinguished Lecture Series on **"From Research to Innovation: A Way forward for India's Higher Educational Institutions"** by Prof. V. Ramgopal Rao, Group Vice-Chancellor, BITS Pilani & Former Director, IIT Delhi online on 18th September 2023.

The Key Points presented in the lecture are as follows. India's contribution to the world's R&D is steadily increasing. In certain specialized areas such as Nanotechnology, India is among the top 3 countries in the world in terms of research publications. Despite the low percentage of GDP spending for R&D in India, Indian researchers have excelled in research output, when measured in terms of the number of research publications. Though these are excellent achievements, the situation is entirely different when one looks at the innovation or the product development potential in the country. For example, India ranks very poorly on the Global Innovation Index (GII), and the research undertaken by Indian academic institutions, whether public or private hasn't resulted in any major technological breakthrough of significant commercial value. Given this scenario, in order to make the Indian research competitive and sustainable in terms of innovation and product development, a multitude of initiatives are required to be taken at the institutional and national level. In this talk, Prof Rao discussed the changing scenario for product innovation in Indian academic and R&D institutions, and also showed

how one can accelerate the culture of product innovation in the country through a multi-disciplinary approach. 68 people participated in the lecture.

You tube Link to the Video: https://youtu.be/DNm4YBjR_Cg

(iv) INAE Bhubaneswar Local Chapter - 27th Lecture of the Distinguished series online lecture was held on 14th October 2023 on "**Advancing Science and Serving Humanity**" by Dr. Tapan K. Gandhi, Professor in the Dept. of Electrical Engineering, Cadence Chair Professor of AI and Automation, Joint Faculty in School of AI, IIT Delhi.

The Key points of the lecture were: The fields of neuroscience and artificial intelligence (AI) have a long and intertwined history. In more recent times, however, communication and collaboration between the two fields has become less commonplace. Understanding how the brain works is considered to be one of the greatest frontiers in modern science and technology. Research in this area is driven not only by curiosity, but also the possibility of making a profound impact on the real world. By advancing our knowledge about the brain, we can help the many millions of people who suffer from neurological disorders, and also realize the promise of artificial intelligence. Some of his work was highlighted that he had undertaken at the intersection of Neuroscience and AI in last few years. Through his work, he demonstrated how humanitarian research will help in advancement of fundamental science that has huge societal impact and in the same time will inspire in building intelligent machines for future applications. 45 people participated in the lecture.

(v) INAE Bhubaneswar Local Chapter - 28th Lecture of the Distinguished series online lectures was held on 26th Oct 2023 on "**Empowering Renewable Energy Integration: A Smart Grid Initiative at IIT Roorkee**" by Dr. Narayana Prasad Padhy, Director, MNIT Jaipur.

The key points covered are highlighted. This project embodies the core objective of the Mission Innovation Challenge on smart grids, seeking to construct cost-effective, resilient, and renewable-powered grids while reducing fossil fuel dependency. It focuses on India's transition to renewable energy, primarily wind and solar, which contribute significantly to the nation's energy portfolio. Recognizing the complexities that arise with the rapid integration of solar energy into distribution systems, the project proposes a standardized approach of incorporating energy storage systems at strategic points within the distribution network. This initiative, carried out at the Indian Institute of Technology Roorkee, serves as a practical demonstration, illustrating the possibilities and benefits of integrating energy storage into real-world applications. The primary challenge involves optimizing the allocation of energy storage systems considering various factors. The project employs mixed-integer linear programming to identify the ideal size and location of batteries within the distribution network. Furthermore, the study explores two-layer control strategies, ensuring voltage stability and facilitating seamless transitions between grid-connected and islanded mode to enhance reliability. In addressing the critical issue of frequency regulation, project leverages energy storage and inverters to mimic the functions of traditional generators. By optimizing five locations for energy storage and validating control strategies through Power Hardware in Loop (PHIL) simulations, this project aims to showcase the practicality and benefits of smart grid technologies. Two battery energy storage systems (BESS) have already been implemented on the IIT Roorkee campus, marking a significant milestone in achieving a self-sustaining, zero-emission green campus. This project not only aids India's renewable energy ambitions but also serves as a global benchmark for efficient energy management and grid resilience in smart campuses. 48 people participated in the lecture.

Youtube Link to the Video: <https://youtu.be/DuwBADE30D0>

INAE Bhubaneswar Local Chapter - 29th Lecture of the Distinguished series online lectures was held on 28th Oct 2023 on "**Modeling, Analysis and Control of the National Air Transportation System**" by Dr. P. K. Menon, Ph.D, Optimal Synthesis Inc., Los Altos, California, USA.

The Key Points covered in the lecture are as follows. The air transportation system is a critical element of all modern economies. The air traffic volume has been experiencing a secular growth over the past three decades, punctuated by two years of the global pandemic. Following the pandemic, the traffic volume has resumed its upward trend with reinforced vigour, especially in India and China. Over the coming decades, this trend is likely to continue, as evidenced by the number of commercial jet transport aircraft orders being placed with major aircraft manufacturers in 2023. Additionally, the recent Urban Air Mobility initiatives being pursued at various population centres around the world are likely to further add to the air traffic volume. Since the airports and terminal airspaces are limited resources, these increases in air traffic volume are expected to lead to severe bottlenecks and the attendant logistic problems. Weather induced attenuation of these resources will introduce additional uncertainties in the system. Recent news items indicate that these effects are already being manifested at several airports around the world. These factors have prompted government agencies responsible for regulating air traffic to launch research initiatives for developing methods and tools to ensure the continued safe and efficient operation of the air traffic system. This talk focused on some of these research initiatives, and the development of potential solutions using the mathematical tools from the Dynamic Systems Theory. The presentation was from a non-specialist's point-of-view. 52 people participated in the lecture.

INAE Kolkata Chapter

Celebrating the National Engineers' Day 2023 by INAE Kolkata Chapter

INAE Kolkata Chapter celebrated the National Engineers' Day on 15 September 2023 at MCKV College of Engineering, Liluah, Howrah. On this occasion, Prof. Sivaji Chakravorti, FNAE, FNASC, President WAST, and Professor of Electrical Engineering Department of Jadavpur University, delivered the Engineers Day Lecture on "**Evolution of the frequency at which we get the electrical power supply**". In his illuminating lecture, Prof. Chakravorti took the audience back to the origin of electric power distribution and how the value of grid frequency took its present values as the widely differing practices followed in different parts of the world gradually converged. The talk was not only unique, but also rich in content. It was an eye-opener for the budding engineers because it described how sustained engineering effort, through multiple iterations and optimization, goes into arriving at certain apparently sacrosanct things – the grid frequency is one of those – which common people generally take for granted. The lecture shed light on the evolution of electrical power systems in different parts of the world. The talk further highlighted how India secured its place in the global electric power map as early as in the nineteenth century. Immense engineering contributions of Sir Mokshagundam Visvesvaraya was also fondly remembered in this regard through the course of discussion that followed the lecture. The talk was attended by nearly eighty students, researchers and faculty members of different disciplines. The program was also attended by a few INAE Fellows. The talk was followed by a Q&A session and it ensued engaging discussions between the students, participants and the INAE Fellows present at the venue.

Prof. A. Lahiri, Principal, MCKV College of Engineering, formally welcomed the gathering at the outset, and Prof. Debatosh Guha, Chair, INAE Kolkata Chapter conducted the proceedings of the meeting. Prior to the talk of Prof. Chakravorti, Prof. Guha spoke a few words about the origin, mission and vision of INAE and highlighted the various programs and initiatives taken by INAE. Prof. Sivaji Chakravorti also elaborated upon INAE activities, particularly the ones promoting innovations amongst the students, and briefly touched upon the processes of selection of INAE Young Associates and election of the Fellows of the Academy. The program ended with a formal vote of thanks offered by Prof. Ranjan Ganguly, Secretary, INAE Kolkata Chapter.

Glimpses of the National Engineers' Day on 15 September 2023 celebrated at MCKV College of Engineering.



Prof. S. Chakravorti delivering the lecture



Prof. D. Guha conducting the proceedings



Audience listening to Prof. S. Chakravorti



Prof. S. Chakravorti delivering the lecture



Felicitation of the speaker



Vote of Thanks at the end of the program

INAE Bangalore Chapter

CSIR-National Aerospace Laboratories organizes Prof. Roddam Narasimha Memorial Lecture every year on July 20th, which happens to be Prof. Narasimha's birthday. This year, the second Prof. Roddam Narasimha Memorial Lecture was delivered by Prof. **Sanjay Mittal**, IIT Kanpur on **20th July 2023 (Thursday)** at SR Valluri Auditorium, NAL, Bangalore held in a hybrid mode. The title of the lecture was “**Swing, Reverse-Swing and Knuckle Ball: Transition of Boundary Layer**”.

Meetings of Forum on Civil Infrastructure held at New Delhi in hybrid mode

Several Meetings of the Forum on Civil Infrastructure were held at New Delhi in hybrid mode to discuss the Study being undertaken by the Forum on “Sustainable Materials for Civil Infrastructure” It is proposed to prepare a study report with recommendations on policies and actions required for sustainability in demand and supply of materials for civil infrastructure. The study will attempt to quantify, on a decade basis, (i) the expected quantities of conventional materials that will be required, and quantity likely to be produced and be available and (ii) the expected quantities of alternative and

innovative as well as waste materials that can be expected to be produced and used, including the merits of their use. This, in turn, will provide a realistic basis for taking up policy initiatives to replace undesirable materials with the more sustainable ones by appropriate directives. During the Meeting of INAE Forum on Civil Infrastructure held virtually on 3rd October 2023, the progress on the project on “Sustainability of Built Infrastructure” was discussed and inputs to be provided by the Members was crystallized. It was expected that Extended Abstracts will be available shortly for circulation amongst the Forum members, which would be finalized.

International Affairs

6th INAE-NAEK, South Korea Workshop on “Perspective on Space Development”

INAE and NAEK, South Korea have been engaged in organizing the series of workshop since 2017. This year 6th INAE-NAEK Workshop was organized on August 29-30, 2023 in hybrid mode at two cities – New Delhi (for INAE participants) and Seoul (for NAEK participants). The theme of the workshop was “Perspective on Space Development” which covered two technical sessions viz. ‘Technical Session I: Development of Satellite’ and ‘Technical Session II: Space exploration and policy’. Researchers and Academicians from the two countries were invited to participate in it. The workshop inaugurated with welcome address by Dr. Kinan Kim, President, National Academy of Engineering of Korea (NAEK), South Korea, and Prof. Indranil Manna, President INAE. Both presidents lauded the success of the recent Chandrayaan-3 mission. They emphasized on the vision of the two academies and called for increased international co-operation/collaboration encompassing industry and academia. The inaugural session was followed by two keynote speeches. Mr. S Somanath (Chairman ISRO; Secretary, Department of Space, Government of India; Chairman, Space Commission) presented the accomplishments of Indian space programme and future visions of ISRO. He stressed on PPP models as the way forward in the development of space infrastructure in the country. The second keynote speech by Dr. Sang-Ryool Lee (President, KARI) was on an overview of the National Space Program of Korea, and the current and future space missions of the country. He shared that a government agency KASA (Korean Administration for Space and Aeronautics) is set to be established for the promotion of the Space programs.

The technical talks of the workshop were split in two sessions with four presentations in each session. The theme of the first session was Development of Satellite. The session was moderated by Prof. Sanjay Mittal (IIT Kanpur) and Prof. Sung Hoon Ahn (Seoul National University). It opened with the talk by Prof. Daegwon Kim (KARI) on the development and journey of the Korea Pathfinder Lunar Orbiter - Korea’s first space exploration program. The next talk by Prof. Debasish Ghose (IISc Bangalore) was on the various space-tech start-ups in India, and their role in increasing the reach of the space programs to traditional sectors like agriculture, FMCG, etc. Prof. Hyochoong Bang (KAIST) elaborated on the challenges posed by increasing density of space debris, and proposed solutions for mitigating them. The final talk of the first session was delivered by Prof. Alope Kumar (IISc Bangalore). He introduced Lab-on-Chip paradigm, and its utility regarding biological experiments, diagnostics and drug delivery during a space mission. The session closed with concluding remarks from the moderators.



