

INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

Vol XIV, Issue 1, January 2023

INAE Vision 2020-2025

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INAE VISION

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

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INAE Mission

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

Technology Roadmap

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

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

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

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

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

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

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

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

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

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

These materials will have to 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 advance 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

Academy News (Covering period from October 1, 2022 to December 31, 2022)

Reports received in this period pertaining to events in previous months

5th INAE-NAEK Workshop on Advanced Materials for Sustainable Development

Indian National Academy of Engineering (INAE), the only engineering Academy in the country represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS). CAETS is an independent non-political, non-governmental, international organization of engineering and technological sciences academies, one-member Academy per country. INAE conducts various joint Workshops with Member Academies of CAETS. One such collaborative workshop between INAE and NAEK has been undergoing since 2017. This year 5th INAE-NAEK Workshop on "Advanced Materials for Sustainable Development" was held on August 25-26, 2022 at Hotel Hyatt Regency, Kolkata in hybrid mode. The two themes of the workshop were "Materials for Quantum Computing" and "Machine Learning for development of Advanced Materials". The Indian and the Korean groups of scientists assembled in two local cities such as Kolkata in India and Seoul in Korea. To adjust the time zones between the two cities, there was a need to restrict the technical discussions within limited hours and as such within a limited number of technical sessions.

Over the course of two days, updates on R&D activities relating to advanced materials, especially those activities associated with Quantum Computing and Machine Learning were highlighted. This workshop provided a platform for future collaboration between researchers from both countries and also served as an important venue for vigorous exchanges and collaborations between Korean and Indian engineers. 16 experts representing Korea and India in the field of Materials for Quantum Computing and Machine Learning for Development of Advanced Materials sessions delivered the technical Presentations.

On 25 August 2022, the event started with the Inauguration session. Prof Sanghamitra Bandyopadhyay, Director, Indian Statistical Institute, Kolkata and Prof Debatosh Guha, FNAE & Professor, Institute of Radio Physics and Electronics, University of Calcutta delivered the Introductory Remarks. Subsequently, Prof Indranil Manna, President, INAE delivered the Welcome Address. During his Address, he gave a brief about INAE activities. He highlighted that India is pursuing the path of development and in words of Our Hon'ble Prime Minister, a goal of Atmanirbhar Bharat or Self-reliant India. In this path of development engineering and technology plays a vital role. We need a peer body like INAE to steer this initiative. Subsequently, Prof Jung-Hee Song, Vice-President, NAEK delivered her Welcome Address. In her Address, she highlighted the possibility of convergence between materials science and ICT under the theme of "Advanced Materials for Sustainable Development". The aim of this workshop is to provide and establish science and technology policy guidelines by examining major issues and technological development in the ICT and materials industries.

The theme of discussions on Day 1 was 'Materials for Quantum Computing' which was designed through two technical sessions. Those sessions were chaired by Samit Kumar Ray, Professor, Department of Physics, IIT Kharagpur, India and Seung-Cheol Lee, Director of Indo-Korea Science & Technology Center, KIST, South Korea. Session I contained four keynote talks:

How to make a Quantum computer? Amlan Mukherjee, QpiAI India Pvt. Ltd, Bengaluru, India

Recent advances in semiconductor quantum dot-based quantum computing Dohun Kim, Dept. of Physics & Astronomy, Seoul National University

Engineering Spin-Orbit Interaction for Qubit Technologies Bhaskaran Muralidharan, Dept. of Electrical Engg., IIT Bombay, India

Quantum computing applications: Quantum algorithm optimization Doyeol (David) Ahn, Dept. of ECE, University of Seoul, Korea & Co-founder and CTO, First Quantum Inc.



Lectures by various eminent experts during the technical sessions

Two technical sessions pertaining to the theme "Materials for Quantum Computing" chaired by Prof Samit Kumar Ray, Professor, Department of Physics, IIT Kharagpur, India and Dr Seung-Cheol Lee, Director of Indo-Korea Science & Technology Center, KIST, South Korea were held. On 26 August 2022, two technical sessions pertaining to the theme "Machine Learning for development of Advanced Materials" which were chaired by Prof Sanghamitra Bandyopadhyay, Director, Indian Statistical Institute, Kolkata, India and Prof Tae-yeon Seong, Professor, Korea University were held.



Welcome Address by Prof Indranil Manna, President, INAE



Prof Jung-Hee Song, Vice-President, NAEK, Korea delivering Welcome Address

The majority of the presentations were made in physical mode except only a very few special cases where the speakers were on overseas travel. Session II comprised four more keynote talks:

Silicon Quantum Information Technology

Samaresh Das, Centre for Applied Research in Electronics, IIT Delhi, India

L0D, 1D, 2D and 3D materials prepared in KIST for the quantum information technology

Jindong Song, Center for Opto-Electronic Convergence Systems, KIST

Light-matter interactions in 2D materials for Quantum Photonic Devices Samit Kumar Ray, Department of Physics, IIT Kharagpur, India

A Chemistry Application of Quantum Krylov Subspace Diagonalization aided by Quantum Power Method

Joonsuk Huh, Institute of Quantum Biophysics, Sungkyunkwan University, South Korea Each talk culminated with very lively question answer session. The participants from both countries took part in that discussion indicating common interests and possibility of developing collaborative research programs. Technical sessions III and IV were planned for Day 2 focusing on '*Machine Learning for development of Advanced Materials*'. Both sessions were chaired by Sanghamitra Bandyopadhyay, Director, Indian Statistical Institute, Kolkata, India and Tae-yeon Seong, Professor, Korea University. Each of the sessions comprised four keynote talks as follows:

Session III

Predictive Models of Materials based on Quantum Physics and Machine Learning Umesh V. Waghmare, Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, India

Machine-Enabled Chemical Structure-Property-Synthesizability Predictions Yousung Jung, Dept. of Chemical & Biomolecular Engineering, KAIST

Machine Learning Approach of Design of New Materials with Targeted Properties Tanusri Saha-Dasgupta, S. N. Bose National Centre for Basic Sciences, Kolkata, India

Machine learning potentials enabling realistic material simulation and accelerated material discovery

Seungwu Han, Materials Science and Engineering, Seoul National University, Korea



Prof Sanghamitra Bandyopadhyay, Director, Indian Statistical Institute Kolkata chairing technical session during the Workshop

Session IV

Application of machine learning and neural network to predict materials properties and design a new material

Seung-Cheol Lee, Indo-Korea Science & Technology Center, KIST

Machine Learning assisted hierarchical filtering to identify novel magnetic materials Prasenjit Sen, Harish-Chandra Research Institute, Prayagraj, India

Data-driven design for high-performance SnSe-based thermoelectric material Hyunju Chang, Chemical Platform Technology Division, KRICT

Machine learning assisted workflows for the discovery of low dimensional/quantum materials

Nawaf Alampara, QpiAI India Pvt. Ltd, Bengaluru, India

A nice blend of Industry, R&D Laboratories, and academia was successfully planned by both Academies. The concluding session indeed became vibrant and interactive. Several thoughts and

suggestions were discussed indicating a fruitful outcome in terms of future planning, proposal, and strengthening collaborative research between these two countries.



Prof Debatosh Guha addressing the gathering

In conclusion, Prof. Indranil Manna expressed his happiness for having such a successful meeting and congratulated the team members of both Academies with a special mention to the dedicated services by Lt. Col Shobhit Rai, Deputy Executive Director, INAE, Ms. Pratigya Laur, Research Officer, INAE and Ms. Chanmi Lee, Officer, International Affairs, NAEK. The Vote of Thanks was proposed by Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE. The event ended with the Concluding Session during which discussion and finalization of statement for future scope of collaboration were held. The workshop was attended physically by 50 participants and online by various participants. This workshop was an outstanding success. The event was also streamed Live on YouTube. The links are as under.

25th August 2022- <u>https://www.youtube.com/watch?v=YxY13tYAqwQ&t=1239s</u> 26th August 2022- <u>https://www.youtube.com/watch?v=Eo9HbTa4KRM</u>



Prof Sanghamitra Bandyopadhyay, Director, ISI, Kolkata delivering Introductory Address

Vote of Thanks proposed by Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE



Indian Participants at the workshop at Kolkata

Celebration of Engineer's Day 2022 by INAE Kolkata Chapter

INAE Kolkata Chapter celebrated Engineer's Day 2022 on 15th September and organized a special lecture delivered by noted Engineer and industry leader Mr. Rabi Chowdhury, Managing Director, CESC Limited Kolkata. The event was organized at the Seminar Hall of the Electrical Engineering Department, Jadavpur University. Prof. Sivaji Chakravorti, Vice President INAE presided over the lecture meeting. He explained the significance of the day and also the activities of INAE to the audience. Prof. Debatosh Guha, President INAE Kolkata Chapter welcomed the participants and introduced the speaker. The lecture was attended by INAE fellows and faculty members, research scholars and students of Jadavpur University.

In his lecture, Mr. Chowdhury elaborated the evolving technologies in power generation, transmission and distribution in the city of Kolkata particularly focusing on the challenges and solutions. He discussed the historical perspectives of power supply in the city and illustrated the present-day challenges regarding environmental regulations, dwindling coal quality and coal import and introduction of power from renewables to the grid. Through lucid explanations of technical theories, Mr. Chowdhury could attract the attention of the audience throughout the lecture who later interacted overwhelmingly with the speaker on various issues.

Prof. Amitava Datta, Secretary and Treasurer of INAE Kolkata Chapter proposed the vote of thanks at the end of the lecture.



Prof. Sivaji Chakravorti, Vice President INAE, explaining the significance of the day to the audience



Prof. Debatosh Guha, President INAE Kolkata Chapter, greeting Mr. Rabi Chowdhury the speaker of the day



Mr. Rabi Chowdhury, MD CESC Ltd presenting the Engineer's Day 2022

CAETS 2022 Annual Meeting and Convocation

CAETS 2022 Annual meetings and Conference was hosted by the National Academy of Technologies of France (NATF) in Versailles, near Paris, France. The International Conference on "Engineering a better world: Breakthrough Technologies for Healthcare" was held on September 27-28, 2022. INAE delegation led by Prof Indranil Manna, President, INAE comprising of Prof Sushmita Mitra, FNAE; Prof GK Ananthasuresh, FNAE; Dr Sharmila Mande, FNAE and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE, participated in the subject event. The following two speakers from INAE delivered talks: Prof Sushmita Mitra, Professor at the Machine Intelligence Unit (MIU), Indian Statistical Institute, Kolkata was a Speaker during Technical Session 2 – The Foundations of Information and Communication Technologies (ICT) for Biology and Health on September 27, 2022 on the topic "Intelligent Analysis of Biomedical Images". Prof GK Ananthasuresh, Professor, Mechanical Engineering & Dean of Mechanical Sciences at Indian Institute of Science Bangalore was a Speaker during Technical Session 3 - Disruptive technologies and global R&D trends on September 28, 2022 on the topic "Micromachinery for Mechano-diagnostics".

