INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

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INAE VISION 2020-2025

INAE VISION

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

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INAE Mission

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

Technology Roadmap

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

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

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

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

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

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

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

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

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

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

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

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

The other important consideration is the speed of development. In order to remain globally competitive in this domain, we must leverage the state of the art digital platforms (equipped with advance modeling, simulation, data analytics and knowledge engineering tools) for accelerating the development cycle from conception to deployment in actual applications as well as the entire life cycle (cradle to cradle or cradle to grave in some cases), that is, even for the structural health monitoring of the structures where these materials will be deployed.

Another important consideration is the environmental impact of these materials, that is, we must undertake a life cycle analysis, both with respect to the environmental footprint as well as the energy efficiency (actual consumption as compared to the thermodynamic energy needed to accomplish the particular task), for every developmental effort.

It is now well established that integrated computational materials engineering (ICME) approach can help accelerate the materials development cycle.

INAE will work towards coming up with a national strategy to establish and institutionalize the ICME based approach for all material development efforts. The digital platform, thus created, must be equipped with knowledge engineering capabilities so that it can not only act as a knowledge repository of all past efforts made thus far but also continues to update the knowledge going forward.

2. **Strategies for Energy Transition to Fossil Fuels free Renewable Energy Sources**

It is inevitable that India, like several other nations of the world, will move away from fossil fuels as a source of energy. While we have made some headway in developing renewable energy sources like solar and wind, the necessary infrastructure to support the energy transition does not exist at the present time. INAE plans to create an interdisciplinary expert group to study the whole energy transition comprehensively and holistically, keeping in mind the challenges inherent in such a massive transformation.

INAE will focus on the following important sectors which will be disrupted in the immediate future and/or the areas of concern which we require a strategy for, urgently to facilitate the transition

- Large scale energy storage solutions - Solutions other than Lithium Ion Batteries which do not seem to be appropriate for a country like India for a variety of reasons including the fact that we do not have the basic raw materials - Liquid Metal Flow batteries (for example, Vanadium Flow Batteries) is another attractive option which must be explored.
- Electricity Grid Infrastructure - current grid will not be able to cater to intermittent and distributed electricity inputs; the concept of smart grids which is adequately robust to cater to both supply side challenges (renewable energy sources) as well as demand management (dynamic pricing to take care of its peak loads).
- Transportation (electric mobility, both for people as well as for goods).
- Mining, Mineral Processing and Extractive Metallurgy Industry (which currently depends totally on fossil fuels not only as a source of heat but also as a reductant to convert metal oxides to metals).
- Recycling of waste by-products including municipal waste, tailings and smelter slags including steel slag, red mud and spent pot lining, electronic waste and hospital waste.
- Supply chains for raw materials needed for the transition - sourcing strategies from other geographies, urban mining, deep sea mining and space mining.
- Finding alternative technology options for the manufacture of steel and cement to reduce the environmental foot-print - currently these two materials which will continue to remain the backbone of the Indian economy for the foreseeable future and the consumption is likely to increase by an order of magnitude in the coming decade.
- Waste-water treatment and recycling.
- Water purification technologies including desalination

3. Excellence in Engineering Education

Several groups including other academies globally, are working on the new curricula for engineering education so that our young emerging leaders are adequately equipped with necessary engineering skill sets to face the challenges in the coming decades.

Various deliberations within India as well as abroad have emphasised the need of providing hands-on design experience, problem solving skills and exposure to the systems engineering concepts, tools and technologies to the engineering students. The curricula also need to be updated with the advancements in digital technologies.

All engineers must be familiar with the sustainability paradigm and must be able to do life cycle analysis for every engineering product. They must be equipped with knowledge and the experience with various digital platforms and modelling tools such as computational materials engineering (all the way from atomistic scale to macroscopic scale), computational fluid dynamics, structural analysis tools, life cycle analysis modelling tools, engineering scale up, robust design methodologies to take care of uncertainty and complexity, machine learning and data analytics tools and algorithms, multi-objective and multi-variate optimization tools and technologies.

It is important that the professional ethics is part of the engineering course curricula. A multi-disciplinary systems perspective to all engineers will certainly broaden their horizons – much needed to face the emerging world scenario. Good communication skills and ability to work in teams, are also prerequisites for engineers to succeed in the real life.

All engineers must possess basic IT skillsets and it is a given since digital technologies are transforming every aspect of our lives.

A multidisciplinary INAE Expert Group will critically examine the current status of engineering education, identify gap areas and strive to fill those gaps with appropriate action plans

4. World Class Infrastructure

INAE will come up with an action plan in consultation with all stake- holders to upgrade our national infrastructure within next few years. This will include

- Requirements, technology options and the investments needed to create a few smart cities in the country - including mobility, healthcare facilities, e-governance, access to affordable housing, utilities (electricity and water), waste collection, processing and recycle, education, communication, maintenance of infrastructural facilities, disaster management infrastructure including extreme events (for example, excessive rain and floods) etc.
- Requirements, technology options and the investments needed to create a rural infrastructure so that they can enjoy access to certain basic amenities where they are located - digital connectivity for example can provide them with access to healthcare, online education, information dissemination, financial inclusion, logistics warehousing and agriculture and farm productivity with engineering focus etc.

5. Cyber-physical Systems

Globally innovations are taking place at the interface of digital technologies and domain expertise. For example, manufacturing is being transformed as a consequence of the following - robotics and automation, Internet of Things (IoT), cloud computing, 3D printing, AI, machine learning and data analytics (Digital Twins), structural health monitoring of built structures and engineered products, drones, autonomy, data analytics based predictive asset maintenance systems, blockchain technology to facilitate complete traceability of the products, digital platforms for integrated design, development, deployment and monitoring of materials and products and knowledge engineering platforms for capturing, retaining and context sensitive retrieval of knowledge to solve challenging problems.

