INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

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INAE VISION 2020-2025

INAE VISION

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

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INAE Mission

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

Technology Roadmap

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

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

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

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

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

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

Our engineering education has to be appropriately re-engineered so as to equip our future leaders with not only the domain expertise but also the skillsets to innovate continuously and consistently in the face

of constant change and dynamic transformations. The human ingenuity and the preparing the well-trained minds, will be critical ingredients in responding to the challenges ahead.

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

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

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

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

The other important consideration is the speed of development. In order to remain globally competitive in this domain, we must leverage the state of the art digital platforms (equipped with 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 ofresidence (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

Inauguration of INAE Office and Meeting of DST-INAE Consultative Committee

INAE has been provided an office space at the DST Complex, Technology Bhawan, New Delhi and INAE office has since been operational from the DST Complex from August 2, 2021 onwards. The new office of INAE at DST Complex was formally inaugurated by Prof. Ashutosh Sharma, the then Secretary, DST on August 25, 2021 on the side-lines of the DST-INAE Consultative Committee meeting held on that day, for which the following members were present:

- Prof Ashutosh Sharma, Secretary, DST
- Prof Indranil Manna, President, INAE
- Dr Sanak Mishra, Immediate Past President, INAE
- Dr BN Suresh, Past President, INAE
- Dr PS Goel, Past President, INAE
- Dr Purnendu Ghosh, Vice-President, INAE
- Prof AB Pandit, Vice-President, INAE - attended online on WebEx
- Prof Sivaji Chakravorti, Vice-President, INAE
- Mr Sunil Kumar, Joint Secretary, AI Cell, DST
- Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE

Inauguration of INAE Office by Prof Ashutosh Sharma, the then Secretary, DST

Prof Indranil Manna, President, INAE presenting a bouquet of flowers to Prof Ashutosh Sharma

Left to right, Dr Purnendu Ghosh, Dr PS Goel, Prof Indranil Manna, Prof Sivaji Chakravorti, Prof Ashutosh Sharma, Dr BN Suresh and Dr Sanak Mishra

Tour of INAE Office

DST-INAE Consultative Committee Meeting in progress

During the said meeting several points were discussed to include association of women engineers, startups and engineering institutions with activities of INAE.

Fellowship and Awards 2021

The following nominees were elected as Fellows of INAE w.e.f. November 1, 2021

Engineering Section-I (Civil Engineering)

1. **Prof Vasant A Matsagar**, Dogra Chair Professor, Department of Civil Engineering, Indian Institute of Technology Delhi. (*Nominated by Prof Santosh Kapuria and Prof Ranjan K Mallik*)

2. **Prof KVL Subramaniam**, Professor, Department of Civil Engineering, Indian Institute of Technology Hyderabad. (*Nominated by Prof Tarun Kant and Prof BS Murty*)

Engineering Section-II (Computer Engineering and Information Technology)

3. **Prof Susmita Sur Kolay,** Professor, Indian Statistical Institute, Kolkata. (Nominated by Prof Bhargab B Bhattacharya and Prof Sanghamitra Bandyopadhyay)

4. **Prof Debdeep Mukhopadhyay**, Professor, Indian Institute of Technology Kharagpur. (Nominated by Prof Jayanta Mukhopadhyay and Prof PP Chakrabarti)

5. **Dr Ramachandran Ramjee,** Senior Principal Researcher and Director Intern program, Microsoft Research India. (Nominated by Prof. Krithi Ramamritham and Dr. Venkat Padmanabhan)

6. **Dr Gautam Shroff,** VP, Chief Scientist & Head, TCS Research, Gurgaon. (Nominated by Mr. K Ananthkrishnan and Prof. K Ramamritham)

7. **Dr Lipika Dey,** Principal Consultant, Tata Consultancy Services, Noida. (Nominated by Prof Sushmita Mitra and Prof PP Chakrabarti)

8. **Prof Andrew Zisserman,** FRS, Professor of Computer Vision Engineering at Oxford University. (Nominated by Prof Subhasis Chaudhuri)

9. **Mr Sundar Pichai,** CEO of Google and Alphabet, USA. (Nominated by Prof Subhasis Chaudhuri)

Engineering Section-III (Mechanical Engineering)

10. **Prof Atul Sharma,** Professor, Department of Mechanical Engineering, Indian Institute of Technology Bombay. (Nominated by Prof Suhas Joshi and Prof K Muralidhar)

11. **Dr BK Sreedhar,** Scientific Officer H, IGCAR, Kalpakkam. (Nominated by Mr. RD Kale and Prof. AB Pandit)

12. **Dr Satya Prasad Mangalaramanan,** Vice President, Product Development, Ashok Leyland Limited, Chennai. (Nominated by Prof. Anindya Deb and Prof. N.K. Gupta)

13. **Mr Vikram Kirloskar,** Chairman and Managing Director of Kirloskar Systems Ltd. and Vice Chairman of Toyota Kirloskar Motor. (Nominated by Prof AB Pandit)

Engineering Section-IV (Chemical Engineering)

14. **Prof V. Shankar**, Professor, Department of Chemical Engineering, Indian Institute of Technology Kanpur. (Nominated by Prof DV Khakhar and Prof Santosh K Gupta)

15. **Prof Ravindra D Gudi,** Professor & Head, Chemical Engineering Department, IIT Bombay. (Nominated by Prof DV Khakhar and Prof AK Suresh)

16. **Dr Amol Arvindrao Kulkarni,** Senior Principal Scientist, Chemical Engineering and Process Development Dept. (CEPD), CSIR-National Chemical Laboratory, Pune. (Nominated by Dr S Sivaram and Prof JB Joshi)

17. **Ms Vartika Shukla,** Chairman & Managing Director (CMD), Engineers India Limited, New Delhi. (Nominated by Dr TSR Prasada Rao and Mr Ajay N Deshpande)

Engineering Section-V (Electrical Engineering)

18. **Prof Saikat Chakrabarti,** Professor, Department of Electrical Engineering Indian Institute of Technology Kanpur. (Nominated by Prof. Suresh Chandra Srivastava and Prof. Ashok K Pradhan)

19. **Dr Rahul Tongia,** Fellow, Brookings India, New Delhi. (Nominated by Dr. V.S. Arunachalam and Prof Rangan Banerjee)

20. **Dr Ajay Kumar,** Secretary, Department of Defence, Govt of India. (Nominated by Prof Sivaji Chakravorti)

Engineering Section-VI (Electronics & Communication Engineering)

21. **Prof Yogesh Singh Chauhan,** Professor, Department of Electrical Engineering, Indian Institute of Technology Kanpur. (Nominated by Prof Souvik Mahapatra and Prof Navakanta Bhat)

22. **Prof Saurabh Lodha**, Dept of Electrical Engineering, IIT Bombay. (Nominated by Prof JM Vasi and Prof. Subhasis Chaudhuri)

23. **Mr Raghavan Muralidharan,** Chief Technology Officer, Tata Advanced Systems Limited, Mumbai. (Nominated by Dr Surendra Pal and Prof Juzer M Vasi)

24. **Prof David Jeffrey Wineland,** 2012 Nobel Prize in Physics, Philip Knight Distinguished Research Chair, Department of Physics, University of Oregon, USA. (Nominated by Prof V Ramgopal Rao)

Engineering Section-VII (Aerospace Engineering)

25. **Prof Mira Mitra,** Professor, Department of Aerospace Engineering, IIT Kharagpur. (Nominated by Prof Srinivasan Gopalakrishnan and Prof Gopalan Jagadeesh)

26. **Dr Ramesh Sundaram,** Chief Scientist; Head Advanced Composites Div (ACD) & Head Centre for Societal Missions and Special technologies (CSMST), CSIR-National Aerospace Laboratories, Bangalore. (Nominated by Prof AR Upadhya and Prof B Dattaguru)

27. **Dr Sunder Ramasubbu,** Research Director, ITW-India Pvt Ltd. (Nominated by Dr. AR Upadhya and Prof. Vikram Jayaram)

Engineering Section-VIII (Mining, Metallurgical and Materials Engineering

28. **Prof Kantesh Balani,** Head, Advanced Centre for Materials Science, Indian Institute of Technology Kanpur. (Nominated by Prof Dipak Mazumdar and Prof Yogesh Joshi)

29. **Prof Jyotsna Dutta Majumdar,** Professor, Metallurgical and Materials Engineering, IIT Kharagpur and Chairperson, Central Research Facility, IIT Kharagpur. (Nominated by Dr Debashish Bhattacharjee and Dr Indranil Chattoraj)

30. **Prof M. Kamaraj,** Professor, Dept of Metallurgical and Materials Engineering, IIT Madras. (Nominated by Dr. G. Sundararajan and Dr. S. Venugopal)

31. **Dr S.V. S. Narayana Murty,** Scientist G and Head, Materials Characterization Division, Vikram Sarabhai Space Centre, Thiruvanthapuram. (Nominated by Dr SC Sharma and Dr. V Adimurthy)

32. **Dr Satyam Suraj Sahay,** John Deere Fellow, John Deere Technology Centre India, Pune. (Nominated by Dr BK Mishra and Prof. Indradev Samajdar)

Engineering Section-IX (Energy Engineering)

33. **Dr BK Nashine,** Outstanding Scientist and Associate Director, Indira Gandhi Centre for Atomic Research, Kalpakkam. (Nominated by Mr RD Kale and Dr P Chellapandi)

34. **Mr A K Balasubrahmanian,** Director (Technical), Nuclear Power Corporation of India Limited, Anushakti Nagar. (Nominated by Mr SA Bhardwaj and Dr RB Grover)

Engineering Section -X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry)

35. **Prof Giridhar Udapi Rao Kulkarni,** President, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru. (Nominated by Prof DD Sarma and Prof V Ramgopal Rao)

36. **Prof Suparna Mukherji,** Professor and Head, Environmental Science & Engineering Department, Indian Institute of Technology Bombay. (Nominated by Prof. Chandra Venkataraman and Prof AK Suresh)

37. **Prof Rohit Srivastava,** Professor and Head of Department of BSBE, IIT Bombay. (Nominated by Prof Jayesh Bellare and Prof B Ravi)

38. **Prof Sandeep Verma,** Secretary, Science and Engineering Research Board (SERB), New Delhi. (Nominated by Prof V Ramgopal Rao and Prof Ashutosh Sharma)

39. **Dr Ajit Kumar Mohanty,** Director, Bhabha Atomic Research Centre, Mumbai. (Nominated by Shri KN Vyas and Dr Srikumar Banerjee)

The following nominees were elected as Foreign Fellows of INAE w.e.f. November 1, 2021.

1. **Prof Mike (Michael) Jon Schlaich**, Professor, Chair of Conceptual and Structural Design at the Technische Universität Berlin, Germany; Managing Director of schlaich bergermann partner, sbp. (Nominated by Prof Mahesh C Tandon and Prof Prem Krishna)

2. **Prof Arup K Chakraborty**, Robert T. Haslam Professor of Chemical Engineering, Professor of Physics, Professor of Chemistry, Massachusetts Institute of Technology. (Nominated by Prof RA Mashelkar and Prof KS Gandhi)

3. **Prof Ned Mohan,** Regents Professor of the University of Minnesota / University of Minnesota at Minneapolis USA. (Nominated by Prof G Bhuvaneswari and Prof Kaushik Rajashekara)

4. **Prof Palghat P Vaidyanathan**, Professor of Electrical Engineering, California Institute of Technology, Pasadena, CA, USA. (Nominated by Prof B Yegnanarayana and Prof Bhaskar Ramamurthi)

5. **Prof Jürgen Eckert**, Director, Erich Schmid Institute of Materials Science of the Austrian Academy of Sciences and Full Professor (Chair "Materials Physics"), Montanuniversität Leoben, Dept. of Materials Science, Leoben, Austria. (Nominated by Prof. N.K. Mukhopadhyay and Prof. B.S. Murty)

The following nominees were selected for conferment of awards for the year 2021

Life Time Contribution Award in Engineering 2021

- **Mr Senapathy Gopalakrishnan,** Co-founder Infosys & Chairman Axilor Ventures
- **Prof MS Ananth**, Emeritus Research Fellow, Department of Chemical Engineering, IIT Madras; and Former Director, Indian Institute of Technology Madras.

Prof Jai Krishna Memorial Award 2021

- **Prof GD Yadav**, Emeritus Professor of Eminence and JC Bose National Fellow, Former Vice Chancellor & R.T. Mody Distinguished Professor, and Tata Chemicals Darbari Seth Distinguished Professor of Leadership and Innovation, Institute of Chemical Technology, Mumbai.

Prof SN Mitra Memorial Award 2021

- **Prof Surendra Prasad**, Department of Electrical Engineering, Indian Institute of Technology Delhi.

Outstanding Teacher Award 2021

- **Prof Suman Chakraborty**, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur.
- **Prof Sukumar Mishra**, Department of Electrical Engineering, Indian Institute of Technology Delhi.

