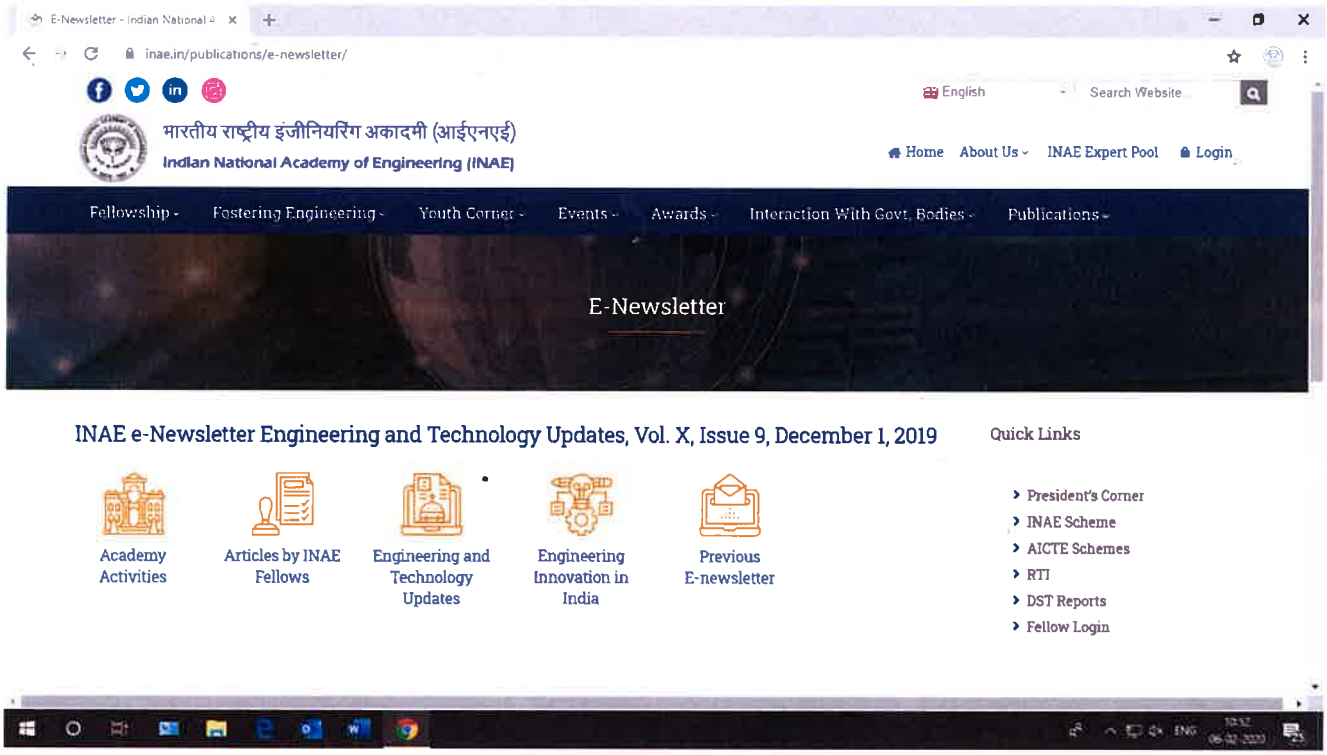
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Home
About Us
INAE Expert Pool
Login
Fellowship
Fostering Engineering
Youth Corner
Events
Awards
Interaction With Govt. Bodies
Publications
E-Newsletter
INAE e-Newsletter Engineering and Technology Updates, Vol. X, Issue 9, December 1, 2019
Academy Activities
Articles by INAE Fellows
Engineering and Technology Updates
Engineering Innovation in India
Previous E-newsletter
Quick Links
President's Corner
INAE Scheme
AICTE Schemes
RTI
DST Reports
Fellow Login

From the Editor's Desk

AGING AIRCRAFT

In recent years, the demand for air travel has increased by many fold worldwide and several countries are also engaged in strengthening their military fleet with aircrafts fitted with several advanced features. The manufacturing of new air planes with ever increasing sophistication is a challenging task and time consuming process. Many reputed firms are lagging behind in their production schedule and are not able to cope up with the increasing demand for new aircrafts. Therefore, it becomes necessary to fly the older planes beyond the intended service life both in civil and military sectors.

Many airlines are trying to reduce their expenses by introducing very few new airplanes which are exorbitantly priced and continuing to use a higher percentage of older aircraft in their fleet. Such initiatives are to be supported by comprehensive maintenance programs involving repair, refurbication and/or replacement of aging components. The continued operation of airplanes is preferred as long as maintenance costs do not exceed the revenue generated by the aging airplane. Airlines will continue to invest in maintenance, under situations where the planes have sound airframes and engines that will last several more years.

The exact period when an airplane attains the aging state is very difficult to predict. In general, aging of aircraft is considered as one where the effects of corrosion and cracking from fatigue, require modification of the maintenance programme to retain adequate structural integrity. The airframe of aircraft consists of wings, fuselage, undercarriage etc. Wing is subjected to varying stresses due to its own weight and prevailing conditions of operation, that include flight maneuver, air turbulence, and stresses from landing gear during take-off and landing. The top and bottom surfaces of the wing are alternately subjected to compression and tension respectively, during airborne and taxing. Fuselage takes into consideration the pressurized cabin and the stresses acting on the body of aircraft. In general, the designers of aircraft have adopted the fail-safe and or damage tolerant approaches for designing the components against fatigue. Fail safe approach requires regular inspection of different parts of airframe and the inspection intervals are based upon fatigue crack growth data for the materials of interest. The damage tolerance approach has led to a greatly improved understanding of aircraft structures and their performance. This approach is believed to eliminate fatigue cracking as a threat to structural integrity. Damage tolerance approach is currently serving as a foundation on which the structural maintenance programmes are being knitted. Fatigue cracking found by inspections based on damage tolerance principles had resulted in many extensive repairs and modifications to the structures including component replacement. The fatigue behaviour leads to the reduction in structural stiffness of the airframe, resulting in under performance and influences the safety of aircraft. Corrosion has always been considered as a major factor in aging aircraft maintenance. The combined effect of corrosion and corrosion fatigue plays a significant role in damaging the aircraft structure.

Damage tolerance philosophies are being used today in the design, development and life management of turbine engines. Several components in engines operating at elevated temperatures may undergo deformation and damage due to creep, thermo-mechanical fatigue and creep-fatigue interaction. The measurement of damage and fracture control has now become an integral part of turbine engine development programs. Non-Destructive Evaluation is assuming greater significance in the assessment of microstructural changes, creep and fatigue deformation and damage initiation and growth, where investment in new airplane is not cost effective and the safe operational life of aging plane needs to be extended. Human factors are also playing a critical role in maintenance and inspection of aging components and ensuring the airworthiness of aging planes. The advanced technologies adopted by different manufacturers are complicating the aviation maintenance system.

The maintenance personnel today shall possess multiple skills to repair metallic and composite sheets, rivets and bolts, control cables, fly-by-wire systems, glass cockpits etc., and shall periodically undergo intelligent training that prepares them to attain appropriate level of technical proficiency for safe, efficient and effective job performance. In order to develop the awareness of challenges associated with operating aging aircraft in India, the unacceptably high threat that could be posed to India's transportation infrastructure by aging aircraft, India-USA Lecture Series on Aging Aircrafts had been organized by the Department of Aerospace Engineering at Indian Institute of Science, Bangalore during 27-29th November 2019. The expert lectures were delivered by 18 distinguished academicians, scientists, engineers and technologists from USA, Canada, Italy and India. Some of the papers will be published in Transactions of Indian National Academy of Engineering in forthcoming issues.

Prof. K. Bhanu Sankara Rao
Chief Editor, INAE Publications
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INAE Local Chapter Activities

- **INAE Bangalore Local Chapter**

India-USA Lecture Series on Aging Aircraft Organized by Indian Institute of Science, Bangalore; INAE Bangalore Local Chapter and CSIR-NAL, Bangalore.

The India-USA Lecture Series on Aging Aircraft organized by Indian Institute of Science, Bangalore; INAE Bangalore Local Chapter and CSIR-National Aerospace Laboratories (CSIR-NAL), Bangalore was held on November 27-29, 2019 a Department of Aerospace Engineering, Indian Institute of Science, Bangalore. The events' Main Sponsors were India---USA Science and Technology Forum (ISSTF) and Office of Naval Research (ONR), USA. The event also received gracious partial support from Institute of Mechanical Engineers (IMechE), UK and Defense Research and Development Organization (DRDO). Prof. S. Gopalakrishnan from Department of Aerospace Engineering was the Coordinator from Indian Side and Prof. Lalita Udpa from The Michigan State University as its Coordinator from US Side. Dr S. G Sampath and Dr AR Upadhya were the course Directors from the US and Indian side respectively

The event featured six speakers from USA, nine from India and two from Canada and one from Italy. The list of speakers who delivered lectures in this Lecture Series are as follows. Speakers From USA: Dr Bill Nickerson, Office of Naval Research, USA; Dr S G Sampath, Former Scientist, FAA, USA and US Army; Prof. Lalita Udpa, Michigan State University, USA; Prof. Sankaran Mahadevan, Vanderbilt University, USA; **Prof. Colin Drury**, University of Buffalo, USA and Dr. Jayanth Kudva, NextGen Aeronautics, California, USA. The speakers from Canada and Europe were: Prof. Afzal Sulaiman, University of Victoria, Canada; Dr Prakash Patnaik, National Research Council, Canada and **Mr Mariani Ugo,** Leonardo Helicopters, Italy. Air Marshal Vibhas Panday, Indian Air Force and Dr R Sundar, Biss Research, Bangalore; Prof. Krishnan Balasubramaniam, IIT, Madras; Dr P D Mangalgiri, Visiting Professor, IIT Kanpur; Dr K Vijayaraju, Aeronautical Development Agency, Bangalore; Mr Yogesh Kumar, Former Executive Director, HAL, Bangalore; Mr HRS Prasad, Center of Excellence in Aerospace, VTU, Bangalore; Dr Ramakanth Singh, DGCA, New Delhi and Mr Siddharha Ghosh, Spice Jet, Gurgaon were the speakers from India

The Lecture series inauguration took place on November 27th 2019 at 9.0 am. The Inaugural Function included speeches by Dr Tessy Thomas, Distinguished Scientist and Director General of Aeronautics, DRDO, Mr G. Rajashekar, Additional Director General, Department of Civil Aviation, Government of India, Dr. S. G Sampath, Course Director of Lecture Series from USA, Prof. Lalita Udpa, Course Coordinator from USA, and Dr A R Upadhya, Course Director of Lecture Series from India. Prof. S. Gopalakrishnan, Course Coordinator from India proposed the Vote of Thanks.