Similarly leveraging the advanced digital technologies, the infrastructure available in a given locality or a city can be upgraded for easy accessibility – for example, healthcare facilities, e-governance, utilities (electricity and water)

It is now possible to make most of healthcare facilities available to the citizens at their place ofresidence (particularly important for senior citizens living alone) through the intervention of digital connectivity, sensors and IoT solutions. Provision of healthcare and affordable Medicare facilities through technological interventions is a key focus area.

INAE will select certain areas for focussed attention during the next five years and develop strategies to create infrastructure to facilitate digital transformation for achieving a set of desirable objectives for example, higher productivity, higher efficiency, better quality of life and better quality of products, reduced cost of services, higher safety of workers, etc.

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ACADEMY ACTIVITIES

New Year Message from President

January 1, 2021

Esteemed Fellows of INAE:

The Year 2020, despite all of us wishing each other and seeking blessings from heaven, turned out to be the biggest nightmare and harrowing experience of our lifetime, possibly comparable to the unforgettable devastation and misery caused by Spanish Flu (100 years ago) and World War II (80 years ago). But 2020 also taught us the need to adopt personal hygiene and protection, treat nature with respect, and shun mindless and infinite greed and profligacy. Ultimately combined strength and collective wisdom of humanity must prevail and triumph. We must learn from the mistakes of the past and vouch never to repeat them again.

Please accept my earnest and warm wishes to you and who you care for, a VERY HAPPY AND ENJOYABLE NEW YEAR 2021! Let the NEW YEAR usher in a new dawn of hope, reassurance, cheer and compassion, and beckon us to a new lease of success, self-reliance and prosperity.

Looking forward to receiving your active cooperation and valuable advice to forge ahead with INAE's multi-faceted programs.

Best regards and cheerful wishes once more to you all.

Prof Indranil Manna
President, INAE

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ACADEMY NEWS

Academy News

INAE Annual Convention 2020

The INAE Annual Convention 2020 was held Online during December 21-22, 2020 due to the unprecedented circumstances all over the world on account of COVID pandemic and the restrictions thereof which limited conduct of a physical Annual Convention. This is the first time that the Annual Convention of INAE was held online. However, the programme was fairly similar to that of the normal Annual Convention held each year. The Annual Convention was preceded by the INAE Governing Council Meeting held online on December 19, 2020. The Programme of the Annual Convention can be viewed by clicking here …. The video recording of the Sessions shall be available on INAE website shortly. There were a large number of registrations from INAE Fellows/ Foreign Fellows, Young Associates, awardees and delegates for the online INAE Annual Convention 2020.

The Inaugural session was held on December 21, 2020 at 10:30 AM which featured the lighting of the lamp by the dignitaries on the dais viz Dr Sanak Mishra, President, INAE; Prof Indranil Manna, Vice-President and President-Elect, INAE; Dr Purnendu Ghosh, Vice-President, INAE; Dr Pradip, Vice-President, INAE and Prof K Bhanu Sankara Rao, Chief Editor of Publications, INAE. This was followed by the delivery of the Presidential Address by Dr Sanak Mishra, President, INAE. A copy of the Presidential Address may be viewed by clicking here ……

Dr Sanak Mishra then gave a brief introduction of the Chief Guest, Mr. TV Narendran, FNAE, CEO and Managing Director, Tata Steel Ltd and invited him to deliver the Inaugural Address. Mr TV Narendran delivered an enlightening address on the topic “Engineering Innovations in Industry”. The Inaugural Session concluded with the Vote of Thanks proposed by Dr Pradip, Vice-President, INAE and Chairman, Annual Convention Organizing Committee.

After the Inaugural Session, a small Quiz was held for the delegates in which interesting questions on INAE were read out by the compere and answers were revealed after giving time for the delegates to submit their answers. The names of the delegates who answered the questions correctly were displayed at the end of the day after the Grand Award Function. The Grand Award function commenced at 2PM during which the various awards instituted by the Academy were conferred. In the first part of the Grand Award Function, the Life Time Contribution Award in Engineering; Prof. Jai Krishna and Prof. SN Mitra Memorial Awards; Outstanding Teachers Award and Woman Engineer of the Year Award 2020 were conferred. The citations for the first part of the Grand Award Function were read out followed by acceptance speech by the awardees. The Life Time Contribution Awards in Engineering 2020 were conferred on Prof KA Padmanabhan and Dr TSR Prasada Rao.

Prof KA Padmanabhan being conferred the Life Time Contribution Award in Engineering 2020 virtually

Dr TSR Prasada Rao being conferred the Life Time Contribution Award in Engineering 2020 virtually