During the event, the winners of the CAETS Communication Prizes were also announced. The nominations for the prize were sought from all member academies during April 2022. INAE had circulated an email requesting for suitable nominations to INAE Fellowship, INAE-SERB Abdul Kalam Fellows, INAE Young Innovator and Entrepreneur Awardees from previous years and INAE Student Projects Awardees from previous years in various categories for (1) Engineering Success Stories (2) High Potential Innovations. Prof Jayanta Mukhopadhyay, FNAE, Professor, Department of Computer Science and Engineering, IIT Kharagpur was conferred with the CAETS Communication prizes 2022 in the Category "High Potential Innovations" with a title of entry "iMediXcare Telemedicine System".



Prof Indranil Manna, President, INAE delivering address



Receipt of award by President, INAE on behalf of Prof Jayanta Mukhopadhyay





Prof Sushmita Mitra, FNAE delivering talk

Prof GK Ananthasuresh, FNAE delivering talk





Mr Bernard Charlès , Dassault Group Photograph of Presidents of CAETS Member Academies Systems, Paris, France & Prof Indranil Manna, President, INAE

Several Meetings of President INAE and INAE Delegation were held on the side lines of CAETS with the representatives of other Academies including US NAE; acatech, Germany; Engineering Academy of Japan; Royal Academy of Engineering, UK; National Academy of Technologies of France (NATF); Croatian Academy of Engineering etc to explore possibility of joint programs and their method of obtaining funds. The Academies expressed working interest to collaborate with INAE on joint technical programmes/activities in virtual/physical mode such as exchange visits, joint programmes, joint call for proposals, outreach to respective Governments for research funding, student internship and mentoring of students etc. It was ascertained from all the foreign Academies with whom meetings were held, that they receive funds for conduct of their activities either directly or indirectly from their respective Governments. The next CAETS Annual Meeting would be held in Croatia to be hosted by the Croatian Academy of Engineering in the year 2023. Prof Indranil Manna was happy to inform that Council that INAE has been requested to Chair the CAETS Engineering Education Working Group for which kind consent has been given by the Academy.

https://www.youtube.com/watch?v=LSEs9m0PF2w&t=75s

EVENTS (held between October 1, 2022 to December 31, 2022)

Engineers Conclave 2022

The Ninth Engineers Conclave-2022 (EC-2022) of the Indian National Academy of Engineering was held jointly with Indian Space Research Organization (ISRO) on **October 13-15, 2022 at Liquid Propulsion Systems Centre (LPSC-ISRO), Thiruvananthapuram.** The two themes for Engineers Conclave-2022 (EC-2022) were: **Theme I** on "**Space for National Development**" coordinated by ISRO, and **Theme II** on "**Transforming India into a Global Manufacturing Hub**" coordinated by INAE. The Inaugural Session was graced by Shri S Somanath, Chairman, ISRO and Chairperson EC-2022; Prof Indranil Manna, President, INAE; Dr V Narayanan, Director, LPSC and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE. The event commenced with the Invocation. In his Welcome Address Dr V Narayanan elucidated the importance of the two themes for this year's conclave. He opined that it was envisaged that the plenary talks, lectures and deliberations shall result in identifying national requirements and shall emanate to actionable recommendations towards implementation of the two themes.

Prof Indranil Manna, President, INAE in his presidential address emphasized that INAE is a conglomeration of eminent engineers dedicated to contributing to national development through engineering innovations and gave an overview of opportunities for Indian manufacturing sector and its role in the vision of *Atmanirbhar Bharat*. Shri Rajeev Chandrasekhar, Hon'ble Minister of State for Electronics and Information Technology and Skill Development, the Chief Guest of the Function delivered the Inaugural Address in video mode. He highlighted that it is expected that there will be a paradigm shift in the next decade when India will switch roles from being a consumer of technologies, to being an architect and designer in developing devises, products, platforms and solutions. Shri S Somanath, delivered the Keynote Address on "Future Perspective of Space Ecosystem" wherein he expressed that the space enterprise must be people centric and application driven. He emphasized that ISRO is currently in its expansion phase, looking forward to innovative missions, new services and global outreach. He also touched upon the major role that INAE is playing in such useful initiatives. Lighting of the lamp was carried out by the dignitaries. The Abstract Booklet of Engineers Conclave 2022 was released during the Inaugural Session which concluded with the Vote of Thanks proposed by Lt Col Shobhit Rai (Retd).





Shri Rajeev Chandrasekhar, Hon'ble Minister of Prof Indranil Manna Delivering Presidential State for Electronics and Information Technology Address and Skill Development delivering Inaugural Address



Lighting of Lamp by Dignitaries



Release of Abstract Booklet

Following the Inaugural function, an exhibition of engineering products was inaugurated by Dr S Unnikrishnan Nair, Director, VSSC/IIST and Dr Sam Dayala Dev D, Director IISU. A luncheon Meeting on "Making India Global Manufacturing Hub" was held with selected dignitaries as invitees. This was followed by two parallel sessions on Two Themes which continued on October 14, 2022 (Day 2 of the conclave). The deliberation on the two themes focused on cutting edge solutions to arrive at specific recommendations. It is envisaged that all such actionable recommendations emanating from the deliberations shall be progressed by the Academy with the concerned Government Departments/Agencies for consideration. The recording of the Inaugural Session of Engineers Conclave 2022 can be viewed by clicking on the link <u>https://www.youtube.com/watch?v=k7wOlDJIbFc</u>

Six enlightening Plenary Talks were delivered during the Engineers Conclave 2022, the first on "Making Manufacturing the next frontier for India's global leadership- Auto Industry" by Mr Girish Wagh, Executive Director, Tata Motors; the second on "Blue Economy Development" by Dr. Shailesh Nayak, Former Secretary, Ministry of Earth Science; the third on "Space for Earth Science" by Dr. Srinivasa Kumar, Director, INCOIS; the fourth Plenary on "Emerging Scientific Missions by Dr Anil Bharadwaj, Director, Physical Research Laboratory; the fifth on "India as an Emerging World Power-Challenges and Opportunities" by Shri G. Mohan Kumar, IAS (Retd), Former Defence Secretary, Govt of India and the sixth on Challenges in Human Space Mission by Dr S Unnikrishnan Nair, Director, VSSC.

On Day 3- October 15, 2022 two Parallel Sessions were held on the two themes viz Theme 1 on "Space for National Development" chaired by Theme 1 Coordinator- Dr Prakash Chauhan, Director, NRSC and Theme 2 on "Transforming India into a Global Manufacturing Hub" chaired by Theme 2 Coordinator-Shri. A.T. Ramchandani, FNAE, Executive Vice-President & Head-Defence IC, L&T during which the recommendations were finalized based on the panel discussion. Theme 1 focused on how India has the potential to be the space hub of the world and some of the recommendations include working on new technologies, expansion of space sector and reduction of production time. Also, opening of new private players and financial institutions in the space sector to transform knowledge and technologies into a business model. Theme 2 focused on Policy interventions for manufacturing including Simplification of processes; Production linked incentives and Enabling of Fiscal policies and MSME. Some key recommendations are advancement of education sector to cope up with the demands of the market and giving problem solving skills paramount importance in order to adhere to market demands.

The conclave concluded with the Valedictory Session in the afternoon of October 15, 2022 wherein the Introductory Remarks were delivered by Prof Indranil Manna, President, INAE followed by Summing up of Technical Sessions of two Themes by the respective Theme Coordinators. The highlights of the Session were the Address by Shri S Somanath, Chairman, EC-2022 and Valedictory Address by Dr Vijay Kumar Saraswat, FNAE, Member, NITI AAYOG & Chancellor, Jawaharlal Nehru University. Dr VK Saraswat in his address brought out that the thrust of the nation was in creating an eco-system for S&T development by setting up world class institutions like CSIR Labs, DRDO, ISRO, IITs. Also, a push was given for progress of steel, energy, textiles, pharmaceuticals, defence and consumer goods

industries in public and private sectors. All this has brought India into the league of developing nation with its GDP growing every year at 6-8%. He mentioned that the world is looking at us with hope to invest.





Felicitation of Dr VK Saraswat, FNAE

About 400 eminent experts and senior functionaries from National and State Centres/ Departments/ Units, Academia, R&D, Industry and INAE participated in the conclave and the event was an astounding success. Actionable recommendations emanating from the deliberations are being compiled which shall be forwarded to the concerned Government Departments/Agencies for consideration. The event was meaningful in achieving the laid down objectives. The Book of Abstracts released during the Engineers Conclave 2022 can be viewed by <u>clicking here...</u>

INAE's Participation in India International Trade Fair 2022 at Pragati Maidan, New Delhi

INAE participated in the India International Trade Fair (IITF 2022) held at Pragati Maidan, New Delhi during November 14-27, 2022 under the aegis of Department of Science and Technology (DST), Government of India. The Pavilion of DST at Hall 7D- Open area housed seven of its Autonomous Institutes namely Indian National Academy of Engineering (INAE) : Aryabhatta Research Institute of Observational Sciences, (AIRIES) Nainital; Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum; Survey of India (SOI), Technology Development Board (TDB); North East Centre for Technology Application and Reach (NECTAR) and National Innovation Foundation (NIF). The pavilion of DST had several new technologies at display and was a platform for the dissemination of information on various new initiatives. INAE representatives present during the period had an informative experience while interacting with general public explaining about the INAE its Mission, Vision, objectives and various initiatives under DST to know about each other's working and mandate.

INAE Annual Convention 2022

INAE Annual Convention 2022 was held on December 14-16, 2022 at Bhabha Atomic Research Centre (BARC), Mumbai in physical mode. The Inaugural Session was held on December 14, 2022. The Welcome Address was delivered by Dr AK Mohanty, FNAE, Director, BARC. Prof Indranil Manna, President, INAE delivered the Presidential Address. Two Compendiums on "Women Engineers in India Vol. I" and "Landmark Achievements in Engineering and Technology in Independent India" prepared by INAE under the aegis of the *Azadi ka Amrit Mahotsav* celebrations were released. INAE Study Report on "Housing in India – Challenges & Way Forward" was also released by the dignitaries on the dais during the Inaugural Session. The Session featured an enlightening Address by the Distinguished Guest - Dr. R Chidambaram, FNAE, Chairman (Honorary), School for Advanced Studies in Nuclear Science & Technology, BARC and Former PSA to Govt. of India. The Inaugural Lecture was delivered by the Chief Guest - Mr Nadir B Godrej, FNAE, Managing Director-Godrej Industries Ltd. and Chairman, Godrej Agrovet Ltd., Mumbai, who also delivered the Keynote Address. The INAE Governing Council

Meeting was held in the evening of December 14, 2022.