IULSAA Inauguration: L---R; Dr Tessy Thomas, Mr Rajashekar, Prof. Lalita Udpa, Dr Sam Sampath and Prof. S. Gopalakrishnan

Dr Tessy Thomas, FNAE addressing the gathering in the Inaugural function

The Inaugural Function was followed by two plenary talks, the first talk by Air Marshal Vibhas Pande, Director General (Aircrafts), Air Headquarters, New Delhi and the second by Dr Bill Nickerson, Office of Naval research---Global, USA. The talk by Air Marshall concentrated on Aging Issues in Air Fleet management, while the plenary talk by Dr Nickerson concentrated on the environmental issues such as corrosion on the aircraft aging.

Air Marshall Vibhas Pande, VSM, Director General (Aircraft), IAF delivering Plenary Talk

Dr Bill Nickerson from Office of Naval research, USA delivering Plenary talk

The talks by various speakers spread over eight sessions. Each talk was of 45 minutes duration with 15 minutes allocated for discussion. The Lecture Session began by Dr S G Sampath giving an overview of the aging aircraft issues based on his own experience on FAA, USA. In all, there were 18 lectures, covering a wide spectrum of areas that included Fatigue behaviour, Corrosion behaviour, Aging Aircraft Engines, Aging Helicopters, Aging Wiring, Aging Avionics, New Material system insertion and Human factor issues and policy guidelines. The Lecture series also featured a lecture from regulator Directorate of Civil Aviation and also a lecture from a private airline Spice jet official. These two lectures in particular, addressed the aging issues faced by aircraft certification agencies and the commercial airlines, respectively.

Prof. Krishnan Balasubramanium from IIT Madras delivering Lecture

Dr S G Sampath from FAA, USA delivering Lecture

Dr Mariani Ugo from Leonardo Helicopters, Italy delivering Lecture

Dr Jayant Kudva from NextGen Aeronautics, USA delivering Lecture

At the end of the first day, a Cultural Program was held during which a Carnatic music concert was rendered by Prof. Sankaran Mahadevan, who also happened to be an expert in Uncertainty Quantification and was also a speaker in the Lecture Series.

Cultural Evening: Carnatic Music Concert given by Prof. Sankaran Mahadevan from Vanderbilt University USA

The response to this Lecture Series was tremendous. In all over 160 delegates from both Government and Private agencies registered for this lecture series out of which there were 25 student registrations. Students who attended the Lecture series were primarily from IISc, IIT Madras, IIT Kharagpur, NIT Calicut, and JNU, Hyderabad. There was substantial participation from Indian Airforce, who were also one of the stakeholders of this Lecture Series.

Air Marshal Vibhas Pande and his IAF team interacting with Dr AR Upadhya, the Course Director IULSAA

Delegates attending Lecture Series Inauguration Program

Delegates from both Government and private aerospace agencies attended this Lecture Series and the list gives the organizations that participated in this event are given below.

Government Organizations: (a) Aeronautical Development Agency (b) Center for Airborne Systems (c) CEMILAC (d) Hindustan Aeronautics Limited (e) National Aerospace Laboratories (f) Department of Civil Aviation (g) R & D E (Engrs) and (g) Indian Air Force –Maintenance Command and Air Headquarters.

Private Aerospace and other Agencies: (a)Boeing Aircraft Company (b) Textron (c) Airbus Industries (d) Axis Cades (e) Several NDT companies in Bangalore (f) GE Aviation (h) Rolls Royce.

Private Airline Companies: (a) Spice Jet (b) Air India and (c) Blue Dart Aviation

Several leading Aerospace Scientists and Engineers participated in this Lecture series, which included Dr Kota Harinarayana, Dr A R Upadhya, Mr Ashok Baweja, Prof. Dattaguru, Cmdr C D Balaji to name a few.

Dr Kota Harinarayana, Former Program Director, ADA Chairing a Session

Mr Ashok Baweja, Former CMD, HAL and Chairman, IMechE India chairing a Session

On the evening of November 28, the Banquet dinner was arranged at Bangalore Golf Club which was attended by over 150 delegates. The Lecture Series ended on November 29, 2019 with a feedback session. The event was greatly appreciated by the delegates and there was a general agreement that India should have a separate Center for Aviation Safety Research and a draft proposal prepared by Dr Ramchand Former Director of CABS and Dr S.G Sampath was circulated to all the delegates. It was decided that a committee will be setup to finalize the details of this center and then talk to the Government for the funding details. At the end of the event, Prof. Gopalakrishnan summarized the critical aspects of different lectures delivered in this event and thanked all the volunteers who made the organization of this Lecture Series possible.

- **INAE Pune Local Chapter and Pune Engineering Forum**

With the objective of bringing together the Core engineering with Computer Science, INAE Pune Chapter organized an event on November 7, 2019 at College of Engineering, (COEP), Bhau Institute Auditorium. Theme of this event was: "Engineering Complex Adaptive systems with Digital Twins". The program comprised invited talks by eminent experts from industry.

At the outset, Mr MV Kotwal, Chairman INAE Pune Chapter and Pune Engineering Forum, delivered the Welcome Address. Dr Pradip, Vice President INAE, gave a brief introduction to INAE to the august audience, while Mr Vinay Kulkarni, Secretary INAE Pune Chapter, introduced the theme along with the invited speakers.

The invited talks were followed by interaction with the workshop participants which are highlighted as follows. Mr Vijay Talele, CEO Bhau Institute, provided a brief overview of Bhau Institute. Mr Ram Kulkarni, Secretary Pune Engineering Forum, proposed the Vote of Thanks. The interactions between the delegated continued post event over tea. The details of the invited talks are given below.

Talk #1: Experience sharing from automotive industry on Model based Systems Engineering by Shri Puran Parekh, iASys

Abstract: Automotive Industry involves very complex multi-domain engineering and a high level of innovation. Right from fundamental material science to advanced AI technology - everything has to work in harmony. Automotive industry has come a long way from pure mechanical engineering to sophisticated complex mechatronics. This necessitates the need for model-based systems-engineering (Digital Twin) approach to speed up the development process. The task gets more complex due to its multi-disciplinary nature.

Need for a structured data management approach from different domains is key for creating Digital Twins of the physical world. A few examples in the vehicle powertrain area were used to explain the complexity and possible solutions.

Talk #2: Supporting dynamic adaptation of enterprise in the face of partial information and uncertainty by Dr Souvik Barat, TCS Research and Innovation

Abstract: Modern enterprises are large complex "system of systems" operating in a dynamic and uncertain environment to achieve their goals. To stay ahead of the competition and achieve moving business targets, these enterprises require continuous analysis, adaptation, transformation, and also design to operate in a new way. The state-of-the-practice to decide appropriate changes and design are primarily intuition based, which is significantly lacking the rigour and often results into ineffective solutions. Pure historical data-centric AI-driven approaches also fail to demonstrate expected precision as the existing data of most of the enterprise is often inadequate and frequently it becomes irrelevant in this dynamic world. The talk covered a model-based simulation-aided, evidence-backed approach to make enterprises adaptive. The approach hinges on the concept of Digital Twin – a set of relevant models that are amenable to analysis and simulation. The efficacy of this approach was clearly brought out using some real-life case studies.

Talk #3: Skin Digital Twin: A Computational Approach Towards Mimicking Nature by Dr Beena Rai, TCS Research and Innovation

Abstract: Human skin is one of the complex and versatile organs, responsible for various functions like preventing the body from excessive loss of water and attack of foreign pathogens. Besides these physiological functions, the importance of the skin aesthetics has been the focus of humankind since ages. Skin is one of the largest organs of human body (~1.5 – 2 sqm of surface area) anatomically being composed of three layers. The top-most layer, called epidermis, is responsible for skin's health apart from providing it glow, youthfulness and texture. Epidermis is further divided into 5 sub-layers of which stratum corneum (SC) – the most external one, is responsible for skin's barrier function. Dermis, located beneath epidermis is primarily made up of collagen and elastin and provides structural support and elasticity. The deepest layer named as hypodermis is composed of adipose tissues and provides the heat resistance. Both pharma and cosmetics industry have been leveraging skin for various businesses like transdermal delivery of drugs or skin care products. However, traditional route of design and development of these products has been laborious and time-consuming experimentations involving in-vitro and in-vivo methods. Needless to add, the process not only remains expensive but also presents a threat to the environment where millions of animals are sacrificed every year. Irony of the situation is that, in spite of these costly and unethical efforts, the success rate for viable products remains very low (10-30% only). Therefore, it is hardly a surprise that both these industries are looking for digital interventions which could substitute or eliminate animal testing. At TCS, we have developed a first principle based computational model of human skin which mimics physiological properties of skin. A multiscale modelling framework linking atomistic-molecular-mesoscale-macroscale is employed to study molecular transport across the skin. The model thus developed has provided a base to develop an IT enabled platform (TCS Digital Skin Twin Platform) for the simulation-based design and development of pharma/cosmetics products. The concept of a skin digital twin was described and its utility in product design & testing was vividly illustrated using examples from the pharma and cosmetics industries.

