INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

Vol. XII, Issue 6, June 1, 2021

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.

Click here to Read More

.

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

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.

Back to Main Page

ACADEMY NEWS

Academy News

INAE Announcements

- **Nominations invited for Abdul Kalam Technology Innovation National Fellowship.** The last date for the receipt of nominations for the call of 2021-22 is **June 30, 2021.** For details click on the link given below.

  https://www.inae.in/research-innovation/abdul-kalam-technology-innovation-national-fellowship-2019-20

- **Nominations invited for Innovative Student Projects Award 2021.** Last date of receipt of nominations is **July 31, 2021.** For details click on the link given below.

  https://www.inae.in/innovative-student-projects-award

- **Nominations invites for INAE Young Innovator and Entrepreneur Award 2021.** Last date of receipt of nominations is **June 30, 2021.** For details click on the link given below.

  https://www.inae.in/inae-innovator-entrepreneur-award

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/indian-national-academy-of-engineering-e

https://www.indiascience.in/videos/indian-national-academy-of-engineering-h

---

Forthcoming Events

- **Joint Workshop with National Academy of Engineering of Korea (NAEK) on "What's next in Aerospace Engineering and Materials"**

INAE being Member Academy of CAETS conducts various collaborative activities with other Member Academies of CAETS. In this direction, series of collaborative activities had been organized jointly with National Academy of Engineering of Korea (NAEK) since 2017. The first Workshop between INAE and NAEK was held on 'High Temperature Materials' on March 16-17, 2017 at IISc Bangalore. The second Workshop on 'High Temperature Materials' was held on May 14-15, 2018 at Changwon, Korea. The third INAE-NAEK Workshop on "High Temperature Materials and System Engineering for Aerospace, Power Generation and Defence Industry" was held on 15-17th July 2019 at Hyderabad. It is now planned to hold the fourth Workshop virtually with NAEK on June 14-15, 2021 on the topics pertaining to "Aerospace Engineering" and "Additive Manufacturing". A total of six speakers and a Session Chair have been identified/confirmed. A two-day event is planned with three technical sessions.

- **National Frontiers of Engineering (NatFOE 2021)**

The National Frontiers of Engineering (NatFOE) Symposium is a flagship event of INAE being held since 2006. The 15th NatFOE 2021 is being organized online from July 9-10, 2021 at Indian Institute of Technology, Hyderabad online. Prof BS Murty, Director, IIT Hyderabad and Prof Sivaji Chakravarti, Vice-President, INAE are the coordinators of the event. Prof Chandrasekhar Sharma, IIT Hyderabad is the Convener of the event. The four themes of the Symposium are (i) ***Artificial Intelligence and Machine Learning; (ii) Advances in Materials and Manufacturing Technology; (iii) Infrastructure & Unconventional Energy; and (iv) Rural Technology & Entrepreneurship.*** Two Coordinators have been identified for each of the Themes. The first announcement can be viewed at https://www.iith.ac.in/natfoe2021/

An "Innovation in Manufacturing Practices (IMP)" event is also being organized online on sidelines of NatFOE 2021. IMP is a manufacturing design competition to provide the bright minds a platform to display and exuberate their talent in design and manufacturing. In this event, the participants (students) are expected to design, fabricate and demonstrate a hardware prototype using an innovative manufacturing process not limited to any engineering discipline. A pamphlet on the IMP 2021 can be viewed by clicking here

---

- **INAE Youth Conclave 2021**

INAE Youth Conclave 2021 has been planned to be organized online by National Institute of Industrial Engineering (NITIE); IIT Bombay and ICT Mumbai on Engineers' Day September 15, 2021. The tentative date is decided to be on Engineer's Day i.e. September 15, 2021. The presentations would be based on five topics of national importance **namely:** Waste to wealth; Digitization and revolution in logistics & Engineering intervention to fight against COVID-19 and healthcare management; Innovative technologies and product developed during COVID; Teaching and learning in pandemic and Azadi Ka Amrit Mahotsav. Preparations are ongoing for planning of the event.

- **Engineers Conclave 2021**

Engineers Conclave 2020 was planned to be held with TERI with Dr Ajay Mathur, DG, TERI as Coordinator from host organization. However, due to impact of Pandemic the event was cancelled. This year, Dr Ajay Mathur has taken over as Director General, International Solar Alliance (ISA) and has expressed his willingness to conduct Engineers Conclave 2021. Thus, the Engineers Conclave 2021 is being planned to be held online in October 2021 jointly with International Solar Alliance (ISA). A Meeting was held on May 26, 2021 to discuss the progress of planning of the event. Dr Ajay Mathur and Prof Indranil Manna, President, INAE are the Co-Chairs of the event. The two themes are being decided and one tentative theme is Engineering challenges for Decarbonizing Indian economy.

Local Chapter Activities

INAE Bhubaneswar Local Chapter

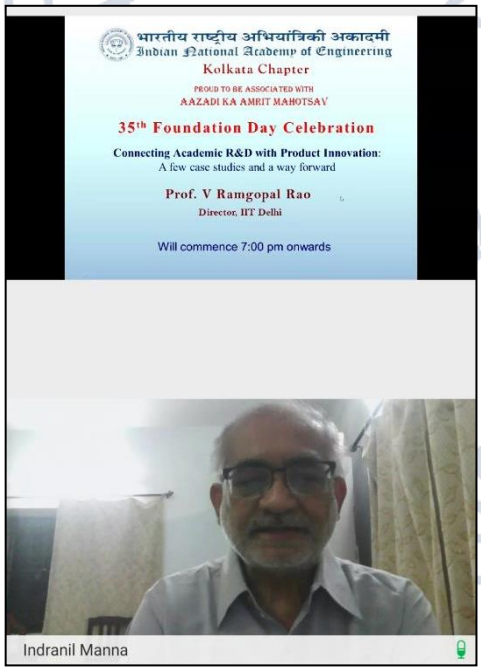
INAE Bhubaneswar Chapter organized a Webinar on Data Analytics, Machine Learning and Deep Learning jointly with Computer Science and Engineering Department of Siksha 'O' Anusandhan (Deemed to be University) on April 27, 2021. Professor Ganapati Panda, a member of Bhubaneswar Chapter gave an overview of the subject in simple and lucid manner for the benefits of the students and faculty. A large number of students and faculty from SOA and other institutes in India and from a few Institutes from abroad attended this seminar. In Addition to Professor Panda, three other Fellows of the

Academy, Professor P.K. Mishra, Dr. Debashis Deb and Prof. Damodar Acharya attended this webinar conducted in virtual mode. INAE Bhubaneswar Chapter thanked CSE Department of SOA University and particularly its HOD, Prof. Debahuti Mishra for help in organizing the Webinar. The Chapter promised to have more such seminars/Webinar to be given by INAE Fellows in future.

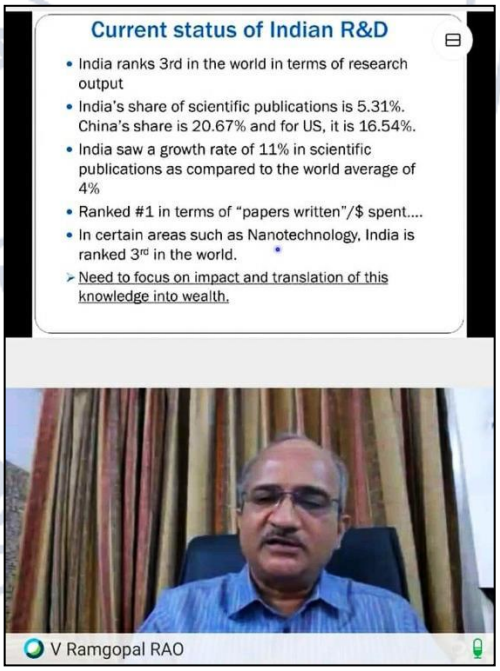
INAE Kolkata Chapter

Celebrating INAE Foundation Day 2021 by INAE Kolkata Chapter

Indian National Academy of Engineering (INAE) Kolkata Chapter celebrated INAE Foundation Day on April 22, 2021 in a virtual mode due to Covid-19 pandemic situation. It was a part of celebrating AAZADI KA AMRIT MAHOTSAV. On this occasion, Prof. V. Ramgopal Rao, Director, IIT Delhi delivered a *Special Lecture* on "*Connecting Academic R&D with Product Innovation: A few case studies and a way forward*". Prof. Indranil Manna, President, INAE graced the occasion and welcomed the audience. The evening talk on the WebEX platform was attended by about 180 participants who included distinguished fellows of the academy along with young researchers and students from the various academic and engineering institutes of the country. In his mesmerizing talk, Prof. Rao addressed the present issues and methods of translating the academic research outputs to commercially available products, paving the path for *atma nirbhar bharat*. It was highly motivating and was appreciated by all. The interesting lecture was followed by an interactive Q/A session. *Padma Shri* Prof. Sankar Kumar Pal, former Director, Indian Statistical Institute, and founding President of INAE Kolkata Chapter had shared the story of inception of INAE Kolkata Chapter as a new entity in 2007 and also encouraged the young engineers to elevate their career with INAE. Prof. Bhargab Bhattacharyya, President, INAE Kolkata Chapter and Prof. Sivaji Chakravorti, Vice-President, INAE were also present the meeting. Prof. Debatosh Guha, Secretary, INAE Kolkata Chapter conducted the proceedings of the meeting.