INAE Woman Engineer of the Year Award 20201

One award recommended in each category, viz., Academia, R&D and Industry as under:

- **Academia** – Prof Sharada Srinivasan, Professor, National Institute of Advanced Studies (NIAS), Bangalore.

- **R&D** – Smt Madhumita Chakravarti, Director, Centre for Millimeterwave Semiconductor Devices and Systems (CMSDS), Kolkata

- **Industry** - Ms Vartika Shukla, Chairperson & Managing Director, Engineers India Limited, New Delhi.

INAE Young Engineer Award 2021

1. **Dr Sri Harsha Kota,** Associate Professor, Indian Institute of Technology Delhi
   (ES-I: Civil Engineering)

2. **Dr Puneet Kumar Patra,** Assistant Professor, Indian Institute of Technology Kharagpur
   (ES-I: Civil Engineering)

3. **Mr Pankaj Malhotra,** Scientist, Tata Consultancy Services, Mumbai
   (ESII: Computer Engineering and Information Technology)

4. **Dr Abir De,** Assistant Professor, Indian Institute of Technology Bombay
   (ESII: Computer Engineering and Information Technology)

5. **Dr Neha Khatri,** Senior Scientist, CSIR-Central Scientific Instruments Organisation (CSIR-CSIO), Chandigarh
   (ES-III: Mechanical Engineering)

6. **Dr Sourav Mondal,** Assistant Professor, Indian Institute of Technology Kharagpur
   (ES-IV: Chemical Engineering)

7. **Mr Sri Harsha Nistala,** Scientist, Tata Consultancy Services Ltd., Pune
   (ES-IV: Chemical Engineering)

8. **Dr Abheejeet Mohapatra,** Assistant Professor, Indian Institute of Technology Kanpur
   (ES-V: Electrical Engineering)

9. **Dr Manas Kumar Jena,** Assistant Professor, Indian Institute of Technology Palakkad
   (ES-V: Electrical Engineering)

10. **Dr Manan Suri,** Associate Professor, Indian Institute of Technology Delhi
    (ES-VI: Electronics & Communication Engineering)

11. **Dr Niraj Kumar,** Principal Scientist, CSIR-Central Electronics Engineering Research Institute, Pilani, Rajasthan
    (ES-VI: Electronics & Communication Engineering)

12. **Dr S Mathavaraj,** Scientist – SE, U. R. Rao Satellite Center, ISRO, Bengaluru
    (ES-VII: Aerospace Engineering)

13. **Dr Samadhan Ananda Pawar,** Post-Doctoral Researcher, Indian Institute of Technology Madras
    (ES-VII: Aerospace Engineering)

14. **Dr Chandra Sekhar Tiwary,** Assistant Professor, Indian Institute of Technology Kharagpur
    (ES-VIII: Mining, Metallurgical and Materials Engineering)

15. **Mr Pushkar Varshney**, Senior Research Manager, Indian Oil Corporation Ltd., Research & Development Centre, Faridabad
    (ES-X: Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry)

INAE Young Innovator & Entrepreneur Award 2021

1. **Dr Chandan Kumar Jha**, Post-Doctoral Fellow, Indian Institute of Technology Gandhinagar, specialized in the field of 'Fiber Optic Sensing' for development of *highly sensitive and reliable instrumented glove*.

2. **Dr Madhan Balaraman,** Senior Principal Scientist, CSIR-Central Leather Research Institute, Chennai, specialized in the field of 'Leather Technology' for development of *Collagen Composite Scaffold for treatment of wounds*.

3. **Mr Nikhil Kurele,** Cofounder & CEO, Noccarc Robotics Private Limited, Pune, and **Mr Harshit Rathore,** Cofounder & CTO, Noccarc Robotics Private Limited, Pune, specialized in the field of 'Mechanical engineering' for development of an *advanced ICU Ventilator.*

4. **Dr Sebastian C. Peter,** Associate Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, specialized in the field of 'CO_2 capture and Utilization' for *Pilot Scale Development of Carbon Recycling.*

Innovative Student Projects Award 2021

Doctoral Level

1. **Dr Indrasis Das,** Indian Institute of Technology Kharagpur (Bioelectric Toilet: For onsite treatment of black water to facilitate reuse of treated water and electricity generation for onsite applications)

2. **Dr Arpita Biswas,** Indian Institute of Science, Bangalore (Algorithms for Fair Decision Making: Provable Guarantees and Applications)

3. **Dr Vijai Laxmi,** Indian Institute of Technology Bombay (Design and Development of Microdevices for Platelet Rich/Poor Plasma Separation from Blood)

4. **Dr Khushboo Suman,** Indian Institute of Technology Kanpur (Microstructure and Viscoelasticity of Physical Gels)

5. **Dr Syed Shahjahan Ahmad,** Indian Institute of Science, Bangalore (Modeling, Characterization, Control and Design of Switched Reluctance Machines)

6. **Dr Sanghamitra Ghosal,** Indian Institute of Engineering Science and Technology Shibpur (Ternary Hybrid Junctions of Semiconducting Oxide Nanostructures, Reduced Graphene Oxide and Noble Metal for Improved Gas Sensor Device Applications)

7. **Dr Syed Idrees Afzal Jalali,** Indian Institute of Science, Bangalore (Evaluation of Power-Law Creep in Bending)

8. **Dr Parvaiz Ahmad Shiekh,** Indian Institute of Technology Kanpur (Engineering Bioinspired Polyurethane Scaffolds to Attenuate Oxidative Stress and Hypoxia for Cardiac and Dermal Tissue Regeneration)

Masters Level

1. **Ms Vasamsetti Sri Harika,** Jawaharlal Nehru Technological University (Health Monitoring of Structures under Ambient and Vehicle Excitations)

2. **Ms Tapadyoti Banerjee,** Indian Institute of Technology Kharagpur (Authenticated Encryption using Cellular Automata)

3. **Mr Sampad Laha,** Indian Institute of Technology Kharagpur (The Dynamics of Blood on Paper Matrix and its Implication in Point of Care Diagnostics)

4. **Ms Lubna Muzamil Rehman,** Birla Institute of Technology and Science-Pilani, K.K Birla Goa Campus, Goa (Understanding the Thermodynamics of Salt-water systems)

5. **Ms Jashaswini Bhuyan,** Indian Institute of Technology Bhubaneswar (Performance Analysis and Optimization of Receive Diversity PLC system with imperfect CSI in Nakagami-m noise environment)

6. **Ms Shruti Tandon,** Indian Institute of Technology Madras (Investigating the intermittency route of chaos to order transition in laminar and turbulent thermoacoustic systems)

7. **Mr Nampelly Ganesh,** Indian Institute of Technology Madras (Eddy Resolving Simulations of Cavity Flows)

Bachelor Level

1. **Mr Love Kush Tak,** Indian Institute of Technology Bombay (Calorific value determination of Reject Fractions from Mechanical Biological Treatment Plant)

2. **Mr Aditya Chetan & Ms Brihi Joshi,** Indraprastha Institute of Information Technology, Delhi (Understanding Adversarial Collusive Activities in Online Social Networks)

3. **Mr Ashwin Agrawal,** Mr Rohan Katkar and Mr Suyash Dadmal, College of Engineering, Pune (Design and Development of agricultural harvester mechanism for bulbous crops like onions)

4. **Mr Merul Ritesh Shah,** Institute of Chemical Technology, Mumbai (Design a brine preparation unit to manufacture 2000 TPD of soda ash using sea water as raw Material)

5. **Ms Sakshi Sushant Naik,** Indian Institute of Technology Hyderabad (Novel strategies in Automated & Physics-driven Deep Learning for Real-time Optimal design of Cascaded Industrial Crystallizers)

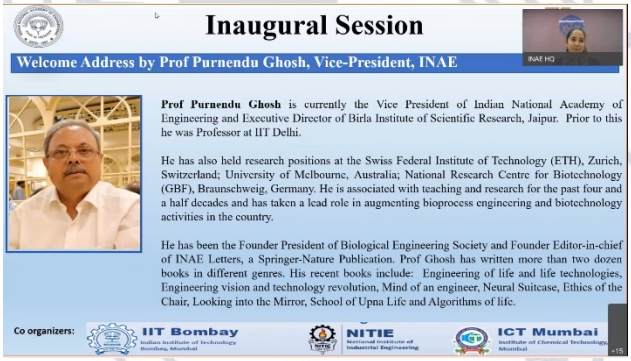
6. **Mr Ishank Shekhar,** Indian Institute of Space Science and Technology, Thiruvananthapuram (Generation of 24-Sided Polygonal Voltage Space Vector Structure with Reduced Hardware Complexity)

7. **Mr Shashank Tomar,** Indian Institute of Space Science and Technology, Thiruvananthapuram (Launch Vehicle Landing Trajectory Optimisation)

8. **Mr Sontam Govardhan Reddy,** Indian Institute of Technology Hyderabad (Dynamic modulation of light using plasmonic nanostructures on elastomeric PDMS substrates)

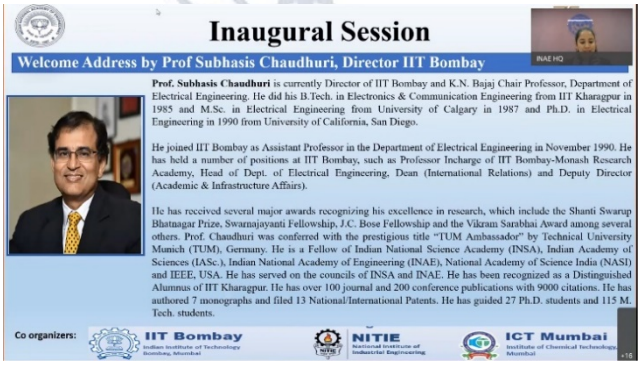
INAE Youth Conclave 2021

INAE takes great pride in shouldering the responsibility to encourage the engineering youth of the Country so as to enhance the engineering excellence, youth leadership, and encourage nation building. With a view to encourage engineering students, INAE Youth Conclaves are organized each year since 2017**.** The objective of the Youth Conclave is to facilitate the engagement of Indian youth in engineering activities at national level. The 4th INAE Youth Conclave 2021 was organized by INAE jointly with IIT Bombay; NITIE, Mumbai and ICT, Mumbai online for the first time on September 24, 2021, which was attended by 190 delegates including INAE Fellows, Young Associates and Engineering Students from across the country. Dr PK Goenka, Chairman-designate of INSPACe, DoS, GOI and formerly ED and Group President (Auto & Farm Sectors), Mahindra & Mahindra Ltd., Mumbai was the Chief Guest of the Inaugural Session of INAE Youth Conclave 2021. The five themes of national importance of the Conclave were Waste to wealth; Digitization and revolution in logistics; Engineering intervention to fight against COVID-19 and healthcare management; Teaching and learning in pandemic and Azadi ka Amrit Mahotsav. During the Youth Conclave competitions are held on various themes and the winners of the competition are invited to share their views through presentation and demonstration. A total of 164 teams registered in the competition and 13 were awarded after due evaluation by the experts.