Technical Sessions in Progress

The second technical session of the workshop was on Space Exploration and Policies. Dr. VR Lalithambika (IIT Madras) and Prof. Jai-ick Yoh (Seoul National University) jointly moderated the session. The first talk in the session, delivered by Dr. Jongwook Park (KASI), was on current bilateral collaborations of Korea in space exploration, and need for promoting international co-operations. Dr. CVS Kiran (Skyroot Aerospace Private Limited) introduced Skyroot Aerospace and elaborated on company's mission of providing on-demand and reliable satellite launch. Dr. Sangwoo Shin (KARI) highlighted Korea's new space policy with emphasis on policies for international collaboration. He presented roadmap for future space programs and strategies for realizing it. The fourth talk of the workshop was delivered by Dr. V Adimurthy (VSSC-ISRO) on the role of multi-disciplinary design process in achieving safe and sustainable missions. He listed the various future planetary missions planned/envisaged by ISRO and elaborated on the strategies for planetary defense against asteroids.

The talks were followed by concluding remarks from the moderators. The final event of the workshop was a Valedictory Session, chaired by Prof. Manna and Prof. Song wherein the participants of the workshop had a detailed discussion on the way forward for collaboration between India and Korea on Space Development. Some of the proposals made towards the same were (a) identifying topics for joint space research, (b) promoting industry academia collaboration between the two countries, (c) explore funding opportunities, and (d) embrace possibilities of mobility of students and researchers. The talks were followed by concluding remarks from the moderators.

CAETS 2023 conference on "e2-mobility Solutions and Opportunities," held in Zagreb in October 9-11, 2023.

The CAETS 2023 conference on "e2-mobility. Solutions and Opportunities," was held in Zagreb in October 9-11, 2023, and brought together leading scientists, researchers and experts in the fields of mobility, electrification of transport, integration with energy systems, batteries, refueling, autonomous driving and changes in mobility modalities. Over the course of five sessions, 28 experts and scientists from around the world participated. INAE Delegation led by Prof Indranil Manna, President, INAE participated in the event. Prof Sushmita Mitra, FNAE participated in the CAETS Working Group: Diversity and Inclusion held online on 3 October 2023. Prof Indranil Manna also participated in the Twelfth Academy of Engineering President's Meeting at STS forum 2023 held online on October 2, 2023 wherein a discussion was held on 'AI and Human Society'. INAE's contribution in CAETS activities was appreciated.

CAETS Engineering Education Working Group

The International Council of Academies of Technological Sciences (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. As requested by CAETS, Prof Indranil Manna, President,

INAE is the Chair of the Working Group with Vice-Chair Dr Katherine Frase Retired Senior Executive from IBM who is active in the US National Academy of Engineering. The Overall objectives of the EEWG are: (i) to create a community across the academies to be able to determine common points of interest concerning status updates on the current framework and priority areas; (ii) to create reports of best practices and policy recommendations to address the concerns and challenges perceived by our member academies in Engineering Education; (iii) to author specific reports related to education delivery methods (physical, virtual, simulation, hybrid); sustainable development goals, engineering ethics, technology forecasting, and engineering pipeline/demographics; and (iv) to develop a virtual platform for networking to facilitate cooperation and collaboration on engineering education among the member academies. Academies' representatives from twenty-two countries are the members of this Working group. Prof GK Ananthasuresh (FNAE), IISc Bangalore and Prof Amit Agrawal (FNAE), IIT Bombay are also members of the EEWG from INAE. It is envisaged to prepare a combined report to cover the topics in engineering education such as flexibility, adaptability, problem-solving, gender parity, ethics / social responsibility / global awareness, promoting quality and mobility etc. Several meetings have been held online so far to arrive at the recommendations based on the laid down objectives of the Working Group.

CAETS Communication Committee

INAE being an only engineering academy in the country represents the Country at the CAETS as one of its member academies. INAE actively participates in CAETS activities and INAE Fellows are invited to represent in various committees. One such committee is the CAETS Communication Committee which is 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. A recent meeting of the subject Committee was held on July 7, 2023 to provide feedback on CAETS Energy Committee report on e-mobility which is to be launched shortly.

INAE Publications

(i) 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 8, Issue 2, June 2023; Volume 8, Issue 3, September 2023 and Volume 8, Issue 4, December 2023** were published through Springer Publishers during the period April 2023 to January 2024.

(ii) Preparation of high quality reports on engineering and technology: Meetings were held of 10 INAE Sectional Committees to discuss the way forward to generate quality expert report on contemporary issues related to Engineering & Technology relevant to the country, that are the outcome of deeply researched studies or surveys on contemporary challenges in engineering and technology and are neither published anywhere nor available in any public domain; but are of immense value to an entrepreneur, a government department, an industrial organization, or a policy making unit. This exercise is to be carried out by exploiting the most eminent talent and expert pool in the Fellowship to offer the most effective, timely and exclusive service to the nation and the profession and do justice to the existence and standing of INAE. The Sectional Committees are progressing this initiative and it is envisaged that several reports shall be prepared within the year.

Donations to INAE Corpus Fund

Prof Indranil Manna, President, INAE has written several letters addressed to the Fellowship in which 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. 31st March 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 last 10 months since the formal letter from DST (dated 6.5.22) was served to INAE about disengagement. While efforts would continue 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.

He further brought out that Engineering is all about evolving viable solution to prevailing or future challenges and aspirations. Hence, the present crisis may be viewed as an opportunity for INAE to emerge stronger and more resolute to fulfil its core objective of serving the profession and the nation in a more comprehensive manner. He hoped that each Fellow would agree that the onus of confronting the current crisis and eventually winning over can rest neither on a few office bearers nor only on a nominated committee. If INAE has to tide over this unprecedented and most unfortunate crisis, every single Fellow, Associate, Awardee and mentor of INAE must come forward and make a useful and decisive contribution. In this direction, he apprised that after sustained efforts, INAE has been given the approval by the Competent Authority for the creation of a new corpus fund from INAE's own resources (internal accruals) in accordance with the Rule 229 (iv) & (v) of General Financial Rules (GFR), 2017 of the GoI on 24th March 2023. Contributions have since been received for INAE Corpus Fund from INAE Fellowship and the process is ongoing. 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 for those under old tax regime. The donors will get a receipt and the 80G certificate within a quarter.

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. The particulars of the donors are being planned to be displayed on INAE Website giving out three particulars namely, photo, name, and year of donation.

Brainstorming Meetings organized on the way forward for INAE

INAE is in the process of working towards self-sustenance and financial autonomy in light of fact 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. 31st March 2025. A series of actions have been taken by INAE since then to address the issue. Two Brain Storming Meetings were held at Bangalore on August 5, 2023 in physical mode to discuss the current challenges being faced by the Academy. The first Brainstorming Meet on "INAE Mission, Vision and Objectives – An Assessment for Future Readiness" was held in the forenoon at Indian Institute of Science, Bangalore organized jointly with INAE Bangalore Chapter, which was attended by about 30 Fellows. A follow-up Special Meeting of selected INAE Fellows on "INAE's roadmap for Financial and Functional Autonomy" was also organized during the same evening Bangalore which was attended by about 20 Fellows. Meaningful suggestions and action -plans on the way forward emanated from the deliberations of both meetings.



Brainstorming Meeting at Bangalore on August 5, 2023

A meeting of INAE Delhi Chapter was organized to seek views, suggestions, and help to formulate a strategy for future sustenance on 21st September 2023 at office of Director IIT Delhi in physical mode. A similar meeting was also organized on 22nd September 2023 at IIT Bombay. A Brainstorming session hosted by Dr Manish Gupta, FNAE was also held on 7th December 2023 at the Google RMZ Infinity office, Bangalore.



Meeting of INAE Delhi Chapter at IIT Delhi on September 21, 2023



Group Photo During Brainstorming Session at Bangalore on December 7, 2023

New Categories of Memberships Introduced in INAE

During the 35th Annual General Meeting (AGM) of Fellows - (Part - B) held on December 11, 2023 at Siksha O Anusandhan University, Bhubaneswar in hybrid mode it was informed that INAE is committed to raise a Corpus Fund of Rs.100 crores for its sustenance over the next one and a half years' time mainly through six sources of generation of funds, viz., (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. Larsen & Toubro Ltd. has agreed to be a donor under the Platinum category of INAE, to be released over the next five years in five equal instalments. So far about 10 premier Educational Institutions/Organizations have already become Institutional Member of INAE/accepted in principle for the same and each of them have/would contribute Rs.10 lakhs against Institutional Membership of INAE in near future. An appeal was made to the Corporate Leaders who have been elected as INAE Fellows affiliated to the category 'Industry' may contribute to this noble cause and help INAE in strengthen its current drive for generation of funds to attain financial and operational autonomy. By virtue of implementing proposed schemes for generation of funds with immediate effect, certain relevant Rules & Regulations of INAE as recommended by the Governing Council were amended with immediate effect. The process of inviting nominations from corporates, institutions and individuals under different categories of Membership has commenced and is being progressed vigorously.

Important Meetings held during April to December 2023

April 2023

- i. First Meeting of PMAC for SERB-INAE Digital and online Gaming Research initiative held on April 6, 2023 in hybrid mode.
- ii. Discussion Meetings held to identify topics to make a research report by Sectional Committees on April 13th, 20th, 26th and 29th, 2023

May 2023

- i. Meeting of Conveners with Prof Sivaji Chakravorti, Vice-President, INAE to discuss important issues regarding Fellowship nominations.
- ii. First Meetings of Sectional Committees held online on May 9th, 11th, 12th, 15th, 16th, and 17th 2023

June 2023

- i. Finance Committee Meeting on June 21, 2023 in hybrid mode.
- ii. INAE Corpus fund Steering Committee Meeting in June 21, 2023 in hybrid mode
- iii. Governing Council Meeting on June 30, 2023 in hybrid mode at New Delhi

July 2023

- i. Meeting of CAETS Engineering Education Working Group online on July 27, 2023
- ii. Second Meeting of Sectional Committees for shortlisting of nominations on July 4th, 5th, 10th, 11th, 12th, 13th, 14th, 17th, 18th and 19th, 2023

August 2023

- i. Selection Committee Meeting for Foreign Fellows on August 8, 2023 over WebEx.
- ii. Selection Committee meeting for Election of Fellows under Rule 37(g) held on 8th August 2023 over WebEx.
- iii. Selection Committee Meeting for INAE Young Associates held on August 10-11, 2023 over WebEx
- iv. Meeting of Annual Convention Organizing Committee held on August 16, 2023 over WebEx
- v. Governing Council Meeting on August 18, 2023 held at New Delhi in hybrid mode wherein main agenda included selection of nominees for INAE Fellowship
- vi. Annual General Meeting (AGM) of Fellows and Special General Meeting (SGM) of Fellows held on August 18, 2023 at New Delhi in hybrid mode

September 2023

- i. Meeting for planning conduct of Engineers Conclave 2023 held on September 13, 2023 over WebEx
- ii. Discussion meeting on final composition of Project Evaluation Committee (PEC) for Indo-Taiwan co-operation in S&T Program held on September 19, 2023 over WebEx.
- iii. Discussion meeting for Finalizing the conduct of Engineers Conclave 2023 held on September 20, 2023 over WebEx.
- iv. 45th Apex Committee Meeting on September 25, 2023 over WebEx
- v. INAE Digital Platform Committee meeting on September 27, 2023 over WebEx

October 2023

- i. Special Apex Committee Meeting held on 6th October 2023 at Indore
- ii. Meeting of the Annual Convention Organizing Committee (ACOC) held on 16th October 2023 over WebEx
- iii. 45th Apex Committee meeting being held on 28th October 2023 (Saturday) over WebEx

November 2023

- i. Meeting of the INAE Forum on Civil Infrastructure held on November 8, 2023 over WebEx
- ii. Meeting of the Conveners/Reps of all Sectional Committees with President, INAE held online on November 15, 2023 to discuss progress and modalities for Presentations on proposed Technology Review / Forecasting / Gap Analysis Reports during INAE Annual Convention 2023.
- iii. Meeting to review proposed INAE Schemes for generation of Corpus Fund of INAE held online on November 16, 2023.
- iv. Third Meeting of Annual Convention Organizing Committee held online on November 17, 2023 to discuss progress of the INAE Annual Convention 2023 to be held at Bhubaneswar
- v. Meeting of the 39th Finance Committee held on 21st November 2023 over WebEx.
- vi. Meeting of the Search-cum-Selection Committee to be held on 27th November 2023 for recommending Vice-President (Academic, Professional and International Affairs) and one-third members of the Governing Council effective from 1st January 2024 to the Governing Council for its approval.

vii. Special Governing Council meeting to be held on 30th November 2023 over WebEx.