Prof. Indranil Manna welcoming the audience



Prof. V Ramgopal Rao delivering his lecture

Kolkata Chapter members interacting with the speaker

A slide from Prof. Rao's presentation: Central Education Minister inaugurating a new product

INAE Delhi Local Chapter

A webinar and Panel Discussion were organized by IEEE ComSoc Bangalore & Delhi Chapters in association with ACM India Council and INAE Delhi Chapter on April 7, 2021 featuring a talk by Dr. Swarun Kumar Assistant Professor, Carnegie Mellon University on the topic "Towards City-Scale Low-Power Wireless Internet".

The **abstract** of the talk is given below:

The number of gadgets in India has crossed then the number people. The challenge is designing the wireless network for city scale IoT, large number of devices cannot be charged every day, must talk to the base station even the UE is 10 miles away. Wi-Fi/Bluetooth does not give such high range. However, Lora can provide wide coverage range. Lora uses chirp spread spectrum technology where the frequency increases linearly with time. The paper titled "Charm: exploiting geographical diversity through coherent combining in low-power wide-area networks", presented in IPSN'2018 proposed coherent combining of the signals at the cloud received from multiple gateways. This method is useful to recover the original signals at the cloud even when the signal is transmitted at a very low power and increases the battery lifetime. Because of the wireless modulation scheme of lora arbitrary data also has some pattern which can be recovered at cloud. Since the data is broken into multiple packets to transmit through multiple gateways, it results a huge bandwidth saving. The method is implemented in FPGA, Raspberry pi, SDR. To make the devices completely battery less, RFID tags are used which are powered by energy harvesters. However, the range is limited to 5-10m. To increase the range between RFID reader and RDID tags, a model named "PushID" is used where existing RFID readers collaborate with each other. It provides 8 times increment in range.

A Panel discussion on "Communication research and mindset" was also held and the Panellists were Dr. Swarun Kumar, Carnegie Mellon University; Dr. Sreeja Sukumaran, Christ University; Dr. Pinaki Bhaskar, Samsung and Dr. Abhinav Kumar, IIT-Hyderabad.

Brief Bio of the Speaker:

Dr Swarun Kumar is an assistant professor at Carnegie Mellon University (CMU) where he heads the laboratory for emerging wireless technologies (WiTech lab). He designs and builds novel systems to enable faster wireless networks and new services. Dr. Kumar is a recipient of the NSF CAREER award and Google Faculty Research Award. Dr. Kumar received the George Sprowls Award for best Ph.D thesis in Computer Science at MIT and the President of India gold medal at IIT Madras.

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

The Government of India has launched a 75-week celebration of India's 75th Year of Independence (*Aazadi ka Amrut Mahotsava*) with a grand celebration on 15th August 2022. In this connection, it has been decided that DST will publish a compendium of most significant scientific and technological achievement of India since independence. For this purpose, the Sectoral Group of Secretaries (SGoS) has been constituted. The Secretary DBT, Chairperson of the Sectoral Group of Secretaries (SGoS) has requested all Science and Engineering Academies of the country including INAE to join hands and produce an encyclopaedia containing all those feats in Science & Technology that make us proud and will inspire future generations since independence. In this regard, the Presidents of INSA, IASc, NASI and INAE had met on April 3, 2021 and committed to help create a volume and a website that would provide a comprehensive view of India's growth and contributions in S&T since independence. Further, it was decided to solicit suggestions (initially only name or item) to propose a list of 75 or 100 landmark innovations (individual or collective) in S&T in India achieved primarily after our independence that eminently merit a mention in the proposed volume so as to select deserving items. Suggestions were invited from Fellows/Conveners.

Subsequently, a meeting was held to consider suggestions received earlier and also to discuss and formalize the methodology to propose a list of 75 or 100 landmark innovations (individual or collective) in S&T in India achieved primarily after our independence that eminently merit a mention in the proposed volume so as to select deserving items. During the said meeting, it has been decided that each Convener of the Sectional Committee may request Fellows affiliated to his/her respective Engineering Section to seek 10 to 20 topics of such landmark technical achievements since independence. The inputs received are since being collated.

Peer Committee for "Technological Preparedness for dealing with National Disruptions"

Last year, INAE had prepared a White Paper on "Technological Preparedness for dealing with National Disruptions". Dr. B.N. Suresh, Past - President, INAE had prepared the base paper in this regard, with inputs from Dr. P.S. Goel, another former President, INAE, Dr. Bhujanga Rao, FNAE and other domain experts from INAE Fellowship. The White Paper on "Technological Preparedness for dealing with National Disruptions" integrating all the inputs was compiled by Dr BN Suresh and forwarded to Shri Amitabh Kant, CEO, NITI Aayog; Dr VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, PSA to Govt. of India and Prof Ashutosh Sharma, Secretary, DST, Govt. of India with a request for an opportunity of consulting with them over a WebEx meeting to take this initiative forward. In response to this initiative, NITI Aayog convened a meeting, through 'Video Conferencing' on 10th August 2020 chaired by Dr. VK Saraswat, Member, NITI Aayog to discuss the future course of action to implement the recommendations of the White Paper on '**Technological Preparedness for dealing with National Disruptions**', with a view to take the initiative forward. It was suggested that a Peer Committee be constituted with member experts from INAE and NITI Aayog who would further identify Sub-committees to take up specific task envisaged to take this initiative to its logical conclusion.

Accordingly, a high-level Peer Committee was constituted under the chairmanship of Dr PS Goel, Former President, INAE with the purpose to bring out a roadmap to recommend a mechanism to maintain an up-to-date dashboard in the public domain and easy-to-access data base on history, experts, facilities, and archives related to all kinds of disasters. The Committee now also has representation from NDMA besides other agencies viz DST, CSIR, ICMR, DRDO, DAE, ISRO, ICG and DBT. Several meetings of the Peer Committee have been held so far in order to review the progress achieved on the initiative. Six expert Committees have been constituted so as to specifically focus on the respective domains. A meeting of the Peer Committee was held on May 14th, 2021 wherein five out of six Chairmen of following Expert Committees made presentation on the progress:

- Atmosphere and Climate related disasters chaired by Dr Mrutyunjay Mohapatra
- Geology related disasters chaired by Dr VM Tiwari
- Health related disasters chaired by Dr Chander Shekhar
- Ocean related disasters chaired by Dr M Ravichandran
- Fire related disasters chaired by Mr Rajiv Narang

Inputs from the sixth expert committee, "Cyber Security related disasters", chaired by Dr Gulshan Rai would be obtained later.

It has been decided during the meeting that first draft of the report should be completed by last week of June 2021. This initiative is important as it enhances the visibility of INAE as an advisory body.

Meetings of the Gender Parity Advisory Committee

INAE has been discussing the Gender Parity issue for the past several years but with no tangible solution. For this purpose, a Gender Parity Advisory Committee has been constituted under the Chairmanship of Dr. BN Suresh, Past-President, INAE to deliberate and suggest proactive measures to achieve acceptable level of gender parity in INAE. The composition of the Committee of INAE Fellows is as follows: Dr. BN Suresh, Former President, INAE is the Chairman of the Committee with Dr. Saswasti B Roy, Prof Sushmita Mitra, Dr. VR Lalithambika, Prof. Ligy Philip, Ms Alpa Seth, Prof K Chattopadhyay, and Prof Prem Krishna as Members. Dr BN Suresh had prepared a Base Paper on the issue of Gender Parity in INAE which is summarized as follows. Gender parity subject is being discussed in many forums in India for a long time including the reservation for women in Indian Parliament. INAE has been discussing this issue for the past several years but with no tangible solution. As on date, INAE has only 28 women Fellows out of 871 Fellows in India, which is a meagre 3% of the entire Fellowship. Similarly, the representation of women in Young Associates is also poor. Although we have been pursuing very proactive policy to induct women into Fellowship for the last few years, the results are not all encouraging. It is therefore felt essential that we deliberate in detail and generate suitable recommendations to improve the situation in all these forums of INAE. There is a need for innovative and out-of-box thinking to drive gender parity. No doubt the implementation aspects also possibly demand certain structural changes to improve the nomination and selection processes and create an enabling environment. The recommendations so made should also be actionable and implementable.