Release of Compendium on "Women Engineers in India Vol. I"



Release of INAE Study Report on "Housing in India – Challenges & Way Forward"



Release of Compendium on "Landmark Achievements in Engineering and Technology in Independent India"

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Dr AK Mohanty, Director, BARC delivering Welcome Address

Prof Indranil Manna, President, INAE delivering Presidential Address





Keynote Address by Mr Nadir B Godrej, FNAE, MD-Godrej Industries Ltd. & Chairman, Godrej Agrovet Ltd., Mumbai

The recording of inaugural Session of the INAE Annual Convention 2022 can be viewed by clicking the following link:

https://www.youtube.com/watch?v=-q2gUKFUHQM&t=7186s

A special presentation on DAE-BARC Technology for Society was organized in the morning of December 15, 2022 wherein the achievements of BARC and applications of Nuclear technology in the societal domain were showcased. Two Special Sessions on Compendiums by INAE, viz., "Women Engineers in India Vol. I" and "Landmark Achievements in Engineering and Technology in Independent India" were held on December 15, 2022, which were presided by Prof Indranil Manna, President, INAE, wherein the Committee Members participated and shared their experiences on the

journey of preparing the documents.

There were four Plenary Talks during the Convention viz. on "*Atmanirbharta* in Defence" by Mr. JD Patil, Member of Executive committee of Management Larsen & Toubro, and Advisor Defence & Smart Technologies to CEO & MD Larsen & Toubro; on "Energy Security and Sustainability: International Cooperation to Solve a Global Problem" by Prof John L Anderson, President, US National Academy of Engineering, (Pre-recorded); on "Role of Nuclear Energy in Climate Change" by Mr BC Pathak, CMD, NPCIL and on "Building Greater Futures with Innovation and Collective Knowledge" by Mr. K Ananth Krishnan, EVP & CTO, TCS, Chennai. These talks by eminent engineering luminaries held the distinguished audience spellbound.



Plenary Talk by Mr. JD Patil, Member of Executive committee of Management Larsen & Toubro, and Advisor Defence & Smart Technologies to CEO & MD Larsen & Toubro

Pre-Recorded Plenary Talk by Prof John L Anderson, President, US National Academy of Engineering



Plenary Talk by Mr BC Pathak, CMD, NPCIL

The Technical Presentations by newly elected Fellows and Young Associates were conducted in three Parallel Sessions on December 15, 2022 which were appreciated by the august audience. The Annual General Meeting (AGM) of Fellows and Induction Ceremony of newly elected Fellows & Young

Associates were held on December 16, 2022. The Convention concluded with the BARC Facility Visit / Electron Beam Centre & BRIT tour on December 16, 2022. About 180 INAE Fellows and Young Associates participated in the Convention which was well appreciated by all the INAE Fellows and Delegates.

Joint Activities with SERB.

I. SERB-INAE Collaborative Initiative in Engineering

INAE jointly with SERB had taken a new 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 organized during this year.

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

INAE has received a tremendous response and the initiative has progressed well with the conduct the above listed events efficiently under all the four verticals. In this regard, the events/programs had been organized during the Quarter October to December 2022 under the umbrella of 'Collaborative Initiative in Engineering'' as given below:

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

(*i*) **SERB-INAE Conclave:** The event was held during November 5-6, 2022 at IIT Kanpur under the aegis of SERB-INAE Conclaves on *Atmanirbhar* Technologies - Engineering Secured Future initiative. The event covered Plenary talks by eminent engineers, Panel Discussion, Student competition, etc. The conclave primarily focused on the following three themes: Clean Energy and Carbon Capture; Medical technology, implantable devices, and non-invasive imaging and Semiconductor technology and the future of electronics. Former Secretary, Department of Science and Technology (DST) Prof Ashutosh Sharma, while speaking to the participants as the Chief Guest, emphasised on the importance of science and engineering to address the future needs effectively, while Prof. Abhay Karandikar, Director, IIT Kanpur, talked about the conclave. A large number of participants from all over India, including students, faculty members, and start-ups, took part in the conclave organised at IIT Kanpur in hybrid mode.



Prof. Abhay Karandikar, Director, IIT Kanpur delivering Address

The event comprised of plenary and technical lectures by eminent dignitaries. In addition, a panel discussion session was held on "Driving India forward through Frugal Innovations" to highlight the importance of frugal ideas and the means to take them forward for

commercialization on the themes. Student competitions were planned on innovative products prototypes, great ideas, challenges, and ideation of start-ups; to cater to the aspiring minds of college students and start-ups. The shortlisted teams were invited to participate in-person at the event in IIT Kanpur, and the winners among them were awarded. Prof Indranil Manna, President, INAE, briefed about the background of the collaboration of science and engineering research board with INAE through various initiatives. He also emphasised the role of INAE to promote and advance the practice of engineering and technology and to identify and recognize top engineering professionals in the country. The event concluded with the speech by Prof. Amalendu Chandra, DoFA, IITK, who distributed the prizes to the winners.



Prof Ashutosh Sharma, Former Secretary, DST, and Chief Guest of the event addressing the participants



Address by Prof Indranil Manna, President, INAE during Valedictory Session

b) SERB-INAE Woman Engineers Program

(i) Workshop on Writing R&D Grant Proposal for Women Engineers

Towards the direction to encourage Women engineers in the country to undertake research and seek funding for their research proposals, an initiative has been taken by INAE and SERB, DST to jointly organize a **Workshop on Writing R&D Grant Proposal for Women Engineers** held on November 10-11, 2022 at IIT Tirupati.



Prof Sivaji Chakravorti, Vice-President, INAE delivering the Inaugural Address

The Workshop started on with welcome address by Prof KN Satyanarayana, Director, IITT. Prof Sivaji Chakravorti, Vice-President, INAE & Professor, Electrical Engineering Department, Jadavpur University, Kolkata was the Chief Guest of the event. During his inaugural address he mentioned that today teaching and research goes hand in hand and to bridge the heterogeneous gender gap, it is essential to encourage women engineers to undertake research for which seeking funding is a prime factor. A book on "Research Insights" authored by Dr Rajiv K Tayal, Formerly Scientist-G, DST, who was also the Resource person for the Workshop, was released during the Inaugural Session.



L to R: Prof Sivaji Chakrvorti, Prof KN Satyanarayana, Dr Rajiv K Tayal and Dr DR Prasada Raju during the book release on "Research Insights"

Around 35 Women faculty/researchers in Engineering disciplines from less endowed Engineering/Technological Institutions/Universities from the states of Andhra Pradesh, Karnataka, Kerala, and Telangana participated during the event. The workshop the aspects such as Research insights, Funding of research, evaluation of research grants, Role of funding agencies, Type of research grants, Evaluation of research grants, writing research grants, contents of proposal, formulation of proposal, defend a research grant, implementation of research grants and group activities by participants. A special lecture on Project based learning and specific funding opportunities was also delivered by Prof Sivaji Chakravorti and Dr DR Prasada Raju, Former Scientist, DST. Besides, technical sessions, various group activities to inculcate confidence in women engineers on writing an effective R&D grant proposal to seek funding from the government agencies, were also conducted over the span of one and half day Workshop.



Group photograph of all the participants

A Certificate of participation to the candidates was presented by Prof G Ranga Janardhana, Vice Chancellor Jawaharlal Nehru National Technological University (JNTU), Anantpur who was the Chief Guest for Valedictory Session held on November 11, 2022.

Photographs google drive link:

https://drive.google.com/drive/folders/1REket8oaHVpzgi9iyqD45w6xG5PJ9IBv?usp=share_link

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

(i) Innovation Contest and Showcasing 2022 The Science and Engineering Research Board (SERB) and Indian National Academy of Engineering (INAE) jointly organized Innovation Contest and Showcasing 2022 in association with NIT Arunachal Pradesh from November 4-5, 2022, to benefit the participants from all the North Eastern Engineering Institutions, Universities and NITs to implement their knowledge to set up their start-up or develop a business model based on either product innovation or service innovation to make it scalable, replicable and self-reliant in NE region. The event was inaugurated by Prof P Mahanta, Director, NIT Arunachal Pradesh. The objectives of the event was (a) to create a common interface for collaboration and showcase the best innovation and Start-up activities through exhibition from all Engineering Institutes, Universities and NITs across the North-East India, (b) to create an environment conductive to the development of local indigenous technologies and innovations, creating the scope and laying the foundation for the promotion of Translational Research and entrepreneurship and (c) to help the country achieve the goals of Start-up platform for academia and to showcase their expertise, products and technology innovations on mission mode. 120 participants from all-over North-East region took part in the contest organised at NIT Arunachal Pradesh in offline mode. The host institute invited talks on Indian Innovation, start-up policy/challenges and opportunities, IPR by eminent dignitaries. In addition, Student competitions such as design thinking, poster presentations, brain storming sessions, debate sessions, essay competitions and quiz were held, and the winners were given prizes. A brief Report on the event can be viewed by clicking here ...





Participants from North-East Region

Certificate Distribution to the winners of Prizes

(ii)Workshop on Skill development for an idea to Prototype at NIT Nagaland under SERB-INAE Outreach Programs for NE, J&K and Ladakh was held on November 26-30, 2022. The event comprised of five days rigorous sessions and training by eminent experts on Skill development for an idea to Prototype. The workshop focused on the students at the level of UG, PG and PhD from all NITs in North Eastern Region of India, and Institutes/Colleges/Universities. The primary objective of the event was to develop various skills such as to covert idea into a prototype, for market survey, for manufacturing and for marketing. 95 participants registered for the workshop from NIT Nagaland; NIT Manipur; St. Joseph University, Nagaland; University of Nagaland and some other Universities from North East region of India.

The workshop was inaugurated by Prof. Indranil Manna, President INAE, Chief Guest; Mr. Suparno Moitra, Guest of Honour, Founder & CEO, Indian Public Policy Foundation & Immediate, Former Chairman of the Board of Governors, NIT Nagaland and Mr. Taliwati Longchar, Guest of Honour, Director MSME. Prof. Manna addressed the gathering and gave a brief on activities of Indian National Academy of Engineering (INAE). He encouraged young minds for entrepreneurship and start-ups which will further lead the country into the biggest economy. The event continued for five days wherein fourteen experts from industry and academia delivered their expertise on entrepreneurship and start-ups and inspire the participants. Prof. D. Viswanathan, Former Vice Chancellor, Anna University and Prof. Sivaji Chakravorti, Vice-President, INAE were present during the valedictory ceremony as the Chief Guest and Guest of Honour respectively. Prof. Sivaji Chakravorti addressed the gathering and inspired the students to be the part of design and manufacturing, such that our country could lead in both. He inspired the participants to go for frugal innovation. Prof. D. Viswanathan addressed the gathering by providing inspiration on entrepreneurship and start-ups. He also requested INAE to sponsor such programs in other institutes to inspire young minds. A brief report on the Workshop can be viewed by clicking here



Students attending the Inauguration



Prof Indranil Manna, President, INAE, Chief Guest addressing the audience



Group photograph of Participants with eminent speakers

II. SERB-INAE Digital Gaming Research Initiative

The SERB-INAE Online and Digital Gaming Research Initiative was launched 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. A Letter of Intent was signed by INAE with SERB during March 2022.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 Indian Express (pg 27on October 13, 2022) and Hindustan Times (pg 8 on October 13, 2022), besides forwarding to INAE Fellows, Young Associates, Directors of IITs, NITs and CFTIs and AICTE for further distribution. The call for proposals was open from October 10, 2022 till December 15, 2022.