December 2023

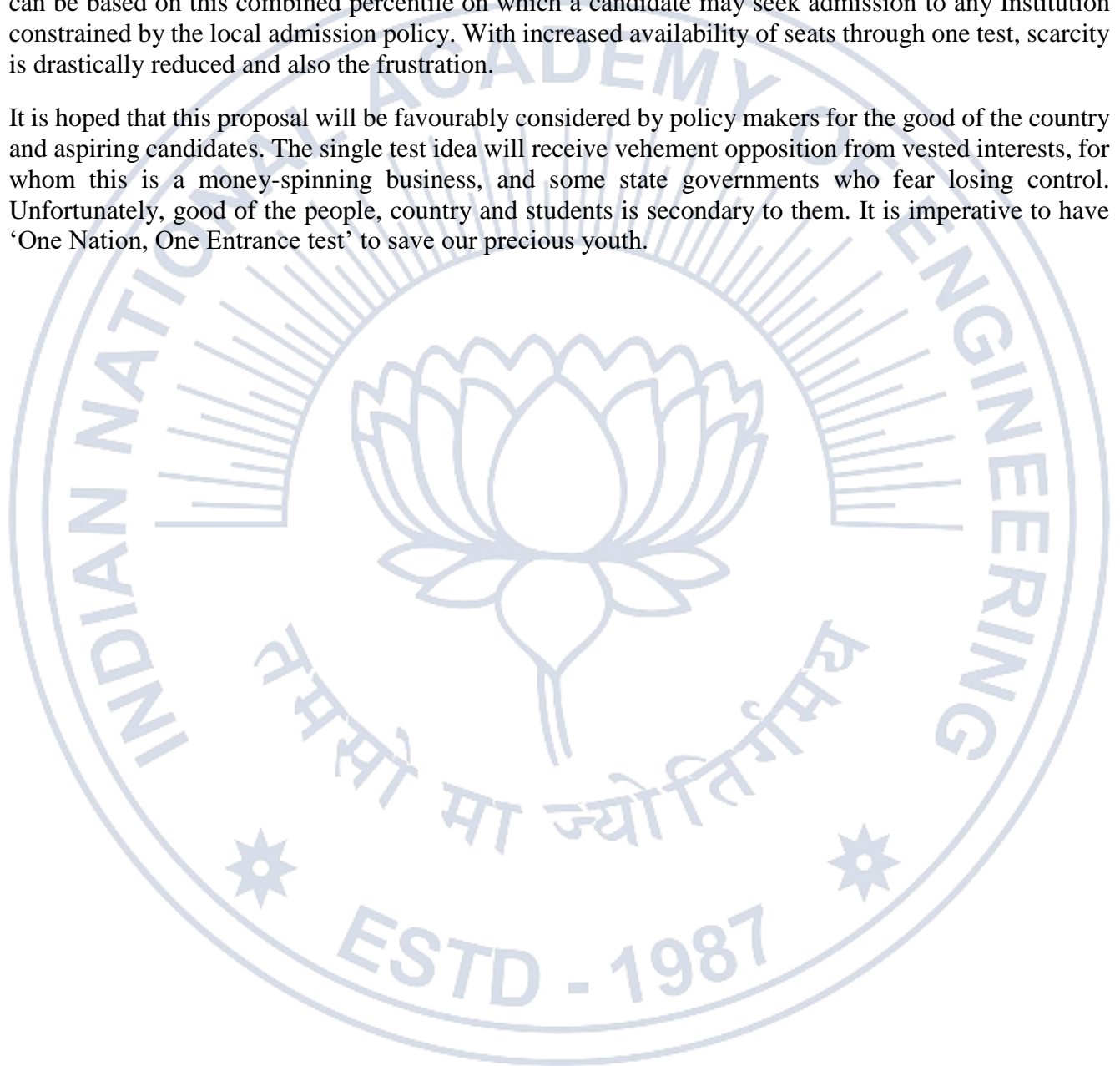
- i. Brainstorming session hosted by INAE Bangalore Chapter on 7th December 2023 at the Google RMZ Infinity office, Bangalore for generation of Corpus Funds in view of current challenge and to discuss the way forward.
- ii. CAETS Communications Committee Quarterly Meeting held online on December 6th, 2023 attended by Representative from INAE.
- iii. 149th Governing Council Meeting held on December 9, 2023 at Siksha O Anusandhan University, Bhubaneswar in hybrid mode.
- iv. Annual General meeting (AGM) of Fellows (Part-B) and Special General Meeting (SGM) of Fellows held on December 11, 2023 at Siksha O Anusandhan University, Bhubaneswar in hybrid mode.

Articles/Contributions by INAE Fellows
One Nation, One Entrance Test to Save Our Youth
by Prof SS Murthy, FNAE, Professor (Retd). IIT Delhi, Formerly Director
NITK Surathkal & Vice Chancellor, Central University of Karnataka.

Establishing unified National Testing Agency (NTA) for admissions to higher education by Govt of India (GoI) was a welcome step presuming it is manned by expert academics with integrity. It is imperative that question papers are set by faculty from National Institutions with proven expertise and impeccable integrity similar to those of IIT JEE. Similarly, one NEET exam for medical admission on all India basis mandated by Supreme Court is a great idea that unburdens the students. These are steps to unify the country. Similarly, we must have one all India entrance test for Engineering admissions to replace multiple tests conducted by several govt and private agencies. Such multiple tests have become lucrative money-making business for organizers conducting them. Tests conducted by many private entities tend to be a racket with dubious results used to extract donations from the weak. Their transparency is suspect and candidates are victims. Such tests have resulted in a huge coaching industry whose annual turnover according to Ashok Thakur, former higher education secretary, was a whopping Rs. 1.2 lakh crore a decade ago which must have now crossed Rs 2 lakh crores which is higher than the higher education budget of GoI. This is the hard-earned money of middle-class parents. Coaching centers spend huge money on full page newspaper advertisements and IITs cannot afford even a fraction of the same- they only resort to websites to advertise even faculty positions. Salary of teachers of these centers is far higher compared to IIT professors. Our 10+2 students aspiring for professional courses are a harassed lot. They go into hibernation during this period cut off from the world devoid of any social or co-curricular activities. They are focused on how to crack entrance tests driven by coaching engine. Multiple tests are huge burden to them often driving many to depression. There are nearly 20 suicides in Kota the coaching capital of India last year. There are 42 reported school stress related suicides per day in the country which is a cruel reflection of our coaching driven education system and any step to unburden them is welcome. Current system under-emphasizes board exams that rarely count. Even teaching in schools is a casualty and just a formality. There is a new racket wherein schools subcontract coaching centres which is quite common in Kota. Schools only give attendance with little teaching as everything happens in coaching centres. In board exams questions are set to ensure that maximum students pass while questions of entrance tests are such that maximum fail. This is a catch 22 situation where a candidate has to take tests of differing emphasis needing special training for entrance test. In view of the above chaotic situation it is proposed here that we have only one all India entrance test for engineering admissions under the ideal 'One Nation, One Entrance test' similar to NEET. Common test (CUET) for central universities mandated by UGC is a welcome step for nonprofessional courses. NTA conducted JEE (Mains) can de facto be that National test for all Engineering UG admissions. JEE (Advanced) can be scrapped as it does not serve much purpose except to add stress to students. Result

of JEE (Mains) is sufficient as additional test is not likely to throw an altogether new merit list. Logically two exams cannot result in entirely two separate merit spectra. However about 10% of JEE (Mains) questions can have increased difficulty levels so that only the brighter candidates may attempt who deserve to be in IIT. With one test both purposes may be served. Another important aspect is to factor board exam results in the admission process to give recognition to formal education and to instil seriousness among candidates to board. In no advanced country board exam performance is ignored although they consider common test such as SAT of USA. Since both entrance test and board exam can provide percentile score, average of the two can be taken as the final percentile assuming that merit of candidates of same percentile of all boards will be equal at National level. National merit list or ranking can be based on this combined percentile on which a candidate may seek admission to any Institution constrained by the local admission policy. With increased availability of seats through one test, scarcity is drastically reduced and also the frustration.

It is hoped that this proposal will be favourably considered by policy makers for the good of the country and aspiring candidates. The single test idea will receive vehement opposition from vested interests, for whom this is a money-spinning business, and some state governments who fear losing control. Unfortunately, good of the people, country and students is secondary to them. It is imperative to have 'One Nation, One Entrance test' to save our precious youth.



Important Meetings held during January, February and March 2023

List of Meetings in January 2023

- Jan 18 42nd Apex Committee Meeting on 18th Jan 2023 (Wednesday) at 5 PM
- Jan 27 CMP Services Management INAE
- Jan 28 Character in Globalization: Retaining dignity and individuality in a not so flat world of free-market and globalization.
- Jan 31 Chemical Parks in India: Sparking a Game changer

List of Meetings in February 2023

- Feb 7 Meeting of INAE Local Chapters Chairpersons/Office Bearers with President, INAE on 7th February from 5 PM to 6:30 PM
- Feb 9 Meeting on future of INAE
- Feb 16 Meeting of CAETS Engineering Education Working Group
- Feb 21 43rd Apex Committee Meeting on 21st February 2023 (Tuesday) from 4 PM to 5:30 PM
- Feb 27 CSIR-INAE Consultative Committee Meeting

List of Meetings in March 2023

- Mar 6 SERB-INAE Consultative Committee Meeting.
- Mar 11 Women contributions in engineering and technology
- Mar 21 37th Finance Committee meeting on 21st March 2023 (Tuesday) from 3 PM to 4 PM
- Mar 24 Meeting of the INAE Forum on Civil Infrastructure (HOUSING)
- Mar 25 Preliminary meeting from 9:30 AM to 10 AM on 25th March 2023 (Saturday) prior to Advisory Committee meeting
- Mar 25 INAE Corpus Fund - Meeting of the Advisory Committee at 10:30 AM on 25th March 2023 (Saturday) over WebEx
- Mar 25 *Atmanirbhar Bharat* through Reforms in Engineering Education
- Mar 25 INAE Corpus Fund - Meeting of the Steering Committee from 4 PM to 5 PM on 25th March 2023 (Saturday) over WebEx
- Mar 27 Proposed online meeting of Conveners of all Sectional Committees with President, INAE from 10 AM to 10:45 AM on 27th March 2023
- Mar 27 146th Governing Council meeting on 27th March 2023 (Monday) from 11 AM to 3 PM in hybrid mode at IIC, New Delhi
- Mar 31 Meeting of CAETS Engineering Education Working Group

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

International Conference on Advanced Innovative Research in Engineering and Technology (ICAIRET 2024); online and in-person on 13th to 15th March 2024 at Aizawl, Mizoram
<https://conferencealerts.com/show-event?id=259438>

4th International Conference on Artificial Intelligence and Smart Computing; in-person on 14th to 16th March 2024 at Erode, Tamilnadu
<https://conferencealerts.com/show-event?id=260434>

International Conference on Recent Advances in Mechanical Engineering and Nanomaterials (SCOPUS/WoS/UGC CARE); online on 16th to 17th March 2024
<https://conferencealerts.com/show-event?id=258220>

4th International Conference on Artificial Intelligence, 5G Communications and Network Technologies; online and in-person on 21st to 22nd March 2024 at Chennai, Tamil nadu,
<https://conferencealerts.com/show-event?id=260016>

IEEE International Conference on Data Engineering and Communication Systems; in-person on 22nd to 23rd March 2024 at Bengaluru, Karnataka.
<https://conferencealerts.com/show-event?id=257072>

4th International Conference on Recent Trends in Engineering; online and in-person on 29th to 30th March 2024 at Coimbatore.
<https://conferencealerts.com/show-event?id=258417>