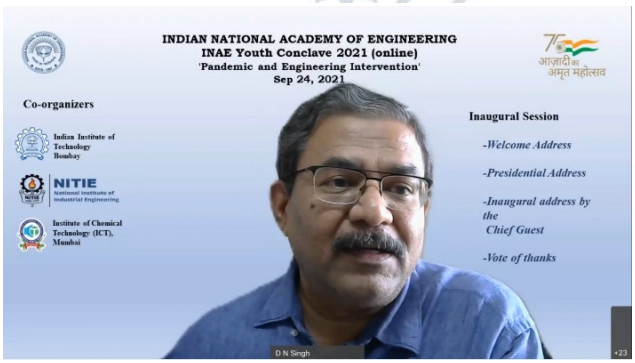


Welcome Address by Prof Purnendu Ghosh

Welcome Address by Prof MK Tiwari



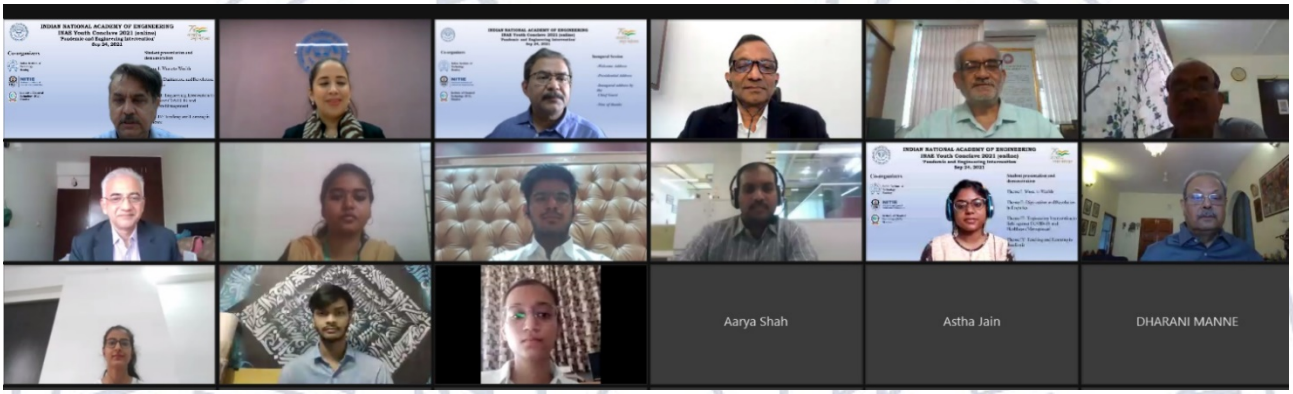
Welcome Address by Prof S Chaudhuri



Vote of Thanks by Prof DN Singh

Presidential Address by Prof Indranil Manna

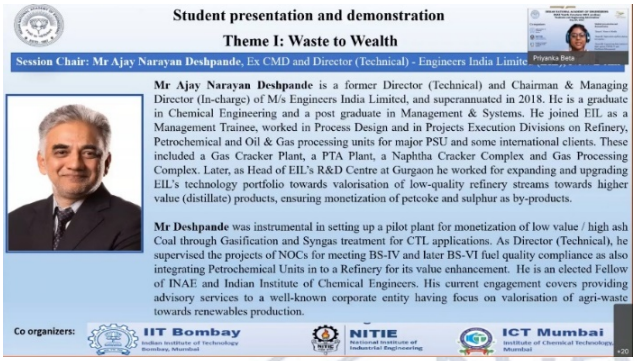
Inaugural Address by Dr Pawan Goenka



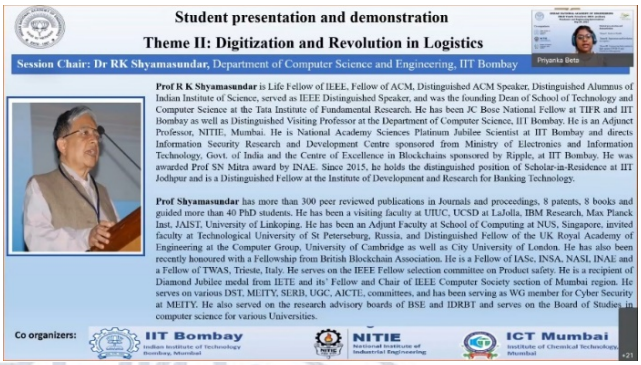
Group Photograph of Delegates in Inaugural Session of INAE Youth Conclave 2021

The Inaugural Session started with the Welcome Address by Dr Purnendu Ghosh, Vice-President, INAE followed by Prof MK Tiwari, Director, NITIE, Prof Subhasis Chaudhuri, Director, IIT Bombay and Prof AB Pandit, Vice President, INAE &Vice Chancellor, ICT, Mumbai. The Presidential Address was delivered by Prof Indranil Manna, President, INAE. Then the Inaugural address was delivered by the Chief Guest, Dr Pawan Kumar Goenka followed by Vote of thanks proposed by Prof DN Singh, IIT Bombay. The talk by the Chief Guest highlighted the role of youth in making India self-reliant and scope for engineering graduates in this country to achieve success in the engineering profession. He also encouraged the youth to learn as to where the future opportunities lie and the necessary skill sets and training required for realizing opportunities. The presentations and demonstrations by 1st, 2nd and 3rd winning teams were held during the INAE Youth Conclave 2021. During the presentation, the Q&A session was also organized so as to encourage interaction of audience. The sessions were chaired by eminent INAE experts as per details give below.

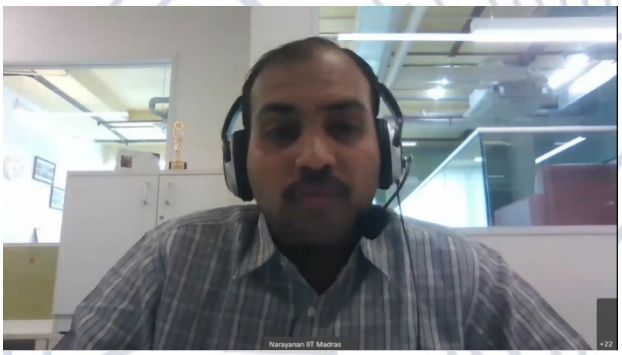
i. Theme I: Waste to Wealth chaired by Mr Ajay Narayan Deshpande, Ex CMD and Director (Technical) - Engineers India Limited (EIL), New Delhi.
ii. Theme II: Digitization and Revolution in Logistics chaired by Dr RK Shyamasundar, Department of Computer Science and Engineering, IIT Bombay.
iii. Theme III: Engineering Intervention to fight against COVID-19 and Healthcare Management chaired by Dr MS Narayanan, Principal Scientist, Bioincubator, IIT Madras.
iv. Theme IV: Teaching and Learning in Pandemic chaired by Prof Santanu Bandyopadhyay, Department of Energy Science and Engineering, IIT Bombay.



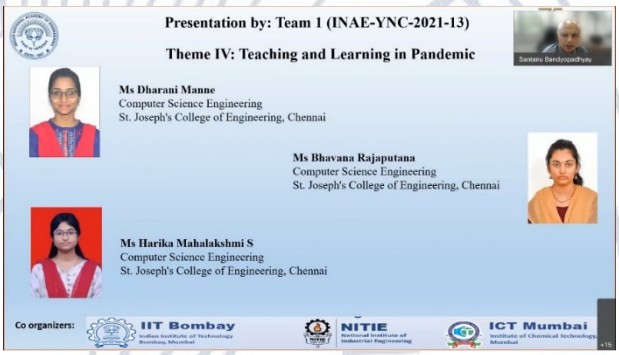
Mr Ajay Narayan Deshpande, Session Chair, Theme I: Waste to Wealth,



Dr RK Shyamasundar, Session Chair, Theme II: Digitization and Revolution in Logistics

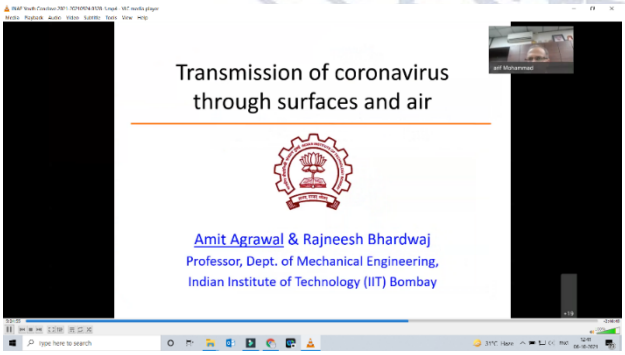


Dr MS Narayanan, Session Chair, Theme III: Engineering Intervention to fight against COVID-19 and Healthcare Management

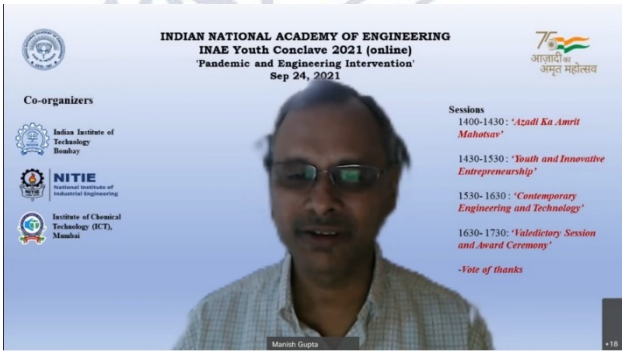


Session on Theme IV: Teaching and Learning in Pandemic Chaired by Prof Santanu Bandyopadhyay

A special session on Azadi ka Amrit Mahotsav was organized, which was chaired by Prof Amit Agrawal, Department of Mechanical Engineering, IIT Bombay. The theme was based on 'Engineering Intervention to fight against COVID-19 and Healthcare Management' and 'Innovative Technologies and Product Developed during COVID'. The students presented their concepts in the form of poster presentations. In order to inspire the students, a brief presentation on the topic "Transmission of coronavirus through surfaces and air" was also made by the Session Chair Prof Amit Agrawal which was very well received by the audience and lauded since the presentation covered important issues on a topic of concern for the world over.



Presentation by Prof Amit Agrawal, Chair, Session on Azadi ka Amrit Mahotsav



Dr Manish Gupta, Chair, Session Chair on 'Youth and Innovative Entrepreneurship'

After the five sessions, a Session on 'Youth and Innovative Entrepreneurship' was organized wherein three young Entrepreneurs presented their personal life experiences on varied topics related to Entrepreneurship. This session was chaired by Dr Manish Gupta, Director, Google Research India, Bengaluru and was very inspiring and presented insights to the young students on innovation and entrepreneurship. Next session held was a Panel Discussion on 'Contemporary Engineering and Technology' wherein four young engineers below the age of 35 years participated in the discussion. This session was appreciated by young and old alike and featured deliberations by the Panelists comprising of the young engineers and future leaders of tomorrow namely: Dr Neha Khatri**,** Senior Scientist, CSIR-CSIO, Chandigarh; Dr Abir De, Assistant Professor, IIT Bombay; Mr Pankaj Malhotra, Scientist, TCS, Mumbai and Mr Sri Harsha Nistala, Scientist, TCS, Pune. The Panel Discussion was chaired by Mr K Ananth Krishnan, Executive Vice- President and Chief Technology Officer, TCS, Chennai. During this session, interesting issues of topical engineering interest shall be discussed such as "What are the mega challenges of today for India and the world", covering Sustainability and its dimensions like climate, energy, livelihood, health and "How can Engineering and Technology help in finding solutions", touching upon the intersection with Basic Sciences and Humanities, translating ideas to scaled outcomes and creating the human capital. Further the discussion also focussed on the suggestions from the panelists to the young audience, as they build their careers in contemporary engineering and technology.

Mr K Ananth Krishnan, Chair, Panel Discussion on 'Contemporary Engineering and Technology'

Concluding Address by Prof AB Pandit

The event concluded with valedictory Session and Award ceremony followed by concluding Address by Prof AB Pandit, Vice President, INAE. During the Award ceremony the Awards and the names of the winning teams were announced by Prof DN Singh and his team at IIT Bombay. Prof Indranil Manna, President, INAE congratulated all the winners and also expressed appreciation for all participants who put in their best efforts and wish all many more accolades in their future career paths. The event concluded with Vote of Thanks proposed by Prof DN Singh, IIT Bombay, Organizer of the INAE Youth Conclave 2021. The gala online event set the trend for future Youth Conclaves being organized by INAE and was distinctive in being the first Youth Conclave organized online with a large audience and interesting interactive sessions which made the event unforgettable for all delegates and participants.

Engineers Conclave 2021

Engineers Conclave 2021 (EC-2021) is being held jointly with International Solar Alliance (ISA) from Oct 26-27, 2021 as a virtual event. Dr Ajay Mathur and Prof Indranil Manna are the co-chairs of the event. Mr Pradeep Chaturvedi and Mr VVR Sastry were identified as two Coordinators with respect to two themes. The two themes of EC-2021 are Theme I: "Engineering challenges for de-carbonizing the

Indian Economy" to be held on Day-1 coordinated by ISA and Theme II: 'Achievements of Indian Engineering – Azadi ka Amrit Mahotsav' to be held on Day-2 coordinated by INAE.

Technical sessions pertaining to Theme I would comprise as follows:

- Technical Session-I: **Energy Transitions: Integrating RE technologies in the electricity sector**
- Technical Session-II: **E-mobility solutions for the transport sector**
- Technical Session-III: **De-carbonizing heavy industry**

Technical sessions pertaining to Theme II would comprise as follows:

- Technical Session-I: Super/Megastructures Civil Engineering (to cover Transport, Conveyance etc, NHAI / Iconic Buildings/Dams/Bridges/ Buildings, Konkan Rail, Sea link, Chenab Bridge)
- Technical Session-II: Mechanical and Chemical Engineering (to cover Pharma sector/ Agriculture; Fertilizers, Insecticides/herbicides etc)
- Technical Session-III: Electronics/ Computer Engg (to cover Software; IRCTC, Banking, Aadhar, GST, Y2K/Computing/ Routers /EVM/ Future of Telecom 5G)
- Technical Session-IV: Strategic sector (to cover Nuclear Industry; Fast Breeder Reactor, Heavy water/ LCA-Tejas and Commercial Aircraft/ GSLV, MARS mission)

The tentative technical program of the event can be viewed by clicking here ….