Talk #4: A platform for integrated engineering of materials, products and manufacturing processes by Shri Sreedhar Reddy, TCS Research and Innovation

Abstract: Industry 4.0 and smart manufacturing are about taking advantage of digital technologies to achieve higher efficiencies in the manufacturing industry. At the heart of manufacturing lies product engineering and doing this right requires taking an integrated view on the design of materials, products and manufacturing processes. At the moment this is largely done in a "silo-ed" manner with a high degree of dependence on human expertise, leading to suboptimal outcomes. Integrated computational material engineering (ICME) is an emerging approach for integrated engineering of products, materials and manufacturing processes. It advocates a knowledge guided, data supported, simulation driven approach for "in-silico" exploration of the design space, thereby significantly reducing the dependence on human expertise and trial-and-error based experimentation cycles. However, this requires a technology platform that enables seamless integration of product design with process and materials design so that all three can be investigated, analyzed and optimized simultaneously to be able to obtain the right material for the right product to be manufactured in the right way. The platform should provide for seamless integration of multiple kinds of simulation models, tools, data sources and decision support systems. It should be capable of extracting and integrating knowledge from various sources and reasoning with it so as to be able to provide context-appropriate guidance to the designers during the design process. In this talk a platform called TCS-PREMAP being developed at TCS was described.

- **INAE Kharagpur Local Chapter**

One-day Workshop on Steel Technology at IIT Kharagpur

The Department of Metallurgical and Materials Engineering, Indian Institute of Technology Kharagpur, the Kharagpur Chapter of Indian Institute of Metals and the Kharagpur Chapter of Indian National Academy of Engineering had jointly organizing **one-day 'Workshop on Steel Technology'** on **24th October 2019**. The workshop was organized at Prof. S.N. Bose Auditorium in IIT Kharagpur. Prof. Sriman Kumar Bhattacharjee, Officiating Director of IIT Kharagpur inaugurated the workshop. Prof. Rahul Mitra, Head of the Department of Metallurgical and Materials Engineering delivered the welcome address and shared the activities of the department. Prof. Suman Chakraborty, Dean of SRIC, IIT Kharagpur and INAE Chair Professor, Prof. Surjya Kanta Pal, Chairman of Steel Technology Center and DHI Center of Excellence in Advanced Manufacturing also addressed the gathering informing about the various initiatives and activities taken by IIT Kharagpur to support the manufacturing sector. The workshop covered various important areas of steel metallurgy through the following theme-based sessions, conducted by eminent academicians of IIT Kharagpur as session chairpersons:

- Progress in iron and steel making, (Chaired by Prof. P.K. Sen),
- Advanced physical metallurgy and processing of steel, (Chaired by Prof. S.B. Singh),
- Innovative coating, joining and modelling studies on steel, (Chaired by Prof. K. Das and Prof. G.G. Roy).

Besides the faculty members and research students of IIT Kharagpur, several faculty members and scientists from IIEST Shibpur, Jadavpur University, NIT Durgapur and Rourkela, National Metallurgical Laboratory and Tata Steel in Jamshedpur, and RDCIS-SAIL Ranchi participated in the workshop and presented their research activities related to steel. The presence of eminent experts like Dr. Soumitra Tarafder from NML Jamshedpur, Prof. Pravash Chandra Chakraborti from Jadavpur University and Prof. Santanu Ray, former scientist of RDCIS-SAIL and present JSPL and JSL Chair-professor and Editor of Metal News, during the workshop, is worth mentioning.

The following two distinguished international doyens attended the workshop and delivered **Institute Lectures**: **1) Dr Debashish Bhattacharjee**, Vice President, Technology and New

Materials, Tata Steel and Former Group Director of Global Research, Development and Technology, Tata Steel and **2) Prof Dr H J Fecht,** Chair Professor and Director "Institute of Micro and Nanomaterials" at Ulm University, Eureka Cluster Office Director Metallurgy Europe, Member of European Academy of Sciences and Arts. The Workshop was coordinated by Prof. Debalay Chakrabarti with the help, support and advice from Prof. Rahul Mitra, Head of the Department of Metallurgical and Materials Engineering, IIT Kharagpur, Prof. Tapas Laha and Prof. G.G. Roy from the Indian Institute of Metals Kharagpur Chapter, Prof. Sumantra Mandal and Prof. Indranil Manna, Vice-President, INAE from INAE Kharagpur Local Chapter.

Prof SK Bhattacharyya, FNAE, Officiating Director, and Prof Indranil Manna, Vice-President, INAE Lighting the Lamp

Lighting of Lamp by Prof Suman Chakraborty

Prof Rahul Mitra Delivering the Welcome Address

Prof SK Bhattacharyya Addressing the Audience

Prof Indranil Manna, Vice-President, INAE Felicitating Prof Dr H J Fecht

Audience in the event

Prof Suman Chakraborty delivering talk

Prof Indranil Manna addressing the audience

Dr Debashish Bhattacharjee giving presentation

Prof Indranil Manna and Prof Dr H J Fecht

Dr Debashish Bhattacharjee delivering lecture

- **INAE Kanpur Chapter**
  - **Learning Through Virtual Laboratories at IIT Kanpur**

A full day **Virtual Laboratory workshop** was organised by Indian Institute of Technology (IIT) Kanpur and INAE Kanpur Chapter on September 14, 2019. Prof. K. Muralidhar, President, INAE Kanpur Chapter, and Prof. Kantesh Balani, Coordinator, Virtual Lab IIT Kanpur, lighted the lamp and inaugurated the workshop. Prof. Muralidhar, in his introductory remarks, highlighted the grand challenges that engineers need to focus on as per global needs. He also emphasised the need of tools, from hammer to virtual laboratories that enhance the value of engineers in today's world. The Virtual Laboratory workshop witnessed the enthusiastic participation of 184 delegates from 13 colleges and 5 schools (from Indore, Sultanpur, Kannauj, Banda, Moradabad, Motihari, and Kanpur). Such large participation highlights that the domain of virtual laboratories is gaining popularity and momentum in the recent times. The technical program started with an introduction to '***Virtual Laboratories***' by Prof. Kantesh Balani, who highlighted the need of building confidence via gaining knowledge through virtual lab platform. This Virtual Laboratory initiative is being supported by Ministry of Human Resource and Development (MHRD) under the National Mission on Education through Information and Communication Technology (NMEICT). The lead

coordinator of this Virtual Lab initiative is IIT Delhi with 23 participating institutes across the country.

Prof K Muralidhar Lighting the lamp *Audience in the event*

Prof. D. Goswami highlighted 'Ultrafast Laser Spectroscopy', and later Ms. Sonal Dixit, Mr. Boda Pool Singh, Mr. Narendra Dhar, and Mr. Arun Kumar Sharma together introduced 'Transducers and Instrumentation' virtual laboratory developed by Prof. Nishchal Verma. Then, Prof. Kantesh Balani demonstrated virtual laboratory on, 'Material Response to Microstructural-, Mechanical-, Thermal- and Biological-Stimuli', followed by showcasing of 'Production Shop Simulation Laboratory', by Prof. Deepu Philip. The lunch break allowed participants to engage in discussions with the eminent speakers. Following lunch, Prof. Pankaj Jain enticed students with 'Virtual Astrophysics Laboratory' talking about fascinations of watching stars from earth. Prof. K.V. Srivastava showcased 'RF and Microwave Characterization Laboratory', which is jointly developed with Prof. M.J. Akhtar. Prof. S. Banerjee elicited conceptual notes on 'Waves and Phenomena' and highlighted that oscillations are inherently present in our daily lives. The last talk by Prof. S. Kamle on 'Aerospace Virtual Laboratory' served as icing on the cake, and emphasized on learning new concepts by conducting experiments.

The participants from various schools and colleges highly appreciated this opportunity of engaging with IIT Kanpur faculty through this Virtual Laboratories platform. The energy in the workshop was never ending, and encouragement by participating faculty and students was without boundaries. The ignited curiosity of students and invigorating participation from faculty was highly satisfying. Involvement of participants percolated to requests of hosting such workshops specifically at their schools and colleges. The program was successfully concluded with distribution of certificates by *Prof. S. Kamle*, and presentation of vote-of-thanks by *Dr. Aparna Dixit*. The workshop was hosted by Prof. Kantesh Balani, and the organisational aspects were assisted by Mr. Dhananjay Umrao, Ms. Sheetal Singh, Mr. Shivam Shukla, Mr. Raj Babu, Mr. Dinesh Diwakar, and volunteers from Pranveer Singh Institute of Technology, and IIT Kanpur.

- **Women in Sciences and Engineering (WiSE) 2019 Conference Organized by IIT Kanpur in association with INAE Kanpur Local Chapter**

As a part of Diamond Jubilee Celebrations at IIT Kanpur, Women in Sciences and Engineering (WiSE) Conference 2019 was organised with support from Indian National Academy of Engineering (INAE) Kanpur Chapter. WiSE 2019 was inaugurated by Dr. Abhay Karandikar, Director, IIT Kanpur, Chief Guest Dr. Asha Agarwal (retired from GSVM), guest of honour Dr. Mamta Vyas (Chief Medical Officer, IIT Kanpur), Dr. S.C. Srivastava (on behalf of Dr. K. Muralidhar, President, INAE Kanpur Chapter), and conference organisers (Dr. Bushra Ateeq and Dr. Kantesh Balani). All expressed a desire to enhance the participation of women in sciences and engineering, and sensitizing the policy makers towards creating sustainable opportunities for women to be able to pursue these as career options.