International Conference on Cognitive Informatics & Soft Computing (CISC-2024); online and in-person on 30th to 31st March 2024 at Bhubaneswar, Odisha,
<https://conferencealerts.com/show-event?id=254323>

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INDIAN INSTITUTE OF TECHNOLOGY
Kharagpur
ESTD - 1987

Honours and Awards

1	<p>Mr T.V. Narendran, FNAE, CEO & MD Tata Steel Ltd was conferred the IIM-JRD Tata Award 2023 for 'Excellence in Corporate Leadership in Metallurgical Industries' at the 7th Annual Technical Meeting of the Indian Institute of Metals (IIM) at Bhubaneswar on November 24, 2023.</p> <p>Read more at: https://www.tatasteel.com/media/newsroom/press-releases/india/2023/tata-steel-ceo-md-t-v-narendran-conferred-the-iim-jrd-tata-award-2023-for-excellence-in-corporate-leadership-in-metallurgical-industries/</p>
2	<p>Dr VR Lalithambika, FNAE, Formerly Distinguished Scientist and Director, Directorate of Human Space Programme, ISRO, Bangalore; Formerly Deputy Director, Vikram Sarabhai Space Centre, Thiruvananthapuram was conferred the top French civilian honour of Légion d'Honneur for her contribution to space cooperation between France and India in November 2023.</p> <p>Read more at: https://www.deccanherald.com/india/karnataka/bengaluru/top-french-civilian-honour-for-isro-scientist-vr-lalithambika-2788542</p>
3	<p>Prof Kaushik Rajasekhara, FNAE, Professor University of Houston, USA was conferred the prestigious Global Energy Prize for outstanding contributions to transportation electrification and energy efficiency technologies while reducing power generation emissions.</p> <p>Read more at : https://timesofindia.indiatimes.com/nri/other-news/indian-american-engineering-professor-wins-global-energy-prize/articleshow/93027237.cms?from=mdr</p>
4	<p>The Infosys Prize 2023 in Engineering and Computer Science was awarded to Prof. Sachchida Nand Tripathi, FNAE, Professor, Joint Faculty in Civil Engineering and Sustainable Energy Engineering, Indian Institute of Technology, Kanpur for the deployment of large-scale sensor-based air quality network and mobile laboratory for hyper local measurements of pollution, data generation and analysis using AI+ML for effective air quality management and citizen awareness, and for the discovery of new pathways of aerosols formation and growth that provide mechanistic understanding of haze formation.</p>
5	<p>Prof Nagesh Iyer, FNAE, Dean (IPS) & Visiting Professor Indian Institute of Technology Dharwad was conferred the Eminent Engineer Award at the 38th National Convention of Civil Engineers held under the auspices of the Institution of Engineers (India) in recognition of his eminence and contribution to the profession of Civil Engineering on October 8-9, 2023.</p> <p>Read more at: https://www.inae.in/wp-content/uploads/2023/10/NIR.pdf</p>
6	<p>Prof Cato T. Laurencin, FNAE, University Professor and Albert and Wilda Van Dusen Distinguished Endowed Professor of Orthopaedic Surgery at The University Of Connecticut was named 2023 Inventor of The Year by the Intellectual Property Owners Education Foundation (IPOEF) for his ground-breaking innovation in Regenerative Engineering in August 2023.</p> <p>Read more at : https://today.uconn.edu/2023/08/regenerative-engineering-pioneer-professor-cato-t-laurencin-named-2023-inventor-of-the-year/</p>

7	<p>Prof Subra Suresh, FNAE, Professor at large at Brown University's School of Engineering and former director of the National Science Foundation, FNAE was awarded the National Medal of Science, the highest honour accorded to a US scientist, by President of USA, Mr John Biden in a ceremony at the White House on 24 October 2023: "For pioneering research across engineering, physical sciences, and life sciences.</p> <p>Read More at: https://www.brown.edu/news/2023-10-24/suresh-medal-science</p>
8	<p>Mr Manmath Kumar Badapanda, FNAE, Scientific Officer-H, Raja Ramanna Centre for Advanced Technology, Indore has received "IEI NMLC FCRIT Research Excellence Awards, National Category"- 2023. This award is on individual's research excellence contribution in national level and jointly given by The Institution of Engineers (India), Navi Mumbai Local Centre (IEI NMLC) and Fr. C. Rodrigues Institute of Technology (FCRIT), Vashi.</p>
9	<p>Dr V Narayanan, FNAE, Director, LPSC, Thiruvananthapuram was conferred Dr APJ Abdul Kalam 2023 Award on July 27, 2023 at Bangalore.</p>
10	<p>Prof Ganapati D. Yadav, National Science Chair (SERB/DST/GOI), Emeritus Professor of Eminence and former Vice Chancellor, Institute of Chemical Technology, Mumbai has been acknowledged as a distinguished patent holder by the Government of India and is invited as a distinguished guest to attend the Republic Day Parade and witness the historic occasion of the commemoration of the 75th Republic Day on January 26, 2024.</p> <p>SusChemE 2023 was organized in honour of Prof GD Yadav, FNAE celebrating his excellence in Chemical Engineering and Research on September 14-16, 2023 at Institute of Chemical Technology, Mumbai.</p> <p>Read More at: https://www.suscheme.in/pdf/SusChemE-2023-Brochure.pdf</p>
11	<p>Prof. Rajendra Prasad Mohanty, FNAE, Chief Consultant, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar was selected by Central Council of the Operational Research Society of India at its meeting held on 6th December 2023 for ORSI Fellowship Award 2023 for his outstanding contributions towards the promotion and development of Operational Research in the country. The award was presented on 18th December 2023 in the inaugural ceremony of the forthcoming ORSI Convention held at J. N. Tata Auditorium, IISc, Bangalore during 18-20 December 2023.</p>
12	<p>Amity University Rajasthan honoured Prof Purnendu Ghosh, Former Vice-President, INAE and Executive Director, Birla Institute of Scientific Research, Jaipur with the Doctor of Science (d.Sc.) - Honoris Causa for his distinctive and extraordinary accomplishments and increasing and selfless contributions to the nation; his deep commitment to research and scientific enquiry, continuous exemplary efforts in innovating and improving the status of planning and execution of several teaching and research programs.</p>

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NEWS OF FELLOWS

1.	<p>During an exclusive interview on LinkedIn, Dr. B. N. Suresh, FNAE, Chancellor, Indian Institute of Space Science & Technology (IIST); Former President, INAE and former Director of Vikram Sarabhai Space Centre briefly spoke about his life journey starting from a small village to his joining ISRO, the India's premier organization. Dr. Suresh mentioned invaluable insights into his contributions to the Indian space program, from launch vehicles to Space Capsule Recovery Experiments (SRE).</p> <p>Read More : https://www.linkedin.com/posts/apalak-ghosh-3105074_india-vision-2030-dr-bn-suresh-activity-7110168696941129728-DtXX?utm_source=share&utm_medium=member_ios</p>
2.	<p>A book by Mr RD Kale, FNAE, Formerly Outstanding Scientist (Rtd) Group Director Fast Reactor Technology Group and Director Engineering Services Group, IGCAR, Kalpakkam and Dr BK Sreedhar, FNAE, Outstanding Scientist & Head, Sodium Experiments & Hydraulics Division, Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam- on "Centrifugal Pumps for Sodium Cooled Reactors" was launched on Nov 21, 2023. The book was published by CRC Press, Taylor and Francis group was launched on Nov. 21, 2023.</p>
3.	<p>BITS Pilani appoints Prof Soumyo Mukherji, FNAE, Professor, IIT Bombay as the Director of the Hyderabad Campus.</p> <p>Read More : https://www.hindustantimes.com/education/news/bits-pilani-appoints-prof-soumyo-mukherji-as-the-director-of-the-hyderabad-campus-101698908657376.html</p>
4.	<p>Prof DN Singh, FNAE, has co-Authored a Book on "Cricket Pitches: The Science Behind The Art of Pitch-Makin-"An Integrated Pitch Management (I.P.M) Approach" published by Springer Nature in December 2023.</p> <p>Further details available at link https://link.springer.com/book/10.1007/978-981-99-2913-9</p>
5.	<p>Dr. Ajit Kumar Mohanty, FNAE, BARC Director took charge of Secretary to the Government of India, Department of Atomic Energy on May 03, 2023.</p>
6.	<p>Prof. U. Kamachi Mudali, FNAE, and formerly Vice Chancellor of VIT Bhopal University & Chairman and Chief Executive of Heavy Water Board, took over as the Vice Chancellor of Homi Bhabha National Institute (HBNI), a deemed to be University affiliated to the Department of Atomic Energy from May 11, 2023.</p>
7.	<p>Shri Vivek Bhasin, FNAE, Distinguished Scientist took over as Director, Bhabha Atomic Research Centre (BARC), Mumbai from September 15, 2023 onwards.</p>
8.	<p>Mr Manmath Kumar Badapanda, FNAE, Scientific Officer-H, Raja Ramanna Centre for Advanced Technology, Indore has been granted Indian patent No. 436206, titled "High voltage DC power supply for high power radio frequency amplifiers", as its sole inventor. The USP of his invented topology is that it uniquely achieves full range 24-pulsed, 11 kV input system with full range 36 kV ripple free output voltage capability, irrespective of the input line voltage variations and output voltage requirements.</p>
9.	<p>Captain Mohan Ram, FNAE, Former Consultant, TVS Motor Company Ltd., Hosur (Tamil Nadu) has published a new book "A Captain in Corporate Wonderland' and is available in Amazon and major bookstores. It is an account of his thirty-six long year career in private sector after retiring from the Navy.</p>

10.	Prof SN Upadhyay, FNAE, Ex-Director and Emeritus Professor, Department of Chemical Engineering & Technology, IIT (BHU) Varanasi has authored a book entitled "जल एवं अपजल के विश्लेषण की मानक विधियाँ" published in May 2023. This is the first book in Hindi on this subject and is in conformity with the NEP-2020.
11.	Prof. Dr. S.N. Mukhopadhyay, FNAE, Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERG, IIT Delhi; has been invited by the Biometrics & Biostatistics International Journal (BBIJ) to be a member of its Editorial Board. Also, he has been invited to review a Research Article "Contribution of Coincidence Detection to Speech Segregation in Noisy Environment. He with his wife Sakuntala have written their Biography under the title "Anande Jeebansrote" in Bangla Medium by AD Print Studio.
12.	Prof Purnendu Ghosh, FNAE, Executive Director, Birla Institute of Scientific Research, Jaipur released his book on "Vaigyanik Vichar Dwipo Ke beech samajik Kavya Putro Ka nirman" on August 18, 2023 at India International Centre, New Delhi.
13.	Dr. Sanak Mishra, FNAE, Former Managing Director, SAIL Rourkela Steel Plant; Former President, INAE delivered the Fifth Dr. Baldev Raj Memorial Lecture on "Evolution of Steel Technology and Current Indian Steel Scenario" on 10th April 2023 organized by IIM-Human Resources Development Centre, Kalpakkam-Chennai; IIM Coimbatore Chapter in association with PSG College of Technology, Coimbatore.