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

Proposals were particularly invited from:

- Scientists in regular service from educational and research institutes / laboratories/ universities, start-ups and industries. More than one academic partner was allowed.
- Ideally from a consortium and should be an industry-academy (including start-ups) collaboration with IP creation as a priority.
- Investigators already having a SERB project.
- Multidisciplinary teams involving technologists, designers, historians and experts in other areas of humanities and social sciences were encouraged for the project.

Forty-three proposals have been 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

The proposals shall be selected by the concerned experts from SERB and INAE shortly.

Joint INAE-SERB Scheme to Promote Translational Research in Engineering

INAE -SERB 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. Ten Fellows were selected in this Financial Year. At present, 45 fellows are functional under the scheme and the work done by these fellows have reached the stage of technology transfer to start-ups and strategic areas to include several patents being filing/granted so far. 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 performance of seven fellowships completing their tenure of three years on January 31, 2023 were reviewed by the Search Cum Selection Expert Committee (SSEC) during its meeting held on December 2, 2022 in hybrid mode, 7 existing Fellows were recommended for extension of tenure of Fellowship by another two years.

Local Chapter Activities

Reports received in this period pertaining to Local Chapter Activities held earlier

INAE Chennai Chapter Webinar featuring Lecture by Prof (Dr) Chitra Rajagopal, Director, Centre of Excellence in Process Safety and Risk Management for a Hydrogen Economy, IIT Delhi on "Process Safety and Risk Management with focus on Hydrogen Safety" was held on 16th September 2022. In this talk, Dr. Chitra Rajagopal talked about the various issues and safety hazards associated with Hydrogen storage and transport. She also outlined a complete plan for safe hydrogen economy. The talk included illustrative case studies for use of advanced tools in hydrogen safety assessment as well as training of industry and emergency response personnel. About 40 people joined the webinar on-line. Prof. S. Narayanan, President INAE Chennai Chapter introduced the speaker. The vote of thanks was proposed by Prof. Nandita DasGupta, Secretary, INAE Chennai Chapter.

Local Chapter Activities held in the Quarter October 2022 to December 2022

A number of webinars/activities/meetings/Technical Lectures were organized by INAE Local Chapters and INAE Headquarters during the quarter October 2022 to December 2022 under the *Azadi ka Amrit Mahotsav Initiative* as given below:

19th Lecture of the Distinguished Lecture Series was organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on 19th October 2022 on "CPS, IoT and AI" by Prof. U B Desai, Former Director IIT Hyderabad. The talk provided a high-level view of CPS (Cyber Physical Systems), IoT (Internet of Things), and AI (Artificial Intelligence). All these three areas are playing a major role in today's technology and also near-term future technologies. All the three domains are very vibrant with AI and CPS leading the way. There is a lot of overlap among CPS, IoT and AI. The talk focused on various applications of IoT, CPS and AI. The applications will be in the broad areas of precision agriculture, autonomous navigation, vehicle detection, and Intelligent transportation. 44 people participated in the talk.

20th Lecture of the Distinguished Lecture Series was organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on 3rd November 2022 on "Konarka Temple and Its Iron Beams: An Epitome of Aesthetics & An Engineering Feat" by Prof. Omkar Nath Mohanty, Director, Technology & Academic Initiative, RSB Metaltech., RSB Group, Pune.

Key Points: Konarka, the magnificent temple with exquisite sculpture described by Tagore as a 'Poem in Stone' for worshipping the Sun God and declared by UNESCO a World Heritage Site in 1984, is situated about 32 kms. North of Puri, on the shore of the Bay of Bengal. The temple is associated with the legend of Samba, the son of Lord Krishna, getting cured of his curse of leprosy through penance before the Sun God on the banks of Chandrabhaga, the holy river that was flowing nearby (now, dried up, only subterranean). The Konarka temple is known to have been completed in the mid-13th century with the main temple rising to over 230 feet from the ground. In one of the earliest eye-witness accounts of the standing temple in its full glory, Abul Fazl, the famous historian in the court of Mughal Emperor Akbar (1556-1605 A.D.), pays glowing tributes to the great edifice in his Ain-i-Akbari. It was probably the tallest temple in the world then. Sadly, the main temple housing the presiding deity collapsed, presumably in the 17th entury. Although the causes of collapse have not been unequivocally established yet, the principal reason for the 'fall' appears to be the structural instability due to land subsidence caused by the proximity to the sea-shore and the resultant inadequate strength of foundation. There are many popular 'theories' about the construction and collapse of the main temple, which are by and large apocryphal. The only portion of the temple that is still standing in its near-entirety is the Jaga Mohana, or the Audience Hall (commonly referred to as 'Black Pagoda' by the European navigators). This came to light in its ruinous state during the early phase of the British rule (beginning in 1803) of Odisha.

Apart from extensive excavations (over 50 years) to unearth the buried portions, some steps were considered necessary for saving this structure from possible collapse. The four entrances were permanently closed, and the interior was filled with sand vertically from the top by drilling a hole and pouring sand through a funnel in order. This exercise was started in the year 1903 and completed in 1909 under the supervision of Bishan Swarup, an engineer from Patna. Over the past 113 years the sand level is known to have descended 4 - 5 metres, after absorbing moisture, and is therefore considered to have outlived its purpose of supporting the structure from inside. The Govt. of India has therefore decided recently to extract the sand from inside, take measures to ensure its integrity and eventually make the interior accessible to visitors. 63 people participated in the talk. The video recording of the talk can be viewed at the YouTube Link: https://youtu.be/s7UyGpBZugo

Technical Talk by INAE Delhi Chapter was organized on October 14, 2022 on "Computational \geq Software and the Future of Intelligent Electronics System Design" by Dr Anirudh Devgan, President and CEO of Cadence Design Systems. Prior to becoming CEO in 2021, he was President of Cadence, before which he served as Executive Vice President and General Manager of the Digital & Signoff and System Verification groups. Prior to joining Cadence in 2012, Dr Devgan was Corporate VP and member of the executive staff at Magma Design Automation, and earlier held management and technical roles at IBM. Dr Devgan is widely recognized as one of the leading authorities in electronic design automation (EDA), and successfully pioneered the application of massively parallel and distributed architectures to create several industry firsts and most impactful products in the areas of SPICE simulation, library characterization, place and route, static timing, power and electromagnetics, among several others. He also drove the first common compiler architecture for emulation and prototyping platforms. Dr Devgan is an IEEE Fellow, has written numerous research papers, and holds 27 US patents. He has won several awards, including the prestigious Phil Kaufman Award for his extensive contributions to EDA as well as the IBM Corporate Award and IEEE McCalla Award. Dr Devgan serves on the boards of the Global Semiconductor Alliance and the Electronic System Design Alliance. Dr Devgan received a Bachelor of Technology Degree in

Electrical Engineering from the Indian Institute of Technology (IIT) Delhi, and MS and PhD degrees in electrical and computer engineering from Carnegie Mellon University.

21st Lecture of the Distinguished Lecture Series was organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on 25th November 2022 on "Accelerator Architectures for Deep Neural Networks and Homomorphic Encryption" by Prof. Keshab K. Parhi, Dept. of Electrical & Computer Engineering, University of Minnesota, Minneapolis.

Key Points: Machine learning and data analytics continue to expand the fourth industrial revolution and affect many aspects of our lives. The talk explored hardware accelerator architectures for deep neural networks (DNNs). A brief review of history of neural networks (IEEE OJCAS-2020) was presented and covered his recent work on Perm-DNN based on permuted-diagonal interconnections in deep convolutional neural networks and how structured sparsity can reduce energy consumption associated with memory access in these systems (IEEE MICRO-2018). He also talked about reducing latency and memory access in accelerator architectures for training DNNs by gradient interleaving using systolic arrays (IEEE ISCAS-2020). He presented his recent work on LayerPipe, an approach for training deep neural networks that leads to simultaneous intra-layer and inter-layer pipelining (ACM/IEEE ICCAD-2021). This approach can increase processor utilization efficiency and increase speed of training without increasing communication costs. Finally, he described ongoing work on accelerators for homomorphic encryption, computing in the encrypted domain. 71 people participated in the talk. **The video recording of the talk can be viewed at the YouTube Link**: https://youtu.be/QQr8SdKSmKs

- Webinar by INAE Chennai Chapter was held on 25th November 2022 on "Education and Research in Emerging and Disruptive Technologies in HEIs" by Prof Kamakoti Veezhinathan, Director, Indian Institute of Technology Madras. In this talk, Prof. Kamakoti talked about the need for accessibility to world-class education by a larger section of the society. He pointed out that various IITs are working towards different online programmes, so that students from anywhere in the country can register for these courses and upskill. He mentioned that IIT Madras has launched an online 4-year Bachelor of Science program in Data Science and Applications, which is the first of its kind in the world. Several such online courses are being planned and will be launched in near future. About 40 people joined the webinar on-line. Prof. S. Narayanan, president INAE Chennai Chapter introduced the speaker. The vote of thanks was proposed by Prof. Nandita DasGupta, Secretary, INAE Chennai Chapter.
- Technical Talk by INAE Delhi Chapter was organized on 22nd November 2022 on "Progress in Bioelectronics - from Lab-on-Chip to Lab-on-Things" by Professor Dr Sameer Sonkusale, Professor of Electrical and Computer Engineering at the Tufts University in the USA with a joint appointment in the department of Biomedical Engineering and also the department of Chemical and Biological Engineering.

Abstract: Spurred by advances in microfabrication, lab-on-chip technologies have revolutionized our study of biology and life sciences and have resulted in the development of point of care diagnostics. In this talk we will look at some of the advances in this field with a vision towards the future, all through the lens of speaker's own work. This vision is to migrate from developing lab-on-chip technologies towards lab-on things. Examples to be discussed in this talk: (1) Flexible smart bandages for monitoring and treating chronic wounds, (2) Functionalized smart threads for tissue-embedded or on-skin diagnostics, (3) Ingestible smart pills for studying the gut microbiome, and (4) CMOS-based single cell engineering. The key theme that permeates through all the projects is the embedding intelligence and adding multi functionality into common things. This is made possible due to advances in flexible electronics for realization of truly conformal and flexible sensors and

actuators and leveraging the large-scale integration of silicon CMOS-based electronics for instrumentation.