The Base Paper on the subject prepared by Dr. BN Suresh was deliberated in the first meeting of said Committee held on 6th May 2021 wherein a number of valuable suggestions/comments emerged. These have been culminated in the form of Draft Recommendations on Gender Parity of INAE. The Draft Recommendation were circulated to the members to seek inputs before further deliberations in the next meeting of the said Committee held on May 22, 2021, so as to consolidate into actionable and implementable recommendations on Gender Parity in INAE. Productive meetings were held, and clear-cut recommendations were crystallized. The final Recommendations shall be put up for further discussion and approval by Governing Council during its forthcoming meeting in June 2021 for implementation from this year itself.

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 a recent visit of industry expert under this scheme are given below:

Dr. Jaiteerth R Joshi Scientist 'G' Defence Research and Development Laboratory	BV Raju Institute of Technology, Narsapur, Telangana Jan 11-13, 2021	Delivered FDP on "NDT- Both Theory and Practices" As per the feedback received from the Institute, the Scheme has benefitted both the students and faculty members of the institute.
Dr. SL Mannan, FNAE Former Outstanding Scientist and Director Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam	Vel Tech Rangarajan Dr. Sagunthala R&D Institute Of Science And Technology, Chennai March 20 – 22, 2021	Delivered lectures on "Fatigue (Stress Controlled Fatigue, LCF and HCF, Mean Stress, Stress Fluctuations)", "Fatigue (Surface Treatment, Effect of Notches, Strain Controlled Fatigue)", "Creep Deformations and Fractures". According to the feedback received from the Institute, students interacted with Distinguished Visiting Professor on topics related to Fatigue and Creep. The interactions were very useful to students to understand the concepts about low and high cycle fatigue, mechanism of creep and creep resisting materials. Students were benefited by the talk given by the Distinguished Visiting Professor and they would like to have many more interactions in near future.
	Government College of Engineering, Salem April 8-10, 2021	Delivered lectures on "Strengthening Mechanism in Metals (Solid solution strengthening and precipitation strengthening), "Fatigue (Stress Controlled Fatigue, LCF and HCF, Mean Stress, Stress

		Fluctuations)", "Fatigue (Surface Treatment, Effect of Notches, Strain Controlled Fatigue)" According to the feedback received from the Institute, there were deep interactions between students, faculty members and Distinguished Visiting Professor. Both faculty and students are benefitted and would like to have such interactions in future.
Dr. SK Gupta, FNAE Former Project Coordinator (Saline Water), CSSRI	Karnal Institute of Technology and Management, Karnal April 12-14, 2021	Delivered lectures on "Water Quality - Physical and Chemical Testing", "National and International Standards on Water Quality", "Rooftop Rainwater Harvesting for Domestic and Artificial Groundwater recharge". As per the feedback received from the Institute, the online interactions with the expert provide the students to have a good opportunity to get a glimpse in the current developments in the area of civil engineering. The institute is hopeful that more useful interactions will emerge as soon as the classroom teaching is resumed.

Constitution of ISRO-INAE Consultative Committee

INAE currently has several Consultative Committees with DST, DRDO, CSIR and Office of PSA which meet periodically to facilitate interaction and identification of topics on thrust areas of engineering for conduct of technical activities and programmes. In this direction, the ISRO-INAE Consultative Committee has been recently constituted on April 27, 2021 to discuss issues of national importance.

Important Meetings held during May 2021

- **Meeting of INAE Forum on Energy held on May 27, 2021 over WebEx Chaired by Dr Ajay Mathur, FNAE.**
- **INAE Apex Committee Meeting held on May 25, 2021 over WebEx, Chaired by Prof Indranil Manna, President, INAE.**

- **First Meeting of ten Sectional Committees to shortlist nominations for Fellowship/ Foreign Fellowship for Peer Review and nominees for presentation for INAE Young Engineer Award 2021 were held during May 11, 2021 to May 21, 2021 over WebEx as per schedule given below:**

Meetings of Sectional Committee	Date
Sectional Committee-I (Civil Engineering)	12th May 2021
Sectional Committee-II (Computer Engineering and Information Technology)	14th May 2021
Sectional Committee-III (Mechanical Engineering)	11th May 2021
Sectional Committee-IV (Chemical Engineering)	21st May 2021
Sectional Committee-V (Electrical Engineering)	14th May 2021
Sectional Committee-VI (Electronics & Communication Engineering)	19th May 2021
Sectional Committee – VII (Aerospace Engineering)	13th May 2021
Sectional Committee-VIII (Metallurgical, Mining and Materials Engg)	17th May 2022
Sectional Committee-IX (Energy Engineering)	18th May 2021
Sectional Committee X (Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry)	21st May 2021

- **1st and 2nd Meetings of the Gender Parity Advisory Committee held on May 6, 2021 and May 22, 2021 over WebEx Chaired by Dr BN Suresh, Former President, INAE.**

- **Meeting of The Peer Committee and Chairmen of Six Expert Committees for "Technological Preparedness for Dealing with National Disruptions" held on May 14, 2021 over WebEx Chaired by Dr PS Goel, Former President, INAE.**

International/National Conferences/Seminars Being Organized by IITs/Other Institutions

3rd Springer International Conference on Data Engineering and Applications (IDEA2k21) Online Conference on 11th to 12th June 2021at Bhopal, Madhya Pradesh
https://conferencealerts.com/show-event?id=233694

International Conference on Communication, Information and Computing Technology (ICCICT-2021) on 25th to 27th June 2021 at Mumbai, Maharashtra
https://conferencealerts.com/show-event?id=231241

International Conference on Computational Intelligence in Engineering Systems (ICCIES-2021) online Conference on 25th to 26th June 2021 at Pandharpur, Maharashtra
https://conferencealerts.com/show-event?id=235528

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

Back to Main Page

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

Back to Main Page

OBITUARY

Prof Jyotirmay Majumder
(July 9, 1951 -April 10, 2021)

Prof Jyotirmay Majumder, a Foreign Fellow of INAE breathed his last on Saturday (April 10th, 2021) afternoon. After graduating from the then B. E. College under Calcutta University, he went to Imperial College, London for higher study. He got his diploma (MS) and Ph.D. in Process Metallurgy in 1978. After his graduation from Imperial College, he returned to India and joined BARC as Pool Officer. However, he did not stay long at BARC and decided to pursue his interest in academics and joined University of Illinois at Urbana-Champaign as a faculty.

Professor Jyoti Mazumder had a very distinguished career. He was the Robert H. Lurie Professor of Engineering and Director of Center for Laser Aided Intelligent Manufacturing at the University of Michigan. He was a creative inventor, scholar and educator, prolific author, and scientist. He had a special zeal in teaching and research. He leaves behind a long history of excellence. He was an elected member of the USA National Academy of Engineering and foreign fellow of the Indian National Academy of Engineering. His career spanning 41 years (16 years at University of Illinois, Urbana-Champaign and 25 years at University Michigan, Ann Arbor) was extraordinary. He has been a world-renowned scientist, and published 400 research papers in reputed international journals, co-authored books on Laser Chemical Vapor Deposition and Laser Materials Processing and edited/co-edited 10 books. He was credited with 25 patents. He was acknowledged expert in the field of Additive Manufacturing. His directed basic research work led to the commercialization of Direct Metal Deposition (DMD) technology and recently developed *in-situ* sensors for 3-D printing and welding that have the capability to detect defects, composition, and phase transformations.

Other than being recognized by his Alma Mater and Academies of Engineering from USA and India for his academic excellence, he received several awards and honours for his outstanding research work that include, Schawlow Award for seminal contribution to Laser application research from Laser Institute of America in 2003, William T Ennor Award for manufacturing from ASME in 2006, Adams Memorial Membership award from American Welding Society in 2007, Thomas A Edison Patent Award from ASME in 2010 for inventing First closed loop Direct Metal Deposition system, which significantly enhances some aspect of Mechanical Engineering, Distinguished University Innovator Award in 2012 from the University of Michigan. He was awarded as Manufacturing Engineer of the Year (1986) from Society of Manufacturing Engineers, University Scholar (1985) and Xerox (1987) from University of Illinois. He is also Fellow of American Society of Mechanical Engineers (ASME), American Society of Metals (ASM), Fellow of International Academy of Photonics and Laser Engineering (IAPLE) and Laser Institute of America (LIA) where he was President (2000).

May God Bless his Soul to Rest in Peace

Dr KN Raju
(April 27, 1936 -April 30, 2021)

Dr K N Raju, FNAE, was one of the key personalities who shaped Aerospace Research and development in India. He was an internationally known expert in the areas of Fatigue, Fracture and Structural Integrity of Aerospace Structures.