Brief Report on National Webinar on 'Ethics in Indian Higher Education' Organized by Society for Professional Ethics & Management jointly with INAE

The webinar was organized on 25th June 2021 with the coordinating office at 10 am. The webinar was organized jointly by Society for Professional Ethics & Management & Indian National Academy of Engineering (INAE) with support from National Assessment and Accreditation Council (NAAC), Jain (Deemed-to-be-University), Visvesvaraya Technological University (VTU) and other academic institutions. A large number of participants from academic institutions and other management participated, mostly faculty and management / administrative persons and a few students. Summary of the program is given below:

- Welcome introductory remarks by *Prof. Sridhara Murthy*
- Introduction about Webinar by *Dr.CG Krishnadas Nair, President, Society for Professional Ethics and Management*
- Special address by *Prof. Indranil Manna**,** President, Indian National Academy of Engineering (INAE)*
- Keynote address by Dr.SC Sharma, NAAC
- UGC requirements for teaching Ethics and Environment by *Prof. Upendra, Resource person from University Grants Commission*
- Evaluation and accreditation of academic institutions with emphasis on Ethical practices by *NAAC*
- Indian Heritage on Ethics based education, Gurukula Systems, student teacher relationship by *Dr. R.N. Iyengar, Distinguished professor*.
- Ethical responsibility of Engineers, Managers and their teachers by *Dr. Karisiddappa, Vice Chancellor, VTU*

Interactive Panel and Discussion

- Role of teachers / students and management of academic institutions led by *Prof. K.R. Sridhara Murthi, Director (Academics and Planning), Jain University.*

An audio / video recording of the proceeding has been taken. Based on this, Society is getting the transcripts of the presentations prepared through an agency with an intention to edit and publish. There was considerable discussion on the need for ethical education to start from home and primary education through parents and teachers, followed by further development of values and ethics along with responsibilities to the Society Sustainable development and Environment during the higher education as prescribed by UGC. Comments / suggestions were also made on the present curricula and guidance given by the UGC and the need for uniformity of detailed Course Content and the Method of delivery. The need for various academic institutions to interact with industries, NGOs and various professional societies, professional ethics and specific code of conduct evolved by these organizations for each type of profession and familiarize the graduating students on these depending upon their disciplines was emphasized.

Engineers Day 2021 Celebrations

Engineers' Day is celebrated in India on September 15 every year to commemorate one of India's finest engineers, Mokshagundam Visvesvaraya. M Visvesvaraya who is considered one of the foremost nation-builders, creating marvels upon which modern India was built. INAE celebrated Engineers' Day on **15th September 2021** wherein the following events were organized.

1. **Panel Discussion on "Closing Research-Entrepreneurship Gaps"**

Dr Anil Kakodkar, Member, Atomic Energy Commission (AEC) and Chairman, Rajiv Gandhi Science & Technology Commission, Govt. of Maharashtra; Former President, INAE; delivered a Key-note Address on "Closing Research-Entrepreneurship Gaps" on September 15, 2021. Prof. Indranil Manna, President, INAE and Vice-Chancellor, Birla Institute of Technology (BIT), Mesra, Ranchi was the Moderator of the said event. The Panellists included five bright young entrepreneurs from engineering fraternity who have sparked off their journey in entrepreneurship through innovative research in engineering. The Panellists were Dr Atharva A Poundarik, Assistant Prof and Chairperson, Industrial and Corporate Relations Cell, IIT Ropar; Mr Tanuj Jhunjhunwala, Co-Founder & CEO, Planys Technologies Pvt Ltd, Bangalore; Dr Anuya A Nisal, Principal Scientist, CSIR-National Chemical Laboratory, Pune and Founder, Serigen Mediproducts; Mr Akshay V Singhal, CEO & Founder, Log9 Materials Scientific Private Ltd, Bengaluru and Mr Tushar Vyas, Director & Chief Business Officer, Stack Finance, Bengaluru.

Dr Anil Kakodkar delivered an inspiring address wherein he emphasized the need for conducting research leading to development of innovative technologies and products and setting up of start-up ventures and enterprises leading to the self-reliance of the country in niche technologies. The Panellists shared their experiences and highlighted the challenges and successes in their career paths. Prof Indranil Manna in his address lauded the work of the entrepreneurs and encouraged the younger generation to rise to the occasion by becoming entrepreneurs in engineering-based start-ups and to develop out- of the box solutions.

2. **2021 Engineer's Day Celebrated by INAE Kolkata Chapter**

The INAE Kolkata Chapter honoured the contributions of engineers by hosting the Engineer's Day on September 15, 2021 in virtual mode. It was also a part of the continuing *Azadi Ka Amrit Mahotsav* program. On this occasion, IEEE President and CEO, Ms Susan Kathy Land delivered the **Engineer's Day Lecture** on "My Personal Journey with IEEE". Prof. Indranil Manna, President, INAE, graced the event and welcomed the audience. He presented a brief sketch of INAE activities and recalled the life and work of *Bharat Ratna* M. Visvesvaraya, whose birth anniversary is celebrated every year in India, as Engineer's Day. Prof. Bhargab Bhattacharya, President, INAE Kolkata Chapter, highlighted how the

work of engineers is recognized as major enabler for nation building on this Engineer's Day, and also by the professional organizations such as INAE and IEEE. Prof. Sivaji Chakravorti, Vice-President, INAE, introduced the speaker with the audience. The evening talk on the WebEX platform was attended by large number participants of widely varying ages and interests. They include distinguished fellows of the academy along with young researchers and students from the various academic and engineering institutes of the country. In her talk, Ms Susan portrayed her personal journey as woman engineer specializing in software development and defense research, recollecting the challenges that she had experienced in the early eighties as a computer professional. The story of her participation in the IEEE activities first as an ordinary volunteer, then with an active role in the leadership programs of IEEE, and finally touching the topmost position of the world's largest professional society was truly exciting and motivating to any young engineer! The lecture was followed by an interactive session. *Padma Shri* Prof. Sankar K. Pal, former Director, Indian Statistical Institute, and founding President of INAE Kolkata Chapter, had shared his views as a concluding part of the meeting. Prof. Debatosh Guha, Secretary, INAE Kolkata Chapter, volunteered to oversee the entire planning of the event, and conducted the proceedings of the meeting.

Prof. Indranil Manna welcoming the audience

Ms Susan Kathy Land delivering her lecture.

Interactions with the audience

Speaker Bio:

Ms Susan K. (Kathy) Land, 2021 IEEE President & CEO

Ms Susan K. (Kathy) Land is a Program Manager for the U.S. Department of Defense's Missile Defense Agency. She has more than 30 years of industry experience in the application of software engineering methodologies, the management of information systems, and leadership of software development teams. She served as the 2018 Vice President, IEEE Technical Activities. She also served two additional terms on the IEEE Board of Directors as Division VIII Director/Delegate in 2011 and 2012 and as Division V

Director/Delegate in 2014 and 2015. She was President of the IEEE Computer Society in 2009. Kathy was a member of the IEEE-USA Board of Directors in 2013 and 2016. She has been an active member of the IEEE Standards Association for more than 20 years and served as the Computer Society Vice President for Standards in 2004. She was the recipient of the 2007 IEEE Standards Medallion. An IEEE Fellow, Ms Kathy is the author and co-author of a number of texts and publications supporting software engineering principles and the practical application of software process methodologies. She is an IEEE-HKN Member and IEEE Computer Society Richard E. Merwin Award recipient.

3. INAE Bangalore Chapter.

INAE Bangalore Chapter presented the following two Lectures on the occasion of the **Engineer's Day on September 15, 2021.**

1. Prof. Anath Ramaswamy, Chair, Department of Civil Engineering, IISc, Bangalore on "Achievements in civil structures and engineering in India", and
2. Dr V K Aatre, Chairman, INAE Bangalore Chapter, and Former SA to RM, DRDO on "India becoming a technology powerhouse "

Local Chapter Activities

- **INAE Mumbai Chapter**

Webinar by INAE Mumbai Chapter on 9th August 2021

INAE Mumbai Chapter organized a Webinar on **"Future Mobility: E Mobility"** on Monday, 9th August 2021, 5 PM to 7 PM through WebEx Platform to commemorate celebration of India's 75th Year of Independence (*Azadi ka Amrit Mahotsav*). Prof. AK Suresh, FNAE, Co-Chair, INAE Mumbai Chapter and Professor of Chemical Engineering, IIT Bombay was the Moderator of the said Webinar. The Flyer giving relevant details of the speakers, title of the lectures can be viewed by clicking here….

- **INAE Delhi Chapter**

Seminar on "Benefits and challenges in the next decade of semiconductor innovation" by Dr. Randhir Thakur, Intel

NAE Delhi Chapter organized a seminar on August 19, 2021, starting at 10:00 AM. The webinar was held over MS Teams. The title of the lecture was "Benefits and challenges in the next decade of semiconductor innovation" and the speaker was Dr. Randhir Thakur, Intel.

Abstract:

In this talk, Dr. Thakur shared a synoptic view of past progress made by the semiconductor industry and of the continuing, insatiable future demand for innovation in semiconductor technology, so we can make sense of the growing volume of data generated in the world and improve the lives of every person on earth. The talk also covered Intel's IDM 2.0 strategy and conclude with opportunities for collaborations with academia and with the India semiconductor ecosystem.

Speaker bio:

Dr. Randhir Thakur is Senior Vice President and the President of Intel Foundry Services. Dr. Thakur joined Intel in 2017, bringing 30 years of experience as a hands-on innovator and business leader with expertise in global manufacturing, research and development, and profitable P&L management. Thakur joined Intel as corporate vice president of Global Supply Management, expanding his role to chief supply chain officer in 2020. His deep expertise in global semiconductor manufacturing, ecosystem leadership, process technology equipment and customer orientation are critical to the success of Intel Foundry Services. Thakur earned a Bachelor's degree in electronics and telecommunications engineering from the National Institute of Technology, Kurukshetra, in India; a Master's degree in Electrical Engineering from the University of Saskatchewan in Canada; and a Ph.D. in Electrical Engineering from the University of Oklahoma. He was named a Fellow of the Institute of Electrical and

Electronics Engineers (IEEE) in 2013 and has made seminal contributions to the semiconductor industry. He holds more than 300 patents.

- **INAE Bangalore Local Chapter**

5th Foundation Day and SAMVAAD – an IIT Dharwad-INAE Bangalore Chapter Lecture Series held on 28th August 2021

INAE Bangalore Chapter organized IIT Dharwad 5th Foundation Day and SAMVAAD - an IIT Dharwad-INAE Bangalore Chapter Lecture Series on 28th August at 11 am wherein a lecture was delivered by Padma Vibhushan and Former Chairman, Atomic Energy Commission, Dr Anil Kakodkar **on "**India's energy security in a carbon constrained world**".**

SAMVAAD - an IIT Dharwad-INAE Bangalore Chapter Lecture Series Lecture on "Decarbonisation and Hydrogen Economy for India" was delivered by Dr Anuradda Ganesh, Director and Chief Technical Advisor, Cummins India on 30th September 2021.

Proposed Document on "Landmark Achievements in Engineering and Technology in Independent India"

To commemorate "Azadi Ka Amrit Mahotsav", INAE is making efforts to publish a Compendium of most significant engineering and technological achievements of India since independence. A Task Force under the Chairmanship of Prof Prem Krishna, former Vice-President, INAE, constituted with representation from all INAE Engineering Sections to undertake the exercise of publishing the Compendium, has since held meetings on August 14, 2021, August 28, 2021 and September 17, 2021 wherein it was decided that about 75 topics pertaining to "landmark innovation and achievement in engineering and technology" would be identified for further scrutiny. Besides conducting a competition for students, inputs were sought from leading Academic institutions including IITs, NITs, etc and a webpage was designed for this purpose with inputs from Mr K Ananth Krishnan, Chairman INAE Digital Platform Committee. The criteria for selection of items pertaining to landmark achievements in engineering and technology have also been specified. Actions have been initiated accordingly and there is good progress on the task being undertaken. The initiative is progressing well and shortly a pruned list of approx. 130 items on landmark achievements in Engineering and Technology shall be made available to the Fellows and Young Associates through the dashboard facility to seek their opinion poll on the suitability of the entries and also three new suggestions, if any.

Special Compendium on Women Engineers of India since Independence

To commemorate "Azadi Ka Amrit Mahotsav", INAE decided to publish a special Compendium highlighting significant/landmark achievements of 75 women engineers since independence, similar to the one published by Indian Academy of Sciences (Lilavati's daughters). Meetings of the Editorial Committee Chaired by Dr Purnendu Ghosh, Vice-President, INAE, constituted for undertaking the task of publication of Compendium on "Women Engineers of India since Independence" were held on 5th August 2021, 27th August 2021 and 8th September 2021 over WebEx. A Master List of suggested names of women engineers has been prepared with inputs received from the Members of the Editorial Committee and Heads of Institutions, in response to letters written by INAE. The next meeting of the Editorial Committee is scheduled on October 20, 2021. The way forward regarding guidelines for selection of nominees and format for preparation of citations of selected women engineers is being discussed and actions initiated to progress this initiative.