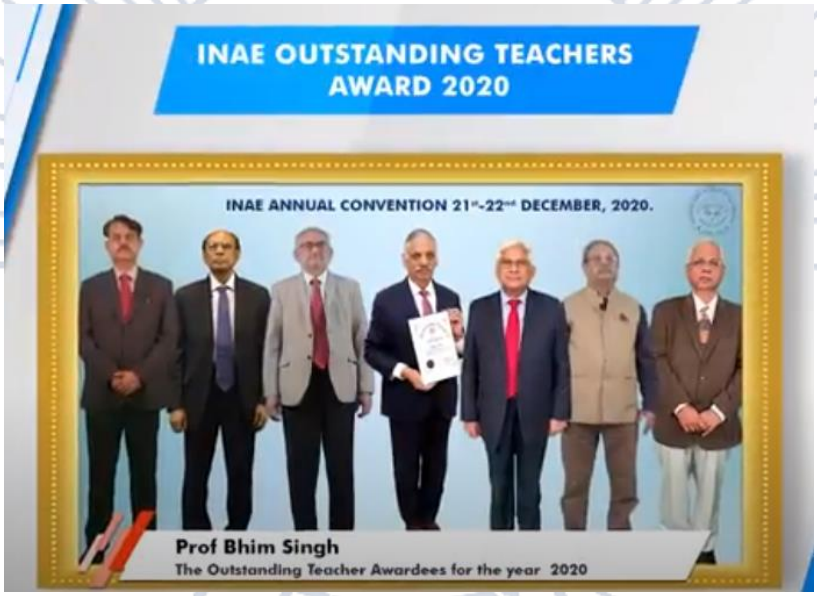
Prof Jai Krishna Memorial Award 2020 was conferred on Dr V Ramaswamy and Prof SN Mitra Memorial Award 2020 was conferred on Prof LM Patnaik.

Dr V Ramaswamy being conferred Prof Jai Krishna Memorial Award 2020 virtually

Prof LM Patnaik being conferred Prof SN Mitra Memorial Award 2020 virtually

The Outstanding Teachers Award 2020 were conferred on Prof Ranjit Kumar Ray and Prof Bhim Singh.

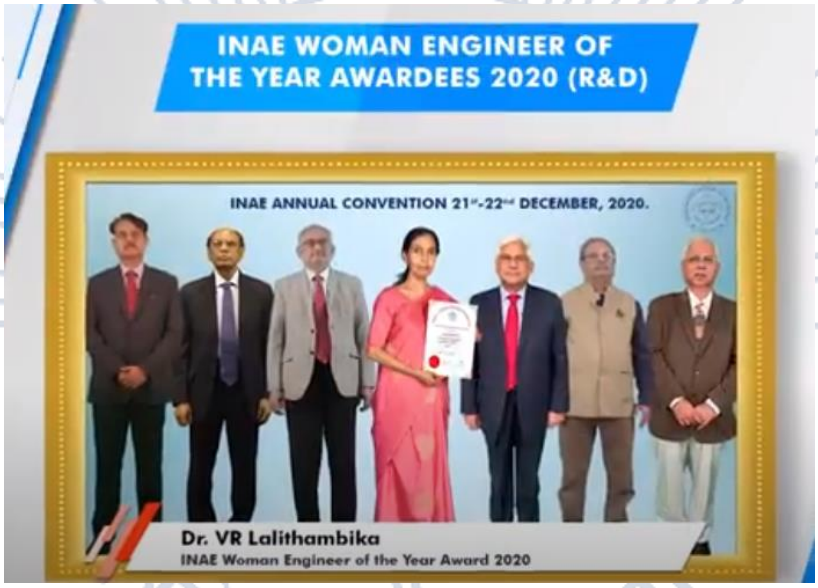
Prof Ranjit Kumar Ray being conferred the Outstanding Teachers Award 2020 virtually



Prof Bhim Singh being conferred the Outstanding Teachers Award 2020 virtually

INAE had instituted the award in the year 2020 called "INAE Woman Engineer of the Year Award". The purpose of the award is to recognize and honour our women engineers every year, who have made outstanding contributions to engineering/technology in India and who serve as role models to upcoming engineering professionals in the future. Three women engineers between the ages of 40 to 60 years, are to be awarded each year- one each from the three categories viz. Academia, R&D and Industry. Nominations were invited for the award this year and the first awardees selected for conferment of the award were Prof. Sanghamitra Bandyopadhyay in Academia category; Dr. Lalithambika VR in R&D category and Dr. Dheepa Srinivasan in Industry category.

Prof. Sanghamitra Bandyopadhyay being conferred the Woman Engineer of the Year Award 2020 virtually



Dr. Lalithambika VR being conferred the Woman Engineer of the Year Award 2020 virtually

Dr. Dheepa Srinivasan being conferred the Woman Engineer of the Year Award 2020 virtually

After the break, the Young Engineer Award, Young Entrepreneur Award and Innovative Student Projects Award were presented. Fifteen candidates were conferred the INAE Young Engineer Award 2020. INAE Young Entrepreneur Award was conferred on Mr. Akshay V Singhal and Dr. Anuya A Nisal and Special Commendation Certificate was given to Dr. Sundararajan Krishnan and Mr. Jayant Sitaram Karve. The Innovative Student Project Award 2020 was conferred on Ten nominees at Doctoral level; One individual Award and four shared Awards (Nine nominees) at Masters' Level and eight individual Awards and two shared Awards (Twelve Nominees) at Bachelor level.

Day 2 of the Annual Convention on December 22, 2020 commenced with the Induction Ceremony for newly elected Fellows/Foreign Fellows and Young Associates. At first the induction was carried out of the two eminent persons from Industry elected under Rule 37 (g) followed by induction of 38 newly elected Fellows and 6 Foreign Fellows. Fifteen Young Engineer Awardees were also inducted as Young Associates. In each case, the citations were read out and Dr Sanak Mishra, President, INAE inducted the Fellows/Young Associates into the fold of the Academy.

Subsequent to the Induction Ceremony, the Annual General Meeting (AGM) and Special General Meeting (SGM) of Fellows was held which was attended by 92 Fellows and Young Associates. During the AGM the revised composition of Governing Council, Sectional Committees and Other Committees/ Forums effective from January 1, 2021 were announced. A Brainstorming Session was held wherein suggestions/inputs were invited from the Fellows on issues of topical concern. During the SGM of Fellows the agenda items included amendment to rules as recommended by the Governing Council. The meetings ended with a vote of thanks to the outgoing President - Dr Sanak Mishra and welcoming of Prof Indranil Manna as the new President of INAE effective from January 1, 2021.