Dr. K.N. Raju did his B. E. in Mechanical Engineering from Govt. college of Engineering (now known as UVCE), Bangalore, M.E (Aeronautics) and Ph.D. (Engineering) from the Indian Institute of Science (IISc). He served the National Aerospace Laboratories (NAL) for 35 years and retired as Director in 1996. After retirement he served as a consultant to Civil Aircraft Design (CCAD) at NAL for more than a decade. Dr. Raju nurtured the field of Fatigue and Fracture Mechanics and was the principal architect in building Full Scale Aircraft Fatigue Test facility which has become a National Facility in India. He had taken up the challenge and successfully carried out the Light Combat Aircraft carbon composite wings from the conceptual stage, design activity and supervised fabrication of the first two prototypes in Italy. As a passionate teacher he participated in several continuing education programs in Fatigue and Fracture at NAL, IISc and several Industrial establishments. He served at the fatigue and Fracture branch of the NASA Langley Research Centre (LARC), the laboratory which pioneered research in the field of Structural Integrity. He was a Fellow of the Indian National Academy of Engineering, the Aeronautical Society of India and received the Distinguished Alumnus award and Platinum Jubilee Award from the Department of Aerospace Engineering, IISc.

Dr Raju Passed away on the morning of April 30, 2021 after prolonged illness. In his passing away, the nation has lost a towering personality whose contributions to Aerospace programs of the country were substantial. INAE would like to send its deepest condolences to his family on his passing away.

May God Bless his Soul to Rest in Peace

Written by Prof S Gopalakrishnan, FNAE

Dr Sanjay Bajpai
(February 19, 1965 – May 12, 2021)

Dr Sanjay Bajpai, FNAE, Scientist-G, Department of Science and Technology (DST), Government of India, who successfully implemented creative national and international R&D programmes, passed away on 12.5.2021. He, born on 19.2.1965, pursued BTech in Mechanical Engineering from Malaviya National Institute of Technology, Jaipur, followed by MBA from University of Rajasthan, Jaipur. He was awarded PhD for the work on 'Alternative Fuels for Internal Combustion Engines' from IIT-Delhi.

After a brief stint in industry, Dr Sanjay joined as Scientist-B in DST in 1991. His outstanding accomplishments ensured elevation to various levels, becoming Head of Technology Division-Water & Energy. During the three decades of dedicated service in DST, he conceptualised and steered various schemes, particularly, State S&T mechanisms through application of appropriate technology development and commercialization endeavours. He was responsible for the field specific initiatives in the areas of water, biofuels and clean energy, whose outcome showed a greater impact on people. His acumen in relating technology for societal relevance, was the reason for assigning Winning, Augmentation and Renovation for Water (WAR for Water) programme, spearheaded by Dr T Ramasami, the then Secretary of DST, on the directions of Hon'ble Supreme Court of India, to come out with technological solutions for addressing various water challenges. His proactive approach and inclusiveness enabled in finding sustainable solutions, through establishment of appropriate drinking water facilities/units in 300 much needed villages, benefiting over 1.60 million people, across the country, which have been replicated by various states, NGOs and a few corporates. This unique approach lead to international collaborations, viz, Dutch India Water Alliance for Leadership Initiative (DIWALI), through a consortium of knowledge institutions and enterprises from The Netherlands and India, between India and European Union, and a new Indigo initiative between DST and R&D institutions of Belgium, Finland, France, The Netherlands, Germany and Spain, in designing solutions to meet the utility price envelope of countries similar to Indian situation.

Dr Sanjay shaped a strong eco-system for R&D and technology demonstration in launching Clean Energy Research Initiative, with initial focus on Solar Energy. Seeing its success, it was expanded to cover programmes related to Methanol, Desalination, Clean Coal, Building Energy Research, Materials for Energy Storage, Carbon Capture Storage and Utilization, etc, by leveraging international collaborations. These enabled India to occupy a leadership position among 23 nations under Mission Innovation. He accelerated Clean Energy Innovation with enhanced funding, greater public private partnership and knowledge sharing. In the process, India became the first country in developing collaborative programmes for Smart Grid and Off Grid in mounting demand driven convergent solutions, in consortia mode, reaching advanced technology readiness levels.

Dr Sanjay's interventions resulted in publication of several papers, technical reports, grant of Indian and USA patents, and successful demonstration of various technologies, a few leading to commercialisation. As part of various technical committees, he ably mentored many young researchers in taking up challenging tasks and projects of great relevance. He also played a stellar role in spearheading many unique programmes of contemporary interest and guided policy makers in formulating significant

initiatives of national importance. The worthy contributions of Dr Sanjay and his team received many honours, to name a few, National Urban Water Award by Union Ministry of Urban Development, Grand Challenges: Top Solutions Award by Technology Review-Massachusetts's Institute of Technology (USA), National Award for Excellence in Ground Water by Union Ministry of Water Resources, FICCI-HSBC Water-Innovation Award by FICCI, Hydrology Research Promotion Award by the Association of Hydrologists of India, Make India Award by Indian Desalination Association, Global Water Award by Energy and Environment Foundation and Aqua Excellence Award by Aqua Foundation. Dr Sanjay is a Fellow of Indian National Academy of Engineering and conferred with Honorary Fellowship of Association of Hydrologists of India.

Dr Sanjay will be fondly remembered by scientific fraternity as the true champion of S&T face of India. He brought together many researchers across academia, R&D Labs and Industry, in taking up some of the challenges faced across the globe. His compassion and ever willing positive attitude were his hall marks, with a great SMILE (characterized by Simplicity, Modesty, Integrity, Leadership and Empathy) in the service of the nation.

Dr Sanjay leaves behind his mother, wife, two daughters and a son. We pray almighty to shower blessings for Dr Sanjay's soul to be in peace and also grant moral strength to members of his family to bear this loss.

May God bless his soul to Rest in Peace

Obituary forwarded by Prof Manoj K Tiwari and Dr Prasada Raju

---

Prof KL Chopra
(July 31, 1933 – May 19, 2021)

Prof. Kasturi Lal Chopra, FNAE founder of Thin Film Laboratory (TFL) of IIT Delhi, former Director, IIT Kharagpur (2 terms beginning 1987) and former Professor & founder Dean (IRD), IIT Delhi breathed his last on 18 May late night due to COVID related complications. He was a recipient of INAE-Life Time Contribution Award in Engineering in 2013 and Shanti Swarup Bhatnagar Award in Physical Sciences in 1975 for specialization in Material Physics. In addition, IITD Golden Jubilee Committee honoured Prof. K L Chopra for his outstanding contributions. In August 1970, in one corner of the Physics of the Indian Institute of Technology, Delhi, a small group of research scholars led by Professor K.L. Chopra commenced work to build thin-film technology facilities. Thus, the nucleus of a Laboratory was born. Despite constraints of finances, personnel and equipment in the early years, rapid growth took place, helped to a large measure by the zeal, of Prof. Chopra.

A distinguished physicist and administrator, Prof Chopra was also a Padma Shri awardee. He moved to USA after graduation and post- Graduation from University of Delhi and earned Doctorate in in Low Temperature Physics from the University of British Colombia (1957). He continued his stay in the USA

and worked at a large number of organizations in Canada and USA>. He also researched at Fritz Haber Institute, Berlin, Philico-Ford Scientific Laboratory and had affiliation with R&D Groups at IBM, Westinghouse, ARCO, etc. In 1970 he returned to India and joined IIT Delhi as Senior Professor of Solid-State Physics and later became Head of Physics Department. He was Dean of Post Graduate Studies, Industrial R&D, and also Centre for Energy Studies at IIT Delhi. He served as Director, IIT Kharagpur for a decade. On superannuation, he continued as Indian Renewable Energy Development Agency Chair Professor at IIT Delhi and was Chairman BoG of BBIT, Kolkata; HDF-SoM, Bhubaneswar, Honorary Professor of IIT D, IIT BB BESU, ITM And KFUPM of Saudi Arabia.

Prof Chopra set up the Thin Film and Micro science laboratories at IIT Delhi and IIT Kharagpur respectively and contributed greatly to the field of thin films, energy, and nano matter. He published over 430 papers in international journals; authored/edited ten books and supervised 100 MTech and 60 PhD Theses. Prof Chopra held six US Patents and transferring of 8 know-hows to his credit.

Prof Chopra stood for ethics and served as President, Society for Scientific Values. He was also President, Indian Vacuum Society; Vice- President, MRSI & EMSI; Chairman, International Conference on Thin Films & Solid Surfaces and member of several national and international committees in related fields. He was on the editorial Boards of many national and international journals such as Solar Energy Materials and Solar Cells.

Prof Chopra was recipient of Shanti Swarup Bhatnagar Award; PC Mahala Nobis Medal (1996); Aryabhata Medal (2004) and KS Krishnan Memorial Medal (1992). He was also conferred with numerous other awards such as Bhabha Award; FICCI Award; Bhasin Foundation Award; Biren Roy Medal; Citation Laureate Award of ISI, USA and Distinguished Scientist/ Life Time Achievement Awards of Materials Research Society of India; Indian Vacuum Society & Solar Energy Society; IITD Freedom of the Institute Award; Distinguished Academician Award of IITP and D.Sc. (hc) of IIT Kharagpur and UPTU.