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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

Prof Pravina P Parikh

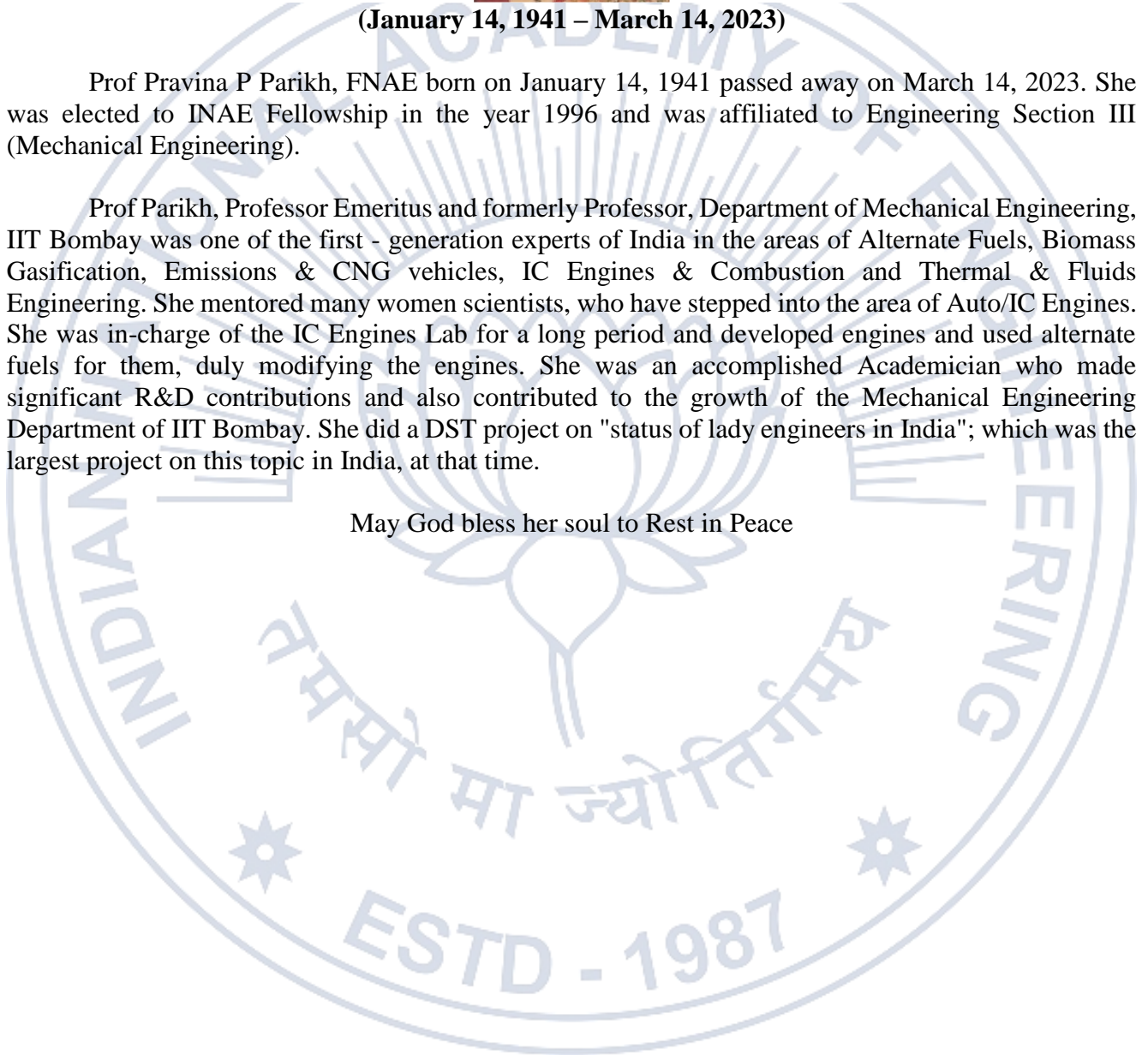


(January 14, 1941 – March 14, 2023)

Prof Pravina P Parikh, FNAE born on January 14, 1941 passed away on March 14, 2023. She was elected to INAE Fellowship in the year 1996 and was affiliated to Engineering Section III (Mechanical Engineering).

Prof Parikh, Professor Emeritus and formerly Professor, Department of Mechanical Engineering, IIT Bombay was one of the first - generation experts of India in the areas of Alternate Fuels, Biomass Gasification, Emissions & CNG vehicles, IC Engines & Combustion and Thermal & Fluids Engineering. She mentored many women scientists, who have stepped into the area of Auto/IC Engines. She was in-charge of the IC Engines Lab for a long period and developed engines and used alternate fuels for them, duly modifying the engines. She was an accomplished Academician who made significant R&D contributions and also contributed to the growth of the Mechanical Engineering Department of IIT Bombay. She did a DST project on "status of lady engineers in India"; which was the largest project on this topic in India, at that time.

May God bless her soul to Rest in Peace



Prof Satya N Atluri

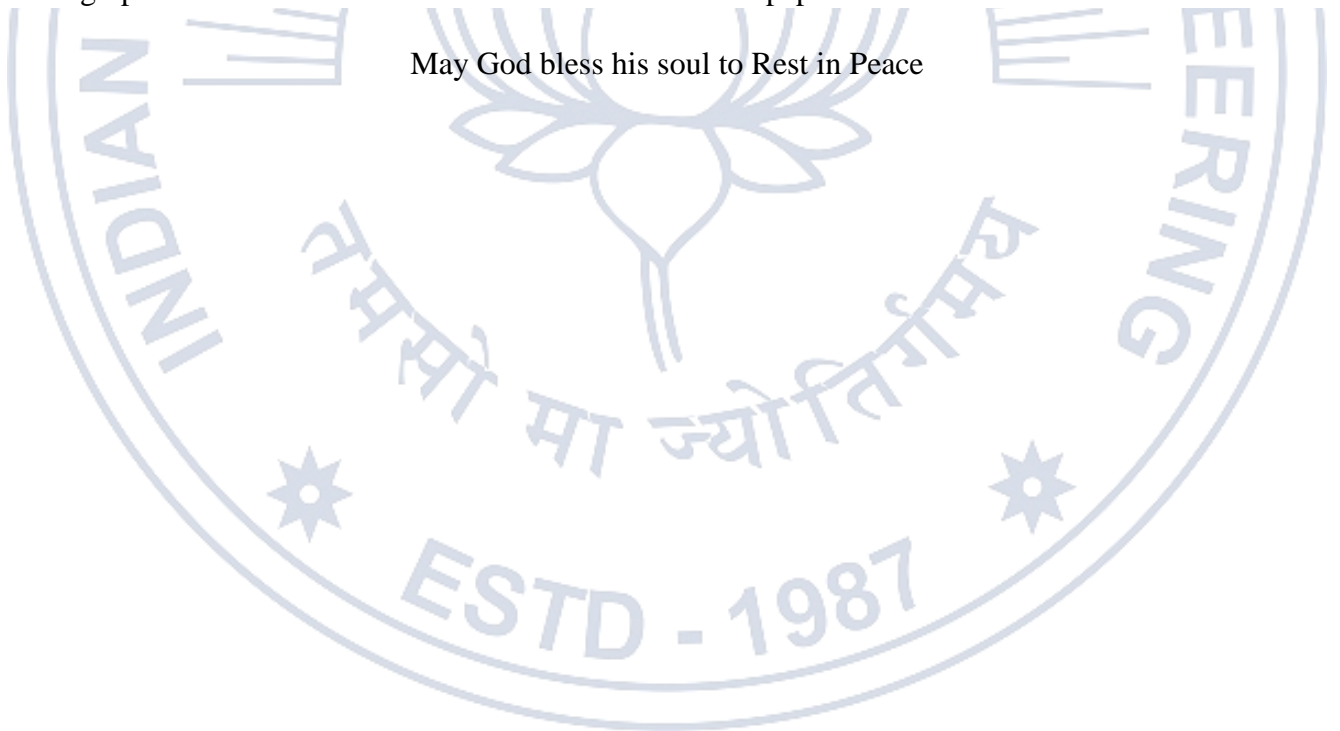


(October 07, 1945– August 5, 2023)

Prof Satya N Atluri, FNAE born on October 7, 1945 passed away on August 5, 2023. He was elected to INAE Foreign Fellowship in the year 1997 and was affiliated to Engineering Section VII (Aerospace Engineering).

Prof SN Atluri, Distinguished Professor Emeritus of Aerospace Engineering, University of California, USA had made fundamental contributions to the development of finite element methods, boundary element methods, Meshless Local Petrov-Galerkin (MLPG) methods, Fragile Points Methods (FPM), Local Variational Iteration Methods, for general problems of engineering, solid mechanics, fluid dynamics, heat transfer, ferromagnetics, nonlinear dynamics, micromechanics of materials, structural integrity and damage tolerance, Astrodynamics, digital Twins of Aerospace Systems, etc. He mentored about 600 undergraduate and graduate students, post-doctoral scholars, visiting scholars, and visiting professors at various universities around the world. Prof Atluri authored or edited 65 research monographs and authored more than 800 archival research papers.

May God bless his soul to Rest in Peace



Dr V S Arunachalam

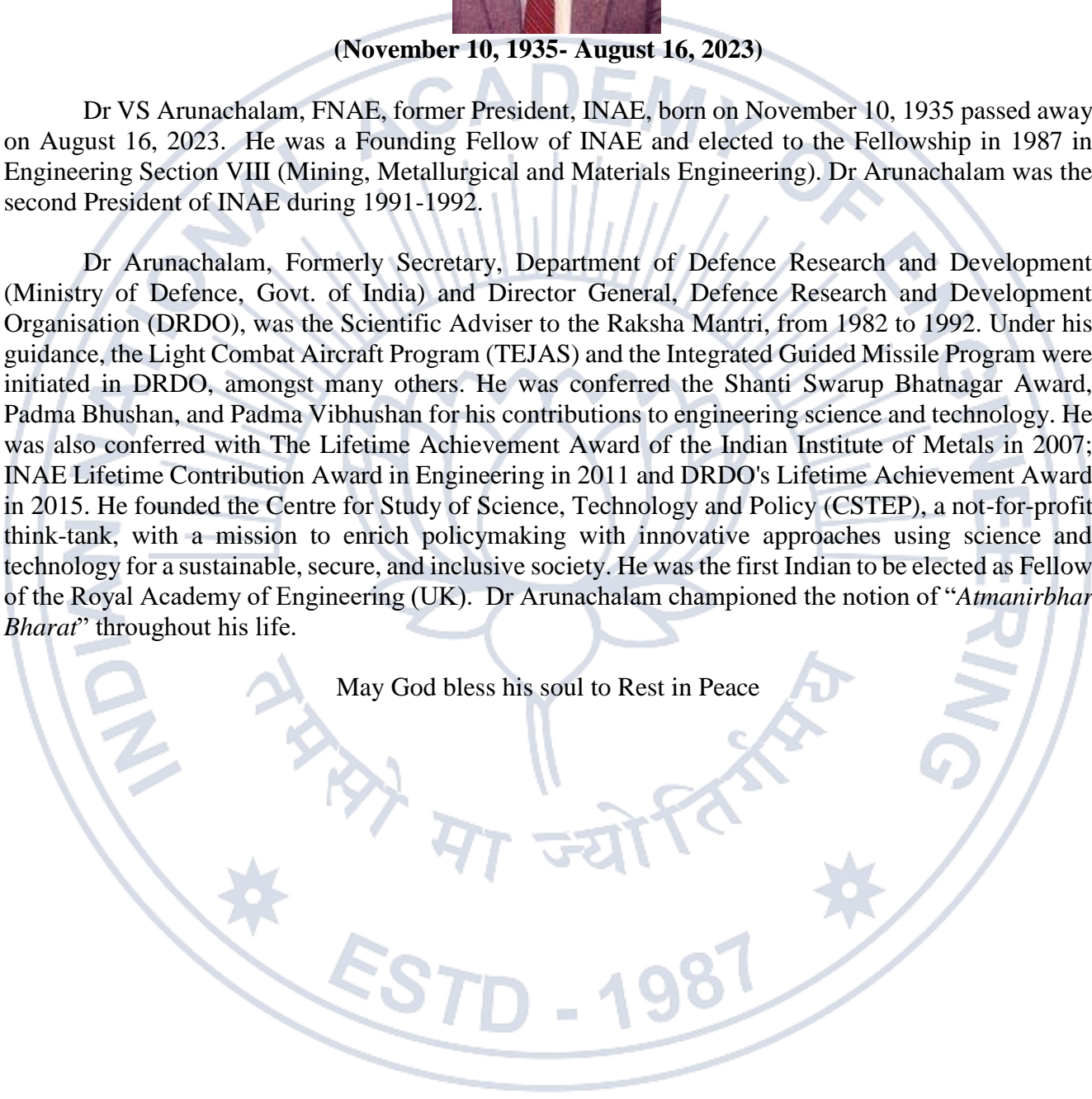


(November 10, 1935- August 16, 2023)

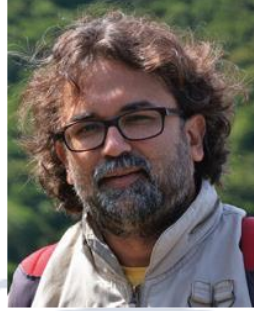
Dr VS Arunachalam, FNAE, former President, INAE, born on November 10, 1935 passed away on August 16, 2023. He was a Founding Fellow of INAE and elected to the Fellowship in 1987 in Engineering Section VIII (Mining, Metallurgical and Materials Engineering). Dr Arunachalam was the second President of INAE during 1991-1992.