Inauguration Ceremony and Address by Prof. Abhay Karandikar during Women in Sciences and Engineering 2019 Conference at IIT Kanpur on October 19, 2019.

The WiSE 2019 conference is a very different and unique concept which witnessed eminent women speakers discuss their research. This conference addressed multi-thematic areas and served as a platform for thought stimulating interactions. The open discussion time for the group of speakers addressing an erudite audience not directly from their domain encouraged cross-discipline and engaging dialogue to force open new areas of collaborative research.

WiSE 2019 conference witnessed two plenary talks, and 20 technical talks including the impact of these technologies on society and need of linguistic diversity. In addition, concept of virtual laboratories and an activity based leadership talk also fascinated the participants. Over 64 participants and occasional footfall raised the participants to over 80. Further, two panel discussions, i.e. "*Opportunities & Challenges for Women in Sciences and Engineering*" and "*Innovation and Entrepreneurship*" were also highly informative and useful for both women and men in sciences and engineering domains.

Video message by Dr. Rohini Godbole (IISc Bangalore), Dr. Madhu Loomba (Madhuraj Hospitals, Kanpur), Dr. Debrupa Lahiri (IIT Roorkee), and Dr. S.T. Aruna (NAL Bangalore), also emphasised that women need to embrace womanhood beyond her home and be able to pursue their career …free of any gender-discrimination. A total of 24 talks (two plenary talks, and other thematic talks) along with two panel discussions are planned for the conference during Oct. 19-20, 2019 at IIT Kanpur. Dr. Asha Agarwal delivered plenary talk highlighting need of early cancer detection, which was followed by 10 invited talks on themes of materials, electronics, and energy/environment.

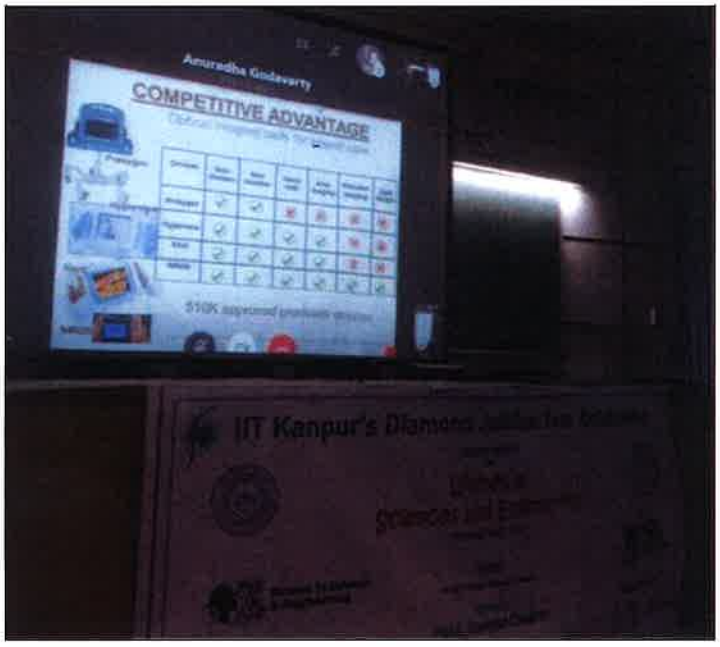
Participants listening to video message by eminent supporters of WiSE 2019.

Collage of talks from various speakers during Women in Sciences and Engineering Conference at IIT Kanpur on October 19, 2019

Later, the panel discussion on "*Opportunities & Challenges for Women in Sciences and Engineering*" was received with very active engagement of audience in sensitizing the gender equality that is demanded in work setting. The session was moderated by Dr. Neetu Singh from IIT Delhi, and panel member included Dr. Emila Panda from IIT Gandhinagar, Dr. Prita Pant from IIT Bombay, Ms. Arpita Gupta (counsellor at IIT Kanpur), Dr. Pratibha Sharma from IIT Kanpur & Ms. Apoorva (student at IIT Kanpur). The gender biases need to be eradicated from the society and a natural flow must ensue towards sharing equal responsibility. The panel members expressed the need of sharing these recommendations to higher bodies for sensitizing these issues for consideration when making policy-decisions.

Panellists of "Opportunities & Challenges for Women in Sciences and Engineering" during Women in Sciences and Engineering Conference at IIT Kanpur on October 19, 2019.

The second day started with plenary talk by Dr. Anuradha Godavarty, Florida International University, FL, USA. She highlighted the aspects and importance of transition from a researcher to an innovator and to an entrepreneur. This talk set the mood for the panel discussion later in the day.



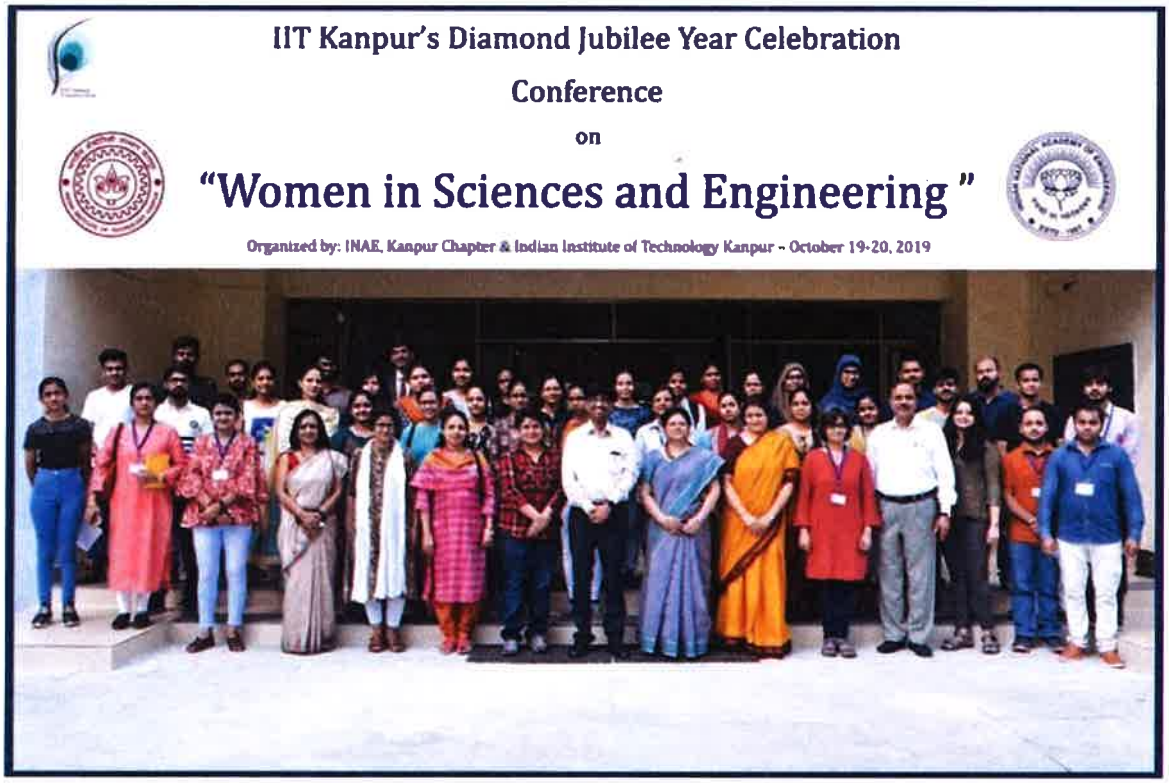
Plenary talk by Dr. Anuradha Godavarty via Skype on October 20, 2019

The next talk was on leadership and women-empowerment that involved the participants in engaging activity and highlighted team building. The enthusiasm persisted on the second day of WiSE 2019 conference with thematic talks hovering on biomedical materials and agricultural sciences. The day ended with an involving panel discussion on "Innovation and Entrepreneurship", which was moderated by Dr. Mini Chandran (IIT Kanpur) and the panellists included Dr. Arpita Amarnani (GIM, Goa), Dr. Neetu Singh (IIT Delhi), Dr. Koumudi Patil (IIT Kanpur), Dr. Renu (Principal Scientist, ICAR-NBAIM, Maunath Bhanjan, U.P.).

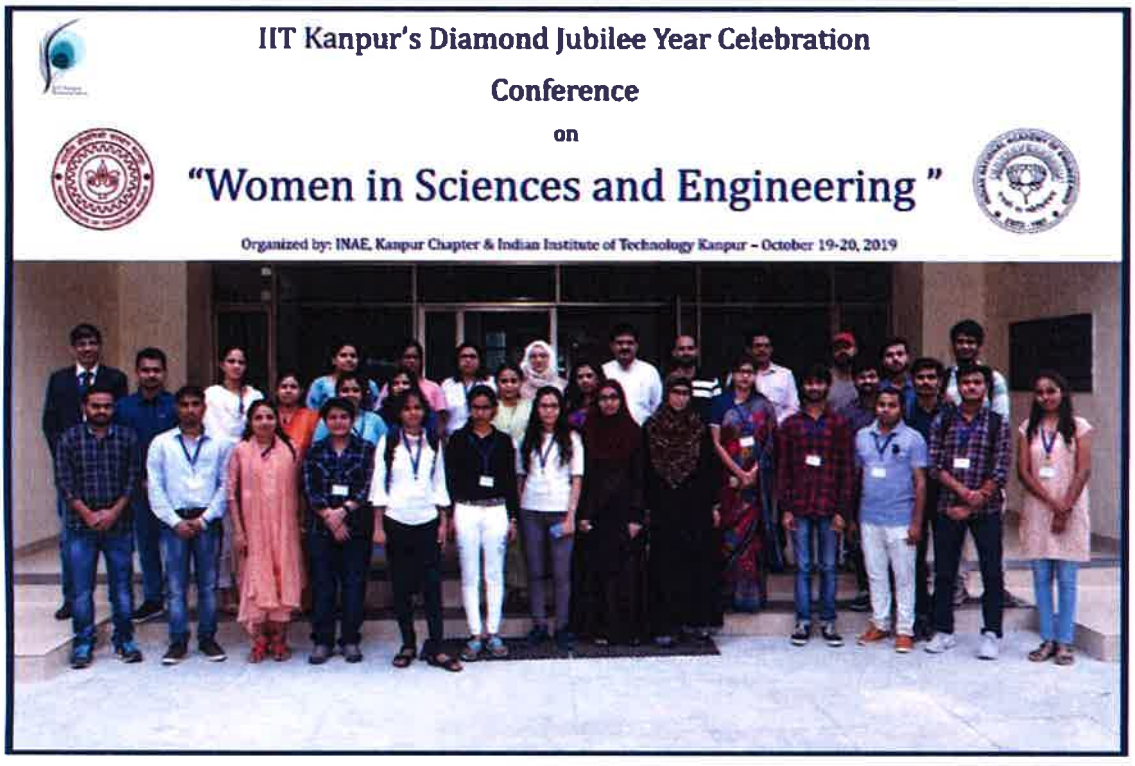
Collage of various speakers giving talk during Women in Sciences and Engineering Conference at IIT Kanpur on October 20, 2019.