Prof KL Chopra was a Fellow of Indian National Academy of Engineering; Indian National Science Academy; Indian Academy of Sciences, Bangalore; National Academy of Sciences (India) and the American Physical Society. He served on INSA Council (1988-90).

“It is a huge loss to all his students and the entire academic fraternity. May God grant his soul eternal peace. We pray for the departed soul and for the family to have courage to bear this great loss. Our heartfelt condolences to his bereaved family.”
- TFL Family (May 19, 2021)

May God bless his soul to Rest in Peace

Obituary forwarded by Prof K Bhanu Sankara Rao

Dr Srikumar Banerjee
(April 25, 1946 – May 23, 2021)

With the passing of Dr. Srikumar Banerjee, in the wee-hours of 23rd May 2021, the Department of Atomic Energy (DAE) has lost a leader, a scientist and an affable gentleman. Dr. Banerjee was Secretary to Government of India, DAE, and Chairman, Atomic Energy Commission (AEC) from 2009-2012. During his illustrious career spanning over 40 years, Dr. Banerjee served in a number of important positions related to Indian nuclear programme. He was the Director of Materials Group, BARC before taking over as Director, BARC in the 2004.

Dr. Srikumar Banerjee was a well-known Indian metallurgist, researcher and academician. He was born on 25th April 1946 in Kolkata to Smt. Shanti and Shri Narayana Banerjee. He received his B.Tech. (Metallurgical Engineering) from Indian Institute of Technology, Kharagpur, in 1967. After graduating from the 11th batch of BARC Training School in 1968, he joined the Metallurgy Division, BARC. He obtained his Ph.D. in 1974 from IIT, Kharagpur. He was a senior visiting fellow at University of Sussex Brighton England during 1978-79 and a Humboldt fellow in Max Planck Institute for Metal research (Metalforschung), Stuttgart, Germany during 1979-80. He also served as a visiting faculty in University of Cincinnati and Ohio State University, USA over several spells.

As Director, BARC, Dr. Banerjee organized research in nuclear fuel cycle, design of innovative reactors, applications of radiation and isotope technology in agriculture, health care, food preservation and industry. He initiated several capacity building activities both in front and back end of the nuclear fuel cycle. He retired as the Chairman, AEC and the Secretary, DAE on April 30, 2012. He also served as a DAE Homi Bhabha Chair Professor at BARC. He has been the Chancellor of Homi Bhabha National Institute, DAE, Mumbai and had served as Chancellor of Central University of Kashmir, Srinagar from 2012 till 2017. Dr. Banerjee was Chairman of Board of Research in Nuclear Sciences, DAE.

Dr. Banerjee carried out pioneering work in the field of martensitic transformations, rapid solidification, omega transformation, quasi-crystalline solids, shape-memory alloys, effect of radiation on order-disorder transitions and tailoring microstructure and texture of nuclear structural materials through thermo-mechanical processing. He has over 400 research papers to his credit, a book entitled 'Phase Transformation: Examples from titanium and zirconium alloys' and has co-edited eight books.

In recognition of his seminal contribution to the field of materials science, Dr. Banerjee was conferred with many prestigious national and international awards including the INSA Young Scientist Award, Acta Metallurgica Outstanding Paper Award; Shanti Swaroop Bhatnagar Prize in Engineering Sciences (1989); GD Birla Gold Medal of the Indian Institute of Metals; INSA Prize for Materials Science; Alexander von Humboldt Research Award; Prof. Brahm Prakash Memorial Medal (2004) from INSA; Indian Science Congress Association's Excellence in Science and Technology Award (2009); Ram Mohun Puraskar of Rammohun Mission (2010); CNR Rao Prize in Advanced Materials; Presidential Citation of American Nuclear Society; National Metallurgist Award from Ministry of Steel in 2010, W. J. Kroll Zirconium Medal Award from American Society for Testing Materials (ASTM) ; and Robert Cahn Memorial Award.

He has been conferred Doctor of Science (Honoris Causa) degrees from 11 universities and institutions. He was an elected fellow of the Indian Academy of Sciences, National Academy of Sciences India, Indian National Science Academy, Indian National Academy of Engineering, Third World Academy of Sciences, and International Nuclear Energy Academy.

In recognition of his excellent scientific contributions to the Indian atomic energy programme, the Government of India conferred Padma Shri upon Dr. Banerjee in 2005.

The DAE fraternity offers its heartfelt condolences to Smt. Ranjana Banerjee, wife of Dr. Banerjee and Shri Rajarshi Banerjee, son of Dr. Banerjee, and pray that Almighty gives strength to the family. May the departed soul rest in eternal peace. A great scholar, dedicated scientist, and a humble human being, Dr. Srikumar Banerjee will forever remain in hearts of those who came in touch with him.

Obituary forwarded by Mr R. K. Vatsa, Head, Public Awareness Division, DAE

Back to Main Page

ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. Rechargeable cement-based batteries

Imagine an entire twenty storey concrete building which can store energy like a giant battery. Thanks to unique research from Chalmers University of Technology, Sweden, such a vision could someday be a reality. Researchers from the Department of Architecture and Civil Engineering recently published an article outlining a new concept for rechargeable batteries -- made of cement.

The ever-growing need for sustainable building materials poses great challenges for researchers. Doctor Emma Zhang, formerly of Chalmers University of Technology, Sweden, joined Professor Luping Tang's research group several years ago to search for the building materials of the future. Together they have now succeeded in developing a world-first concept for a rechargeable cement-based battery. The concept involves first a cement-based mixture, with small amounts of short carbon fibres added to increase the conductivity and flexural toughness. Then, embedded within the mixture is a metal-coated carbon fibre mesh -- iron for the anode, and nickel for the cathode. After much experimentation, this is the prototype which the researchers now present. Luping Tang and Emma Zhang's research has produced a rechargeable cement-based battery with an average energy density of 7 Watthours per square metre (or 0.8 Watthours per litre). Energy density is used to express the capacity of the battery, and a modest estimate is that the performance of the new Chalmers battery could be more than ten times that of earlier attempts at concrete batteries. The energy density is still low in comparison to commercial batteries, but this limitation could be overcome thanks to the huge volume at which the battery could be constructed when used in buildings. The fact that the battery is rechargeable is its most important quality, and the possibilities for utilisation if the concept is further developed and commercialized are almost staggering. Energy storage is an obvious possibility, monitoring is another. The researchers see applications that could range from powering LEDs, providing 4G connections in remote areas, or cathodic protection against corrosion in concrete infrastructure. "It could also be coupled with solar cell panels for example, to provide electricity and become the energy source for monitoring systems in highways or bridges, where sensors operated by a concrete battery could detect cracking or corrosion," suggests Emma Zhang. The concept of using structures and buildings in this way could be revolutionary, because it would offer an alternative solution to the energy crisis, by providing a large volume of energy storage. Concrete, which is formed by mixing cement with other ingredients, is the world's most commonly used building material. From a sustainability perspective, it is far from ideal, but the potential to add functionality to it could offer a new dimension. The idea is still at a very early stage. The technical questions remaining to be solved before commercialisation of the technique can be a reality include extending the service life of the battery, and the development of recycling techniques. "Since concrete infrastructure is usually built to last fifty or even a hundred years, the batteries would need to be refined to match this, or to be easier to exchange and recycle when their service life is over. For now, this offers a major challenge from a technical point of view," says Emma Zhang. But the researchers are hopeful that their innovation has a lot to offer. "We are convinced this concept makes for a great contribution to allowing future building materials to have additional functions such as renewable energy sources," concludes Luping Tang.

Source https://www.sciencedaily.com/releases/2021/05/210518114247.htm

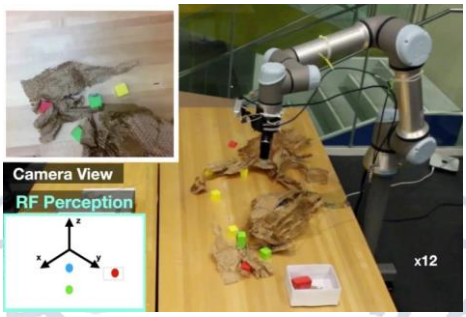
2. Interactive typeface for digital text

Scientists develop adaptive font that speeds up reading. AdaptiFont has recently been presented at CHI, the leading Conference on Human Factors in Computing.Language is without doubt the most pervasive medium for exchanging knowledge between humans. However, spoken language or abstract text need to be made visible in order to be read, be it in print or on screen. How does the way a text looks affect its readability, that is, how it is being read, processed, and understood? A team at TU Darmstadt's Centre for Cognitive Science investigated this question at the intersection of perceptual science, cognitive science, and linguistics. Electronic text is even more complex. Texts are read on different devices under different external conditions. And although any digital text is formatted initially, users might resize it on screen, change brightness and contrast of the display, or even select a different font when reading text on the web. The team of researchers from TU Darmstadt now developed a system that leaves font design to the user's visual system. First, they needed to come up with a way of synthesizing new fonts. This was achieved by using a machine learning algorithm, which learned the structure of fonts analysing 25 popular and classic typefaces. The system is capable of creating an infinite number of new fonts that are any intermediate form of others -- for example, visually halfway between Helvetica and Times New Roman. Since some fonts may make it more difficult to read the text, they may slow the reader down. Other fonts may help the user read more fluently. Measuring reading speed, a second algorithm can now generate more typefaces that increase the reading speed. In a laboratory experiment, in which users read texts over one hour, the research team showed that their algorithm indeed generates new fonts that increase individual user's reading speed. Interestingly all readers had their own personalized font that made reading especially easy for them. However: This individual favourite typeface does not necessarily fit in all situations. "AdaptiFont therefore can be understood as a system which creates fonts for an individual dynamically and continuously while reading, which maximizes the reading speed at the time of use. This may depend on the content of the text, whether you are tired, or perhaps are using different display devices," explains Professor Constantin A. Rothkopf, Centre for Cognitive Science und head of the institute of Psychology of Information Processing at TU Darmstadt.