Dr Arunachalam, Formerly Secretary, Department of Defence Research and Development (Ministry of Defence, Govt. of India) and Director General, Defence Research and Development Organisation (DRDO), was the Scientific Adviser to the Raksha Mantri, from 1982 to 1992. Under his guidance, the Light Combat Aircraft Program (TEJAS) and the Integrated Guided Missile Program were initiated in DRDO, amongst many others. He was conferred the Shanti Swarup Bhatnagar Award, Padma Bhushan, and Padma Vibhushan for his contributions to engineering science and technology. He was also conferred with The Lifetime Achievement Award of the Indian Institute of Metals in 2007; INAE Lifetime Contribution Award in Engineering in 2011 and DRDO's Lifetime Achievement Award in 2015. He founded the Centre for Study of Science, Technology and Policy (CSTEP), a not-for-profit think-tank, with a mission to enrich policymaking with innovative approaches using science and technology for a sustainable, secure, and inclusive society. He was the first Indian to be elected as Fellow of the Royal Academy of Engineering (UK). Dr Arunachalam championed the notion of “*Atmanirbhar Bharat*” throughout his life.

May God bless his soul to Rest in Peace



Prof Sameer Khandekar



(November 10, 1971 – December 22, 2023)

Prof Sameer Khandekar, Sir M Visvesvaraya Chair Professor, Department of Mechanical Engineering and Dean of Student Affairs, Indian Institute of Technology Kanpur born on November 10, 1971 passed away on December 22, 2023. Prof Khandekar was affiliated to Engineering Section – III (Mechanical Engineering) and elected to INAE Fellowship in the year 2019.

Prof Khandekar had made significant research contributions in the areas of Two-phase heat transfer, Heat Pipes and Thermosyphons and Energy systems. His contributions towards the understanding of Pulsating Heat Pipes are noteworthy and have enabled the development of the device for large-scale as well as specialized applications. His research blended theory and experimental exploration. He had served as an invited faculty member at five international universities at Germany, France, Brazil, Russia and Thailand. He had over eighty-five research publications in international journals, over one hundred publications/presentations in international conferences, including 16 keynote lectures/ Invited Talks, and had eight patents and four books to his credit. Prof Khandekar won the Young Scientist Award by the Department of Atomic Energy, Government of India in 2005. He was a recipient of P. K. Kelkar Research Fellowship from IIT Kanpur in 2008, DAAD Fellowship (2011), Prof. K. N. Seetharamu Award from the Indian Society of Heat and Mass Transfer in 2010, George Grover Medal from the International Heat Pipe Committee in 2007, and Young Scientist Award (Department of Atomic Energy, Indian, 2005). He also served as the Associate Dean (Innovation and Incubation) and coordinator of the SIDBI Innovational and Incubation Center, IIT Kanpur from 2015-2017. He was also the President of Shiksha Sopan, a voluntary organization (registered NGO), serving the underprivileged sections of the society in and around IIT Kanpur.

May God bless his soul to Rest in Peace

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. New method simplifies the construction process for complex materials

Engineers are constantly searching for materials with novel, desirable property combinations. For example, an ultra-strong, lightweight material could be used to make airplanes and cars more fuel-efficient, or a material that is porous and biomechanically friendly could be useful for bone implants. Cellular metamaterials -- artificial structures composed of units, or cells, that repeat in various patterns -- can help achieve these goals. But it is difficult to know which cellular structure will lead to the desired properties. Even if one focuses on structures made of smaller building blocks like interconnected beams or thin plates, there are an infinite number of possible arrangements to consider. So, engineers can manually explore only a small fraction of all the cellular metamaterials that are hypothetically possible. Researchers from MIT and the Institute of Science and Technology Austria have developed a computational technique that makes it easier for a user to quickly design a metamaterial cell from any of those smaller building blocks, and then evaluate the resulting metamaterial's properties. Their approach, like a specialized CAD (computer-aided design) system for metamaterials, allows an engineer to quickly model even very complex metamaterials and experiment with designs that may have otherwise taken days to develop. The user-friendly interface also enables the user to explore the entire space of potential metamaterial shapes, since all building blocks are at their disposal. When a scientist develops a cellular metamaterial, the researcher typically begins by choosing a representation that will be used to describe her potential designs. This choice determines the set of shapes that will be available for exploration. For instance, one may choose a technique that represents metamaterials using many interconnecting beams. However, this prevents one from exploring metamaterials based on other elements, such as thin plates or 3D structures like spheres. Those shapes are given by different representations, but so far, there hasn't been a unified way to describe all shapes in one method. The scientists took a step back and closely examined different metamaterials. They saw that the shapes that comprise the overall structure could be easily represented by lower-dimensional shapes -- a beam could be reduced to a line or a thin-shell could be compressed to a flat surface. They also noticed that cellular metamaterials often have symmetries, so only a small part of the structure needs to be represented. The rest can be built by rotating and mirroring that initial piece. With their graph-based representation, a user builds a metamaterial skeleton using building blocks that are created by vertices and edges. For instance, to create a beam structure, one places a vertex at each end point of the beam and connects them with a line. Then the user employs a function over that line to specify the thickness of the beam, which can be varied so one part of the beam is thicker than another. The process for surfaces is similar -- the user marks the most important features with vertices and then chooses a solver that infers the rest of the surface. These easy-to-use solvers even allow users to quickly construct a highly complex type of metamaterial, called a triply periodic minimal surface (TPMS). These structures are incredibly powerful, but the usual process to develop them is arduous and prone to failure. At the end of the process, the system outputs the entire graph-based procedure, showing every operation the user took to reach the final structure -- all the vertices, edges, solvers, transformations, and thickening operations.

Within the user interface, designers can preview the current structure at any point in the building procedure and directly predict certain properties, such as its stiffness. Then, the user can iteratively tweak some parameters and evaluate it again until a suitable design is reached. The researchers used their system to recreate structures that spanned many unique classes of metamaterials. Once they had designed the skeletons, each metamaterial structure took only seconds to generate. They also created automated exploration algorithms, giving each a set of rules and then turning it loose in their system. In one test, an algorithm returned more than 1,000 potential truss-based structures in about an hour. In addition, the researchers conducted a user-study with 10 individuals who had little prior experience modeling metamaterials. The users were able to successfully model all six structures they were given, and most agreed that the procedural graph representation made the process easier.

Computer Engineering and Information Technology

2. Denial of service threats detected thanks to asymmetric behavior in network traffic

Scientists have developed a better way to recognize a common internet attack, improving detection by 90 percent compared to current methods. The new technique developed by computer scientists at the Department of Energy's Pacific Northwest National Laboratory works by keeping a watchful eye over ever-changing traffic patterns on the internet. The scientists modified the playbook most commonly used to detect denial-of-service attacks, where perpetrators try to shut down a website by bombarding it with requests. Motives vary: Attackers might hold a website for ransom, or their aim might be to disrupt businesses or users. Many systems try to detect such attacks by relying on a raw number called a threshold. If the number of users trying to access a site rises above that number, an attack is considered likely, and defensive measures are triggered. But relying on a threshold can leave systems vulnerable. A threshold can also create false alarms that have serious consequences themselves. False positives can force defenders to take a site offline and bring legitimate traffic to a standstill -- effectively doing what a real denial-of-service attack, also known as a DOS attack, aims to do. To improve detection accuracy, the PNNL team sidestepped the concept of thresholds completely. Instead, the team focused on the evolution of entropy, a measure of disorder in a system. Usually on the internet, there's consistent disorder everywhere. But during a denial-of-service attack, two measures of entropy go in opposite directions. At the target address, many more clicks than usual are going to one place, a state of low entropy. But the sources of those clicks, whether people, zombies or bots, originate in many different places -- high entropy. The mismatch could signify an attack. In PNNL's testing, 10 standard algorithms correctly identified on average 52 percent of DOS attacks; the best one correctly identified 62 percent of attacks. The PNNL formula correctly identified 99 percent of such attacks. The improvement isn't due only to the avoidance of thresholds. To improve accuracy further, the PNNL team added a twist by not only looking at static entropy levels but also watching trends as they change over time. In addition, the researcher explored alternative options to calculate entropy. Many denial-of-service detection algorithms rely on a formula known as Shannon entropy. They instead settled on a formula known as Tsallis entropy for some of the underlying mathematics. Researchers found that the Tsallis formula is hundreds of times more sensitive than Shannon at weeding out false alarms and differentiating legitimate flash events, such as high traffic to a World Cup website, from an attack. That's because the Tsallis formula amplifies differences in entropy rates more than the Shannon formula. Think of how we measure temperature. If our thermometer had a resolution of 200 degrees, our outdoor temperature would always appear to be the same. But if the resolution were 2 degrees or less--like most thermometers--we'd detect dips and spikes many times each day. They showed that it's similar with subtle changes in entropy, detectable through one formula but not the other. The PNNL solution is automated and doesn't require close oversight by a human to distinguish between legitimate traffic and an attack. The researchers say that their program is "lightweight" -- it doesn't need much computing power or network resources to do its job. This is different from solutions based on machine learning and artificial intelligence, said the researchers. While those approaches also avoid thresholds, they require a large amount of training data. Now, the PNNL team is looking at how the buildout of 5G networking and the booming internet of things landscape will have an impact on denial-of-service attacks.

Source <https://www.sciencedaily.com/releases/2023/08/230803132226.htm>

Mechanical Engineering

3. Robotic grippers offer unprecedented combo of strength and delicacy

Researchers at North Carolina State University have developed a robotic gripping device that is gentle enough to pick up a drop of water, strong enough to pick up a 6.4kilogram (14.1 pound) weight, dexterous enough to fold a cloth, and precise enough to pick up microfilms that are 20 times thinner than a human hair. In addition to possible manufacturing applications, the researchers also integrated the device with technology that allows the gripper to be controlled by the electrical signals produced by muscles in the forearm, demonstrating its potential for use with robotic prosthetics. The design for the new grippers builds on an earlier generation of flexible, robotic grippers that drew on the art of kirigami, which involves both cutting and folding two-dimensional sheets of material to form three-dimensional shapes. The new design is able to achieve high degrees of strength and gentleness because of how it distributes force throughout the structure of the gripper. "The strength of robotic grippers is generally measured in payload-to-weight ratio," a researcher says. "Our grippers weigh 0.4 grams and can lift up to 6.4 kilograms. That's a payload-to-weight ratio of about 16,000. That is 2.5 times higher than the previous record for payload-to-weight ratio, which was 6,400. Combined with its characteristics of gentleness and precision, the strength of the grippers suggests a wide variety of applications." Another benefit of the new technology is that its attractive characteristics are driven primarily by its structural design, rather than by the materials used to fabricate the grippers. "In practical terms, this means that you could fabricate the grippers out of biodegradable materials, such as sturdy plant leaves," says another researcher. "That could be particularly useful for applications where you would only want to use the grippers for a limited period of time, such as when handling food or biomedical materials. For example, we've demonstrated that the grippers can be used to handle sharp medical waste, such as needles." The researchers also integrated the gripping device with a myoelectric prosthetic hand, meaning the prosthesis is controlled using muscle activity. The new gripper can't replace all of the functions of existing prosthetic hands, but it could be used to supplement those other functions. One of the advantages of the kirigami grippers is that you would not need to replace or augment the existing motors used in robotic prosthetics. You could simply make use of the existing motor when utilizing the grippers. In proof-of-concept testing, the researchers demonstrated that the kirigami grippers could be used in conjunction with the myoelectric prosthesis to turn the pages of a book and pluck grapes off a vine."We think the gripper design has potential applications in fields ranging from robotic prosthetics and food processing to pharmaceutical and electronics manufacturing," a researcher says. "We are looking forward to working with industry partners to find ways to put the technology to use."