Documentary film on INAE

At the behest of DST, the Vigyan Prasar had coordinated a series of films made on various institutes of DST including INAE. In this connection, Vigyan Prasar, DST informed INAE regarding release of film on INAE on Wednesday, 26th May 2021 to be watched on India's 24x7 national science channel on the internet, called India Science (www.indiascience.in) . The English and Hindi versions of the film can be viewed by clicking on the links given below:

https://www.indiascience.in/videos/dst-inae-e

https://www.indiascience.in/videos/dst-inae-h

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions over technological changes have become essential in recent times so that relevant knowledge that would be sustainable in the changing conditions can be imparted to the students in the engineering institutions. While industries could gain by using the academia's knowledge base to improve the industry's cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, academics benefit by seeing their knowledge and expertise being fruitfully utilized practically and by strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched "AICTE-INAE Distinguished Visiting Professorship Scheme" in 1999. Under this scheme, Industry experts are encouraged to give a few lectures in engineering institutions. This scheme has become popular among industry experts as well as engineering colleges.

Brief details pertaining to recent visits of industry experts under this scheme are given below.

Prof. Perumal Chellapandi, FNAE	PSG College of Technology, Coimbatore Mar 9, 2021 Aug 6-7, 2021	Delivered lecture on " Numerical investigation of flow characteristics in helical coils with geometrical irregularities". As per the feedback received from engineering college, the DVP helped students of post-graduation and research scholars with projects and problem solving. Delivered lectures on "Part-1 Theory and application of fracture mechanics to structural integrity assessment of power plant components" and "Part-2- Testing and evaluation of nuclear powerplant components". According to the feedback received from the engineering college, the DVP guided Research scholars for writing research papers and post-graduation students in problem solving and respective projects. Continuous interactions helped students to clarify their technical doubts.
Dr. D. Antony Louis Piriyakumar	Thiagarajar College of Engineering, Madurai	Delivered lectures on "Engineering Mathematics", "Research Methodology", "C Programming" and "Feature Engineering". As per the feedback received from the engineering college, the DVP guided the scholars to help identify topics for research and patents. The online

	May 6-8, 2021 Jun 28-30, 2021	sessions were very useful for imparting expert knowledge amongst students in the pandemic period. Delivered lectures on "Project Management", "Engineering Mathematics", "PR Patent Search" and "Deep Learning Tensor Flow". As per the feedback received from the faculty coordinator, the DVP also helped prepare students to face Interview and trained them on image processing. Series of lectures on Engineering mathematics helped students get a practical perspective of the subject.
Prof. V Radhakrishnan, FNAE	College of Engineering Pune Jul 22, 24 & 26, 2021	Delivered lectures on "Basic Concepts in Metrology, shop Floor standards and their calibration using interferometry", " Tolerances, gauging, selective assembly, matched machining, Concept of Precision" and " Digital metrology and Software metrology". According to the feedback received form the faculty coordinator of the college, Prof. Radhakrishnan's input has helped the department to strengthen the knowledge base in areas he has delivered lectures. His interactions with students, research scholars and faculty members have helped them immensely.
Dr. Lalit Kumar, FNAE	Siddaganga Institute of Technology, Tumkur Jun 2-4, 2021 Jun 16-18, 2021 Dayananda Sagar Academy of Technology &	Delivered lectures on " Maxwell's Equation", "Electromagnetic Waves" and "Applications of RF and Microwaves". As per the feedback received from the faculty coordinator of the associated engineering college, the lectures delivered by the DVP will help students strengthen knowledge in the area of electromagnetics, Radio frequency and microwaves. He has also guided students with their project and helped in updating the syllabus of Electromagnetic Field Theory. Delivered lectures on "Transmission Lines and Microstrip Lines", "High Power Vacuum Electronic Devices" and "Computational Electromagnetics". As per the feedback received from the college, the lectures delivered by the DVP has helped student in enhancing their knowledge in the area of electromagnetics. He has guided projects on RF and Microwave Circuit. He was involved in developing and formulating the required syllabus for Microwave engineering and Antennas. Delivered lectures on "Introduction to Microwaves and applications", "Klystron Tubes" and " Microwave antennas Overview". As per the feedback received from the faculty coordinator of the associated college, the scheme helps to create a platform for interaction between industry, academia and Government organizations. The DVP has also helped in identifying projects by initiating discussion on new technologies and development related to

	Management, Bangalore May 25-27, 2021 Jun 29-30 & Jul 1, 2021	microwaves. He guided students with existing projects and helped College authority suggesting improvement in syllabus of the course. Delivered lectures on "Microwave Directed Energy System", "Tetra hertz- Introduction" and " Basics of Computational Electromagnetics". The feedback from associated college endorses these interactions with the DVP have helped the students understand concepts on Microwave from industry perspective. This enabled students to explore more and enhance their skills. He also guided students with their projects.
Mr. S. Krishna Kumar, Former Senior Vice President (Retired), Lucas TVS Ltd, Chennai	RMK Engineering College, Kavaraipettai, Tamil Nadu Apr 1-3, 2021 Jun 23-26, 2021	Delivered lectures on "Reliability Engineering-Basic Concepts related to Industry requirements", "Workshop on New Product Reliability- case studies from Industry" and "Background of business with a Virtual Tour of TVS". According to the feedback received from the college, the DVP guided students in projects and helped in identifying new projects. His recommendation for changes in syllabus has been incorporated in course. Delivered lectures on "Generative design of Products and Components", "Workshop on Generative Design-case studies from Industry" and "Selection of Software and Hardware for 3D printing of components optimized through generative design process". As per the feedback from the College, the scheme helps engineering colleges to provide lectures based on rich experience of Industry expert and real Industrial case studies.

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Important Meetings held during August/ September 2021

- **Meeting on Mentoring Platform for INAE held on August 2, 2021 over WebEx.**
- **Meeting on Landmark Achievements in Science and Technology in Independent India held on August 4, 2021 over WebEx.**
- **Meeting of Editorial Committee on Special Compendium on Women Engineers of India Since Independence held on August 5, 2021 over WebEx.**
- **Meeting of Search Cum Selection Expert Committee of Abdul Kalam Technology Innovation National Fellowship held on August 6, 2021 over WebEx.**
- **Meeting to plan the conduct of Engineers Conclave 2021 held on August 9, 2021 over WebEx.**

- **Meeting of the "Expert Committee on Cyber Security related Disasters" held virtually on August 10, 2021 through WebEx.**
- **Meeting on Update regarding the 4th INAE Youth Conclave held on August 10, 2021 through WebEx.**
- **34th Apex Committee Meeting held on August 11, 2021 over WebEx.**
- **Finance Committee Meeting held on August 12, 2021 over WebEx.**
- **Selection Committee Meeting for consideration of Nomination for INAE Awards and Election of Fellows under 37(g) held on August 12, 2021 over WebEx.**
- **First Meeting of the Task Force on Proposed Compendium On "Landmark Achievements in Engineering and Technology in Independent India" held on August 14, 2021 over WebEx.**
- **Meeting to plan the conduct of Engineers Conclave 2021 held on August 27, 2021 over WebEx.**
- **Second Meeting of Committee on INAE Young Innovator and entrepreneur Award 2021 held on August 27, 2021 over WebEx.**
- **Meeting of Editorial Committee on Special Compendium on Women Engineers of India Since Independence held on August 27, 2021 over WebEx.**
- **Second Meeting of the Task Force on Proposed Compendium On "Landmark Achievements in Engineering and Technology in Independent India" held on August 28, 2021 over WebEx.**
- **First Meeting of Selection Committee on Innovative Student projects Award 2021 held on August 30, 2021 over WebEx.**
- **Meeting for Review of progress of INAE Youth Conclave 2021 held on August 31, 2021 over WebEx.**
- **Meeting of the Selection Committee for Election of Foreign Fellows held on September 6, 2021 over WebEx.**
- **Meeting to plan conduct of Engineers Conclave 2021 held on September 7, 2021 over WebEx.**
- **Meeting of the Editorial Committee Compendium on Women Engineers of India since Independence held on September 8, 2021 over WebEx.**
- **140th Meeting of Governing Council held on September 10, 2021 over WebEx.**
- **Meeting of the INAE Forum on Infrastructure (Housing) held on September 13, 2021 over WebEx.**

- **Third Meeting of the Task Force on Proposed Compendium on "Landmark Achievements in Engineering and Technology in Independent India" held on September 17, 2021 over WebEx.**

- **Meeting on Sanitizing data of Spread Sheet on Landmark Compendium held on September 21, 2021 over WebEx.**

- **Meeting on Reviewing of Data of Spread Sheet for Landmark Compendium held on September 22, 2021 over WebEx.**

- **Meeting on Sanitizing Data of Spread Sheet for Landmark Compendium held on September 25, 2021 over WebEx.**

- **Meeting with Past Presidents and Office Bearers of INAE Regarding Presentation to DST held on September 28, 2021 over WebEx.**

Presentation by candidates before Selection Committee for Innovative Student Projects Award 2021 held on September 30, 2021 over WebEx.

International/National Conferences/Seminars being Organized By IITs/other Institutions

International Conference on Trends in Smart Material Engineering and Technology Conference to be held online and in-person on 21st to 22nd October 2021 at Salem, Tamil Nadu, India
https://conferencealerts.com/show-event?id=235150

3rd International conference on Communication, Computing and Electronics Systems ICCCES 2021 to be held online on 28th to 29th October 2021Coimbatore, Tamil Nadu
https://conferencealerts.com/show-event?id=232399

International Conference on Modern Electronics Devices and Communication systems MEDCOM 2021 Conference to be held online on 29th to 31st October 2021 Greater Noida, Uttar Pradesh,
https://conferencealerts.com/show-event?id=236758

Note: Due to Lockdowns imposed by Government in view of Covid-19, schedule of these conferences may be rechecked.

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News of Fellows

1	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, has received invitations and has forwarded abstracts which have been accepted for the following events. ➢ IconSWM-CE and IPL, December 2021 at Mechanical Engineering Department, Jadavpur University, Kolkata on Natural and Artificial Photosynthesis (NAP) in Treating Waste Materials". ➢ ICMS-ACMS 2022 to be organized by IIChE HQ, Kolkata in February 2022. Title of the abstract "LHGBRS PRSTEP aided by LPGBRS for AGOU and SGOE". ➢ Vidya Kutir Publications (VKP), Delhi, a book chapter for the book Advances in Atmospheric Research with title of abstract as "Discovered God Particles in Advancing Atmospheric Research".
2	Prof. Prahlada Ramarao, FNAE, Padma Shri; Former Distinguished Scientist and Chief Controller, DRDO; Former Vice Chancellor, DIAT, Pune; Pro Chancellor, S-VYASA and Director, Centre for Energy Research, S-VYASA University, Bengaluru delivered an online Special lecture on the occasion of National Innovation Day (Former President Dr. A.P.J. Abdul Kalam's Birthday) on October 12, 2021 on "India warming up to cold fusion" organized by Centre for Nano and Soft Matter Sciences. As part of *Azadi ka Amrit Mahotsav* celebrations.

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INAE on Facebook And Twitter

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

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

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

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Obituaries

Prof. Jorg Michael Schlaich

(October 17, 1934 – September 4, 2021)

Prof. Jorg Michael Schlaich, a Foreign Fellow of INAE and co-founder, Schlaich Bergermann und Partner, Hohenzollernstr, Stuttgart, Germany and Formerly Director, Institute of Structural Design, University of Stuttgart, Germany born on October 17, 1934 passed away on September 4, 2021. He was a reputed German structural engineer and was known internationally for his ground-breaking work in the creative design of bridges, long-span roofs, and other complex structures. He was a co-founder of the structural engineering and consulting firm Schlaich Bergermann Partner. The many notable structures he worked on include innovative roofs, bridges and towers. He was a particular advocate of lightweight structures, highlighting a number of cultural, ecological and social benefits. He pointed out that light structures are transparent and show the flow of forces in a natural way.