Source https://www.sciencedaily.com/releases/2021/05/210512143558.htm

Mechanical Engineering

3. Robot That Senses Hidden Objects – "We're Trying to Give Robots Superhuman Perception"



In recent years, robots have gained artificial vision, touch, and even smell. The researchers have developed a robot that uses radio waves, which can pass through walls, to sense occluded objects. The robot, called RF-Grasp, combines this powerful sensing with more traditional computer vision to locate and grasp items that might otherwise be blocked from view. The advance could one day streamline e-commerce fulfilment in warehouses or help a machine pluck a screwdriver from a jumbled toolkit. As e-commerce continues to grow, warehouse work is still usually the domain of humans, not robots, despite sometimes-dangerous working conditions. That's in part because robots struggle to locate and grasp objects in such a crowded environment. Using optical vision alone, robots can't perceive the presence of an item packed away in a box or hidden behind another object on the shelf — visible light waves, of course, don't pass through walls. But radio waves can. For decades, radio frequency (RF) identification has been used to track everything from library books to pets. RF identification systems have two main components: a reader and a tag. The tag is a tiny computer chip that gets attached to — or, in the case of pets, implanted in — the item to be tracked. The reader then emits an RF signal, which gets modulated by the tag and reflected back to the reader. The reflected signal provides information about the location and identity of the tagged item. The technology has gained popularity in retail supply chains — Japan aims to use RF tracking for nearly all retail purchases in a matter of years. The researchers realized this profusion of RF could be a boon for robots, giving them another mode of perception. RF Grasp uses both a camera and an RF reader to find and grab tagged objects, even when they're fully blocked from the camera's view. It consists of a robotic arm attached to a grasping hand. The camera sits on the robot's wrist. The RF reader stands independent of the robot and relays tracking information to the robot's control algorithm. So, the robot is constantly collecting both RF tracking data and a visual picture of its surroundings. Integrating these two data streams into the robot's decision making was one of the biggest challenges the researchers faced. The robot initiates the seek-and-pluck process by pinging the target object's RF tag for a sense of its whereabouts. The sequence is akin to hearing a siren from behind, then turning to look and get a clearer picture of the siren's source. With its two complementary senses, RF Grasp zeroes in on the target object. As it gets closer and even starts manipulating the item, vision, which provides much finer detail than RF, dominates the robot's decision making. RF Grasp proved its efficiency in a battery of tests. Compared to a similar robot equipped with only a camera, RF Grasp was able to pinpoint and grab its target object with about half as much total movement. Plus, RF Grasp displayed the unique ability to "declutter" its environment — removing packing materials and other obstacles in its way in order to access the target. RF Grasp could one day perform fulfilment in packed e-commerce warehouses. Its RF sensing could even instantly verify an item's identity without the need to manipulate the item, expose its barcode, then scan it.

Source https://scitechdaily.com/robot-that-senses-hidden-objects-were-trying-to-give-robots-superhuman-perception

Chemical Engineering

4. New technology converts waste plastics to jet fuel in an hour

Washington State University researchers have developed an innovative way to convert plastics to ingredients for jet fuel and other valuable products, making it easier and more cost effective to reuse plastics. The researchers in their reaction were able to convert 90% of plastic to jet fuel and other valuable hydrocarbon products within an hour at moderate temperatures and to easily fine-tune the process to create the products that they want. In recent decades, the accumulation of waste plastics has caused an environmental crisis, polluting oceans and pristine environments around the world. As they degrade, tiny pieces of microplastics have been found to enter the food chain and become a potential, if unknown, threat to human health. Plastics recycling, however, has been problematic. The most common mechanical recycling methods melt the plastic and re-mould it, but that lowers its economic value and quality for use in other products. Chemical recycling can produce higher quality products, but it has required high reaction temperatures and a long processing time, making it too expensive and cumbersome for industries to adopt. Because of its limitations, only about 9% of plastic in the U.S. is recycled every year. In their work, the WSU researchers developed a catalytic process to efficiently convert polyethylene to jet fuel and high-value lubricants. Polyethylene, also known as #1 plastic, is the most commonly used plastic, used in a huge variety of products from plastics bags, plastic milk jugs and shampoo bottles to corrosion-resistant piping, wood-plastic composite lumber and plastic furniture. For the process, the researchers used a ruthenium on carbon catalyst and a commonly used solvent. They were able to convert about 90% of the plastic to jet fuel components or other hydrocarbon products within an hour at a temperature of 220 degrees Celsius, which is more efficient and lower than temperatures that would be typically used. Jia was surprised to see just how well the solvent and catalyst worked. "Before the experiment, we only speculated but didn't know if it would work," he said. "The result was so good." Adjusting processing conditions, such as the temperature, time or amount of catalyst used, provided the critically important step of being able to fine-tune the process to create desirable products, Lin said. "Depending on the market, they can tune to what product they want to generate," he said. "They have flexibility. The application of this efficient process may provide a promising approach for selectively producing high-value products from waste polyethylene."

Source https://www.sciencedaily.com/releases/2021/05/210517124937.htm

---

Electrical Engineering

5. Smaller chips open door to new RFID applications

Researchers at North Carolina State University have made what is believed to be the smallest state-of-the-art RFID chip, which should drive down the cost of RFID tags. In addition, the chip's design makes it possible to embed RFID tags into high value chips, such as computer chips, boosting supply chain security for high-end technologies. "As far as we can tell, it's the world's smallest Gen2-compatible RFID chip," says Paul Franzon, corresponding author of a paper on the work and Cirrus Logic Distinguished Professor of Electrical and Computer Engineering at NC State. Gen2 RFID chips are state of the art and are already in widespread use. One of the things that sets these new RFID chips apart is their size. They measure 125 micrometers (µm) by 245 µm. Manufacturers were able to make smaller RFID chips using earlier technologies, but Franzon and his collaborators have not been able to identify smaller RFID chips that are compatible with the current Gen2 technology. "The size of an RFID tag is largely determined by the size of its antenna -- not the RFID chip," Franzon says. "But the chip is the expensive part." The smaller the chip, the more chips you can get from a single silicon wafer. And the more chips you can get from the silicon wafer, the less expensive they are. "In practical terms, this means that we can manufacture RFID tags for less than one cent each if we're manufacturing them in volume," Franzon says. That makes it more feasible for manufacturers, distributors or retailers to use RFID tags to track lower-cost items. For example, the tags could be used to track all of the products in a grocery store without requiring employees to scan items individually. "Another advantage is that the design of the circuits we used here is compatible with a wide range of semiconductor technologies, such as those used in conventional computer chips," says Kirti Bhanushali, a researcher. "This makes it possible to incorporate RFID tags into computer chips, allowing users to track individual chips throughout their life cycle. This could help to reduce counterfeiting, and allow you to verify that a component is what it says it is." "We've demonstrated what is possible, and we know that these chips can be made using existing manufacturing technologies," Franzon says. "We're now interested in working with industry partners to explore commercializing the chip in two ways: creating low-cost RFID at scale for use in sectors such as grocery stores; and embedding RFID tags into computer chips in order to secure high-value supply chains."