Source <https://www.sciencedaily.com/releases/2023/08/230802132108.htm>

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Chemical Engineering

4. New, simple and accessible method creates potency-increasing structure in drugs

Chemical structures called cyclopropanes can increase the potency and fine-tune the properties of many drugs, but traditional methods to create this structure only work with certain molecules and require highly reactive -- potentially explosive -- ingredients. Now, a team of researchers from Penn State has identified and demonstrated a safe, efficient and practical way to create cyclopropanes on a wide variety of molecules using a previously undescribed chemical process. With additional development, the new method could transform how this important process occurs during drug development and creation. Cyclopropanes are a key feature in many drugs currently approved by the U.S. Food and Drug Administration, including those used to treat COVID-19, asthma, hepatitis C, and HIV/AIDs. These structures can increase a drug's potency, alter its ability to dissolve in the body, minimize its interactions with unintended targets, and otherwise fine-tune performance. Cyclopropanes are a ring of three connected carbon atoms, with one carbon attached to the rest of the drug molecule and the other two each attached to two hydrogen atoms. "Cyclopropanes are an essential component of many drugs and adding them to drug candidates can be an important part of the drug discovery process," said Ramesh Giri, professor of chemistry in the Eberly College of Science at Penn State and leader of the research team. "Previous efforts to improve the creation of cyclopropanes have focused on altering a mechanistic pathway devolved more than 60 years ago. We approached this from a different angle and identified a completely new pathway that is a simple, practical, and broadly applicable." The new method transforms a specific chemical structure on compounds called alkenes -- used in the synthesis of many molecules - - into cyclopropanes. The method takes advantage of "radical chemistry," where intermediate steps of reactions leave some carbon atoms with unpaired electrons called free radicals that propel the reaction forward. This specific method uses visible light to initiate the reaction and uses common chemical ingredients, including oxygen. Traditional methods to create cyclopropanes require highly reactive and difficult-to-acquire ingredients and must be conducted under controlled conditions, and the resulting compounds often have a very short shelf life. These unstable ingredients are critical to producing an intermediate compound in the process called a carbene -- a highly reactive carbon atom with two unpaired electrons. The new method completely bypasses the carbene intermediate, producing the unpaired electrons one at a time as radicals. "All of the ingredients used in this pathway are commercially available or easy to create in the lab and do not require any special safety precautions, and the end product can be stored for prolonged periods," Giri said. "We can add all the ingredients together in one mixture while exposed to air with as little as 10% oxygen, and it proceeds in one step. The reaction is simple and safe enough that we are even planning to include it as part of an undergraduate chemistry lab." Another shortcoming of traditional methods is that they generally do not work with complex molecules. For this reason, cyclopropanes are typically installed early in the synthesis when the molecule is less complex but following steps can cause the ring to open up, and later attempts to make derivatives of the molecule would require backtracking to those early steps. Using the new method, the researchers successfully transformed a variety of alkenes with a wide range of complexities into cyclopropanes, including pharmaceutically relevant compounds such as the steroid estrone, penicillin and vitamin B. Some of the ingredients in the reaction can also be swapped out to add additional chemical groups to the final product to achieve various therapeutic goals. One of the reaction's ingredients is as a type of compound called a methylene. There are hundreds of different methylenes that are commercially available, each with a specific chemical group that makes it a methylene as well as other groups that differ and could theoretically be added to the alkene as a cyclopropane is created. The researchers demonstrated the breadth of the new method using 19 different methylene compounds. Next, Giri and his lab plan to scale up the method so that it is industrially viable.

Source <https://www.sciencedaily.com/releases/2023/08/230803141658.htm>

Electrical Engineering

5. Thermal imaging innovation allows AI to see through pitch darkness like broad daylight

Researchers at Purdue University are advancing the world of robotics and autonomy with their patent-pending method that improves on traditional machine vision and perception. Zubin Jacob, the Elmore Associate Professor of Electrical and Computer Engineering in the Elmore Family School of Electrical and Computer Engineering, and research scientist Fanglin Bao have developed HADAR, or heat-assisted detection and ranging. Jacob said it is expected that one in 10 vehicles will be automated and that there will be 20 million robot helpers that serve people by 2030. "Each of these agents will collect information about its surrounding scene through advanced sensors to make decisions without human intervention," Jacob said. "However, simultaneous perception of the scene by numerous agents is fundamentally prohibitive." Traditional active sensors like LiDAR, or light detection and ranging, radar and sonar emit signals and subsequently receive them to collect 3D information about a scene. These methods have drawbacks that increase as they are scaled up, including signal interference and risks to people's eye safety. In comparison, video cameras that work based on sunlight or other sources of illumination are advantageous, but low-light conditions such as night-time, fog or rain present a serious impediment. Traditional thermal imaging is a fully passive sensing method that collects invisible heat radiation originating from all objects in a scene. It can sense through darkness, inclement weather and solar glare. But Jacob said fundamental challenges hinder its use today. HADAR combines thermal physics, infrared imaging and machine learning to pave the way to fully passive and physics-aware machine perception. "Our work builds the information theoretic foundations of thermal perception to show that pitch darkness carries the same amount of information as broad daylight. Evolution has made human beings biased toward the daytime. Machine perception of the future will overcome this long-standing dichotomy between day and night," Jacob said. Bao said, "HADAR vividly recovers the texture from the cluttered heat signal and accurately disentangles temperature, emissivity and texture, or TeX, of all objects in a scene. It sees texture and depth through the darkness as if it were day and also perceives physical attributes beyond RGB, or red, green and blue, visible imaging or conventional thermal sensing. It is surprising that it is possible to see through pitch darkness like broad daylight." The team tested HADAR TeX vision using an off-road night-time scene. "HADAR TeX vision recovered textures and overcame the ghosting effect," Bao said. "It recovered fine textures such as water ripples, bark wrinkles and culverts in addition to details about the grassy land." Additional improvements to HADAR are improving the size of the hardware and the data collection speed. "The current sensor is large and heavy since HADAR algorithms require many colours of invisible infrared radiation," Bao said. "To apply it to self-driving cars or robots, we need to bring down the size and price while also making the cameras faster. The current sensor takes around one second to create one image, but for autonomous cars we need around 30 to 60 hertz frame rates, or frames per second." HADAR TeX vision's initial applications are automated vehicles and robots that interact with humans in complex environments. The technology could be further developed for agriculture, defence, geosciences, health care and wildlife monitoring applications.

Source <https://www.sciencedaily.com/releases/2023/08/230801131652.htm>

Electronics and Communication Engineering

6. The Low Earth Orbit Satellite Space Race: Starlink Versus AST SpaceMobile



Today, a new space race is emerging in telecommunications. Low earth orbit (LEO) satellite constellations promise to disrupt mature, higher-altitude geosynchronous earth orbit (GEO) deployments. The communications advantages of LEO are undeniable—lower latency given the shorter distance, lower power requirements and flexibility, because unlike GEO, the technology does not require a fixed connection point. GEO's limitations have also made it very expensive for subscribers and challenging to scale, given the significant investment required in both satellite construction and terrestrial infrastructure. The latter is what LEO hopes to disrupt. Starlink and AST SpaceMobile are emerging as the early front-runners in the LEO telecommunications world. Starlink probably needs no introduction, given its association with Musk's SpaceX operations. It offers broadband internet services to rural locations underserved by cable, fiber, LTE and 5G fixed wireless access services, and is supported by more than 4,000 satellites launched to date. In the long term, Musk promises to raise that number to 30,000 birds in the sky with a reusable design that aims to lower the cost of satellite construction. With that said, Musk has a track record of over-promises and under-delivery, as evidenced in his Tesla operations and recent stumbles with SpaceX. One of the other significant challenges is that Starlink's initial service has been fraught with both expensive consumer premise equipment and poor performance. These challenges could resolve themselves over time with scale, but the company's partnership announcement with T-Mobile late last year might be premature. Initially, the Starlink service is focused on enabling emergency text messaging in areas lacking coverage using T-Mobile's mid-band spectrum assets, with plans to add voice and data later. What needs to be clarified now are the specific deployment plans and whether they could create interference with terrestrial mobile networks. Avellan has laid a solid foundation for AST SpaceMobile. It is rooted in a direct-to-device connection, unlike Starlink's focus on fixed-point broadband services. However, Starlink seems to be moving beyond that focus, considering that it now also offers a mobility solution for recreational vehicles. So far, AST SpaceMobile has launched two LEO satellites, and the second one integrates phased-array and digital beam-forming technologies to focus and pinpoint signals more accurately. However, more satellite launches are planned in the future. AST SpaceMobile has also signed agreements and understandings with more than 35 mobile network operators globally, including AT&T in the U.S., and the company is content to serve as a wholesaler to provide connectivity gap coverage. That gives AST SpaceMobile a decided edge over Starlink in driving scale and adoption; the wholesaler approach will allow it to serve a large swath of operators to monetize services, including fixed wireless access broadband, where Starlink is a direct competitor. Maybe the most powerful proof suggesting AST SpaceMobile's potential to lead in LEO was the first smartphone-to-satellite phone call, made in April on a Samsung device over the AT&T network. The latter is an extraordinary accomplishment that eclipses emergency text messaging support. LEO satellite connectivity will play a major role in bridging the digital divide for nearly three billion people globally who don't have access to the internet.

Source <https://www.forbes.com/sites/moorinsights/2023/06/15/the-low-earth-orbit-satellite-space-race-starlink-versus-ast-spacemobile/>

Aerospace Engineering

7. India ISRO's Aditya-L1 solar mission reaches destination

The Indian Space Research Organisation's inaugural solar mission, Aditya-L1, has reached its destination within the anticipated four-month timeframe. Launched on [September 2, 2023](#) the spacecraft positioned itself at Lagrange Point 1, from where it will undertake a comprehensive study of the sun, focusing on the solar corona and its influence on space weather. The satellite covered approximately 1.5 million kilometers (930,000 miles) over the span of four months, just a fraction of the Earth-sun distance of 150 million kilometers. The Lagrange Point, where the satellite is stationed, benefits from gravitational forces that allow objects to remain relatively stationary, reducing fuel consumption for the spacecraft. Equipped with seven payloads, Aditya-L1 is slated to conduct remote sensing of the sun and in-situ observations for an estimated five years. Named after the Hindi word for the sun, this mission follows India's recent achievement of being the first country to successfully land on the moon's south pole, surpassing Russia's failed Luna-25 with the Chandrayaan-3 mission. Chandrayaan-3 landed on the unexplored south pole of the moon in August last year. Scientists involved in the project aim to gain insights into the impact of solar radiation on the increasing number of satellites in orbit, with a particular focus on phenomena affecting ventures like Elon Musk's Starlink communications network. The low earth orbit is going to get "super" crowded over the coming years, said an engineer. "Satellites are going to become the main stay of all tech on Earth with Quantum implemented, with internet connectivity, disaster warning system, resource utilisation and many more applications," he said. Stationing a spacecraft at L1 acts as an early warning system, with roughly one-hour advantage, for an upcoming storm from the Sun, he said. The mission to study the sun is among a slate of projects ISRO has lined up through the year, key among them its first human space mission and a low-Earth orbit observatory system jointly developed by NASA and ISRO, called NISAR. NISAR will map the entire planet once every 12 days, providing data for understanding changes in ecosystems, ice mass, vegetation biomass, sea level rise, ground water and natural hazards including earthquakes, tsunamis, volcanoes and landslides.