Panellists of "Innovation and Entrepreneurship" interacting with audience during Women in Sciences and Engineering Conference at IIT Kanpur on Oct. 20, 2019.

In summary, WiSE 2019 conference was very well received by the community and all the participants recommended that such an event should become a regular event. All the participants extended their full-hearted support for organisation of next WiSE at much bigger scale in near future.



Day 1: October 19, 2019



Day 2: October 20, 2019

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 also 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.

Dr. SK Gupta, FNAE, Former Project Coordinator (Saline Water), Central Soil Salinity Research Institute (CSSRI), Karnal	Karnal Institute of Technology and Management, Karnal Nov 13-15, 2019 Nov 27- 29, 2019	Delivered lectures on "Groundwater Development and Management", "Aquifer Characteristics and Design of Wells" and "Water Quality: National and International Standards". According to the feedback received from the engineering college, the lectures delivered by the DVP have been very beneficial for the students. Delivered Lectures on "Water Measurement - Theory of Weirs", "Dimensionless Numbers and their Applications in Dynamic Sealing" and "Flow Measurements in Pipes - Techniques and Instruments".
Dr. Suvankar Ganguly Principal Scientist, R&D Division, TATA Steel Ltd., Jamshedpur, Jharkhand	Jadavpur University, Kolkata Nov 23, 2019	Held Discussion with Post Graduate students on Design of Experiments and Modelling of Heat Transfer.
Dr. G. Janakiram, General Manager (Technical Services), Eurotex Industries & Exports Ltd, Kolhapur	DKTE Society's Textile & Engineering Institute, Ichalkaranji Nov 13-15, 2019	Delivered lectures on "Basic Concepts of Blow Room", "Research Findings for Development in Blow Room", "Future Scope and Requirements of Chemical Processing Industries" and "Future Scope and Requirements of Garment Industries". Held interactions with UG students for preparing the research plan for work to be undertaken on the topic: Influence of Yarn Studies on Fabric with Recycled Textured Polyester Yarn.
Prof. V Radhakrishnan, FNAE, Formerly Professor, Department of Mechanical Engineering,	Indian Institute of Space Science and Technology, Thiruvananthapuram	Delivered lectures on "Survival Strategies in Academic Research", " How to be Different in Academic Research" and "On the Art and Craft of Publishing Research Findings". As

Indian Institute of Technology Madras and Formerly, Emeritus Professor, Indian Institute of Space Science and Technology, Thiruvanthapuram.	Nov13 -15, 2019	per the feedback received from the engineering college, the Visiting Professor has reviewed and provided inputs for guidance of PhD projects and held discussions on proposal for introduction of a new course. In addition, the lectures delivered by the Visiting Professor have been found to be beneficial for students and Research Scholars.
Prof. M.L. Kothari, FNAE, Former Professor, Department of Electrical Engineering, Indian Institute of Technology Delhi	Dayalbagh Educational Institute (DEI), Agra Nov 12-15, 2019	Delivered lecture on "Load Frequency Control: Automatic Gain Control (AGC) of a Two Area System", "Introduction to Flexible AC Transmission System", "Static VAR Compensator" and "Thyristor Controlled Compensation". The Visiting Professor has proposed to start work on Composite Battery Management. He has also suggested "Modernization of Electrical Machine Lab" as a new Elective Course covering Modern Concepts of Flexible AC Transmission systems, Synchophasers and Wide Area Monitoring Systems (WAMS) in Power Systems Programme for B.Tech and M.Tech students.
Prof. Bidyut Baran Chaudhuri, FNAE Formerly Head, Computer Vision & Pattern Recognition Unit, Indian Statistical Institute, Kolkata	Jalpaiguri Government Engineering College, Jalpaiguri Nov 12-16, 2019	Delivered lectures on "Introduction to Document Analysis", "Indian Language Optical Character Recognition", "Handwritten Words Strike Out Detection" and "Introduction to Artificial Intelligence and Multi - Objective Optimization"
Dr. Vishwas R. Udpikar, Managing Director, SCI-COM Software India Pvt. Ltd., Pune	Rajarambapu Institute of Technology, Sangli Nov 11, 2019	Delivered Faculty Development Programme (FDP) on "Embedded Systems and IoT" and had interactions with Faculty Participants from nearby colleges.
Dr. Chitra Rajagopal Distinguished Scientist and Director General, System Analysis and Modelling (SAM), DRDO, Delhi	Alagappa College of Technology Campus, Anna University, Chennai Nov 7-8, 2019	Delivered lectures on "Process Safety-Quantitative Risk Assessment", "Hazardous Waste Management" and "Green Technologies". According to feedback received from the engineering college, the lectures delivered by the Visiting Professor were beneficial for the students and faculty and the college would like more of such interactions. During her visit, she had also guided projects and initiated discussions on value added course inclusion.

Dr. Ananta Lal Das Ex Director, Society for Applied Microwave Electronics Engineering and Research (SAMEER)	National Institute of Technical Teachers Training and Research, Chandigarh Nov 6-8, 2019	Delivered lectures on "Frequency Independent Antennas'", "Design of Archimedean Spiral Antenna" and "Multi-Arm Multi-Mode Spiral Antennas and their Applications". As per the feedback received from the engineering college, the impact of the scheme is good, as the students were exposed to new areas of research through the interactions with the Visiting Professor.
Dr. SK Gupta, FNAE Former Project Coordinator (Saline Water), Central Soil Salinity Research Institute (CSSRI), Karnal	ICAR-National Dairy Research Institute, Karnal Oct 22-24, 2019	Delivered lectures on "Centrifugal Pumps and their Applications", "Dimensional Analysis and Similitude in Modelling" and "Instrumentation for Pressure Measurement". According to the feedback received from the engineering college, the lectures by the DVP were useful for students and the discussions held thereafter, with engineering Faculty Members were beneficial to facilitate useful orientation for developing instruments related to Agricultural and Dairy Engineering.
Dr. Raja Manuri Venkata Gopala Krishna Rao, FNAE, Formerly Scientist 'G', Founder Head-FRP Division CSIR-NAL, Bangalore.	East Point College of Engineering & Technology, Bangalore October 18, 2019 November 11, 2019 Nov 8 and Nov 22, 2019	Delivered lectures on "Inauguration and Induction to the AICTE-INAE DVP Scheme - Significance and Benefits" and "Conventional - Composite for Polymer Materials". According to the feedback received from the engineering college, the interactions with the DVP have brought out a comprehensive understanding of the uniqueness and benefits of the scheme and have provided an opportunity to understand concepts on advanced -age materials. Delivered lectures on "Structure - Property Relationship in Polymer Composite Materials" and "Processing and Manufacture of Polymer Composite Materials, (Fiber Reinforced Thermoset Matrix Composites)". According to the feedback received from the engineering college, the lectures by the DVP have been very thorough in technical content and highly beneficial for students. Delivered lectures on "Composite Testing and Characterism Design Allowables" and held a Tutorial for Faculty on the topic: Quality Test Laminate/Specimen Development.

Mr. S. Krishna Kumar, Former Senior Vice President (Retired), Lucas TVS Ltd, Chennai.	RMK Engineering College, Kavaraipettai, Tamil Nadu Oct 15-17, 2019	Held Discussion on "e - Mobility Programmes and Requirements of Indian Automotive Industry. Delivered Lectures and presented Case Study on "Product Life Cycle Management with Specific Focus on Industry Expectations and Career Opportunities". Gave a Presentation on Digital Transformation and suggested recommendations on changes in curriculum of selected courses.
Dr. J Krishnan, FNAE Former L&T Chair, MS University, Baroda	Dr. Mahalingam College of Engineering and Technology Oct 14-16, 2019	Delivered lectures on "Flux-Cored Arc Welding (FCAW) and Resistance Welding", "Solid State Welding Processes", "Weld Defects and Welding of Chromium - Molybdenum Steel and Duplex Stainless Steel" and "Innovation for Technological Progress". According to the feedback received from the engineering college, the lectures were very well organized and informative. The interactions have motivated PhD Research Scholars who are pursuing research in the subject area. The DVP also had discussion with HoD and Faculty of Mechanical Engineering Department regarding formulation of curriculum for courses.
Mr. Nawal Kishore Gupta, Former Deputy Director, LPSC/ ISRO	Madhav Institute of Technology & Science, Gwalior Oct 13-15, 2019	Delivered lectures on " Introduction to World Space Program Scenario - An Overview", "'Introduction to ISRO, Planetary Sciences and Astronomy" and "Calculations of Planet Orbits and Escape Velocity".