Source https://www.sciencedaily.com/releases/2021/05/210512115531.htm

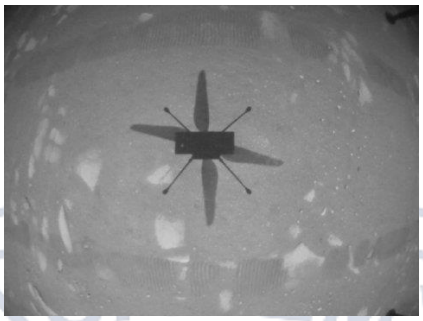
6. Engineers harvest WiFi signals to power small electronics

With the rise of the digital age, the amount of WiFi sources to transmit information wirelessly between devices has grown exponentially. This results in the widespread use of the 2.4GHz radio frequency that WiFi uses, with excess signals available to be tapped for alternative uses. To harness this under-utilised source of energy, a research team from the National University of Singapore (NUS) and Japan's Tohoku University (TU) has developed a technology that uses tiny smart devices known as spin-torque oscillators (STOs) to harvest and convert wireless radio frequencies into energy to power small electronics. In their study, the researchers had successfully harvested energy using WiFi-band signals to power a light-emitting diode (LED) wirelessly, and without using any battery. "We are surrounded by WiFi signals, but when we are not using them to access the Internet, they are inactive, and this is a huge waste. Our latest result is a step towards turning readily-available 2.4GHz radio waves into a green source of energy, hence reducing the need for batteries to power electronics that we use regularly. In this way, small electric gadgets and sensors can be powered wirelessly by using radio frequency waves as part of the Internet of Things. With the advent of smart homes and cities, our work could give rise to energy-efficient applications in communication, computing, and neuromorphic systems," said Professor Yang Hyunsoo from the NUS Department of Electrical and Computer Engineering, who spearheaded the project. Spin-torque oscillators are a class of emerging devices that generate microwaves and have applications in wireless communication systems. However, the application of STOs is hindered due to a low output power and broad linewidth. While mutual synchronisation of multiple STOs is a way to overcome this problem, current schemes, such as short-range magnetic coupling between multiple STOs, have spatial restrictions. On the other hand, long-range electrical synchronisation using vortex oscillators is limited in frequency responses of only a few hundred MHz. It also requires dedicated current sources for the individual STOs, which can complicate the overall on-chip implementation. To overcome the spatial and low frequency limitations, the research team came up with an array in which eight STOs are connected in series. Using this array, the 2.4 GHz electromagnetic radio waves that WiFi uses was converted into a direct voltage signal, which was then transmitted to a capacitor to light up a 1.6-volt LED. When the capacitor was charged for five seconds, it was able to light up the same LED for one minute after the wireless power was switched off. In their study, the researchers also highlighted the importance of electrical topology for designing on-chip STO systems and compared the series design with the parallel one. They found that the parallel configuration is more useful for wireless transmission due to better time-domain stability, spectral noise behaviour, and control over impedance mismatch. On the other hand, series connections have an advantage for energy harvesting due to the additive effect of the diode-voltage from STOs. Commenting on the significance of their results, Dr Raghav Sharma, a lead researcher, shared, "Aside from coming up with an STO array for wireless transmission and energy harvesting, our work also demonstrated control over the synchronising state of coupled STOs using injection locking from an external radio-frequency source. These results are important for prospective applications of synchronised STOs, such as fast-speed neuromorphic computing."

Source https://www.sciencedaily.com/releases/2021/05/210518114153.htm

Aerospace Engineering

7. NASA's Ingenuity Mars Helicopter succeeds in historic first flight



NASA's Ingenuity Mars Helicopter became the first aircraft in history to make a powered, controlled flight on another planet. The Ingenuity team at the agency's Jet Propulsion Laboratory in Southern California confirmed the flight succeeded after receiving data from the helicopter via NASA's Perseverance Mars rover. The solar-powered helicopter first became airborne at 3:34 a.m. EDT (12:34 a.m. PDT) -- 12:33 Local Mean Solar Time (Mars time) -- a time the Ingenuity team determined would have optimal energy and flight conditions. Altimeter data indicate Ingenuity climbed to its prescribed maximum altitude of 10 feet (3 meters) and maintained a stable hover for 30 seconds. It then descended, touching back down on the surface of Mars after logging a total of 39.1 seconds of flight. Additional details on the test are expected in upcoming downlinks. Ingenuity's initial flight demonstration was autonomous -- piloted by onboard guidance, navigation, and control systems running algorithms developed by the team at JPL. Because data must be sent to and returned from the Red Planet over hundreds of millions of miles using orbiting satellites and NASA's Deep Space Network, Ingenuity cannot be flown with a joystick, and its flight was not observable from Earth in real time. NASA Associate Administrator for Science Thomas Zurbuchen announced the name for the Martian airfield on which the flight took place. Ingenuity's chief pilot, Håvard Grip, announced that the International Civil Aviation Organization (ICAO) -- the United Nations' civil aviation agency -- presented NASA and the Federal Aviation Administration with official ICAO designator IGY, call-sign INGENUITY. As one of NASA's technology demonstration projects, the 19.3-inch-tall (49-centimeter-tall) Ingenuity Mars Helicopter contains no science instruments inside its tissue-box-size fuselage. Instead, the 4-pound (1.8-kg) rotorcraft is intended to demonstrate whether future exploration of the Red Planet could include an aerial perspective. This first flight was full of unknowns. The Red Planet has a significantly lower gravity -- one-third that of Earth's -- and an extremely thin atmosphere with only 1% the pressure at the surface compared to our planet. This means there are relatively few air molecules with which Ingenuity's two 4-foot-wide (1.2-meter-wide) rotor blades can interact to achieve flight. The helicopter contains unique components, as well as off-the-shelf-commercial parts -- many from the smartphone industry -- that were tested in deep space for the first time with this mission. Parked about 211 feet (64.3 meters) away at Van Zyl Overlook during Ingenuity's historic first flight, the Perseverance rover not only acted as a communications relay between the helicopter and Earth, but also chronicled the flight operations with its cameras. The pictures from the rover's Mastcam-Z and Navcam imagers will provide additional data on the helicopter's flight. Perseverance touched down with Ingenuity attached to its belly on Feb. 18. Deployed to the surface of Jezero Crater on April 3, Ingenuity is currently on the 16th sol, or Martian day, of its 30-sol (31-Earth day) flight test window. Over the next three sols, the helicopter team will receive and analyze all data and imagery from the test and formulate a plan for the second experimental test flight, scheduled for no earlier than April 22. If the helicopter survives the second flight test, the Ingenuity team will consider how best to expand the flight profile.

Source https://www.sciencedaily.com/releases/2021/04/210419100103.htm

8. Less than a nanometer thick, stronger and more versatile than steel

Scientists create stable nanosheets containing boron and hydrogen atoms with potential applications in nanoelectronics and quantum information technology.What's thinner than thin? One answer is two-dimensional materials -- exotic materials of science with length and width but only one or two atoms in thickness. They offer the possibility of unprecedented boosts in device performance for electronic devices, solar cells, batteries and medical equipment. In collaboration with Northwestern University and the University of Florida, scientists from the U.S. Department of Energy's (DOE) Argonne National Laboratory report in Science magazine a breakthrough involving a 2D material called borophane, a sheet of boron and hydrogen a mere two atoms in thickness. One of the most exciting developments in materials science in recent decades has been a 2D sheet of carbon (graphene), which is one atom thick and 200 times stronger than steel. A similarly promising and newer material is an atom-thick sheet of boron, called borophene -- with an "e." A multi-institutional team, including researchers in Argonne's Center for Nanoscale Materials (a DOE Office of Science User Facility), first synthesized borophene in 2015. While graphene is simply one atomic layer out of the many same layers in the common material graphite, borophene has no equivalent parent structure and is very difficult to prepare. What's more, the rapid reaction of borophene with air means it is very unstable and changes form readily."Borophene by itself has all kinds of problems," said Mark Hersam, Professor of Materials Science and Engineering at Northwestern University. "But when we mix borophene with hydrogen, the product suddenly becomes much more stable and attractive for use in the burgeoning fields of nanoelectronics and quantum information technology." The research team grew borophene on a silver substrate then exposed it to hydrogen to form the borophane. They then unraveled the complex structure of borophane by combining a scanning tunneling microscope with a computer-vision based algorithm that compares theoretical simulations of structures with experimental measurements. Computer vision is a branch of artificial intelligence that trains high performance computers to interpret and understand the visual world. Even though the borophane material is only two atoms thick, its structure is quite complex because of the many possible arrangements for the boron and hydrogen atoms. "We have tackled a significant challenge in determining the atomic structures from scanning tunneling microscopy images and computational modeling at the atomic scale with the help of computer vision," said Argonne's Maria Chan, nanoscientist at the Center for Nanoscale Materials. Given the success in unraveling this complex structure, the team's automated analytical technique should be applicable in identifying other complex nanostructures in the future. "What is really encouraging from our results is that we found a borophane nanosheet on a silver substrate to be quite stable, unlike borophene," said Pierre Darancet, nanoscientist at Argonne's Center for Nanoscale Materials. "This means it should be easily integrated with other materials in the construction of new devices for optoelectronics, devices combining light with electronics." Such light-controlling and light-emitting devices could be incorporated into telecommunications, medical equipment and more.