Source <https://www.reuters.com/science/india-isros-aditya-l1-solar-mission-reaches-destination-2024-01-06/>

8. Butterfly-inspired films create vibrant colors while passively cooling objects

On a hot summer day, white clothing feels cooler than other colours due to reflecting -- not absorbing -- sunlight. Other colours like blue or black, will undergo a heating effect as they absorb light. To circumvent this heating effect in coloured cooling films, researchers drew inspiration from nanostructures in butterfly wings. The new films, which don't absorb any light, could be used on the outside of buildings, vehicles and equipment to reduce the energy needed for cooling while preserving vivid colour properties. The researchers showed that the films they developed lower the temperature of colourful objects to about 2 °C below the ambient temperature. They also found that when left outside all day, the blue version of the films was approximately 26°C cooler than traditional blue car paint. This represents an annual energy savings of approximately 1377 MJ/m² per year. A car with blue paint appears blue because it absorbs yellow light and reflects blue light. The large amount of light that is absorbed heats the car. *Morpho* butterflies, however, produce their highly saturated blue colour based on the nanostructure of their wings. The design of the cooling nanofilm mimics these structures to produce vibrant colours that don't absorb light like traditional paint. To create their *Morpho*-inspired nanofilms, the researchers placed a disordered material (rough frosted glass) under a multilayer material made of titanium dioxide and aluminium dioxide. They then placed this structure on a silver layer that reflects all light, thus preventing the absorption of solar radiation and the heating associated with that absorption. The film's colour is determined by how components within its multi-layered structure reflect light. To create blue, for example, the multilayer material is designed to reflect yellow light in a very narrow range of angles while the disordered structure diffuses the blue light across a broad area. Although this type of passive photonic thermal management has been accomplished before, it has only been used with white or clear objects because it is difficult to maintain a wide viewing angle and high colour saturation. To test the new technology, the researchers created blue, yellow and colourless films, which they placed outdoors at Shenzhen University, on surfaces such as roofs, cars, cloth and cell phones, from 9 a.m. to 4 p.m. in both winter and summer. Using thermocouple sensors and infrared cameras to measure temperature, they found that the cooling films were much cooler than the surfaces they were placed on in the winter and further cooler in the summer. The researchers point out that replacing the silver film with an aluminium film would make the films less expensive and manufacturable by a scalable fabrication method such as electron beam evaporation and magnetron sputtering. Now that they have demonstrated the cooling and colour performance of the films, the researchers plan to study and optimize other properties such as mechanical and chemical robustness.

Source <https://www.sciencedaily.com/releases/2023/08/230803112920.htm>

Energy Engineering

9. Faster thin film devices for energy storage and electronics

An international research team from the Max Planck Institute of Microstructure Physics, Halle (Saale), Germany, the University of Cambridge, UK and the University of Pennsylvania, USA reported the first realization of single-crystalline $T\text{-Nb}_2\text{O}_5$ thin films having two-dimensional (2D) vertical ionic transport channels, which results in a fast and colossal insulator-metal transition via Li ion intercalation through the 2D channels. Since the 1940s, scientists have been exploring the use of niobium oxide, specifically a form of niobium oxide known as $T\text{-Nb}_2\text{O}_5$, to create more efficient batteries. This unique material is known for its ability to allow lithium ions, the tiny charged particles that make batteries work, to move quickly within it. The faster these lithium ions can move, the faster a battery can be charged. The challenge, however, has always been to grow this niobium oxide material into thin, flat layers, or 'films' that are of high enough quality to be used in practical applications. This problem stems from the complex structure of $T\text{-Nb}_2\text{O}_5$ and the existence of many similar forms, or polymorphs, of niobium oxide. Researchers from the Max Planck Institute of Microstructure Physics, University of Cambridge and the University of Pennsylvania have successfully demonstrated the growth of high-quality, single-crystal thin films of $T\text{-Nb}_2\text{O}_5$, aligned in such a way that the lithium ions can move even faster along vertical ionic transport channels. The $T\text{-Nb}_2\text{O}_5$ films undergo a significant electrical change at an early stage of Li insertion into the initially insulating films. This is a dramatic shift -- the resistivity of the material decreases by a factor of 100 billion. The research team further demonstrate tunable and low voltage operation of thin film devices by altering the chemical composition of the 'gate' electrode, a component that controls the flow of ions in a device, further extending the potential applications. The Max Planck Institute of Microstructure Physics group realized the growth of the single-crystalline $T\text{-Nb}_2\text{O}_5$ thin films and showed how Li-ion intercalation can dramatically increase their electrical conductivity. Together with the University of Cambridge group multiple previously unknown transitions in the material's structure were discovered as the concentration of lithium ions was changed. These transitions change the electronic properties of the material, allowing it to switch from being an insulator to a metal, meaning that it goes from blocking electric current to conducting it. Researchers from the University of Pennsylvania rationalized the multiple phase transitions they observed, as well as, how these phases might be related to the concentration of lithium ions and their arrangement within the crystal structure. These results could only have been successful through synergies between the three international groups with diverse specialties: thin films from the Max Planck Institute of Microstructure Physics, batteries from the University of Cambridge, and theory from the University of Pennsylvania. The ability to control the orientation of these films allows the researches to explore anisotropic transport in this technologically-important class of materials, which is fundamental to the understanding of how these materials operate.

Source <https://www.sciencedaily.com/releases/2023/08/230802105803.htm>

10. Surgical and engineering innovations enable unprecedented control over every finger of a bionic hand

Prosthetic limbs are the most common solution to replace a lost extremity. However, they are hard to control and often unreliable with only a couple of movements available. Remnant muscles in the residual limb are the preferred source of control for bionic hands. This is because patients can contract muscles at will, and the electrical activity generated by the contractions can be used to tell the prosthetic hand what to do, for instance, open or close. A major problem at higher amputation levels, such as above the elbow, is that not many muscles remain to command the many robotic joints needed to truly restore the function of an arm and hand. A multidisciplinary team of surgeons and engineers has circumvented this problem by reconfiguring the residual limb and integrating sensors and a skeletal implant to connect with a prosthesis electrically and mechanically. By dissecting the peripheral nerves and redistributing them to new muscle targets used as biological amplifiers, the bionic prosthesis can now access much more information, so the user can command many robotic joints at will. The research was led by Professor Max Ortiz Catalan, Founding Director of the Centre for Bionics and Pain Research (CBPR) in Sweden, Head of Neural Prosthetics Research at the Bionics Institute in Australia, and Professor of Bionics at Chalmers University of Technology in Sweden. The researchers show that rewiring nerves to different muscle targets in a distributed and concurrent manner is not only possible but also conducive to improved prosthetic control. A key feature of the work is that they have the possibility to clinically implement more refined surgical procedures and embed sensors in the neuromuscular constructs at the time of the surgery, which is then connected to the electronic system of the prosthesis via an osseointegrated interface. A.I. algorithms take care of the rest. Prosthetic limbs are commonly attached to the body by a socket that compresses the residual limb causing discomfort and is mechanically unstable. An alternative to socket attachment is to use a titanium implant placed within the residual bone which becomes strongly anchored -- this is known as osseointegration. Such skeletal attachment allows for comfortable and more efficient mechanical connection of the prosthesis to the body. The cutting-edge surgical and engineering innovation can provide a high level of functionality for an individual with an arm amputation. The surgery took place at the Sahlgrenska University Hospital, Sweden, where CBPR is located. The neuromuscular reconstruction procedure was conducted by Dr. Paolo Sassu, who also led the first hand transplantation performed in Scandinavia. "The incredible journey we have undertaken together with the bionic engineers at CBPR has allowed us to combine new microsurgical techniques with sophisticated implanted electrodes that provide single-finger control of a prosthetic arm as well as sensory feedback. Patients who have suffered from an arm amputation might now see a brighter future," says Dr. Sassu, who is presently working at the Istituto Ortopedico Rizzoli in Italy. The research article illustrates how the transferred nerves progressively connected to their new hosting muscles. Once the innervation process had advanced enough, the researchers connected them to the prosthesis, so the patient could control every finger of a prosthetic hand as if it would be his own. The researchers also demonstrated how the system respond in activities of the daily life and are currently in the process of further improving the controllability of the bionic hand.

Source <https://www.sciencedaily.com/releases/2023/07/230712165138.htm>

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ENGINEERING INNOVATION IN INDIA

I. Indigenous Equipment Developed for Mechanical Recycling of Waste Thermoplastic Polymers to Composites

Indigenous equipment called single screw extruder developed for mechanical recycling through melt-mixing of waste thermoplastic polymers and inorganic particulate fillers can help manufacture and characterize polymer composites that can be molded to the required shape for making paver blocks, tiles, and bricks. At present, commercially available melt-mixing equipment are not designed for handling waste thermoplastic polymers that are often adhered by contaminants, as the barrel and screw system are not robust enough. IIT Bombay has developed an instrument named GOLDN (pronounced as Golden) for melt-mixing of waste thermoplastic polymers and inorganic particulate fillers to manufacture polymer composites. It can carry out melt mixing as a continuous process, particularly in laboratory conditions, to replicate the real-life conditions as compared to other conventionally available instruments. The researchers at the institute considered some key parameters such as compression ratio and clearance depth to facilitate efficient mixing of waste polymers and fillers. The above technology, developed with the support of Department of Science and Technology (DST) through Waste Management Technologies, is now ready for commercialization for carrying out melt- mixing operations in a laboratory environment. It can bring down the cost of this instrument to INR 5 lakhs (by 6-8 times at least) by avoiding the complex design and operating tools and including the indigenous fabrication that are required. The researchers have also developed a TGeosA for obtaining thermogravimetric analyses of the polymer composites obtained from the melt mixing instrument. The setup facilitates a sample size as high as 200 g that can incorporate the heterogeneity aspect of the materials being tested.

Further, a pilot-scale setup for manufacturing polymer composites has been indigenously fabricated. This setup consists of a shredder, a mixer cum preheater, and an extruder to obtain the fresh binder filler composite to shred the plastic waste, mix and preheat plastic waste and IBPs, and melt plastic waste along with IBPs followed by conveying at the end, respectively. The technology developed by IIT Bombay in collaboration with Belagavi works of M/s. Hindalco Industries Ltd. (Industry collaborator) is at the TRL-09 and a field-scale plant has been set up.

Source <https://dst.gov.in/indigenous-equipment-developed-mechanical-recycling-waste-thermoplastic-polymers-composites>

II. Chandrayaan-3 back on Earth! ISRO Confirms Controlled Disposal After Successful Mission



An LVM3 rocket carrying Chandrayaan 3 (Image: PTI)

The Indian Space Research Organisation (ISRO) in November 2023 reported the uncontrolled re-entry of the cryogenic upper stage of the LVM3 M4 launch vehicle, which successfully placed the Chandrayaan-3 spacecraft into orbit on July 14 this year. The ISRO indicated that the probable impact

area was anticipated to be over the North Pacific Ocean, and the final trajectory did not cross over India, as stated in their released statement. This rocket component formed part of the LVM-3 M4 launch vehicle and re-entered the Earth's atmosphere at approximately 14:42 IST. The re-entry occurred within 124 days of its launch, complying entirely with the "25-year rule" for low-Earth orbit objects, as per the guidelines recommended by the Inter-Agency Space Debris Coordination Committee (IADC), ISRO affirmed. Following the Chandrayaan-3 injection, the upper stage underwent "passivation" to eliminate any remaining propellant and energy sources, adhering to space debris mitigation guidelines set by the United Nations and IADC. "Passivation and post-mission disposal of this rocket body in adherence to the internationally accepted guidelines once again reaffirms India's commitment to preserve the long-term sustainability of outer space activities," the ISRO said in a statement.

About Chandrayaan-3

Chandrayaan-3 marks India's third mission to the moon, aiming for a soft landing on its surface for the second time. Departing from the Satish Dhawan Space Centre in Sriharikota on July 14, 2023, the spacecraft smoothly entered lunar orbit by August 5, 2023. The monumental moment arrived when the lander achieved a flawless touchdown near the lunar south pole on August 23, 2023.

Chandrayaan-3 Key Objectives

- Showcase a secure and gentle landing on the lunar surface.
- Demonstrate rover mobility and exploration on the moon.
- Conduct on-site scientific experiments.

Chandrayaan-3 Significant Discoveries

- Lunar Surface Temperature Surprise: ChaSTE recorded temperatures up to 70 degrees Celsius, challenging earlier expectations of 20 to 30 degrees Celsius.
- Confirmation of Lunar Surface Elements: The Pragyan rover's Laser-Induced Breakdown Spectroscopy confirmed the presence of Sulphur near the lunar south pole. Additionally, it detected elements like Aluminium, Calcium, Iron, Chromium, Titanium, Manganese, Silicon, and Oxygen.

Source: <https://www.businesstoday.in/technology/news/story/chandrayaan-3-back-on-earth-isro-confirms-controlled-disposal-after-successful-mission-405893-2023-11-16>

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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