Important Meetings held during November 2019

- **INAE Apex Committee Meeting on November 8, 2019 at INAE Office, Gurgaon**
- **Meeting of the INAE Forum on Civil Infrastructure held at INAE Office, Gurgaon on November 6, 2019**
- **Meeting of the Technology Foresight and Management Forum held on 21st November 21, 2019 at INAE Office, Gurgaon**

International/National Conferences/Seminars being organized by IITs/other Institutions

To view a list of International/ National Conferences/Seminars being held in the month of January 2020, click here….

Honours and Awards

1.	Dr. J.C. Misra, Ph.D., D.Sc., FNASc., FNAE, FIMA (UK), FIThP, FRSM (London), FIET (UK); Adjunct Professor, Indian Institute of Engineering Science and Technology, Shibpur, Howrah; Formerly, Pro Vice-Chancellor, SOA University, Bhubaneswar; Former Professor and Head,

	Department of Mathematics, IIT Kharagpur; Ex- President, Mathematical Sciences Section, Indian Science Congress and Recipient of INAE Outstanding Teachers Award and Ram Mohan Puraskar has been elected a Fellow of the Institution of Engineering and Technology (IET),London - a highly prestigious world-famous multidisciplinary professional engineering institution.

News of Fellows

1.	Mr Ajay N Deshpande, FNAE and Ex CMD/D(T) of EIL was invited to speak in Leadership Panel titled "Excellence Strategies & Leadership Insights" at the India Operational Excellence Conference (IOPEX) organised by The Energy & Climate Initiatives Society at New Delhi on November 18, 2019. Mr Deshpande in his talk covered the operational excellence benchmarks to be improved upon in both the project implementation as well as post-operational stages of Oil & Gas projects. While process intensification, modularisation, smart 3D modelling, construction mechanisation and overall digitalisation of activities are the bench marks to be met in project implementation stage, capacity utilisation energy numbers, operational availability, volumetric expansion in production with GHG footprint are the bench marks in plant operations. The talk was met with an enthusiastic response in Q&A session by the audience.

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/pages/Indian-National-Academy-of-Engineering/714509531987607?ref=hl

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

International/National Conferences in January 2020

International Conference on Data Science and Intelligent Applications (ICDSIA-20) on 24th to 25th January 2020 at Gandhinagar, Gujarat
https://conferencealerts.com/show-event?id=221125

First International Conference on Advances in Distributed Computing and Machine Learning (ICADCML-2020) on 30th to 31st January 2020 at Vellore, Tamilnadu
https://conferencealerts.com/show-event?id=222369.

Civil Engineering

1. World's Deepest Subsea Tunnel Opens in Norway

Norwegian road infrastructure operator Statens Vegvegsen has officially opened world's deepest subsea tunnel, the 14.4km Ryfylke tunnel near Stavanger. The tunnel reaches a maximum depth of 292m below sea level. It is part of the Ryfast road project to link national highway 13 between Stavanger with Strand in Rogaland. Work on the project started in 2014 with contractor AF Gruppen achieving breakthrough on the first bore in autumn 2017 and joint venture contractors Marti and IAV breaking through on the second bore in early 2018. The previous holder of the deepest subsea tunnel was Eiksund Tunnel below the Vartdalsfjorden in Norway, which reaches 287m below sea level and was opened in 2008. The Ryfylke Tunnel is not set to be a long term holder of the deepest tunnel title as the Boknafjord Tunnel - also known as the Rogfast Tunnel, which is part of the Rogfast project that connects into the Ryfast scheme - is to become the longest and deepest subsea tunnel at 26.7km long and 392m deep when it opens in 2027.

Source https://www.newcivilengineer.com/latest/worlds-deepest-subsea-tunnel-opens-in-norway-06-01-2020/

2. New Device Enables Battery-Free Computer Input at The Tip of Your Finger

Computer scientists at the University of Waterloo have created a device for wearable computer input suitable for many situations, just by touching your fingertips together in different ways. The device, called Tip-Tap, is inexpensive and battery-free through the use of radio frequency identification (RFID) tags to sense when fingertips touch. The device could, therefore, be added to disposable surgical gloves, allowing surgeons to access preoperative planning diagrams in an operating room. "One of the many possible applications of the device is in surgeries. What typically happens now with operation digital preplanning is that an assistant is responsible for navigating the computer and communicating with the surgeon, but this is slow and difficult," said Daniel Vógel, a professor in Waterloo's David R. Cheriton School of Computer Science. "If the surgeon tries to navigate it themselves using a touchscreen or a mouse, it's problematic because it would require constant sterilization, and current alternatives such as big gestures tracked by computer vision can get very tiring. "The idea is if you mount Tip-Tap in surgical gloves, surgeons could navigate the computer themselves from where they are, and it won't affect their other actions like picking up the scalpel." Researchers created the prototype of Tip-Tap as part of a new partnership with the National Research Council of Canada (NRC). In developing the method, the researchers mapped the most comfortable areas on the index finger for people to touch with their thumb, and tested different designs for the input points, such as smooth, bumps, or magnets. Following user tests with an early "wired" prototype to benchmark performance, they tackled the problem of making it "battery-free." The researchers were able to make Tip-Tap battery-free by splitting the antenna of an RFID tag in two, and equipping each side with three chips to enable two-dimensions of fingertip input, the first time this had ever been done. The new RFID tag can be integrated into a glove or attached directly on the skin as a temporary tattoo. "We used this design in two prototype Tip-Tap devices, a glove with a range of four meters, and an on-skin tattoo," said Vogel. "Such devices are useful for issuing simple commands when a user cannot easily hold an input device, and the usage context is a defined area -- for example, factory workers, surgeons, or people exercising in a gym. "This is the only device of its kind that we're aware of that doesn't require a battery or cumbersome wires to make it work."

Source https://www.sciencedaily.com/releases/2019/12/191202102055.htm

3. Two-Legged Robot Mimics Human Balance While Running and Jumping

Rescuing victims from a burning building, a chemical spill, or any disaster that is inaccessible to human responders could one day be a mission for resilient, adaptable robots. Imagine, for instance, rescue-bots that can bound through rubble on all fours, then rise up on two legs to push aside a heavy obstacle or break through a locked door. Engineers are making strides on the design of four-legged robots and their ability to run, jump and even do backflips. But getting two-legged, humanoid robots to exert force or push against something without falling has been a significant stumbling block. Now engineers at MIT and the University of Illinois at Urbana-Champaign have developed a method to control balance in a two-legged, teleoperated robot -- an essential step toward enabling a humanoid to carry out high-impact tasks in challenging environments. The team's robot, physically resembling a machined torso and two legs, is controlled remotely by a human operator wearing a vest that transmits information about the human's motion and ground reaction forces to the robot. Through the vest, the human operator can both direct the robot's locomotion and feel the robot's motions. If the robot is starting to tip over, the human feels a corresponding pull on the vest and can adjust in a way to rebalance both herself and, synchronously, the robot. In experiments with the robot to test this new "balance feedback" approach, the researchers were able to remotely maintain the robot's balance as it jumped and walked in place in sync with its human operator. Previously, Kim and Ramos built the two-legged robot HERMES (for Highly Efficient Robotic Mechanisms and Electromechanical System) and developed methods for it to mimic the motions of an operator via teleoperation, an approach that the researchers say comes with certain humanistic advantages. Enter Little HERMES, a miniature version of HERMES that is about a third the size of an average human adult. The team engineered the robot as simply a torso and two legs and designed the system specifically to test lower-body tasks, such as locomotion and balance. As with its full-body counterpart, Little HERMES is designed for teleoperation, with an operator suited up in a vest to control the robot's actions. For the robot to copy the operator's balance rather than just their motions, the team had to first find a simple way to represent balance. Ramos eventually realized that balance could be stripped down to two main ingredients: a person's center of mass and their center of pressure -- basically, a point on the ground where a force equivalent to all supporting forces is exerted. The location of the center of mass in relation to the center of pressure, Ramos found, relates directly to how balanced a person is at any given time. He also found that the position of these two ingredients could be physically represented as an inverted pendulum. To define how center of mass relates to center of pressure, Ramos gathered human motion data, including measurements in the lab, where he swayed back and forth, walked in place, and jumped on a force plate that measured the forces he exerted on the ground, as the position of his feet and torso were recorded. He then condensed this data into measurements of the center of mass and the center of pressure, and developed a model to represent each in relation to the other, as an inverted pendulum. He then developed a second model, similar to the model for human balance but scaled to the dimensions of the smaller, lighter robot, and he developed a control algorithm to link and enable feedback between the two models. The researchers tested this balance feedback model, first on a simple inverted pendulum that they built in the lab, in the form of a beam about the same height as Little HERMES. They connected the beam to their teleoperation system, and it swayed back and forth along a track in response to an operator's movements. As the operator swayed to one side, the beam did likewise -- a movement that the operator could also feel through the vest. If the beam swayed too far, the operator, feeling the pull, could lean the other way to compensate, and keep the beam balanced. The researchers also developed an algorithm for the robot to automatically translate the simple model of balance to the forces that each of its feet would have to generate, to copy the operator's feet. Little HERMES also mimicked Ramos in other exercises, including running and jumping in place, and walking on uneven ground, all while maintaining its balance without the aid of tethers or supports.