Biography of Speaker: Professor Dr Sameer Sonkusale is currently a Professor of Electrical and Computer Engineering at the Tufts University in the USA with a joint appointment in the department of Biomedical Engineering and also the department of Chemical and Biological Engineering. He also held a visiting appointment at the Wyss Institute at Harvard University and at Brigham and Women's Hospital of the Harvard Medical School for 2011-2012 and 2018-2019. For 2012-2013 Prof. Sonkusale was also the Associate Dean of Graduate Education in the School of Engineering at the Tufts University. Currently, Prof. Sonkusale directs an interdisciplinary research group "Nano Lab" with research focus on biomedical micro devices circuits and systems, flexible bioelectronics, point of care diagnostics, precision medicine and CMOS-based instrumentation. The technologies developed in his labs have been licensed to several companies and have resulted in creation of several start-ups. Several national and international media (Forbes, Economist, Wall Street Journal, STAT News, Fast Company, Telegraph UK, National Public Radio-NPR, BBC Radio, WBUR radio, ABC News-TV, IEEE Spectrum, etc.) have highlighted his work extensively. Prof. Sonkusale received his MS and PhD degrees in Electrical Engineering from the University of Pennsylvania, USA. He has received several awards including the National Science Foundation CAREER Award in 2010. He also received the Acorn Innovation Award from Massachusetts Technology Transfer Office in 2018. He is an alumnus of the National Academy of Engineering US Frontiers of Engineering meeting in 2015, and the National Academy of Sciences Arab-America Frontiers meeting in 2014 and 2016. He also recently received the Distinguished Alumnus award from his alma mater, BITS Pilani. Prof. Sonkusale is on the editorial boards of Scientific Reports (Nature Publishing Group), IEEE Transactions on Biomedical Circuits and Systems, Journal of Low Power Electronics and Application, Chips, PLoS One, and Electronic Letters. He is a Senior Member of the IEEE, and a member of OSA, MRS, BMES and AAAS.

- 22nd Lecture of the Distinguished Lecture Series organised by INAE Bhubaneswar Chapter, jointly with SOA University and IMMT Bhubaneswar on 5th December 2022 on "Design of Experiments" by Professor Tapan P. Bagchi, Indian Institute of Technology Kharagpur; Vinod Gupta School of Management, Kharagpur; Adjunct Professor of Quantitative Methods.
- Webinar by INAE Chennai Chapter was held on 22nd December 2022 on "Rethinking the Idea of a University" by Prof. MS Ananth, Former Director, IIT Madras. This was held in hybrid mode with about 30 people joining online and another 25 in person. In this talk, Prof. Ananth talked about the challenges faced by the universities and the need for reaching out to a larger number of students. In this context, he mentioned the important role played by NPTEL (National Programme on Technology Enhanced Learning), which has benefitted a large number of students who can freely access the lectures by experienced professors. He also talked about the importance of Industry-academia interaction and discussed how the Research Park was set up adjacent to IIT Madras to promote such interaction. The talk was followed by a lively discussion with members of the audience both on and off-line. Prof. S. Narayanan, President INAE Chennai Chapter introduced the speaker. The vote of thanks was proposed by Prof. Nandita DasGupta, Secretary, INAE Chennai Chapter.

INAE Publications

Transactions of INAE Volume 7, Issue 4, December 2022 was published through Springer Publishers which is a full-fledged journal of Peer reviewed papers instituted by INAE.

Compendium on "Women Engineers in India Vol. I"

The Government of India launched a 75-week celebration of India's 75th year of Independence (Azadi ka Amrit Mahotsav) in March 2021 and Department of Science and Technology (DST), Government of India requested all Autonomous bodies under its aegis to conduct technical programmes and activities to mark the celebrations. It was thus envisaged in June 2021 to bring out a Compendium on "Women Engineers in India- Volume I" as no such document is available anywhere. An Editorial Committee was constituted under the Chairmanship of Prof Purnendu Ghosh, Vice-President, INAE to undertake the task. Periodic meetings of the Editorial Committee were held with active and sustained contributions of all Members. A Master List of nominees based on suggested names of women engineers was prepared with inputs received from the Members of the Editorial Committee and Heads of Academic Institutions, R&D organizations and Industry in response to letters from President, INAE and the nominees for this volume were chosen by adopting laid down yardsticks and criteria. The Compendium by INAE on "Women Engineers in India Vol. I" was released during the Inaugural Session of the INAE Annual Convention 2022 held on December 14-16, 2022 at Bhabha Atomic Research Centre (BARC), Mumbai. Messages from Dr Jitendra Singh, Hon'ble Minister of State (Independent Charge) for Science and Technology and Earth Sciences and Dr. Srivari Chandrasekhar, Secretary, Department of Science and Technology (DST), Govt. of India were featured in the Compendium on "Women Engineers in India Vol. I"

Compendium on "Landmark Achievements in Engineering and Technology in Independent India"

The Compendium on "Landmark Achievements in Engineering and Technology in Independent India" was also compiled by the INAE as a part of the 75-week celebration of India's 75th Year of Independence (Azadi ka Amrit Mahotsav) to showcase the country's seminal achievements in this domain. For pursuing this activity, the INAE Governing Council had constituted a Task Force Chaired by Prof Prem Krishna, former Vice-President, INAE and comprising of ten Members representing respectively the 10 Engineering Sections of INAE. Suggestions and nominations for entry into the compendium were invited from the major industries, strategic Departments, national institutions, R&D Organizations besides Fellowship of INAE, INAE Young Associates, students, professionals and top organizations. The topics were chosen based on well-defined criteria and after due deliberations by the Task Force Members. The Compendium by INAE on "Landmark Achievements in Engineering and Technology in Independent India" was released during the Inaugural Session of the INAE Annual Convention 2022 held on December 14-16, 2022 at Bhabha Atomic Research Centre (BARC), Mumbai. Messages from Dr Jitendra Singh, Hon'ble Minister of State (Independent Charge) for Science and Technology and Earth Sciences and Dr. Srivari Chandrasekhar, Secretary, Department of Science and Technology (DST), Govt. of India were featured in the Compendium on "Landmark Achievements in Engineering and Technology in Independent India".

Study Report on "Housing in India – Challenges & Way Forward"

The report on Study on "Housing in India – Challenges & Way Forward" incorporating all inputs from invited experts was released during the INAE Annual Convention 2022 held on December 14-16, 2022 at Bhabha Atomic Research Centre (BARC), Mumbai. Civil Infrastructure touches the lives of millions, and thus the reduction or removal of its deficiencies create an enormous challenge The Academy therefore set up the forum on Civil Infrastructure in January 2018 to address the issues of Traffic & Transportation, Housing and Water in the context of National Development. The study on Housing problems in India contained in this report has been carried

out by authors with considerable experience and expertise in the subject domain drawn from within the INAE Fellowship as well other eminent experts. The report contains an analysis of the challenges faced and their possible solutions and, contains a set of actionable - recommendations. Before its finalization, an extended executive summary based on the draft was shared with a select group of stakeholders in the domain, and also discussed subsequently in an online meeting, wherein besides invited experts, officials from the Ministry of Housing & Urban Affairs, Government of India, also participated. The comments from the stakeholders, experts and officials served as valuable inputs for finalizing the report and helped in making it more meaningful and relevant. The report on Study on "Housing in India – Challenges & Way Forward" is being disseminated to the concerned stakeholders from the Government agencies, besides INAE Fellows and other experts for follow up actions on the recommendations accordingly.

Important Meetings held during October 2022, November 2022 and December 2022

List of Meetings in October 2022

- Oct 6 INAE Annual Convention 2022
- Oct 6 Meeting to discuss the status of Engineers Conclave 2022
- Oct 7 Discussion on Report of Housing Forum
- Oct 22 Meeting to discuss Modalities for the conduct of INAE Annual Convention 2022
- Oct 27 Finalizing the program of Annual Convention 2022
- Oct 31 Meeting with President INAE
- Oct 31 Meeting with Accounts Department (BARC)

List of Meetings in November 2022

- Nov 3 Meeting to discuss the requirement for IITF
- Nov 7 Meetings of Selection Committee and Search-cum-Selection Committee from 5:30 PM to 6 PM on 7th November 2022
- Nov 7 Meeting with President INAE
- Nov 7 Apex Committee Meeting from 6 PM to 7 PM on 7th November 2022
- Nov 10 Discussion on Landmark Compendium Final Layout
- Nov 15 Meeting with creative design team with INAE Core Committee for landmark compendium
- Nov 21 Discussion on memento for Annual Convention 2022
- Nov 21 Meeting of Design Team with INAE Core Committee to finalize the manuscript of Landmark Compendium
- Nov 25 Webinar on "Education and Research in Emerging and Disruptive Technologies in HEIs"
- Nov 28 Meeting of INAE Core Committee to discuss manuscript of Landmark Compendium
- Nov 28 Meeting of Convention Organizing Committee of INAE Annual Convention 2022
- Nov 30 Meeting of Convention Organizing Committee of INAE Annual Convention 2022

List of Meetings in December 2022

- Dec 2 Review Meeting for INAE-SERB Abdul Kalam Technology Innovation National Fellowship
- Dec 2 36th Finance Committee Meeting of INAE followed by 41st Apex Committee meeting on Dec 2nd, 2022.
- Dec 6 INAE Annual Convention 2022 Meeting with 'Accommodation & Reception Committee' and 'Transport Committee'
- Dec 6 INAE Annual Convention 2022 Meeting with 'Catering Committee'
- Dec 8 Meeting for INAE Corpus Fund

- Dec 9 Discussion on Progress of Annual Convention 2022
- Dec 14 145th Governing Council Meeting on 14th December at 6:15 PM
- Dec 16 Agenda: 34th AGM of Fellows of INAE (Part B) on 16th December at 10:00 AM
- Dec 22 Webinar on "Rethinking the Idea of a University"
- Dec 26 INAE Bhubaneswar Chapter Meeting at Bhubaneswar Office in SOA University.

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

International Conference on Machine Intelligence for Geo Analytics and Remote Sensing (MIGARS) – 2023 being held in-person on 27th to 29th January 2023 at Hyderabad, Telangana. https://conferencealerts.com/show-event?id=246521

Innovative Research in Engineering Sciences Environment, Business Management and Humanities for Sustainable Development being held in person on 27th to 28th January 2023at New Delhi <u>https://conferencealerts.com/show-event?id=249660</u>

International Conference on Artificial Intelligence and Smart Systems Conference being held online and in person on 2nd to 4th February 2023 at Coimbatore, Tamilnadu, https://conferencealerts.com/show-event?id=246705

14th International Conference on "Industry 4.0 & Optimising Operations and Shaping the Future of Business" being held online on 11th to 12th February 2023 at Gwalior, M.P https://conferencealerts.com/show-event?id=250813

5th International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV-2023) being held online and in person on 16th to 17th February 2023 at Tirunelveli, Tamil Nadu,

https://conferencealerts.com/show-event?id=247285

International Conference on Inspiring Innovations in Engineering, Technology & Managements 2023 being held in person on 17th to 18th February 2023 at Aurangabad, Maharashtra https://conferencealerts.com/show-event?id=250289

Second International Conference on Materials Design and Manufacturing Process being held online and in person on 23rd to 25th February 2023 at Chennai, Tamil Nadu. https://conferencealerts.com/show-event?id=249325

Eighth International Conference on "Emerging Research in Computing, Information, Communication and Applications" being held in person on 24th to 25th February 2023 at Bengaluru, Karnataka https://conferencealerts.com/show-event?id=248839