The INAE Annual Convention was a grand success and several messages/emails had been received praising the event a few of which are reproduced below.

- *"My congratulations Dr Mishra and Team INAE for the wonderful way the Inaugural Session welcomed each Fellow to the Function. Lots of work and shows the Engineers perfection"*
- "*Very comprehensive Presidential Address"*
- *"hearty congratulations to Dr Sanak Mishra, Dr BN Suresh, Dr PS Goel and all the past Presidents of INAE who have brought INAE to the current level of eminence."*
- "*Hello everyone, greetings from Chicago. Very well organized"*
- *"Excellent*"
- *"A new experience- so well done"*
- *"Excellently done in COVID19 time"*
- *Congrats for a well-organized inaugural function in the virtual mode."*
- *"Congrats for an excellent digital display of the inaugural event"*
- *"I am excited and luckiest person to get an opportunity to be part of this function. The way technology usage has been conceptualized and video has been done is awesome"*

- *"Excellent conf & speeches with good connectivity."*
- *"Extremely well organized event."*
- *"Good evening from Austin, Texas. Congratulations to INAE. Extremely successful meeting. Very impressed with how this meeting is handled. Very high standards. Excellent. Bravo and warm wishes for the meeting".*
- *"I am now enjoying the Inaugural season, and congratulations to you and Team INAE for the excellent and flawless start today."*
- *"The inaugural session was a great success. It was like a clock-work. Congratulations to you and your team and Dr. Pradip and his colleagues, and also to Vaishali and Mayank, and the compere Juhi for her clear pronunciation of every single word."*
- *"I found the session quite good and appealing. Compliments to everyone who has contributed."*
- *"The ceremony is beautifully organised and I am watching it with enjoyment.*
- *"Hearty Congratulations on a fabulous event today, that went with clockwork precision. Truly experienced "virtual reality" and what better organization than INAE to experiment with this, for the grand function."*
- *"The Award Function was very grand though it is virtual."*
- *"I thank the organizers for putting in lot of efforts to organize the virtual award ceremony".*
- *"That was an excellently conducted event. Both days were handled extremely well and all events went like clockwork. My congratulations and best wishes."*
- *"I attended INAE convention both the days on Dec.21 & 22. The event was very well organised. I wish to convey my congratulations to the President Dr. Sanak Mishra and the whole team who was responsible in organising the whole event so well."*

INAE Webinar Series Programme subsequent to Annual Convention 2020

The presentations by distinguished awardees (Life Time Contribution Award in Engineering awardees; Prof Jai Krishna and Prof SN Mitra Memorial Awardees, INAE Outstanding Teachers Awardees and INAE Woman Engineer of the Year Awardees); Newly elected Fellows/ Foreign Fellows and Young Associates are being held separately through the Webinar Series during January 2021.

The Programme for INAE Webinar Series being held from January 4-20, 2021 featuring presentations by distinguished awardees/Newly Elected Fellows/Foreign Fellows can be viewed by clicking here……

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

International Conference on Contemporary Issues in Engineering and Technology (CIET-2021) online on 8th to 9th January 2021
https://conferencealerts.com/show-event?id=231155

International Conference on Convergence of Smart Technologies (IC2ST-2021) on 9th to 10th January 2021at Pune,
https://conferencealerts.com/show-event?id=230922

3rd International Conference on Inventive Research in Material Science and Technology (ICIRMCT 2021) on 22nd to 23rd January 2021 at Coimbatore, Tamil Nadu,
https://conferencealerts.com/show-event?id=228784

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

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NEWS OF FELLOWS

1.	Prof Suresh K Bhargava, FNAE, Dean- R & I (India), STEM College, RMIT University was the only elected fellow of AAAS from Australia in 2020. Nearly 500 members of the American Association for the Advancement of Science have earned the lifetime distinction of AAAS Fellow. AAAS Fellows are elected each year by their peers serving on the Council of AAAS, the organization's member-run governing body. The title recognizes important contributions to STEM disciplines, including pioneering research, leadership within a given field, teaching and mentoring, fostering collaborations, and advancing public understanding of science. A virtual induction ceremony for the 489 newly elected Fellows will take place on February 13, 2021, the Saturday following the AAAS Annual Meeting. The honourees will receive official certificates and rosette pins in gold and blue, colours symbolizing science and engineering, by mail.
2.	Prof N Viswanadham, FNAE, Emeritus Professor & INSA Honorary Scientist, Computer Science and Automation, Indian Institute of Science, Bangalore has authored a paper on a subject of topical interest viz" Orchestrating the World's Largest Covid-19 Vaccinations in India" which can be viewed by clicking here….. He has also delivered a talk which is uploaded on YouTube and can be viewed by clicking on the link given below. https://youtu.be/Ujf5f18SX0k
3.	Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; Former Professor SOBT, GBU, Greater Noida, UP has authored a paper abstract on "Waste Heat and Waste Sources for Renewable Energy in Prevention of Pollution" which has been accepted for poster presentation in 36th ICSWTM 2021 to be held in Annapolis, MD, Washington DC, USA in March 2021. Prof SN Mukhopadhyay also delivered a lecture as an invited online speaker in ICRM 2020, on December 13, 2020 at MGU, Kottayam, Kerala, on "Recycling of LHGBRs Wastes for Renewable Energy and Prevention of Pollution". In addition, in a session on Polymer Recycling on the same day he was an invited Chairperson in the event.