Schlaich was made a partner and was responsible for the Alster-Schwimmhalle in Hamburg, and more importantly, the Olympic Stadium in Munich. He stayed with the firm until 1969. In 1974 he became an academic at Stuttgart University, and in 1980 he founded his own firm, Schlaich Bergermann Partner. In 1993, with the roof of the Gottlieb-Daimler-Stadion in Stuttgart, he introduced the "speichenrad" principle to structural engineering. Indeed, this principle was employed for the first time in the history of Structural Engineering by the Italian engineer Massimo Majowiecki, the designer of the roof of the Olympic Stadium, Rome (built in 1990). Since then, his company has successfully employed it in stadium projects across the globe. Other structures include the observation tower at the Killesbergpark in Stuttgart. Most of his work as well of that of his company is documented on their website. He was also the developer of the solar tower (or solar chimney) and is largely credited with inventing the strut and tie model for reinforced concrete**.**

May God bless his soul to Rest in Peace

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Engineering And Technology Updates

Civil Engineering

1. Mumbai Coastal Road: The Coast is Clear

While the world is seeing an unprecedented crisis with the pandemic, Mumbai is seeing a project that was only hitherto imagined. Municipal Corporation of Greater Mumbai (MCGM) is executing it. Today, the 29.80 km Mumbai Coastal Road Project (MCRP) is an under construction access-controlled expressway with a route connecting Princess Street Flyover in South Bombay with Kandivali in the northern suburbs. The completed work includes about 470 metres (m) or 25% of tunnelling work of one tunnel and reclamation of 105 hectares (ha) of the total 111ha. At present, the piling work, casting of piers and girders, construction of the ramp work at Marine Drive and tunnelling work are in progress. The road will extend the coast up to 100 meters inside the sea. Plans are afoot to reclaim 111-hectare area in the Arabian Sea which is 12 times the size of Oval Maidan at Mumbai's Churchgate. Of the 111-hectare land reclamation required for the project so far, the civic body has completed about 100 hectares. Overall, the project is divided in two parts: Phase 1: The South End – From Princess Street flyover to Worli end of Bandra Worli Sea Link – a stretch of 9.98 km - to be executed by Municipal Corporation of Greater Mumbai – MCGM. Phase 2: The North End – From Bandra end of Bandra Worli Sea Link to Kandivali – to be executed by MSRDC. The 8-lane freeway, with 2-lanes reserved for BRTS corridor, will have 22 entries and exits, two earthquake resistant undersea tunnels of 3.4 km each at Girgaum Chowpaty and Malabar Hill, and 13 cross tunnels to be used for emergency. The entire stretch is expected to be ready by the end of 2023, if all goes well. In its first phase, a 9.98 km section from Princess Street flyover to the Worli end of the Bandra-Worli Sea Link, is expected to be completed by mid-2023. The Coastal Road will be built in two phases. The project will require the reclamation of 415 acres of land from the sea. Mavala, the Tunnel Boring Machine, has completed digging 500 meters of the coastal road tunnel. The TBM, with its diameter of 12.19-meters, is said to be the country's biggest road tunnel boring machine. It weighs 2,300 tonnes and is 80-meters long. It is digging on an average of 8-10 meters per day and around 20 meters below the ground at the Priyadarshini park site. The country's first undersea tunnel is a set of twin tunnels one for each carriageway. The length of each is 2.07 km from Priyadarshini park to Chotti Chowpatty at Marine drive, close to the landmark Chowpatty beach at Girgaon. From Malabar Hill to the Sea Link, the Coastal Road will mostly be built on reclaimed land, around 50-70 meters inside the sea. Green zones are developed alongside the freeway on reclaimed land for various public utilities like jogging & cycling tracks and gardens. Walking, jogging and cycling on the promenade will bring a different paradigm of urban comfort. The entire infrastructure shall be a visual delight for Worli. Flexible roads are also being constructed on reclaimed land. The substructure of intertidal area of interchanges are being constructed by Group Pile method followed by construction of Piers and Pier Cap by in situ casting. The pre-cast segments are erected by ground supported staging arrangements and post tensioned. The substructure of marine area of bridge and interchanges are constructed by monopile method followed by construction of piers and pier cap by insitu casting. The pre-cast segments are erected by use of launching girder tailor made for the project and then

segments are post tensioned. What the BMC is doing is creating approach roads/dykes to reach the sea wall locations by filling of rocks. The sea wall core layer is being built for a certain length by dumping quarries into the sea by end tipping method. It is also placing rocks of specific sizes using excavators to a specific height of 4 meters above mean sea level.

Source https://www.constructionweekonline.in/projects-tenders/18912-mumbai-coastal-road-the-coast-is-clear

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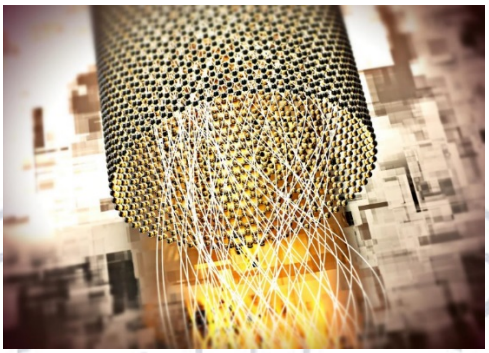
2. Running Quantum Software on a Classical Computer

EPFL Professor Giuseppe Carleo and Matija Medvidovic, a graduate student at Columbia University and at the Flatiron Institute in New York, have found a way to execute a complex quantum computing algorithm on traditional computers instead of quantum ones. The specific "quantum software" they are considering is known as Quantum Approximate Optimization Algorithm (QAOA) and is used to solve classical optimization problems in mathematics; it's essentially a way of picking the best solution to a problem out of a set of possible solutions. "There is a lot of interest in understanding what problems can be solved efficiently by a quantum computer, and QAOA is one of the more prominent candidates," says Carleo. Ultimately, QAOA is meant to help us on the way to the famed "quantum speedup," the predicted boost in processing speed that we can achieve with quantum computers instead of conventional ones. Understandably, QAOA has a number of proponents, including Google, who have their sights set on quantum technologies and computing in the near future: in 2019 they created Sycamore, a 53-qubit quantum processor, and used it to run a task it estimated it would take a state-of-the-art classical supercomputer around 10,000 years to complete. Sycamore ran the same task in 200 seconds. "But the barrier of "quantum speedup" is all but rigid and it is being continuously reshaped by new research, also thanks to the progress in the development of more efficient classical algorithms," says Carleo. In their study, Carleo and Medvidovic address a key open question in the field: can algorithms running on current and near-term quantum computers offer a significant advantage over classical algorithms for tasks of practical interest? "If we are to answer that question, we first need to understand the limits of classical computing in simulating quantum systems," says Carleo. This is especially important since the current generation of quantum processors operate in a regime where they make errors when running quantum "software," and can therefore only run algorithms of limited complexity. Using conventional computers, the two researchers developed a method that can approximately simulate the behaviour of a special class of algorithms known as variational quantum algorithms, which are ways of working out the lowest energy state, or "ground state" of a quantum system. QAOA is one important example of such family of quantum algorithms, that researchers believe are among the most promising candidates for "quantum advantage" in near-term quantum computers. The approach is based on the idea that modern machine-learning tools, e.g. the ones used in learning complex games like Go, can also be used to learn and emulate the inner workings of a quantum computer. The key tool for these simulations are Neural Network Quantum States, an artificial neural network that Carleo developed in 2016 with Matthias Troyer, and that was now used for the first time to simulate QAOA. The results are considered the province of quantum computing, and set a new benchmark for the future development of quantum hardware. "Our work shows that the QAOA you can run on current and near-term quantum computers can be simulated, with good accuracy, on a classical computer too," says Carleo. "However, this does not mean that all useful quantum algorithms that can be run on near-term quantum processors can be emulated classically. In fact, we hope that our approach will serve as a guide to devise new quantum algorithms that are both useful and hard to simulate for classical computers."

Source https://www.sciencedaily.com/releases/2021/08/210803121404.htm

Mechanical Engineering

3. Graphene Nano-Inks for Additive Manufacturing of Supercapacitors



Research led by Kansas State University's Suprem Das, assistant professor of industrial and manufacturing systems engineering, in collaboration with Christopher Sorensen, university distinguished professor of physics, shows potential ways to manufacture graphene-based nano-inks for additive manufacturing of supercapacitors in the form of flexible and printable electronics. As researchers around the world study the potential replacement of batteries by supercapacitors, an energy device that can charge and discharge very fast — within few tens of seconds — the team led by Das has an alternate prediction. The team's work could be adapted to integrate them to overcome the slow-charging processes of batteries. Furthermore, Das has been developing additive manufacturing of small supercapacitors — called micro-supercapacitors — so that one day they could be used for wafer-scale integration in silicon processing. "Additive manufacturing is fascinating, cost-effective, and has versatile design considerations," Das said. The team has developed supercapacitors that have been tested for 10,000 cycles of charging and discharging cycles, a number that is promising to evaluate the reliability of these devices, Das said The team is also studying the versatility of these micro-supercapacitors by printing on mechanically flexible surfaces. For this, they used 20-micrometer-hin polyimide — plastic — substrates with high reliability. Das is highly interested in translating emerging materials to devices. Another advantage of Das' invention is the green aspects of the research that he visualized through constructive discussions with Sorensen. When Das met Sorensen, he realized he could use his expertise in additive manufacturing to transform these materials into useful things; in this case, making tiny energy storage devices. Das is particularly interested in forming this synergistic collaboration with Sorensen because of the energy-efficient, highly scalable and chemical-free nature of the graphene production process and his own group's graphene ink manufacturing process. Both of these processes are patented/patent-pending technologies and are industrially relevant, Das said. "We make high-quality, multilayer graphene by detonating fuel-rich mixtures of unsaturated hydrocarbons such as acetylene with oxygen in a multi-litre chamber," Sorensen said. "Our patented method is simple requires very little energy, hence is ecologically benign; requires no toxic chemicals; and has been scaled up to yield high-quality, inexpensive graphene." Graphene has been recognized as a wonder material with much potential because of its many superlative physical properties Many graphene manufacturing methods have been developed across the globe and graphene has been produced in ton quantities. Technologists, however, are well aware that graphene is not yet in the marketplace because none of these methods have had the right combination of economy, ecology and product quality to allow graphene to fulfil its potential. But both the methods of producing graphene and nano-inks pursued at Kansas State University are on target to address all of these requirements, according to Sorensen and Das.

Source https://scitechdaily.com/graphene-nano-inks-for-additive-manufacturing-of-supercapacitors

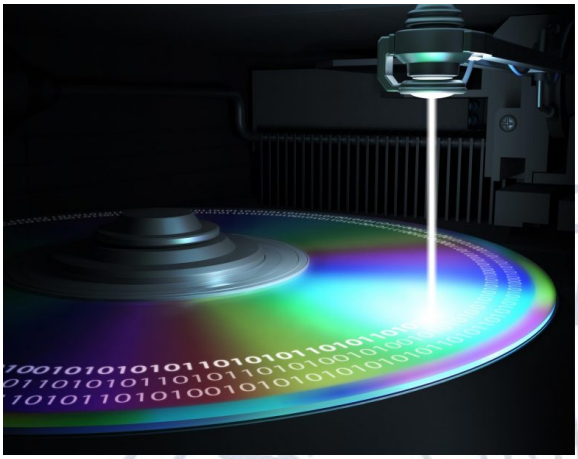
4. Green Hydrogen: Focus on The Catalyst Surface

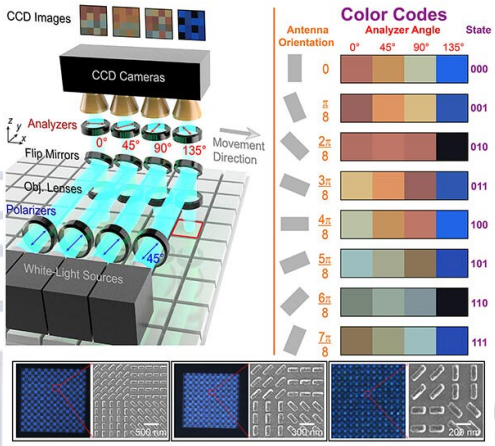
Hydrogen produced from renewable energy sources with the help of electric power is deemed a key to the energy transition: It can be used to chemically store wind and solar energy in a CO2-neutral way. Researchers have studied water electrolysis processes on the surface of an iridium oxide catalyst. Using energy from solar modules and wind turbines, water can be split by electrolysis into its constituents hydrogen and oxygen without producing any dangerous emissions. As the availability of energy from renewable sources varies when producing green, i.e. CO2-neutral, hydrogen, it is very important to know the behaviour of the catalysts under high loading and dynamic conditions. "At high currents, strong oxygen bubble evolution can be observed on the anode, which aggravates measurement. It has made it impossible so far to obtain a reliable measurement signal," says the first author of the study, Dr. Steffen Czioska from KIT's Institute for Chemical Technology and Polymer Chemistry (ITCP). By combining various techniques, the researchers have now succeeded in fundamentally investigating the surface of the iridium oxide catalyst under dynamic operation conditions. For catalysis, researchers from KIT's ITCP, the Institute of Catalysis Research and Technology, and the Electrochemical Technologies Group of the Institute for Applied Materials combined X-ray absorption spectroscopy for the highly precise investigation of modifications on the atomic level with other analysis methods. Understanding of the processes on the catalyst surface paves the way to further investigation of catalysts at high electric potentials and will contribute to the development of improved and more efficient catalysts meeting the needs of the energy transition, Czioska points out. Green hydrogen is deemed an environmentally compatible chemical energy storage material and, hence, an important element in the decarbonization of e.g. steel and chemical industries.