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HONOURS AND AWARDS

- Prof Suresh Bhargava, AM; FTSE, FNAE, FAAAS, FRSC, FRACI, FNASI, FTWAS-UNESCO, KIA Laureate and QPM Chair, Dean, Research & Innovation Research partnerships (India), Director for CAMIC, STEM College, RMIT University, Melbourne, Australia, a Foreign Fellow of INAE, received one of the Highest Civilian honours in Australia from the late Queen of England last year viz Member-order of Australia, Queens Honour,2022.
- 2 Prof Suman Chakraborty, FNAE, Professor of Mechanical Engineering, Indian Institute of Technology Kharagpur has been awarded the Infosys Prize 2022 for his contribution in the fields of Engineering and Computer Science. He was rewarded as his work helped advance healthcare in resource limited settings.
- 3 Prof K. Ramesh, FNAE, K Mahesh Chair Professor, Department of Applied Mechanics, IIT Madras, Chennai was selected to receive the "2023 M M Frocht Award" in recognition of outstanding achievements as an educator in the field of experimental mechanics by the Society of Experimental Mechanics, USA. The award ceremony will be on 7th June 2023 at their Annual conference to be held at Orlando, USA. For more details you can see the following link: <u>https://sem.org/awardsfrocht</u>



| | NEWS OF FELLOWS |
|---|---|
| 1 | Prof Ganapati D. Yadav, FNAE, National Science Chair of Govt. of India and Emeritus Professor |
| | of Eminence, and Former Vice Chancellor of the Institute of Chemical Technology (ICT) Mumbai |
| | was elected as the Fellow of the US National Academy of Inventors (NAI). He is the only second |
| | Indian to be so honoured. The NAI was founded in 2010 to recognize and encourage inventors |
| | with patents issued from the U.S. Patent and Trademark Office, enhance the visibility of academic |
| | technology and innovation, encourage the disclosure of intellectual property, educate and mentor |
| | innovative students, and translate the inventions of its members to benefit society. |
| 2 | Hon'ble Chief Minister of Karnataka, Mr Basavaraj Bommai released biography of Dr BN Suresh, |
| | Former President, INAE, Chancellor, Indian Institute of Space Science & Technology (IIST) and |
| | Honorary Distinguished Professor, ISRO Headquarters, Bangalore on October 29, 2022. The book |
| | authored by his son Mr Sunil Suresh tracks Dr. Suresh's journey from a small village called |
| | Hoskare near the town of Koppa to overseeing the development of India's launch vehicles. |
| 3 | Dr Bhujanga Rao, Vepakomma, FNAE, ISRO Chair Professor, National Institute of Advanced |
| | Technologies (NIAS), Bengaluru has been elected as Fellow of Indian National Science Academy |
| | (INSA) Effective from January 1, 2023 under a special category. |
| | |
| 4 | Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, |
| | Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; |
| | Former Professor SOBT, GBU, Greater Noida jointly with his wife Mrs Sakuntala has published |
| | a short paragraph in Bangla Medium with a title "Maner Majhe Mandir Mahima" in the Souvenir |
| | of Durgotsab 1429/year 2022 of C.R.Park, Kali Mandir Society in December 2022. |
| | |

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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 <u>https://www.facebook.com/inaehq1</u>
- (b) Twitter handle link <u>https://twitter.com/inaehq1</u>



Obituaries Dr Jamshed J Irani



(June 2, 1936- October 31, 2022)

Dr Jamshed J Irani, FNAE born on June 2, 1936 passed away on October 31, 2022.

Dr Jamshed J Irani, Formerly Managing Director, Tata Steel was also known as the steel man of India. He was associated with Tata Steel for over four decades when he decided to retire from the board committee in June 2011, leaving behind a legacy that earned him and the organisation several international and national acclaim. He attended Science College and Nagpur University to pursue BSc and MSc in Geology. Later, he shifted to the United Kingdom to attend the University of Sheffield as a JN Tata Scholar, where he completed a Master's in Metallurgy and a PhD in Metallurgy. He started his professional career by joining Sheffield's British Iron and Steel Research Association. While working in a British company, he always yearned to contribute to India's development. After five years in Britain, he returned to his homeland and joined Tata Steel (then The Tata Iron and Steel Company) as an Assistant to the Director in charge of Research and Development (R&D). He became the company's General Manager in 1979, the President of Tata Steel in 1985 and the Managing Director in 1988. He joined the company as a Non-Executive Director in 2001, which continued for a decade. Besides Tata Sons and Tata Steel, he also held positions at several Tata Group companies- Tata Teleservices and Tata Motors. As an industrialist, Dr Irani was conferred with several honours, including his appointment in the Royal Academy of Engineering as an International Fellow and an Honorary Knighthood by Queen Elizabeth II for his contributions to Indo-British trade and cooperation. Dr Irani also served as the national president of the Confederation of Indian Industry for 1992-93. He was conferred the INAE Life Time Contribution Award in Engineering in the year 2002 and the Padma Bhushan in 2007 by President of India for contributing to the country as an industrialist.

May God Bless His Soul to Rest in Peace



(November 19, 1958- November 29, 2022)

Mr Vikram S Kirloskar, FNAE born on November 19, 1958 passed away on November 29, 2022. He was elected to INAE Fellowship in the year 2021 and affiliated to ES -III (Mechanical Engineering).

Mr Vikram S Kirloskar, Chairman and Managing Director of Kirloskar Systems Ltd. & Vice Chairman of Toyota Kirloskar Motor obtained his Bachelor's in Science in Mechanical Engineering from MIT, USA in 1981. He was responsible for partnering the Toyota Group and starting a major automobile manufacturing industry in Karnataka; for which he conferred with "Suvarna Karnataka" award by Government of Karnataka. He had designed and developed many processes and machine tools in his career. Mr Kirloskar was a staunch advocate of green mobility solutions. According to him, it was

crucial to align technology with the energy mix and the infrastructure available to cut emissions in a world grappling with the fallout of climate change. He was President of Confederation of Indian Industry (CII) during 2019-20 and was conferred with Indian Institute of Metals JRD Tata Award 2020, for his excellence in corporate leadership in Metallurgical Industries. Mr Kirloskar had made seminal contributions in promotion of the growth of the Indian industry.

May God Bless His Soul to Rest in Peace

Mr. VCV Chenulu

(December 01, 1931 - December 1, 2022)

Mr VCV Chenulu, FNAE born on December 1, 1931 passed away on December 1, 2022. He was elected to INAE Fellowship in the year 1990 and affiliated to ES - V (Electrical Engineering).

Mr VCV Chenulu, Formerly Member (Electrical), Railway Board, Indian Railways held various important appointments in Indian Railways such as Assistant Electrical Engineer, Chief Electrical Engineer; Director General (Research, Designs & Standards Organization) and as the first Member (Electrical) Railway Board. As Member (Electrical), he made significant contributions in development of proper infrastructure for discharging the responsibility of reliable and efficient operation and maintenance of Electrical assets under his charge. In the modernization plans, acquisition of three phase high horsepower electric locomotives was a major step, under his guidance. The Research Designs and Standards Organisation (RDSO) and the Chittaranjan Locomotive works also successfully upgraded the designs and improved reliability, under his tenure.

May God Bless His Soul to Rest in Peace

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ENGINEERING AND TECHNOLOGY UPDATES Civil Engineering

1. New Technology to Reduce Potholes

Researchers have developed new "intelligent compaction" technology, which integrates into a road roller and can assess in real-time the quality of road base compaction. Improved road construction can reduce potholes and maintenance costs, and lead to safer, more resilient roads. Months of heavy rain and floods have highlighted the importance of road quality, with poor construction leading to potholes and road subsidence. This not only causes tyre blowouts and structural damage to cars and trucks, but also increases the chance of serious accidents. The innovative machine-learning technique, which processes data from a sensor attached to construction roller, was developed by a research team from the University of Technology Sydney. They developed an advanced computer model that incorporates machine-learning and big data from construction sites to predict the stiffness of compacted soil with a high degree of accuracy in a fraction of second, so roller operators can make adjustments. Roads are made up of three or more layers, which are rolled and compacted. The subgrade layer is usually soil, followed by natural materials such as crushed rock, and then asphalt or concrete on top. The variable nature of soil and moisture conditions can result in under or over-compacted material. The compaction needs to be 'just right' to provide the correct structural integrity and strength. Over-compaction can break down the material and change its composition, and under-compaction can lead to uneven settlement. The research suggests the application of this technology could help build longer-lasting roads that can better withstand severe weather conditions. The team is now looking to test the new technology onsite for various ground and roller conditions for road, railway and dam construction projects, and explore techniques to measure density and moisture content of the compacted soil in real-time during construction.

Source https://www.sciencedaily.com/releases/2022/11/221104100254.htm

Computer Engineering and Information Technology

2. Revolutionary AI System Learns Concepts Shared Across Video, Audio, and Text

A machine-learning model can identify the action in a video clip and label it, without the help of humans. Humans observe the world through a combination of different modalities, like vision, hearing, and our understanding of language. Machines, on the other hand, interpret the world through data that algorithms can process. So, when a machine "sees" a photo, it must encode that photo into data it can use to perform a task like image classification. This process becomes more complicated when inputs come in multiple formats, like videos, audio clips, and images. Researchers at the Computer Science and Artificial Intelligence Laboratory (CSAIL) have developed an artificial intelligence (AI) technique that allows machines to learn concepts shared between different modalities such as videos, audio clips, and images. The AI system can learn that a baby crying in a video is related to the spoken word "crying" in an audio clip, for example, and use this knowledge to identify and label actions in a video. The technique performs better than other machine-learning methods at cross-modal retrieval tasks, where data in one format (e.g. video) must be matched with a query in another format (e.g. spoken language). It also allows users to see the reasoning behind the machine's decision-making. In the future, this technique could potentially be used to help robots learn about the world through perception in a way similar to humans. MIT researchers developed a machine learning technique that learns to represent data in a way that captures concepts which are shared between visual and audio modalities. Their model can identify where certain action is taking place in a video and label it. The researchers developed an artificial intelligence technique that learns to represent data in a way that captures concepts which are shared between visual and audio modalities. For instance, their method can learn that the action of a baby crying in a video is related to the spoken word "crying" in an audio clip. Using this knowledge, their machine-learning model can identify where a certain action is taking place in a video and label it. It performs better than other machine-learning methods at cross-modal retrieval tasks, which involve finding a piece of data, like a video, that matches a user's query given in another form, like spoken language. Their model also makes it easier for users to see why the machine thinks the video it retrieved matches their query. This technique could someday be utilized to help robots learn about concepts in the world through perception, more like the way humans do. The researchers' focus their work on representation learning, which is a form of machine learning that seeks to transform input data to make it easier to perform a task like classification or prediction. The representation learning model takes raw data, such as videos and their corresponding text captions, and encodes them by extracting features, or observations about objects and actions in the video. Then it maps those data points in a grid, known as an embedding space. The model clusters similar data together as single points in the grid. Each of these data points, or vectors, is represented by an individual word. For instance, a video clip of a person juggling might be mapped to a vector labeled "juggling." The researchers constrain the model, so it can only use 1,000 words to label vectors. The model can decide which actions or concepts it wants to encode into a single vector, but it can only use 1,000 vectors. The model chooses the words it thinks best represent the data. Rather than encoding data from different modalities onto separate grids, their method employs a shared embedding space where two modalities can be encoded together. This enables the model to learn the relationship between representations from two modalities, like video that shows a person juggling and an audio recording of someone saying "juggling." To help the system process data from multiple modalities, they designed an algorithm that guides the machine to encode similar concepts into the same vector. They tested the model on cross-modal retrieval tasks using three datasets: a video-text dataset with video clips and text captions, a video-audio dataset with video clips and spoken audio captions, and an image-audio dataset with images and spoken audio captions. For example, in the video-audio dataset, the model chose 1,000 words to represent the actions in the videos. Then, when the researchers fed it audio queries, the model tried to find the clip that best matched those spoken words.Not only was their technique more likely to find better matches than the models they compared it to, it is also easier to understand.