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INAE ON FACEBOOK AND TWITTER

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

(a) Facebook -link https://www.facebook.com/pages/Indian-National-Academy-of-Engineering/714509531987607?ref=hl

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

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. Nanoengineered Cement Shows Promise for Sealing Leaky Gas Wells

Leaking natural gas wells are considered a potential source of methane emissions, and a new nanomaterial cement mixture could provide an effective, affordable solution for sealing these wells, according to a team of Penn State scientists." We have invented a very flexible cement that is more resistant to cracking," said Arash Dahi Taleghani, associate professor of petroleum engineering at Penn State. "That's important because there are millions of orphaned and abandoned wells around the world, and cracks in the casings can allow methane to escape into the environment." When natural gas wells are drilled, cement is used to secure the pipe, or casing, to the surrounding rock, creating a seal that prevents methane from migrating into the shallow subsurface, where it could enter waterways, or the atmosphere, where it is a potent greenhouse gas, the scientists said.Wells can extend miles underground and over time changing temperatures and pressures can degrade the cement, causing cracks to form. The scientists said repairs involve injecting cement in very narrow areas between the casing and rock, requiring special cement. "In construction, you may just mix cement and pour it, but to seal these wells you are cementing an area that has the thickness of less than a millimeter, or that of a piece of tape," Dahi Taleghani said. "Being able to better pump cement through these very narrow spaces that methane molecules can escape from is the beauty of this work." Adding almost 2D graphite created a cement mixture that better filled these narrow spaces and that was also stronger and more resilient, the scientists found. The scientists developed a multi-step process to uniformly distribute sheets of the nanomaterial into a cement slurry. By treating the graphite first with chemicals, the scientists were able to change its surface properties so the material would dissolve in water instead of repelling it. "If we just pour this material in the water and mix it, these small particles have a tendency to stick together and form a conglomerate," Dahi Taleghani said. "If they are not dispersing evenly then the graphite is not as strong inside the cement." The cement mixture can be used in active unconventional wells like those found in the Marcellus Shale gas play, or to seal orphaned and abandoned gas wells, the scientists said. It also shows promise for use in carbon dioxide capture and storage technology. Graphite is more affordable than other nanomaterials previously used to bolster cement performance. In addition, very little of the material is needed to strengthen the cement, the scientists said.

Source https://www.sciencedaily.com/releases/2020/12/201214192332.htm

2. Big Step with Small Whirls

The magnetic interactions between atoms at such minute scales can create unique states, such as skyrmions. Skyrmions have very special properties and can exist in certain material systems, such as a "stack" of different sub-nanometer-thick metal layers. Modern computer technology based on skyrmions -- which are only a few nanometers in size -- promises to enable an extremely compact and ultrafast way of storing and processing data. As an example, one concept for data storage with skyrmions could be that the bits "1" and "0" are represented by the presence and absence of a given skyrmion. This concept could thus be used in "racetrack" memories (see info box). However, it is a prerequisite that the distance between the skyrmion for the value "1" and the skyrmion gap for the value "0" remains constant when moving during the data transport, otherwise large errors could occur. As a better alternative, skyrmions having different sizes can be used for the representation of "0" and "1." These could then be transported like pearls on a string without the distances between the pearls playing a big role. The existence of two different types of skyrmions (skyrmion and skyrmion bobber) has so far only been predicted theoretically and has only be shown experimentally in a specially-grown monocrystalline material. In these experiments, however, the skyrmions exist only at extremely low temperatures. These limitations make this material unsuitable for practical applications. The research group led by Hans Josef Hug at Empa has now succeeded in solving this problem: "We have produced a multilayer system consisting of various sub-nanometer-thick ferromagnetic, noble metal and rare-earth metal layers, in which two different skyrmion states can coexist at room temperature," says Hug. His team had been studying skyrmion properties in ultra-thin ferromagnetic multilayer systems using the magnetic force microscope that they developed at Empa. For their latest experiments, they fabricated material layers made from the following metals: iridium (Ir), iron (Fe), cobalt (Co), platinum (Pt) and the rare-earth metals terbium (Tb) and gadolinium (Gd). Between the two ferromagnetic multilayers that generate skyrmions -- in which the combination of Ir/Fe/Co/Pt layers is overlaid five times -- the researchers inserted a ferrimagnetic multilayer consisting of a TbGd alloy layer and a Co layer. The special feature of this layer is that it cannot generate skyrmions on its own. The outer two layers, on the other hand, generate skyrmions in large numbers.The researchers adjusted the mixing ratio of the two metals Tb and Gd and the thicknesses of the TbGd and Co layers in the central layer in such a way that its magnetic properties can be influenced by the outer layers: the ferromagnetic layers "force" skyrmions into the central ferrimagnetic layer. This results in a multilayer system where two different types of skyrmions exist. The two types of skyrmions can easily be distinguished from each other with the magnetic force microscope due to their different sizes and intensities. The larger skyrmion, which also creates a stronger magnetic field, penetrates the entire multilayer system, i.e. also the middle ferrimagnetic multilayer. The smaller, weaker skyrmion, on the other hand only exists in the two outer multilayers. This is the great significance of the latest results with regard to a possible use of skyrmions in data processing: if binary data -- 0 and 1 -- are to be stored and read, they must be clearly distinguishable, which would be possible here by means of the two different types of skyrmions. Using the magnetic force microscope, individual parts of these multilayers were compared with each other. This allowed Hug's team to determine in which layers the different skyrmions occur. Furthermore, micromagnetic computer simulations confirmed the experimental results. These simulations were carried out in collaboration with theoreticians from the universities of Vienna and Messina. The concept of such a memory was designed in 2004 at IBM. It consists of writing information in one place by means of magnetic domains -- i.e. magnetically aligned areas -- and then moving them quickly within the device by means of currents. One bit corresponds to such a magnetic domain. This task could be performed by a skyrmion, for example. The carrier material of these magnetic information units are nanowires, which are more than a thousand times thinner than a human hair and thus promise an extremely compact form of data storage.