Source https://www.sciencedaily.com/releases/2021/04/210405131042.htm

9. Wake steering potentially boosts energy production at US wind plants

Wake steering is a strategy employed at wind power plants involving misaligning upstream turbines with the wind direction to deflect wakes away from downstream turbines, which consequently increases the net production of wind power at a plant. Researchers at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) illustrate how wake steering can increase energy production for a large sampling of commercial land-based U.S. wind power plants. While some plants showed less potential for wake steering due to unfavourable meteorological conditions or turbine layout, several wind power plants were ideal candidates that could benefit greatly from wake steering control. Overall, a predicted average annual production gain of 0.8% was found for the set of wind plants investigated. In addition, the researchers found that on wind plants using wake steering, wind turbines could be placed more closely together, increasing the amount of power produced in a given area by nearly 70% while maintaining the same cost of energy generation. "We were surprised to see that that there was still a large amount of variability in the potential energy improvement from wake steering, even after accounting for the wake losses of different wind plants," said author David Bensason. Just as umbrellas may cast a shadow, wind turbines create a region of slower, more turbulent air flow downstream of their rotor, which is known as a wake. When these wakes flow into another turbine, they reduce its power production capacity. The wake steering strategy "steers" these wakes away from turbines by offsetting the angle between the rotor face and the incoming wind direction. This technique sacrifices the power efficiencies of a few turbines in order to increase the performance of the wind power plant as a whole. Wake steering can only increase energy production if there are wake losses to start. Consequently, the benefits of wake steering tend to increase for wind plants with higher wake losses. The study is one of the first to use the Gauss-Curl-Hybrid wake model, which NREL developed. This model predicts wake behaviour in a wind plant more accurately than prior models and captures effects that are more prominent in large-scale plants. The researchers also combined several publicly available databases and tools that together make the investigation of wake steering potential for a large sample of U.S. wind plants possible.

Source https://www.sciencedaily.com/releases/2021/05/210518114759.htm

Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry
10. Microfluidic Chip Simplifies COVID-19 Testing, Delivers Results on a Phone in 55 Minutes or Less

COVID-19 can be diagnosed in 55 minutes or less with the help of programmed magnetic nanobeads and a diagnostic tool that plugs into an off-the-shelf cellphone, according to Rice University engineers. The Rice lab of mechanical engineer Peter Lillehoj has developed a stamp-sized microfluidic chip that measures the concentration of SARS-CoV-2 nucleocapsid (N) protein in blood serum from a standard finger prick. The nanobeads bind to SARS-CoV-2 N protein, a biomarker for COVID-19, in the chip and transport it to an electrochemical sensor that detects minute amounts of the biomarker. The researchers argued their process simplifies sample handling compared to swab-based PCR tests that are widely used to diagnose COVID-19 and need to be analyzed in a laboratory. A system developed by Rice University engineers employs a stamp-sized microfluidic chip that measures the concentration of SARS-CoV-2 nucleocapsid protein in blood serum to diagnose COVID-19 in less than an hour. The system uses an off-the-shelf cellphone and potentiostat to deliver the results. Lillehoj Research Group/Rice University Lillehoj and Rice graduate student and lead author Jiran Li took advantage of existing biosensing tools and combined them with their own experience in developing simple diagnostics, like a microneedle patch introduced last year to diagnose malaria. The new tool relies on a slightly more complex detection scheme but delivers accurate, quantitative results in a short amount of time. To test the device, the lab relied on donated serum samples from people who were healthy and others who were COVID-19-positive. Lillehoj said a longer incubation yields more accurate results when using whole serum. The lab found that 55 minutes was an optimum amount of time for the microchip to sense SARS-CoV-2 N protein at concentrations as low as 50 picograms (billionths of a gram) per milliliter in whole serum. The microchip could detect N protein in even lower concentrations, at 10 picograms per milliliter, in only 25 minutes by diluting the serum fivefold. Paired with a Google Pixel 2 phone and a plug-in potentiostat, it was able to deliver a positive diagnosis with a concentration as low as 230 picograms for whole serum. Rice University mechanical engineer Peter Lillehoj, left, and graduate student Jiran Li developed a system that uses programmable magnetic nanobeads, an off-the-shelf cellphone, and a plug-in diagnostic tool to diagnose COVID-19 in 55 minutes or less. A capillary tube is used to deliver the sample to the chip, which is then placed on a magnet that pulls the beads toward an electrochemical sensor coated with capture antibodies. The beads bind to the capture antibodies and generate a current proportional to the concentration of biomarker in the sample. The potentiostat reads that current and sends a signal to its phone app. If there are no COVID-19 biomarkers, the beads do not bind to the sensor and get washed away inside the chip. Lillehoj said it would not be difficult for industry to manufacture the microfluidic chips or to adapt them to new COVID-19 strains if and when that becomes necessary.

Source https://scitechdaily.com/microfluidic-chip-simplifies-covid-19-testing-delivers-results-on-a-phone-in-55-minutes-or-less/

Back to Main Page

ENGINEERING INNOVATION IN INDIA

1. DRDO Develops Critical Near Isothermal Forging Technology for Aeroengines

Defence Research and Development Organisation (DRDO) has established the near isothermal forging technology to produce all the five stages of high-pressure compressors (HPC) discs out of difficult-to-deform titanium alloy using its unique 2000 MT isothermal forge press. The technology has been developed by Defence Metallurgical Research Laboratory (DMRL), a premier metallurgical laboratory of DRDO at Hyderabad. This is a crucial technology for establishing self-reliance in aeroengine technology. With this development, India has joined the league of limited global engine developers to have the manufacturing capabilities of such critical aero engine components.

To meet the bulk production requirements, DMRL technology was transferred to M/s MIDHANI through a licensing agreement for technology transfer (LAToT). Using the isothermal forge press facility available at DMRL, Hyderabad, bulk quantity (200 numbers) of HPC disc forgings pertaining to various compressor stages have been jointly (DMRL & MIDHANI) produced and successfully supplied to HAL (E), Bengaluru for fitment in to Adour Engine that powers the Jaguar/Hawk Aircrafts.

In India, the Adour engine is overhauled by HAL (E), Bengaluru under a licensed manufacturing agreement with OEM. Like in any aeroengine, the HPC Drum assembly has to be replaced after a specified number of operations or in case of damage. The annual requirements of these high value HPC discs are quite large, warranting indigenisation. HPC drum is a highly stressed sub-assembly and is also subjected to low cycle fatigue and creep at elevated temperature. The raw materials and forgings for HPC drum are required to be of the highest quality which can meet the specified combination of static and dynamic mechanical properties.

DMRL developed this forging technology by integrating various science and knowledge-based tools. The methodology adopted by DMRL is generic in nature and can be tuned to develop other similar aeroengine components. The compressor discs produced using this methodology met all the requirements stipulated by the airworthiness agencies for the desired application. Accordingly, the technology was type certified and letter of technical approval (LoTA) was accorded. Based on the exhaustive component level and performance evaluation test results, HAL (E) and Indian Air Force cleared the components for engine fitment. Apart from DMRL and HAL (E), various agencies such as MIDHANI, CEMILAC and DGAQA worked in unison to establish this crucial technology.

Raksha Mantri Shri Rajnath Singh has congratulated the scientists of DRDO, Industry and all other agencies involved in the development of this critical Aero Engine related technology. Secretary Department of Defence R&D and Chairman DRDO Dr G Satheesh Reddy expressed his satisfaction on achieving this crucial milestone and congratulated the teams involved.

Source https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1722418

2. India's first ever 3D printed house - IIT Madras creates history

India's Finance Minister Nirmala Sitharaman recently virtually inaugurated India's first 3-D Printed house which is situated within IIT Madras, said the Institute. Constructed by Tvasta Manufacturing solutions, this 600 sq. ft, single-story home has a functional space comprising of a single bedroom, hall, and kitchen, all of which have been designed and developed by the firm's indigenous 3-D printing technology. The concrete 3D printing technology is a 'Ready-to-Implement Methodology' with no lead time on manufacturing and is touted to offer advantages including - reduction in overall construction cost and time, brings down the carbon footprint, higher productivity of labour, and utilization of eco-friendly materials. Tvasta's 'Concrete 3D Printing' is an automated manufacturing method, where their 3-D printer accepts a computerized three-dimensional design file and fabricates a 3D structure in a layer-by-layer manner by extruding a custom-made variant of concrete. Tvasta's primarily aims to cater to the various infrastructure needs in the Indian subcontinent, with the focus on providing construction-related 3D Printing services for Government schemes that aim to alleviate problems of housing, sanitation, disaster-time rehabilitation, among others. On the work done by Tvasta, Prof. Bhaskar Ramamurthi, Director, IIT Madras, said, "This technology is the first to be beneficiary-led in the construction industry. The machine for constructing this house can be rented, like borewells rented by farmers. It provides for large-scale, high quality and also, price assurance for the customers." The firm's Co-Founder and Chief Executive Officer, Adithya VS, believes that their technology and efforts can ensure personalization of homes for the users and make affordable, quality housing a reality for all Indians.

Source https://zeenews.india.com/india/iit-madras-alumni-s-startup-3d-prints-600-sqft-concrete-home-comprising-hall-kitchen-bedroom-2358311.html

Back to Main Page