Source https://www.sciencedaily.com/releases/2021/08/210824135333.htm

Electrical Engineering

5. Say Goodbye to the Dots and Dashes: Enhanced Optical Storage Media

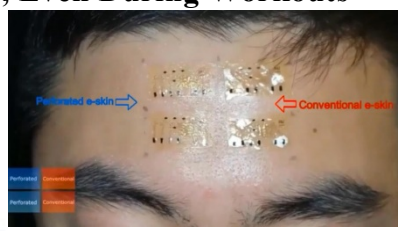




Purdue University innovators have created technology aimed at replacing Morse code with coloured "digital characters" to modernize optical storage. They are confident the advancement will help with the explosion of remote data storage during and after the COVID-19 pandemic. Morse code has been around since the 1830s. The familiar dots and dashes system may seem antiquated given the amount of information needed to be acquired, digitally archived and rapidly accessed every day. But those same basic dots and dashes are still used in many optical media to aid in storage. A new technology developed at Purdue is aimed at modernizing the optical digital storage technology. This advancement allows for more data to be stored and for that data to be read at a quicker rate. Rather than using the traditional dots and dashes as commonly used in these technologies, the Purdue innovators encode information in the angular position of tiny antennas, allowing them to store more data per unit area. "The storage capacity greatly increases because it is only defined by the resolution of the sensor by which you can determine the angular positions of antennas," said Alexander Kildishev, an associate professor of electrical and computer engineering in Purdue's College of Engineering. "We map the antenna angles into colours, and the colours are decoded." Technology has aided in increasing storage space availability in optical digital storage technologies. Not all optical data storage media needs to be laser-writable or rewritable. The majority of CDs, DVDs, and Blu-Ray discs are "stamped" and not recordable at all. This class of optical media is an essential part of disposable cold storage with a rapid access rate, long-lasting shelf life, and excellent archival capabilities. The making of a Blu-Ray disc is based on the pressing process, where the silicon stamper replicates the same dot-and-dashes format the final disc is getting. A thin nickel coating is then added to get a negative stamp. The Blu-Rays, as well as DVDs and CDs, are just mass-produced. This new development not only allows for more information to be stored but also increases the readout rate. Future applications for this technology include security tagging and cryptography. To continue developing these capabilities, the team is looking to partner with interested parties in the industry.

Source Source https://scitechdaily.com/say-goodbye-to-the-dots-and-dashes-enhanced-optical-storage-media

6. Sweat-Proof Electronic "Smart Skin" Takes Reliable Vitals, Even During Workouts

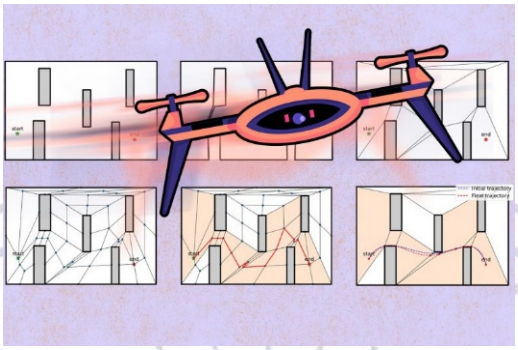


The design could lead to conformable wearable monitors to track skin cancer and other conditions. MIT engineers and researchers in South Korea have developed a sweat-proof "electronic skin" — a conformable, sensor-embedded sticky patch that monitors a person's health without malfunctioning or peeling away, even when a wearer is perspiring. The patch is patterned with artificial sweat ducts, similar to pores in human skin, that the researchers etched through the material's ultrathin layers. The pores perforate the patch in a kirigami-like pattern, similar to that of the Japanese paper-cutting art. The design ensures that sweat can escape through the patch, preventing skin irritation and damage to embedded sensors. The kirigami design also helps the patch conform to human skin as it stretches and bends. This flexibility, paired with the material's ability to withstand sweat, enables it to monitor a person's health over long periods of time, which has not been possible with previous "e-skin" designs. The results are a step toward long-lasting smart skins that may track daily vitals or the progression skin cancer and other conditions. The researchers tested the e-skin by sticking it to a volunteer's wrist and forehead for a week. The volunteer wore the tape during sweat-inducing activities, such as running on a treadmill for 30 minutes and consuming a spicy meal, pictured. But the team soon came against a barrier that other e-skin designs have yet to clear: sweat. If an e-skin were to work over the long-term, Kim realized it would have to be permeable to not just vapor but also sweat. For design inspiration, the researchers looked to human sweat pores. They found that the diameter of the average pore measures about 100 microns, and that pores are randomly distributed throughout skin. They ran some initial simulations to see how they might overlay and arrange artificial pores, in a way that would not block actual pores in human skin. They started with a periodic pattern of holes, each about the size of an actual sweat pore. They found that if pores were spaced close together, at a distance smaller than an average pore's diameter, the pattern as a whole would efficiently permeate sweat. But they also found that if this simple hole pattern were etched through a thin film, the film was not very stretchable, and it broke easily when applied to skin. The researchers found they could increase the strength and flexibility of the hole pattern by cutting thin channels between each hole, creating a pattern of repeating dumbbells, rather than simple holes, that relaxed strain, rather than concentrating it in one place. This pattern, when etched into a material, created a stretchable, kirigami-like effect. Following this rationale, the team fabricated an electronic skin from multiple functional layers, each which they etched with dumbbell-patterned pores. The skin's layers comprise an ultrathin semiconductor-patterned array of sensors to monitor temperature, hydration, ultraviolet exposure, and mechanical strain. This sensor array is sandwiched between two thin protective films, all of which overlays a sticky polymer adhesive. The researchers tested the e-skin by sticking it to a volunteer's wrist and forehead. The volunteer wore the tape continuously over a week. Throughout this period, the new e-skin reliably measured his temperature, hydration levels, UV exposure, and pulse, even during sweat-inducing activities, such as running on a treadmill for 30 minutes and consuming a spicy meal. The team's design also conformed to skin, sticking to the volunteer's forehead as he was asked to frown repeatedly while sweating profusely, compared with other e-skin designs that lacked sweat permeability, and easily detached from the skin.

Source https://scitechdaily.com/sweat-proof-electronic-smart-skin-takes-reliable-vitals-even-during-workouts

Aerospace Engineering

7. New Algorithm Trains Drones to Fly Around Obstacles at High Speeds



New algorithm could enable fast, nimble drones for time-critical operations such as search and rescue. If you follow autonomous drone racing, you likely remember the crashes as much as the wins. In drone racing, teams compete to see which vehicle is better trained to fly fastest through an obstacle course. But the faster drones fly, the more unstable they become, and at high speeds their aerodynamics can be too complicated to predict. Crashes, therefore, are a common and often spectacular occurrence. But if they can be pushed to be faster and more nimble, drones could be put to use in time-critical operations beyond the race course, for instance to search for survivors in a natural disaster. Now, aerospace engineers at MIT have devised an algorithm that helps drones find the fastest route around obstacles without crashing. The new algorithm combines simulations of a drone flying through a virtual obstacle course with data from experiments of a real drone flying through the same course in a physical space. The researchers found that a drone trained with their algorithm flew through a simple obstacle course up to 20 percent faster than a drone trained on conventional planning algorithms. Interestingly, the new algorithm didn't always keep a drone ahead of its competitor throughout the course. In some cases, it chose to slow a drone down to handle a tricky curve, or save its energy in order to speed up and ultimately overtake its rival. Training drones to fly around obstacles is relatively straightforward if they are meant to fly slowly. That's because aerodynamics such as drag don't generally come into play at low speeds, and they can be left out of any modeling of a drone's behavior. But at high speeds, such effects are far more pronounced, and how the vehicles will handle is much harder to predict. To get an understanding for how high-speed aerodynamics affect drones in flight, researchers have to run many experiments in the lab, setting drones at various speeds and trajectories to see which fly fast without crashing — an expensive, and often crash-inducing training process. Instead, the MIT team developed a high-speed flight-planning algorithm that combines simulations and experiments, in a way that minimizes the number of experiments required to identify fast and safe flight paths. The researchers started with a physics-based flight planning model, which they developed to first simulate how a drone is likely to behave while flying through a virtual obstacle course. They simulated thousands of racing scenarios, each with a different flight path and speed pattern. They then charted whether each scenario was feasible (safe), or infeasible (resulting in a crash). From this chart, they could quickly zero in on a handful of the most promising scenarios, or racing trajectories, to try out in the lab. To demonstrate their new approach, the researchers simulated a drone flying through a simple course with five large, square-shaped obstacles arranged in a staggered configuration. They set up this same configuration in a physical training space, and programmed a drone to fly through the course at speeds and trajectories that they previously picked out from their simulations. They also ran the same course with a drone trained on a more conventional algorithm that does not incorporate experiments into its planning. Overall, the drone trained on the new algorithm "won" every race, completing the course in a shorter time than the

conventionally trained drone. In some scenarios, the winning drone finished the course 20 percent faster than its competitor, even though it took a trajectory with a slower start, for instance taking a bit more time to bank around a turn. The researchers plan to fly more experiments, at faster speeds, and through more complex environments, to further improve their algorithm.

Source https://scitechdaily.com/new-algorithm-trains-drones-to-fly-around-obstacles-at-high-speeds

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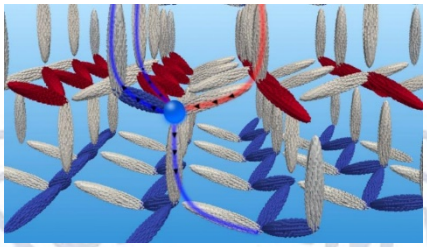
8. 3D Magnetic Nanonetwork Breakthrough Could Enable New Generation of 3D Storage Technologies

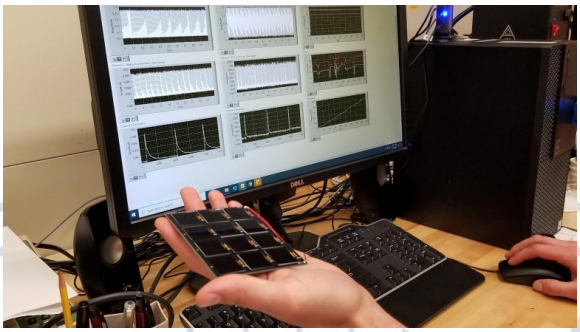


Three dimensional (3D) nano-network promise a new era in modern solid state physics with numerous applications in photonics, bio-medicine, and spintronics. The realization of 3D magnetic nano-architectures could enable ultra-fast and low-energy data storage devices. Due to competing magnetic interactions in these systems magnetic charges or magnetic monopoles can emerge, which can be utilized as mobile, binary information carriers. Researchers at University of Vienna have now designed the first 3D artificial spin ice lattice hosting unbound magnetic charges. The results present a first theoretical demonstration that, in the new lattice, the magnetic monopoles are stable at room temperature and can be steered on-demand by external magnetic fields. Emergent magnetic monopoles are observed in a class of magnetic materials called spin ices. However, the atomic scales and required low temperatures for their stability limit their controllability. This led to the development of 2D artificial spin ice, where the single atomic moments are replaced by magnetic nano-islands arranged on different lattices. The up-scaling allowed the study of emergent magnetic monopoles on more accessible platforms. Reversing the magnetic orientation of specific nano-islands propagates the monopoles one vertex further, leaving a trace behind. This trace, Dirac Strings, necessarily stores energy and bind the monopoles, limiting their mobility. Researchers around Sabri Koraltan and Florian Slanovc, and led by Dieter Suess at the University of Vienna, have now designed a first 3D artificial spin ice lattice that combines the advantages of both atomic- and 2D artificial spin ices. In a cooperation with Nanomagnetism and Magnonics group from University of Vienna, and Theoretical Division of Los Alamos Laboratory, USA, the benefits of the new lattice are studied employing micromagnetic simulations. Here, flat 2D nano-islands are replaced by magnetic rotational ellipsoids, and a high symmetry three-dimensional lattice is used. “Due to the degeneracy of the ground state the tension of the Dirac strings vanish unbinding the magnetic monopoles,” remarks Sabri Koraltan, one of the first-authors of the study. The researchers took the study further to the next step, where in their simulations one magnetic monopole was propagated through the lattice by applying external magnetic fields, demonstrating its application as information carriers in a 3D magnetic nano-network. Sabri Koraltan adds “We make use of the third dimension and high symmetry in the new lattice to unbind the magnetic monopoles, and move them in desired directions, almost like true electrons.” The other first-author Florian Slanovc concludes, “The thermal stability of the monopoles around room temperature and above could lay the foundation for groundbreaking new generation of 3D storage technologies.”

Source https://scitechdaily.com/3d-magnetic-nanonetwork-breakthrough-could-enable-new-generation-of-3d-storage-technologies

Energy Engineering

9. Self-Harvesting Energy to Power Rechargeable Devices, Sensors



Self-harvesting energy from indoor environments proves effective for charging batteries. As more of our devices require recharging of their batteries, researchers are looking to ambient lighting as a potential source of generating small amounts of power for indoor devices. Andrew Shore and Behrang Hamadani, from the National Institute of Standards and Technology, present their findings on the capabilities of indoor solar cells in generating power under an LED. The researchers used one lighting source, a white LED with a color coordinate temperature of 3,000 K and an illuminance of 1,000 lux, akin to normal brightness for indoor lights, to test three different modules — a gallium indium phosphide (GaInP) semiconductor, a gallium arsenide (GaAs) semiconductor, and a silicon (Si) semiconductor. The light source peaked in intensity on the shorter wavelengths of light. “Under these light settings, the GaInP mini module performed with the highest power conversion efficiency, followed by the GaAs mini module, with the Si mini module as the lowest performer,” Shore said. “The GaInP and GaAs modules have a better spectral match with this visible-spectrum LED light source.” Since there is usually plenty of indoor ambient light from different sources, a ceiling light in an office environment would be enough to charge any of the mini modules that were tested, making them all viable as power sources for indoor batteries and sensors. Shore said the GaInP would require the least amount of light and still maintain high efficiency, but not all indoor light sources are LEDs. “Different light sources have different spectra,” he said. “For instance, an incandescent light source has a large portion of its irradiance in the near infrared region. Fluorescent lights have several spikes in intensity at different places in the visible spectrum. LED lights generally have one short, prominent peak around 450 nanometers and another more gradual peak around 600 nm. Each of these light sources will affect the power conversion efficiency of the photovoltaic technology.” Shore said the next step will be testing the mini modules under real-world conditions, like a person turning a light on and off at regular intervals. They hope to operate more than one sensor being powered by a module during that testing.