The transport of data along the wires also works extremely fast, about 100,000 times faster than in a conventional flash memory and with a much lower energy consumption.

Source https://www.sciencedaily.com/releases/2020/12/201221121728.htm

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3. Algorithms and Automation: Making New Technology Faster and Cheaper

Additive manufacturing (AM) machinery has advanced over time, however, the necessary software for new machines often lags behind. To help mitigate this issue, Penn State researchers designed an automated process planning software to save money, time and design resources. Newer, five-axis machines are designed to move linearly along an x, y and z plane and rotate between the planes to allow the machine to change an object's orientation. These machines are an advancement on the traditional three-axis machines that lack rotation capabilities and require support structures. Such a machine can potentially lead to large cost and time savings; however, five-axis AM lacks the same design planning and automation that three-axis machines have. This is where the creation of planning software becomes critical. "Five-axis AM is a young area, and the software isn't there yet," said Xinyi Xiao, now an assistant professor in mechanical and manufacturing engineering at Miami University in Ohio. "Essentially, we developed a methodology to automatically map designs from CAD -- computer-aided design -- software to AM to help cut unnecessary steps. You save money by taking less time to make the part and by also using less materials from three-axis support structures." "We want to automate the decision process for manufacturing designs to get to 'push button additive manufacturing,'" a researcher Joshi said. "The idea of the software is to make five-axis AM fully automated without the need for manual work or re-designs of a product. Xinyi came to me when she needed guidance or had questions, but ultimately, she held the key." The software's algorithm automatically determines a part's sections and the sections' orientations. From this, the software designates when each section will be printed, and in which orientation within the printing sequence. Through a decomposition process, the part's geometry boils down into individual sections, each printable without support structures. As each piece is made in order, the machine can rotate throughout its axes to reorient the part and continue printing. Xiao compared it to working with Lego building blocks. The algorithm can help inform a designer's process plan to manufacture a part. It allows designers opportunities to make corrections or alter the design before printing, which can positively affect cost. The algorithm can also inform a designer how feasible a part may be to create using support-free manufacturing. "With an algorithm, you don't really need the expertise from the user because it's in the software," Joshi said. "Automation can help with trying out a bunch of different scenarios very quickly before you create anything on the machine." Xiao said she intends to continue this research as some of the major application areas of this technology are aerospace and automobiles. "Large metal components, using traditional additive manufacturing, can takes days and waste lots of materials by using support structures," Xiao said. "Additive manufacturing is very powerful, and it can make a lot of things due to its flexibility; however, it also has its disadvantages. There is still more work to do."

Source https://www.sciencedaily.com/releases/2020/12/201208163010.htm

Chemical Engineering

4. Artificial Chemist 2.0: Quantum Dot R&D in Less Than an Hour

A new technology, called Artificial Chemist 2.0, allows users to go from requesting a custom quantum dot to completing the relevant R&D and beginning manufacturing in less than an hour. The tech is completely autonomous and uses artificial intelligence (AI) and automated robotic systems to perform multi-step chemical synthesis and analysis. Quantum dots are colloidal semiconductor nanocrystals, which are used in applications such as LED displays and solar cells. Artificial Chemist 2.0 is industrially relevant for both R&D and manufacturing. From a user standpoint, the whole process essentially consists of three steps. First, a user tells Artificial Chemist 2.0 the parameters for the desired quantum dots. For example, what color light do you want to produce? The second step is effectively the R&D stage, where Artificial Chemist 2.0 autonomously conducts a series of rapid experiments, allowing it to identify the optimum material and the most efficient means of producing that material. Third, the system switches over to manufacturing the desired amount of the material. "Quantum dots can be divided up into different classes," Abolhasani says. "For example, well-studied II-VI, IV-VI, and III-V materials, or the recently emerging metal halide perovskites, and so on. Basically, each class consists of a range of materials that have similar chemistries." And the first time you set up Artificial Chemist 2.0 to produce quantum dots in any given class, the robot autonomously runs a set of active learning experiments. This is how the brain of the robotic system learns the materials chemistry," researcher Abolhasani says. "Depending on the class of material, this learning stage can take between one and 10 hours. After that one-time active learning period, Artificial Chemist 2.0 can identify the best possible formulation for producing the desired quantum dots from 20 million possible combinations with multiple manufacturing steps in 40 minutes or less." The researchers note that the R&D process will almost certainly become faster every time people use it, since the AI algorithm that runs the system will learn more -- and become more efficient -- with every material that it is asked to identify. Artificial Chemist 2.0 incorporates two chemical reactors, which operate in a series. The system is designed to be entirely autonomous, and allows users to switch from one material to another without having to shut down the system. "In order to do this successfully, we had to engineer a system that leaves no chemical residues in the reactors and allows the AI-guided robotic system to add the right ingredients, at the right time, at any point in the multi-step material production process," Abolhasani says. "So that's what we did. "We're excited about what this means for the specialty chemicals industry. It really accelerates R&D to warp speed, but it is also capable of making kilograms per day of high-value, precisely engineered quantum dots. Those are industrially relevant volumes of material."