Source https://scitechdaily.com/revolutionary-ai-system-learns-concepts-shared-across-video-audio-and-text

Mechanical Engineering

3. A Precision Arm for Miniature Robots

A single robot can be used to carry out a variety of tasks. Until today, miniature systems that transport miniscule amounts of liquid through fine capillaries have had little association with such robots. eveloped by researchers as an aid for laboratory analysis, such systems are known as microfluidics or lab-on-a-chip and generally make use of external pumps to move the liquid through the chips. To date, such systems have been difficult to automate, and the chips have had to be custom-designed and manufactured for each specific application. Scientists at ETH are now combining conventional robotics and microfluidics. They have developed a device that uses ultrasound and can be attached to a robotic arm. It is suitable for performing a wide range of tasks in microrobotic and microfluidic applications and can also be used to automate such applications. The device comprises a thin, pointed glass needle and a piezoelectric transducer that causes the needle to oscillate. Similar transducers are used in loudspeakers, ultrasound imaging and professional dental cleaning equipment. The ETH researchers can vary the oscillation frequency of their glass needle. By dipping the needle into a liquid, they create a three-dimensional pattern composed of multiple vortices. Since this pattern depends on the oscillation frequency, it can be controlled accordingly. The researchers were able to use this to demonstrate several applications. First, they were able to mix tiny droplets of highly viscous liquids. "The more viscous liquids are, the more difficult it is to mix them," a researcher explains. "However, our method succeeds in doing this because it allows us to not only create a single vortex, but to also efficiently mix the liquids using a complex three-dimensional pattern composed of multiple strong vortices." Second, the scientists were able to pump fluids through a mini-channel system by creating a specific pattern of vortices and placing the oscillating glass needle close to the channel wall. Third, they succeeded in using their robotassisted acoustic device to trap fine particles present in the fluid. This works because a particle's size determines its reaction to the sound waves. Relatively large particles move towards the oscillating glass needle, where they accumulate. The researchers demonstrated how this method can capture not only inanimate particles but also fish embryos. They believe it should also be capable of capturing biological cells in the fluid. "In the past, manipulating microscopic particles in three dimensions was always challenging. Our microrobotic arm makes it easy," the researcher says. "Until now, advancements in large, conventional robotics and microfluidic applications have been made separately," he says. "Our work helps to bring the two approaches together." As a result, future microfluidic systems could be designed similarly to today's robotic systems. An appropriately programmed single device would be able to handle a variety of tasks. "Mixing and pumping liquids and trapping particles -- we can do it all with one device," Ahmed says. This means tomorrow's microfluidic chips will no longer have to be custom-developed for each specific application. The researchers would next like to combine several glass needles to create even more complex vortex patterns in liquids. In addition to laboratory analysis, other applications envisaged are for microrobotic arms, such as sorting tiny objects. The arms could conceivably also be used in biotechnology as a way of introducing DNA into individual cells. It should ultimately be possible to employ them in additive manufacturing and 3D printing.

Source https://www.sciencedaily.com/releases/2023/01/230113112749.htm

Chemical Engineering

4. Simple method destroys dangerous 'forever chemicals,' making water safe

If you're despairing at recent reports that Earth's water sources have been thoroughly infested with hazardous human-made chemicals called PFAS that can last for thousands of years, making even rainwater unsafe to drink, there's a spot of good news. Chemists at UCLA and Northwestern University have developed a simple way to break down almost a dozen types of these nearly indestructible "forever chemicals" at relatively low temperatures with no harmful byproducts. The researchers show that in water heated to just 176 to 248 degrees Fahrenheit, common, inexpensive solvents and reagents severed molecular bonds in PFAS that are among the strongest known and initiated a chemical reaction that "gradually nibbled away at the molecule" until it was gone, said UCLA distinguished research professor and co-corresponding author Kendall Houk. The simple technology, the comparatively low temperatures and the lack of harmful byproducts mean there is no limit to how much water can be processed at once, Houk added. The technology could eventually make it easier for water treatment plants to remove PFAS from drinking water. Per- and polyfluoroalkyl substances -- PFAS for short -- are a class of around 12,000 synthetic chemicals that have been used since the 1940s in nonstick cookware, waterproof makeup, shampoos, electronics, food packaging and countless other products. They contain a bond between carbon and fluorine atoms that nothing in nature can break. When these chemicals leach into the environment through manufacturing or everyday product use, they become part of the Earth's water cycle. Over the past 70 years, PFAS have contaminated virtually every drop of water on the planet, and their strong carbon-fluorine bond allows them to pass through most water treatment systems completely unharmed. They can accumulate in the tissues of people and animals over time and cause harm in ways that scientists are just beginning to understand. Certain cancers and thyroid diseases, for example, are associated with PFAS. For these reasons, finding ways to remove PFAS from water has become particularly urgent. Scientists are experimenting with many remediation technologies, but most of them require extremely high temperatures, special chemicals or ultraviolet light and sometimes produce byproducts that are also harmful and require additional steps to remove. Northwestern chemistry professor William Dichtel and his team noticed that while PFAS molecules contain a long "tail" of stubborn carbon-fluorine bonds, their "head" group often contains charged oxygen atoms, which react strongly with other molecules. Dichtel's team built a chemical guillotine by heating the PFAS in water with dimethyl sulfoxide, also known as DMSO, and sodium hydroxide, or lye, which lopped off the head and left behind an exposed, reactive tail. "That triggered all these reactions, and it started spitting out fluorine atoms from these compounds to form fluoride, which is the safest form of fluorine," Dichtel said. "Although carbon-fluorine bonds are super-strong, that charged head group is the Achilles' heel." But the experiments revealed another surprise: The molecules didn't seem to be falling apart the way conventional wisdom said they should. The researchers had expected the PFAS molecules would disintegrate one carbon atom at a time, but researchers ran computer simulations that showed two or three carbon molecules peeled off the molecules simultaneously, just as they had observed experimentally. The simulations also showed the only byproducts should be fluoride -- often added to drinking water to prevent tooth decay -- carbon dioxide and formic acid, which is not harmful. Dichtel confirmed these predicted byproducts in further experiments. The current work degraded 10 types of perfluoroalkyl carboxylic acids (PFCAs) and perfluoroalkyl ether carboxylic acids (PFECAs), including perfluorooctanoic acid (PFOA). The researchers believe their method will work for most PFAS that contain carboxylic acids and hope it will help identify weak spots in other classes of PFAS. They hope these encouraging results will lead to further research that tests methods for eradicating the thousands of other types of PFAS.

Source https://www.sciencedaily.com/releases/2022/08/220818163721.htm

Electrical Engineering

5. Lithium-Sulfur Batteries Are One Step Closer to Powering the Future

With a new design, lithium-sulfur batteries could reach their full potential. Batteries are everywhere in daily life, from cell phones and smart watches to the increasing number of electric vehicles. Most of these devices use well-known batteries-lithium-ion battery technology. And while lithium-ion batteries have come a long way since they were first introduced, they have some familiar drawbacks as well, such as short lifetimes, overheating and supply chain challenges for certain raw materials. Scientists at the U.S. Department of Energy's (DOE) Argonne National Laboratory are researching solutions to these issues by testing new materials in battery construction. One such material is sulfur. Sulfur is extremely abundant and cost effective and can hold more energy than traditional ion-based batteries. In a new study, researchers advanced sulfur-based battery research by creating a layer within the battery that adds energy storage capacity while nearly eliminating a traditional problem with sulfur batteries that caused corrosion. "These results demonstrate that a redox-active interlayer could have a huge impact on Li-S battery development. We're one step closer to seeing this technology in our everyday lives" said scientists. A promising battery design pairs a sulfur-containing positive electrode (cathode) with a lithium metal negative electrode (anode). In between those components is the electrolyte, or the substance that allows ions to pass between the two ends of the battery. Early lithium-sulfur (Li-S) batteries did not perform well because sulfur species (polysulfides) dissolved into the electrolyte, causing its corrosion. This polysulfide shuttling effect negatively impacts battery life and lowers the number of times the battery can be recharged. To prevent this polysulfide shuttling, previous researchers tried placing a redox-inactive interlayer between the cathode and anode. The term "redox-inactive" means the material does not undergo reactions like those in an electrode. But this protective interlayer is heavy and dense, reducing energy storage capacity per unit weight for the battery. It also does not adequately reduce shuttling. This has proved a major barrier to the commercialization of Li-S batteries. To address this, researchers developed and tested a porous sulfur-containing interlayer. Tests in the laboratory showed initial capacity about three times higher in Li-S cells with this active, as opposed to inactive, interlayer. More impressively, the cells with the active interlayer maintained high capacity over 700 charge-discharge cycles. To further study the redox-active layer, the team conducted experiments at the 17-BM beamline of Argonne's Advanced Photon Source (APS), a DOE Office of Science user facility. The data gathered from exposing cells with this layer to X-ray beams allowed the team to ascertain the interlayer's benefits. The data confirmed that a redox-active interlayer can reduce shuttling, reduce detrimental reactions within the battery and increase the battery's capacity to hold more charge and last for more cycles.