Source https://scitechdaily.com/self-harvesting-energy-to-power-rechargeable-devices-sensors

10. Low-Cost, Inflatable Bionic Hand Gives Amputees Real-Time Tactile Control

For the more than 5 million people in the world who have undergone an upper-limb amputation, prosthetics have come a long way. Beyond traditional mannequin-like appendages, there is a growing number of commercial neuroprosthetics — highly articulated bionic limbs, engineered to sense a user's residual muscle signals and robotically mimic their intended motions. But this high-tech dexterity comes at a price. Neuroprosthetics can cost tens of thousands of dollars and are built around metal skeletons, with electrical motors that can be heavy and rigid. Now engineers at MIT and Shanghai Jiao Tong University have designed a soft, lightweight, and potentially low-cost neuroprosthetic hand. Amputees who tested the artificial limb performed daily activities, such as zipping a suitcase, pouring a carton of juice, and petting a cat, just as well as — and in some cases better than —those with more rigid neuroprosthetics. The researchers found the prosthetic, designed with a system for tactile feedback, restored some primitive sensation in a volunteer's residual limb. The new design is also surprisingly durable, quickly recovering after being struck with a hammer or run over with a car. The smart hand is soft and elastic, and weighs about half a pound. The team's artificial hand is made from soft, stretchy material — in this case, the commercial elastomer EcoFlex. The prosthetic comprises five balloon-like fingers, each embedded with segments of fiber, similar to articulated bones in actual fingers. The bendy digits are connected to a 3-D-printed "palm," shaped like a human hand. Rather than controlling each finger using mounted electrical motors, as most neuroprosthetics do, the researchers used a simple pneumatic system to precisely inflate fingers and bend them in specific positions. This system, including a small pump and valves, can be worn at the waist, significantly reducing the prosthetic's weight. Lin developed a computer model to relate a finger's desired position to the corresponding pressure a pump would have to apply to achieve that position. Using this model, the team developed a controller that directs the pneumatic system to inflate the fingers, in positions that mimic five common grasps, including pinching two and three fingers together, making a balled-up fist, and cupping the palm. The pneumatic system receives signals from EMG sensors — electromyography sensors that measure electrical signals generated by motor neurons to control muscles. The sensors are fitted at the prosthetic's opening, where it attaches to a user's limb. In this arrangement, the sensors can pick up signals from a residual limb, such as when an amputee imagines making a fist. The team then used an existing algorithm that "decodes" muscle signals and relates them to common grasp types. They used this algorithm to program the controller for their pneumatic system. When an amputee imagines, for instance, holding a wine glass, the sensors pick up the residual muscle signals, which the controller then translates into corresponding pressures. The pump then applies those pressures to inflate each finger and produce the amputee's intended grasp. Going a step further in their design, the researchers looked to enable tactile feedback — a feature that is not incorporated in most commercial neuroprosthetics. To do this, they stitched to each fingertip a pressure sensor, which when touched or squeezed produces an electrical signal proportional to the sensed pressure. Each sensor is wired to a specific location on an amputee's residual limb, so the user can "feel" when the prosthetic's thumb is pressed, for example, versus the forefinger. To test the inflatable hand, the researchers enlisted two volunteers, each with

upper-limb amputations. Once outfitted with the neuroprosthetic, the volunteers learned to use it by repeatedly contracting the muscles in their arm while imagining making five common grasps.

Source https://scitechdaily.com/low-cost-inflatable-bionic-hand-gives-amputees-real-time-tactile-control

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ENGINEERING INNOVATION IN INDIA

1. UoH, ARCI Researchers Develop Chemically Stable Fertilizer

Material scientists and plant biologists from the University of Hyderabad (UoH) and International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) have developed an industrially viable dry method to generate chemically stable and smaller nano-diammonium phosphate (n-DAP) fertilizer that would reduce over-dependence on chemical fertilisers. Subsequent testing of both types of fertilizers on tomato and wheat seedlings demonstrated an extraordinary superiority of nano-DAP fertilizer over the conventional granular DAP (c-DAP). In the lab-scale experiments, the reduced quantity of nano-DAP fertilizer input than c-DAP promoted the early seedlings growth and development in both crops. It also led to enhanced phosphate uptake efficiency in these seedlings. Based on these promising results in the lab-scale experiments, the research team is now planning to test the efficacy of nano-DAP on tomato plants under field conditions. "n-DAP in reduced doses while meeting the plants' optimum P nutrient requirement would also be preferred for better soil health and agricultural sustainability," said the research team consisting of Naorem Ronald Reagan Singh, Harita Pant, research scholars at UoH; Srikanth Venkata Satya Siva Vadali and Rahul Kumar, faculty at UoH, and Sreedhara Sudhakara Sarma and Tata Narasinga Rao from ARCI, Hyderabad. While several hurdles remain to be overcome before the real potential of nano-DAP can be realised under field conditions, the researchers think its application in reduced quantity may significantly cut down on the overall input of conventional phosphorous-fertilizers currently applied in agriculture. Their work titled 'Cryo-milled nano-DAP for enhanced growth of monocot and dicot plants' was recently published in Nanoscale Advances, a reputed scientific journal published by the Royal Society of Chemistry, UK. Chemical fertilizers application is critical to boosting crop productivity. In fact, besides improved varieties and better irrigation methods, one of the factors that contributed to the enhanced crop productivity during the green revolution and afterwards is the application of chemical nitrogen (N), phosphorus (P), and potassium (K) fertilizers. However, excessive use of these chemicals over decades has affected the soil quality. Moreover, global phosphorus reserves are finite and likely to be irreversibly exhausted in the next 100-200 years. India lacks big natural P-reserves and meets its P-fertilizers demand by importing. In this context, the research findings assume importance.

Source https://www.thehindu.com/news/cities/Hyderabad/uoh-arci-researchers-develop-chemically-stable-fertilizer/article35133784.ece

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2. Indian researchers perfect manufacture of additive used in aircraft engine repair.

Indian scientists have for the first time repaired components of an aero-engine using additive manufacturing or a 3D printing technique called the Directed Energy Deposition (DED) process that can significantly reduce repair costs and overhaul time. They have developed indigenously powders suitable for the additive manufacturing process. Nickel-based superalloys are widely used in aero-engine components. Despite having exceptional properties, they are prone to damage due to extreme operational conditions. Manufacturing defects during the casting or machining process are another major cause of rejection, and tonnes of such unused components are scrapped due to minor defects. A team of scientists from the Hyderabad-based International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), an autonomous R&D Centre of the Department of Science and Technology, indigenously developed powders suitable for additive manufacturing using the inert gas atomiser available at the institute, by melting unused scrap material. Utilising this, ARCI is developing the Laser-DED process for the repair of aero-engine components made of Ni-based superalloy.

Further, the ARCI team has developed a technology to refurbish the pinion housing assembly (critical component in helicopters used for power transmission to the main fan) by machining out the damaged layer and rebuilding it using the laser cladding process, followed by final machining. Laser cladding and Laser-DED (both processes) are the same. In general, termaser cladding is used for two-dimensional deposition (surface coating), and termlaser-DED is used for the manufacture of three-dimensional parts. A patent has been filed for the same. These laser-clad repaired prototypes were found to be free from distortion and exhibited excellent performance. The team has also developed repair and refurbishment technologies for other industrial sectors, such as refurbishing diesel engine cylinder heads made of grey cast iron and refurbishing shafts used in the refinery. This work has been published in the journal *Transactions of The Indian Institute of Metals*. The technology developed by ARCI can be best realised in the aerospace sector due to the expensive materials used, manufacturing costs, and stringent quality checks, the statement said.

Source https://www.thehindubusinessline.com/news/science/indian-researchers-perfect-manufacture-of-additive-used-in-aircraft-engine-repair/article36080063.ece

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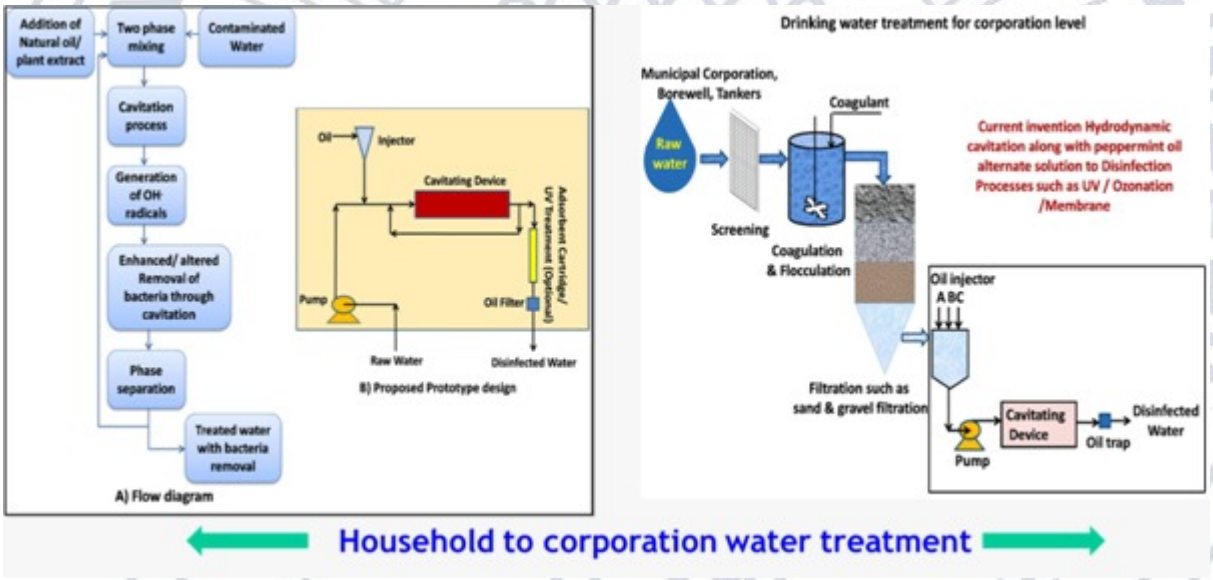
3. NCL-DST Scientists Develop Novel Technology to Disinfect Water



Scientists from the National Chemical Laboratory (NCL), Pune in collaboration with the Water Technology Initiative under the Department of Science & Technology (DST), GoI have developed a novel technology to disinfect water. The technology named 'SWASTIIK' (Safe Water and Sustainable Technology Initiative from Indian Knowledgebase) is a combined solution for not just disinfecting water, but for offering possible health benefits of natural oils. Pathogenic microorganisms in water are one of the primary root-cause of water-borne diseases.

Although, chemical processes such as chlorination strive to do away with water impurities, the formation of carcinogenic disinfection by-products poses a serious health hazard. Thus, it is imperative to develop a technology that provides safe, healthy and cost-effective drinking water with substantial ease of operation, free of harmful disinfectant by-products. SWASTIIK technology is a unique and rather rare amalgamation of modern technology and traditional Ayurvedic knowledge that claims to disinfect water completely. The technique uses hydrodynamic cavitation, combining chemistry, biology, and chemical engineering, with natural resources in the form of natural oils and plant extracts. The process involves

boiling of a liquid (water) as a result of pressure reduction called cavitation. It also uses natural oils with antimicrobial properties to eliminate harmful bacteria, including antimicrobial-resistant bacteria. The technology developed by scientists from the National Chemical Laboratory (NCL) and Department of Science & Technology (DST) has significantly increased efficiency and reduced the cost of water treatment. Further, it was observed that the increased rate of disinfection using oil can drastically reduce the time of operation, consequently reducing the cost as compared to other advanced treatment processes. Its health benefits include providing safe drinking water that can boost immunity, an important aspect as underlined during the current pandemic times. Scientists from the National Chemical Laboratory (NCL) and Department of Science & Technology (DST) developed this path-breaking technology to disinfect water sustainably.

Dr. V M Bhandari and his group at the CSIR-NCL Pune, with support from the DST, developed the hybrid technology.

Source https://newsonair.com/2021/08/24/ncl-dst-scientists-develop-novel-technology-to-disinfect-water

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