Source https://www.sciencedaily.com/releases/2019/10/191030151155.htm

4. Development of Ultrathin Durable Membrane for Efficient Oil and Water Separation

Researchers led by Professor MATSUYAMA Hideto and Professor YOSHIOKA Tomohisa at Kobe University's Research Center for Membrane and Film Technology have succeeded in developing an ultrathin membrane with a fouling-resistant silica surface treatment for high performance separation of oil from water. Furthermore, this membrane was shown to be versatile; it was able to separate water from a wide variety of different oily substances. The development of technology to separate oil from water is crucial for dealing with oil spills and water pollution generated by various industries. By 2025, it is predicted that two thirds of the world's population won't have sufficient access to clean water. Therefore, the development of technologies to filter oily emulsions and thus increase the amount of available clean water is gaining increasing attention. Compared with traditional purification methods including centrifugation and chemical coagulation, membrane separation has been proposed as a low cost, energy efficient alternative. Although this technology has been greatly developed, most membranes suffer from fouling issues whereby droplets of oil get irreversibly absorbed onto the surface. This leads to membrane pore blocking, subsequently reducing its lifespan and efficiency. One method of mitigating the fouling issues is to add surface treatments to the membrane. However, many experiments with this method have encountered problems such as changes in the original surface structure and the deterioration of the treated surface layer by strong acid, alkaline and salt solutions. These issues limit the practical applications of such membranes in the harsh conditions during wastewater treatment. In this study, researchers succeeded in developing a membrane consisting of a porous polyketone (PK) support with a 10 nanometer thick silica layer applied on the top surface. This silica layer was formed onto the PK fibrils using electrostatic attraction- the negatively charged silica was attracted to the positively charged PK. The PK membrane has a high water permeance due to its large pores and high porosity. The silicification process- the addition of silica on the PK fibrils- provides a strong oil-repellant coating to protect the surface modified membrane from fouling issues. Another advantage of this membrane is that it requires no large pressure application to achieve high water penetration. The membrane exhibited water permeation by gravity- even when a water level as low as 10cm (with a pressure of approx. 0.01atm) was utilized. In addition, the developed membrane was able to reject 99.9% of oil droplets- including those with a size of 10 nanometers. By using this membrane with an area of $1m_2$, 6000 liters of wastewater can be treated in one hour under an applied pressure of 1atm. It was also shown to be effective at separating water from various different oily emulsions. As mentioned, the silification provided a strong oil repellant coating. Through the experiments carried out on the membrane to test its durability against fouling, it was discovered that oil did not become adsorbed onto the surface and that the oil droplets could be easily cleaned off. This membrane showed great tolerance against a variety of acidic, alkaline, solvent and salt solutions. The ultrathin membrane developed by this research group has demonstrated efficient separation of water from oily emulsions, in addition to anti-fouling resistance. Technology to separate emulsions is indispensable in the fight against water pollution and clean water shortages. It is hoped that this development could be utilized in the treatment of industry waste water.

Source https://www.sciencedaily.com/releases/2019/12/191226094332.htm

5. Researchers Build A Particle Accelerator That Fits on A Chip

On a hillside above Stanford University, the SLAC National Accelerator Laboratory operates a scientific instrument nearly 2 miles long. In this giant accelerator, a stream of electrons flows through a vacuum pipe, as bursts of microwave radiation nudge the particles ever-faster forward until their velocity approaches the speed of light, creating a powerful beam that scientists from around the world use to probe the atomic and molecular structures of inorganic and biological materials. Now, for the first time, scientists at Stanford and SLAC have created a silicon chip that can accelerate electrons -- albeit at a fraction of the velocity of that massive instrument -- using an infrared laser to deliver, in less than a hair's width, the sort of energy boost that takes microwaves many feet. A team led by electrical engineer Jelena Vuckovic carved a nanoscale channel out of silicon, sealed it in a vacuum and sent electrons through this cavity while pulses of infrared light -- to which silicon is as transparent as glass is to visible light -- were transmitted by the channel walls to speed the electrons along. The accelerator-on-a-chip is just a prototype, but Vuckovic said its design and fabrication techniques can be scaled up to deliver particle beams accelerated enough to perform cutting-edge experiments in chemistry, materials science and biological discovery that don't require the power of a massive accelerator. Accelerator-on-a-chip technology could also lead to new cancer radiation therapies, said physicist Robert Byer. Again, it's a matter of size. Today, medical X-ray machines fill a room and deliver a beam of radiation that's tough to focus on tumours, requiring patients to wear lead shields to minimize collateral damage. Researchers say it might be possible to deliver electron beam radiation directly to a tumour, leaving healthy tissue unaffected. The team built a chip that fires pulses of infrared light through silicon to hit electrons at just the right moment, and just the right angle, to move them forward just a bit faster than before. To accomplish this, they turned the design process upside down. In a traditional accelerator, like the one at SLAC, engineers generally draft a basic design, then run simulations to physically arrange the microwave bursts to deliver the greatest possible acceleration. But microwaves measure 4 inches from peak to trough, while infrared light has a wavelength one-tenth the width of a human hair. That difference explains why infrared light can accelerate electrons in such short distances compared to microwaves. But this also means that the chip's physical features must be 100,000 times smaller than the copper structures in a traditional accelerator. This demands a new approach to engineering based on silicon integrated photonics and lithography. Vuckovic's team solved the problem using inverse design algorithms that her lab has developed. These algorithms allowed the researchers to work backward, by specifying how much light energy they wanted the chip to deliver and tasking the software with suggesting how to build the right nanoscale structures required to bring the photons into proper contact with the flow of electrons. The design algorithm came up with a chip layout that seems almost otherworldly. Imagine nanoscale mesas, separated by a channel, etched out of silicon. Electrons flowing through the channel run a gantlet of silicon wires, poking through the canyon wall at strategic locations. Each time the laser pulses -- which it does 100,000 times a second -- a burst of photons hits a bunch of electrons, accelerating them forward. All of this occurs in less than a hair's width, on the surface of a vacuum-sealed silicon chip, made by team members at Stanford. The researchers want to accelerate electrons to 94 percent of the speed of light, or 1 million electron volts (1MeV), to create a particle flow powerful enough for research or medical purposes. This prototype chip provides only a single stage of acceleration, and the electron flow would have to pass through around 1,000 of these stages to achieve 1MeV. But that's not as daunting at it may seem, said Vuckovic, because this prototype accelerator-on-a-chip is a fully integrated circuit. That means all of the critical functions needed to create acceleration are built right into the chip and increasing its capabilities should be reasonably straightforward. The researchers plan to pack a thousand stages of acceleration into roughly an inch of chip space by the end of 2020 to reach their 1MeV target. Although that would be an important milestone, such a device would still pale in power alongside the capabilities of the SLAC research accelerator, which can generate energy levels 30,000 times greater than 1MeV. But Byer believes that, just as transistors eventually replaced vacuum tubes in electronics, light-based devices will one day challenge the capabilities of microwave-driven accelerators. The team has already begun work on a possible cancer-fighting application.

Source https://www.sciencedaily.com/releases/2020/01/200102143352.htm

6. Reorganizing A Computer Chip: Transistors Can Now Both Process and Store Information

A computer chip processes and stores information using two different devices. If engineers could combine these devices into one or put them next to each other, then there would be more space on a chip, making it faster and more powerful. Purdue University engineers have developed a way that the millions of tiny switches used to process information -- called transistors -- could also store that information as one device. The method accomplishes this by solving another problem: combining a transistor with higher-performing memory technology than is used in most computers, called ferroelectric RAM. Researchers have been trying for decades to integrate the two, but issues happen at the interface between a ferroelectric material and silicon, the semiconductor material that makes up transistors. Instead, ferroelectric RAM operates as a separate unit on-chip, limiting its potential to make computing much more efficient. A team led by Peide Ye, the Richard J. and Mary Jo Schwartz Professor of Electrical and Computer Engineering at Purdue, discovered how to overcome the mortal enemy relationship between silicon and a ferroelectric material. "We used a semiconductor that has ferroelectric properties. This way two materials become one material, and you don't have to worry about the interface issues," Ye said. The result is a so-called ferroelectric semiconductor field-effect transistor, built in the same way as transistors currently used on computer chips. The material, alpha indium selenide, not only has ferroelectric properties, but also addresses the issue of a conventional ferroelectric material usually acting as an insulator rather than a semiconductor due to a so-called wide "band gap," which means that electricity cannot pass through and no computing happens. Alpha indium selenide has a much smaller band gap, making it possible for the material to be a semiconductor without losing ferroelectric properties. Researchers built and tested the transistor, finding that its performance was comparable to existing ferroelectric field-effect transistors, and could exceed them with more optimization. The team also worked with researchers at the Georgia Institute of Technology to build alpha indium selenide into a space on a chip, called a ferroelectric tunneling junction, which engineers could use to enhance a chip's capabilities. In the past, researchers hadn't been able to build a high-performance ferroelectric tunneling junction because its wide band gap made the material too thick for electrical current to pass through. Since alpha indium selenide has a much smaller band gap, the material can be just 10 nanometers thick, allowing more current to flow through it. More current allows a device area to scale down to several nanometers, making chips more dense and energy efficient, a researcher said. A thinner material -- even down to an atomic layer thick -- also means that the electrodes on either side of a tunneling junction can be much smaller, which would be useful for building circuits that mimic networks in the human brain.

Source https://www.sciencedaily.com/releases/2019/12/191209161323.htm

7. ISRO Successfully Launches RISAT-2BR1 Surveillance Satellite, 9 Foreign Satellites Aboard PSLV-QL Rocket

India's Polar Satellite Launch Vehicle-QL (PSLV-QL) rocket carrying the country's advanced radar imaging earth observation satellite RISAT-2BR1 and nine foreign satellites lifted off from the first launch pad of the rocket port on December 11, 2019. At about 3:25pm the 44.4 metres tall rocket broke free of the first launch pad and started its upward one-way journey carrying the 628 kg RISAT-2BR1 is an advanced radar imaging earth observation satellite. To be placed in an orbit at an altitude of 576 kg, the RISAT-2BR1 over its five-year life span can look through the clouds and take sharp pictures. ISRO says the satellite will be used for agriculture, forestry, and disaster management activities. Piggybacking on the Indian satellite were nine foreign satellites from four countries- USA (multi-mission Lemur-4 satellites, technology demonstration Tyvak-0129, earth imaging 1HOPSAT), Israel (remote sensing Duchifat-3), Italy (search and rescue Tyvak-0092) and Japan (QPS-SAR - a radar imaging earth observation satellite) for an unknown fee contracted by NewSpace India Ltd, the new commercial arm of ISRO. Just over 16 minutes into its flight, the rocket would sling RISAT-2BR1 and a minute later the first of the nine customer satellites would be ejected. The launch mission was expected to conclude in about 21 minutes when the last of the customer satellites will be put into orbit. Till date, the ISRO has put into orbit 310 foreign satellites and with this mission then that number has gone up to 319. The PSLV-QL is a four stage/engine expendable rocket powered by solid and liquid fuels alternatively. The rocket has four strap-on booster motors to give additional thrust during the initial flight stages.