Source https://www.sciencedaily.com/releases/2023/01/230106144444.htm

Electronics and Communication Engineering 6. A Cheaper and Greener Internet of Things with No Wires Attached

Emerging forms of thin-film device technologies that rely on alternative semiconductor materials, such as printable organics, nanocarbon allotropes, and metal oxides, could contribute to a more economically and environmentally sustainable internet of things (IoT), a KAUST-led international team suggests. The IoT is set to have a major impact on daily life and many industries. It connects and facilitates data exchange between a multitude of smart objects of various shape and size — such as remote-controlled home security systems, self-driving cars equipped with sensors that detect obstacles on the road, and temperature-controlled factory equipment — over the internet and other sensing and communications networks. This burgeoning hypernetwork is projected to reach trillions of devices by next decade, boosting the number of sensor nodes deployed in its platforms. Current approaches used to power sensor nodes rely on battery technology, but batteries need regular replacement, which is costly and environmentally harmful over time. Also, the current global production of lithium for battery materials may not keep up with the increasing energy demand from the swelling number of sensors. Wirelessly powered sensor nodes could help achieve a sustainable IoT by drawing energy from the environment using so-called energy harvesters, such as photovoltaic cells and radio-frequency (RF) energy harvesters, among other technologies. Large-area electronics could be key in enabling these power sources. KAUST researchers assessed the viability of various large-area electronic technologies and their potential to deliver ecofriendly, wirelessly powered IoT sensors. Large-area electronics have recently emerged as an appealing alternative to conventional silicon-based technologies thanks to significant progress in solution-based processing, which has made devices and circuits easier to print on flexible, large-area substrates. They can be produced at low temperatures and on biodegradable substrates such as paper, which makes them more ecofriendly than their silicon-based counterparts. Over the years, the team has developed a range of RF electronic components, including metal-oxide and organic polymer-based semiconductor devices known as Schottky diodes. These devices are crucial components in wireless energy harvesters and ultimately dictate the performance and cost of the sensor nodes. Key contributions from the KAUST team include scalable methods for manufacturing RF diodes to harvest energy reaching the 5G/6G frequency range. Such technologies provide the needed building blocks toward a more sustainable way to power the billions of sensor nodes in the near future. The team is investigating the monolithic integration of these low-power devices with antenna and sensors to showcase their true potential.

Source https://scitechdaily.com/a-cheaper-and-greener-internet-of-things-with-no-wires-attached

Aerospace Engineering

7. ISRO operates cryo engine CE-20 at high thrust for 650 seconds

The Indian Space Research Organisation recently said the CE-20 — a cryogenic rocket engine developed by the Liquid Propulsion Systems Centre (LPSC) — was successfully operated with a thrust level of 22t for a long duration of 650 seconds on December 23, 2022. The activity was carried out at the Cryogenic Main Engine & Stage Test Facility of ISRO Propulsion Complex (IPRC) in Mahendragiri, Tamil Nadu. "With this, the engine qualification for 20t thrust level is also successfully completed for induction in flight. The CE20 engine was operated with a 20.2t thrust level for the first 40 seconds, followed by an operation at 20t off-nominal zones before operating it at 22.2t for a duration of 435 seconds, by moving the thrust control valve," ISRO said. The mixture ratio and thrust control were in open-loop mode, the space agency said. It added that during the test, the engine and the facility performed normally, and the required engine performance parameters were achieved as predicted. "The engine used for this hot test had undergone 11 hot tests with a cumulative duration of 2,720 seconds earlier. Thus, this engine has undergone 3,370 seconds cumulative burn duration at different thrust and mixture ratio levels," ISRO said.

Source <u>https://timesofindia.indiatimes.com/home/science/isro-operates-cryo-engine-ce-20-at-high-thrust-for-650-seconds/articleshow/96482142.cms</u>



Mining, Metallurgical and Materials Engineering

8. Scientists discover material that can be made like a plastic but conducts like metal

Scientists with the University of Chicago have discovered a way to create a material that can be made like a plastic but conducts electricity more like a metal. The research shows how to make a kind of material in which the molecular fragments are jumbled and disordered but can still conduct electricity extremely well. This goes against all of the rules we know about for conductivity. But the finding could also be extraordinarily useful; if you want to invent something revolutionary, the process often first starts with discovering a completely new material. Conductive materials are absolutely essential if you're making any kind of electronic device, whether it be an iPhone, a solar panel, or a television. By far the oldest and largest group of conductors is the metals: copper, gold, aluminium. Then, about 50 years ago, scientists were able to create conductors made out of organic materials, using a chemical treatment known as "doping," which sprinkles in different atoms or electrons through the material. This is advantageous because these materials are more flexible and easier to process than traditional metals, but the trouble is they aren't very stable; they can lose their conductivity if exposed to moisture or if the temperature gets too high. But fundamentally, both of these organic and traditional metallic conductors share a common characteristic. They are made up of straight, closely packed rows of atoms or molecules. This means that electrons can easily flow through the material, much like cars on a highway. In fact, scientists thought a material had to have these straight, orderly rows in order to conduct electricity efficiently. Then researchers began experimenting with some materials discovered years ago, but largely ignored. He strung nickel atoms like pearls into a string of molecular beads made of carbon and sulfur and began testing. To the scientists' astonishment, the material easily and strongly conducted electricity. What's more, it was very stable. But to the scientists, the most striking thing was that the molecular structure of the material was disordered. The team tried to understand how the material can conduct electricity. After tests, simulations, and theoretical work, they think that the material forms layers, like sheets. Even if the sheets rotate sideways, no longer forming a neat stack, electrons can still move horizontally or vertically -- as long as the pieces touch. The end result is unprecedented for a conductive material. The scientists are excited because the discovery suggests a fundamentally new design principle for electronics technology. Conductors are so important that virtually any new development opens up new lines for technology, they explained. One of the material's attractive characteristics is new options for processing. For example, metals usually have to be melted in order to be made into the right shape for a chip or device, which limits what you can make with them, since other components of the device have to be able to withstand the heat needed to process these materials. The new material has no such restriction because it can be made at room temperatures. It can also be used where the need for a device or pieces of the device to withstand heat, acid or alkalinity, or humidity has previously limited engineers' options to develop new technology. The team is also exploring the different forms and functions the material might make.

Source https://www.sciencedaily.com/releases/2022/10/221026114443.htm

Energy Engineering

9. Researchers Create Smaller, Cheaper Flow Batteries for Clean Energy

Clean energy is the leading solution for climate change. But solar and wind power are inconsistent at producing enough energy for a reliable power grid. Alternatively, lithium-ion batteries can store energy but are a limited resource. Flow batteries offer a solution. Electrolytes flow through electrochemical cells from storage tanks in this rechargeable battery. The existing flow battery technologies are too expensive for practical application, but scientists in the School of Chemical and Biomolecular Engineering developed a more compact flow battery cell configuration that reduces the size of the cell by 75%, and correspondingly reduces the size and cost of the entire flow battery. Flow batteries get their name from the flow cell where electron exchange happens. Their conventional design, the planar cell, requires bulky flow distributors and gaskets, increasing size and cost but decreasing overall performance. The cell itself is also expensive. To reduce footprint and cost, the researchers focused on improving the flow cell's volumetric power density (W/L-of-cell). They turned to a configuration commonly used in chemical separation -- sub-millimeter, bundled microtubular (SBMT) membrane -made of a fiber-shaped filter membrane known as a hollow fiber. This innovation has a space-saving design that can mitigate pressure across the membranes that ions pass through without needing additional support infrastructure. They were interested in the effect of the battery separator geometry on the performance of flow batteries and were aware of the advantages that hollow fibers imparted on separation membranes and set out to realize those same advantages in the battery field. Applying this concept, the researchers developed an SMBT that reduces membrane-to-membrane distance by almost 100 times. The microtubular membrane in the design works as an electrolyte distributor at the same time without the need for large supporting materials. The bundled microtubes create a shorter distance between electrodes and membranes, increasing the volumetric power density. This bundling design is the key discovery for maximizing flow batteries' potential. To validate their new battery configuration, the researchers used four different chemistries: vanadium, zinc-bromide, quinone-bromide, and zinciodide. Although all chemistries are functional, two were most promising. Vanadium was the most mature chemistry, but also less accessible, and the reduced form of it is unstable in air. They found zinc iodide was the most energy-dense option, making it the most effective for residential units. Zinc-iodide offered many advantages even compared to lithium: It has less of a supply chain issue and also can be turned into zinc oxide and dissolve in acid, making it much easier to recycle. This electrochemical solution for this unique shape of the flow battery proved more powerful than conventional planar cells. The researchers are already working on commercialization, focusing on developing batteries with different chemistries like vanadium and scaling up their size. Scaling will require coming up with an automated process to manufacture a hollow fiber module, which now is done manually, fiber by fiber. The SBMT cells could also be applied to different energy storage systems like electrolysis and fuel cells. The technology could even be strengthened with advanced materials and different chemistry in various applications.

Source https://www.sciencedaily.com/releases/2023/01/230113145335.htm

Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry 10. Screen-Printing Method Can Make Wearable Electronics Less Expensive

The glittering, serpentine structures that power wearable electronics can be created with the same technology used to print rock concert t-shirts, new research shows. The study, led by Washington State University researchers, demonstrates that electrodes can be made using just screen printing, creating a stretchable, durable circuit pattern that can be transferred to fabric and worn directly on human skin. Such wearable electronics can be used for health monitoring in hospitals or at home. They wanted to make flexible, wearable electronics in a way that is much easier, more convenient and lower cost. That's why they focused on screen printing: it's easy to use. It has a simple setup, and it is suitable for mass production. Current commercial manufacturing of wearable electronics requires expensive processes involving clean rooms. While some use screen printing for parts of the process, this new method relies wholly on-screen printing, which has advantages for manufacturers and ultimately, consumers. In the study the team details the electrode screen-printing process and demonstrate how the resulting electrodes can be used for electrocardiogram monitoring, also known as ECG. They used a multi-step process to layer polymer and metal inks to create snake-like structures of the electrode. While the resulting thin pattern appears delicate, the electrodes are not fragile. The study showed they could be stretched by 30% and bend to 180 degrees. Multiple electrodes are printed onto a pre-treated glass slide, which allows them to be easily peeled off and transferred onto fabric or other material. After printing the electrodes, the researchers transferred them onto an adhesive fabric that was then worn directly on the skin by volunteers. The wireless electrodes accurately recorded heart and respiratory rates, sending the data to a mobile phone. While this study focused on ECG monitoring, the screen-printing process can be used to create electrodes for a range of uses, including those that serve similar functions to smart watches or fitness trackers, researchers said. The lab is currently working on expanding this technology to print different electrodes as well as entire electronic chips and even potentially whole circuit boards.



ENGINEERING INNOVATION IN INDIA

IISC-Bangalore Develops 'Green' Tech to Rid Air Filters of Germs

A newly developed air filtering technique that uses ingredients commonly found in green tea can deactivate germs that find refuge inside air filters. A research team led by Prof Survasarathi Bose and Prof Kaushik Chatterjee at Indian Institute of Science (IISc), Bangalore, has developed a germdestroying air filter that can inactivate germs using ingredients like polyphenols and polycationic polymers commonly found in green tea. With a prolonged use, air filters become a breeding ground for captured germs. The growth of these germs clog the pores of the filter, reducing their life. Re-suspension of these germs can infect people in the vicinity. The novel antimicrobial air filters were tested at an NABL accredited laboratory and were found to be 99.24 per cent effective against SARS-CoV-2 (delta variant). The technology was transferred to AIRTH, a start-up that is replacing the existing germgrowing air filters with these germ-destroying air filters for commercial purposes. The deployment of these novel antimicrobial filters in ACs, central ducts, and air purifiers can play a crucial role in fight against air pollution and mitigate the spread of air-borne pathogens such as several coronaviruses.

Source https://economictimes.indiatimes.com/tech/technology/iisc-bangalore-develops-green-tech-torid-air-filters-of-germs/articleshow/96370862.cms