Source https://www.sciencedaily.com/releases/2020/12/201211083041.htm

Electrical Engineering

5. High-Five or Thumbs-Up? New Device Detects Which Hand Gesture You Want to Make

Berkeley -- Imagine typing on a computer without a keyboard, playing a video game without a controller or driving a car without a wheel. That's one of the goals of a new device developed by engineers at the University of California, Berkeley, that can recognize hand gestures based on electrical signals detected in the forearm. The system, which couples wearable biosensors with artificial intelligence (AI), could one day be used to control prosthetics or to interact with almost any type of electronic device. "Prosthetics are one important application of this technology, but besides that, it also offers a very intuitive way of communicating with computers." said Ali Moin, who helped design the device as a doctoral student in UC Berkeley's Department of Electrical Engineering and Computer Sciences. "Reading hand gestures is one way of improving human-computer interaction. And, while there are other ways of doing that, by, for instance, using cameras and computer vision, this is a good solution that also maintains an individual's privacy." To create the hand gesture recognition system, the team collaborated with Ana Arias, a professor of electrical engineering at UC Berkeley, to design a flexible armband that can read the electrical signals at 64 different points on the forearm. The electrical signals are then fed into an electrical chip, which is programmed with an AI algorithm capable of associating these signal patterns in the forearm with specific hand gestures. The team succeeded in teaching the algorithm to recognize 21 individual hand gestures, including a thumbs-up, a fist, a flat hand, holding up individual fingers and counting numbers. "When you want your hand muscles to contract, your brain sends electrical signals through neurons in your neck and shoulders to muscle fibers in your arms and hands," Moin said. "Essentially, what the electrodes in the cuff are sensing is this electrical field. It's not that precise, in the sense that we can't pinpoint which exact fibers were triggered, but with the high density of electrodes, it can still learn to recognize certain patterns." Like other AI software, the algorithm has to first "learn" how electrical signals in the arm correspond with individual hand gestures. To do this, each user has to wear the cuff while making the hand gestures one by one. However, the new device uses a type of advanced AI called a hyperdimensional computing algorithm, which is capable of updating itself with new information. For instance, if the electrical signals associated with a specific hand gesture change because a user's arm gets sweaty, or they raise their arm above their head, the algorithm can incorporate this new information into its model. "In gesture recognition, your signals are going to change over time, and that can affect the performance of your model," Moin said. "We were able to greatly improve the classification accuracy by updating the model on the device." Another advantage of the new device is that all of the computing occurs locally on the chip: No personal data are transmitted to a nearby computer or device. Not only does this speed up the computing time, but it also ensures that personal biological data remain private. "When Amazon or Apple creates their algorithms, they run a bunch of software in the cloud that creates the model, and then the model gets downloaded onto your device," said Jan Rabaey, the Donald O. Pedersen Distinguished Professor of Electrical Engineering at UC Berkeley and senior author of the paper. "The problem is that then you're stuck with that particular model. In our approach, we implemented a process where the learning is done on the device itself. And it is extremely quick: You only have to do it one time, and it starts doing the job. But if you do it more times, it can get better. So, it is continuously learning, which is how humans do it." While the device is not ready to be a commercial product yet, Rabaey said that it could likely get there with a few tweaks. "Most of these technologies already exist elsewhere, but what's unique about this device is that it integrates the biosensing, signal processing and interpretation, and artificial intelligence into one system that is relatively small and flexible and has a low power budget," Rabaey said.

Source https://www.sciencedaily.com/releases/2020/12/201221160414.htm

6. Flexible and Powerful Electronics

Researchers at the University of Tsukuba have created a new carbon-based electrical device, π-ion gel transistors (PIGTs), by using an ionic gel made of a conductive polymer. This work may lead to cheaper and more reliable flexible printable electronics. Organic conductors, which are carbon-based polymers that can carry electrical currents, have the potential to radically change the way electronic devices are manufactured. These conductors have properties that can be tuned via chemical modification and may be easily printed as circuits. Compared with current silicon solar panels and transistors, systems based on organic conductors could be flexible and easier to install. However, their electrical conductivity can be drastically reduced if the conjugated polymer chains become disordered because of incorrect processing, which greatly limits their ability to compete with existing technologies. Now, a team of researchers led by the University of Tsukuba have formulated a novel method for preserving the electrical properties of organic conductors by forming an "ion gel." In this case, the solvent around the poly(para-phenyleneethynylene) (PPE) chains was replaced with an ionic liquid, which then turned into a gel. Using confocal fluorescent microscopy and scanning electron microscopy, the researchers were able to verify the morphology of the organic conductor. "We showed that the internal structure of our π-ion gel is a nanofiber network of PPE, which is very good at reliably conducting electricity" says author Professor Yohei Yamamoto. In addition to acting as wires for delocalized electrons, the polymer chains direct the flow of mobile ions, which can help move charge-carriers to the carbon rings. This allows current to flow through the entire volume of the device. The resulting transistor can switch on and off in response to voltage changes in less than 20 microseconds -- which is faster than any previous device of this type. "We plan to use this advance in supramolecular chemistry and organic electronics to design a whole arrange of flexible electronic devices," explains Professor Yamamoto. The fast response time and high conductivity open the way for flexible sensors that enjoy the ease of fabrication associated with organic conductors, without sacrificing speed or performance.