Source https://gadgets.ndtv.com/science/news/isro-india-launch-risat-2br1-surveillance-9-foreign-satellites-pslv-ql-2147121

8. Development of A Stretchable Vibration-Powered Device Using A Liquid Electret

NIMS and AIST developed a liquid electret material capable of semi-permanently retaining static electricity. They subsequently combined this material with soft electrodes to create the first bendable, stretchable vibration-powered device in the world. Because this device is highly deformable and capable of converting very subtle vibrations into electrical signals, it may be applicable to the development of healthcare-devices, such as self-powered heartbeat and pulse sensors. An electret material capable of semi-permanently retaining an electrical charge can generate voltage as its distance to the associated electrode changes. Because of this property, electret materials may be applicable to the development of vibration-powered (piezoelectric) devices and sensors capable of converting externally applied vibration and pressure into electrical signals. However, conventional electret materials are solid or in film form, and as such are inflexible and incapable of deformation into complex shapes, making them unsuitable for use in the development of wearable heartbeat and pulse sensors. A great deal of interest therefore exists in the development of bendable and stretchable vibration-powered devices that can be processed into a variety of shapes and used as such sensors. This research group shielded porphyrin -- an organic compound -- with a flexible yet insulating structure (i.e., branched alkyl chains), thereby developing a liquid material at room temperature which is able to stably retain static charge on the porphyrin unit. The group subsequently developed a bendable and stretchable vibration-powered device. First, a high voltage was applied to this liquid material, thereby electrically charging it. The liquid material was then allowed to soak into a stretchable textile and the soaked textile was then sandwiched between soft, polyurethane electrodes integrated with silver-plated fibers as a wiring material. When the surface of the device is pressed with a fingertip, it generates a voltage in a range of ±100-200 mV and operates stably for at least 1.5 months. In future research, the group hopes to achieve healthcare use of this device by enhancing the ability of the liquid electret material to retain static electricity and making modifications to the processing techniques applied to the device. The group will also pursue potential use of this vibration-powered device as a power source for IoT devices by combining it with a voltage-current conversion system and capacitor, etc.

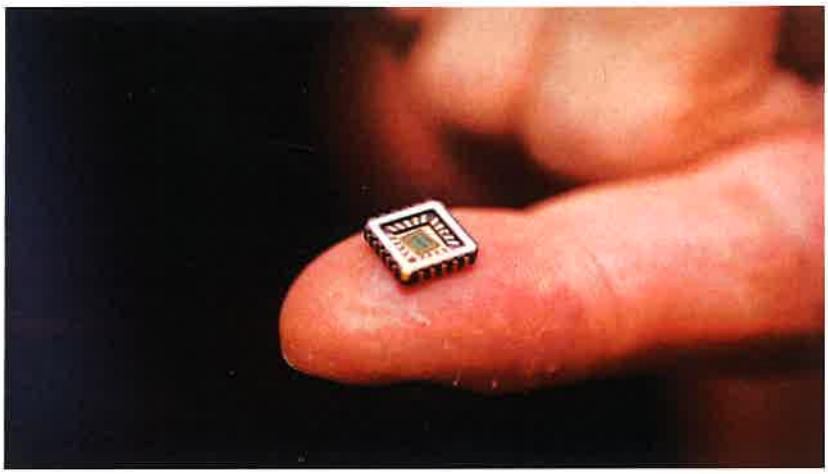
Source https://www.sciencedaily.com/releases/2019/12/191223095349.htm

9. Supercharging Tomorrow: World's Most Efficient Lithium-Sulfur Battery

Imagine having access to a battery, which has the potential to power your phone for five continuous days, or enable an electric vehicle to drive more than 1000km without needing to "refuel." Monash University researchers are on the brink of commercialising the world's most efficient lithium-sulphur (Li-S) battery, which could outperform current market leaders by more than four times, and power Australia and other global markets well into the future. Dr Mahdokht Shaibani from Monash University's Department of Mechanical and Aerospace Engineering led an international research team that developed an ultra-high capacity Li-S battery that has better performance and less environmental impact than current lithium-ion products. The researchers have an approved filed patent (PCT/AU 2019/051239) for their manufacturing process, and prototype cells have been successfully fabricated by German R&D partners Fraunhofer Institute for Material and Beam Technology. Professor Mainak Majumder said this development was a breakthrough for Australian industry and could transform the way phones, cars, computers and solar grids are manufactured in the future. "Successful fabrication and implementation of Li-S batteries in cars and grids will capture a more significant part of the estimated $213 billion value chain of Australian lithium, and will revolutionise the Australian vehicle market and provide all Australians with a cleaner and more reliable energy market," Professor Majumder said. "Our research team has received more than $2.5 million in funding from government and international industry partners to trial this battery technology in cars and grids from this year, which we're most excited about." Using the same materials in standard lithium-ion batteries, researchers reconfigured the design of sulphur cathodes so they could accommodate higher stress loads without a drop in overall capacity or performance. Inspired by unique bridging architecture first recorded in processing detergent powders in the 1970s, the team engineered a method that created bonds between particles to accommodate stress and deliver a level of stability not seen in any battery to date. Attractive performance, along with lower manufacturing costs, abundant supply of material, ease of processing and reduced environmental footprint make this new battery design attractive for future real-world applications, according to Associate Professor Matthew Hill. "This approach not only favours high performance metrics and long cycle life, but is also simple and extremely low-cost to manufacture, using water-based processes, and can lead to significant reductions in environmentally hazardous waste," Associate Professor Hill said.

Source https://www.sciencedaily.com/releases/2020/01/200103141043.htm

10. A Silicon Chip That Mimics The Brain's Neurons Could Help Fight Paralysis



Artificial neurons that mimic the way our body's nerve cells transfer electrical signals could one day help patients with nerve damage.

Messengers: The neurons are built into small silicon chips (pictured above) and could be used to pass signals between nerve cells that may be damaged by disease or injury. Crucially, the chips only need one billionth the power of a standard microprocessor, meaning they could theoretically be used in medical implants to help treat chronic diseases like heart failure or Alzheimer's.

How they were developed: The researchers used a simulation to model how two types of neurons in rats fire in response to stimuli: respiratory ones that are responsible for breathing and ones in the hippocampus. The models were translated to silicon chips in which replicas of biological ion channels (which transmit signals in the body) were created. The process was described in a paper in Nature Communications.

Stand-in: In theory, circuits of artificial neurons could replicate the healthy function of failing nerve cells and pass on electrical messages between different parts of the body. For example, when someone's heart fails, neurons in the brain don't respond properly to nervous system feedback, so the heart doesn't pump as hard as it should. A chip containing artificial neurons could transmit the right signal to get it back on track.

In fact, some of the researchers are now developing smart pacemakers with these chips embedded. Tests in rats showed that this approach was more effective than just a standard pacemaker—although it's still a long time before any such device is ready to be implanted in human patients.

Source https://www.technologyreview.com/f/614819/a-silicon-chip-that-mimics-the-brains-neurons-could-help-fight-paralysis/

Engineering Innovation in India

Kaleshwaram Lift Irrigation Project: Facts on World's Largest Multi-Purpose Lift Irrigation Project

World's largest multi-stage, multi-purpose lift irrigation project Kaleshwaram was inaugurated in June 2019. The project constructed by Megha Engineering and Infrastructure Limited (MEIL) started from July 2019. The inaugural ceremony was held at the project site in Jayashankar Bhupalpally district near the borders with Maharashtra and Chhattisgarh. Till date, the biggest lift schemes in the world were the Colorado lift scheme in America and the Great Manmade River in Egypt. The capacities of these schemes are in horsepower and they took over three decades for completion. Now, the Kaleshwaram lift irrigation project, an Indian lift scheme has become the **world's biggest in terms of capacities.**

Facts about Kaleshwaram Lift Irrigation Project (KLIP)

1. Built across Godavari river, KLIP will lift the water to a height of half-a-kilometer.
2. It is designed to irrigate 45 lakh acres for two crops in a year, meet the drinking water requirement of 70 percent of the state and also to cater to the needs of the industry.
3. The foundation stone for the Rs 80,500 crore project was laid in 2016 and claimed to be the world's biggest project of its kind, completed in the shortest time.
4. The government is planning to lift two thousand million cubic (TMC) feet of Godavari water per day from Medigadda barrage.
5. Claimed to be an engineering marvel, the project comprises 1,832 km water supply route, 1,531 km gravity canal, 203 km tunnel routes, 20 lifts, 19 pump houses and 19 reservoirs with a storage capacity of 141 TMCs.
6. It requires nearly 4,992 MW of electricity to pump 2 TMC of water every day in the first phase. The requirement will go up to 7,152 MW for lifting 3 TMC from next year.

Source https://www.indiatoday.in/education-today/gk-current-affairs/story/kaleshwaram-lift-irrigation-project-facts-worlds-largest-multipurpose-lift-irrigation-project-1553474-2019-06-21