Source https://www.sciencedaily.com/releases/2020/12/201216104640.htm

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7. ISRO Successfully Launches CMS-01 Communication Satellite on Board PSLV-C50 Rocket

India successfully launched its latest communication satellite CMS-01 on board its Polar rocket from the spaceport, on December 17, 2020 the second and last launch this year amid the COVID-19 pandemic. ISRO's trusted polar satellite launch vehicle, PSLV-C50, injected the satellite into the predefined orbit around 20 minutes after the lift-off from the second launch pad at the spaceport of Sriharikota. CMS-01 is the 42nd communication satellite of the space agency and it is envisaged for providing services in Extended-C Band of the frequency spectrum covering India, Andaman and Nicobar, and Lakshadweep islands. The satellite is functioning "very well", ISRO Chairman K Sivan said. The solar panels of the satellite, a crucial operation, have been deployed, he said, addressing scientists from the Mission Control Centre. ISRO Launches PSLV-C49 With EOS-01, Nine Other Satellites "I am extremely happy to declare that the PSLV-C50 successfully injected CMS-01 communication satellite precisely into the predefined sub-Geosynchronous Transfer Orbit. In another four days from now, the satellite will be placed into the specified slot into the GTO," he said. Sivan said the satellite is going to function as a replacement for communication satellite GSAT-12 which was launched 11 years ago. CMS-01 will have a lifespan of over seven years, according to ISRO. Congratulating the space agency's launch and satellite vehicle teams, the chairman said "I am sure that this satellite will be doing all the functions as planned successfully." Outlining ISRO'S future missions, Chandrayaan-3, flagship mission Aditya L-1, and Gaganyaan, he said they were planning to have missions at the earliest.These included the much awaited GSLV (Geosynchronous Satellite Launch Vehicle) and SSLV (Small Satellite Launch Vehicle) missions. "Series of missions are on hand and as usual team ISRO will rise to the occasion..," he said. PSLV-C50 is the 22nd flight of PSLV in "XL" configuration (equipped with six strap-on motors), and it was the 77th launch vehicle mission from Sriharikota, about 120 km from Chennai. It follows the successful launch of PSLV-C49 (EOS-01) earth observation satellite and nine customer spacecraft on November 7 which was ISRO's first mission of the year amid the COVID-19 pandemic. Today's launch is the last one of 2020 for ISRO.

Source https://gadgets.ndtv.com/science/news/isro-pslv-c50-cms-01-launch-successful-communication-satellite-polar-rocket-sriharikota-2340052

8. Putting on The Pressure Improves Glass for Fiber Optics

Rapid, accurate communication worldwide is possible via fiber optic cables, but as good as they are, they are not perfect. Now, researchers from Penn State and AGC Inc. in Japan suggest that the silica glass used for these cables would have less signal loss if it were manufactured under high pressure. "Signal loss means that we have to use amplifiers every 80 to 100 kilometers (50 to 62 miles)," said John C. Mauro, professor of materials science and engineering, Penn State. "After that distance, the signal wouldn't be detected properly. Across continents or across oceans that becomes a big deal."Glass fibers lose signal strength because of Rayleigh scattering -- scattering of light that comes from fluctuations in the glass's atomic structure. "Glass, on an atomic scale, is heterogeneous," said Mauro. "It has an open porosity on an atomic scale that occurs randomly." The strands in fiber optical cables are made from ultra-high purity silica glass. "Historically, the biggest breakthrough was the discovery that led to the original optical fiber -- how to get rid of the water in the glass," said Mauro. Normally glass has a lot of water that absorbs the signal at the frequencies commonly used for telecommunications. Using a modified form of chemical vapor deposition, the fibers could be made free of water. But, like nearly all glass, optical fibers are manufactured at ambient pressure. Mauro and his team used molecular simulations to investigate the effects of pressure when making optical fibers. The simulations showed that using pressure quenching of the glass, the Rayleigh scattering loss could be reduced by more than 50%. Pressure treatment of the glass would make the material more homogeneous and decrease the microscopic holes in the structure. This would create a higher mean density material with less variability. "We were looking for the independent processes that can control mean and variance," said Mauro. "We realized that the pressure dimension had not been explored previously." To manufacture optical fiber under pressure, the glass would need to be formed and cooled under pressure while it is in the glass transition phase -- the temperatures when glass is sticky, not a solid and not truly liquid. To do this would require a pressure chamber capable of 40,000 atmospheres.

Source https://www.sciencedaily.com/releases/2020/12/201222192937.htm

9. New Blended Solar Cells Yield High Power Conversion Efficiencies

Researchers at Hiroshima University in Japan have blended together various polymer and molecular semiconductors as photo-absorbers to create a solar cell with increased power efficiencies and electricity generation. These types of solar cells, known as organic photovoltaics (OPV), are devices that generate electricity when light is incident upon their photo-absorbers. The efficiency of a solar cell is determined by comparing how much electricity is generated to how much light is incident upon the cell. This is referred to as "photon harvest," or how many particles of light are converted into electrical current. The more efficient the solar cell, the more cost effective and pragmatic the cell is for commercial use. The team at the Graduate School of Advanced Science and Engineering added only a small amount of a compound that absorbs long wavelengths of light resulting in an OPV that was 1.5 times more efficient than the version without the compound. The compound was able to enhance the absorption intensity due to the optical interference effect within the device. The group went on to show that how they are distributed is key to further improved power generation efficiency. "The addition of a very small amount of a sensitizer material to an OPV cell, which consists of a semiconducting polymer that we developed previously and along with other materials," said researcher Itaru Osaka,. "This leads to a significant increase in the photocurrent and thereby the power conversion efficiency due to the amplified photon absorption that originates in the optical interference effect. A key is to use a very specific polymer, one that allows us to have a very thick semiconductor layer for OPV cells, which significantly enhances optical interference effect compared to a thin layer." As for future work, Osaka has his eyes set on pushing the boundaries of state-of-the-art solar cells. "Our next step is to develop better semiconducting polymers as the host material for this type of OPV and better sensitizer materials that can absorb more photons in the longer wavelength regions. This would lead to the realization of the world's highest efficiency in OPV cells."

Source https://www.sciencedaily.com/releases/2020/12/201209115159.htm

Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry
10. Bio-Inspired Endoscope Provides 3D Visible and Near-Infrared Images Simultaneously

Researchers have developed a new bio-inspired medical endoscope that can acquire 3D visible light and near-infrared fluorescence images at the same time. It features an optical design that combines the high-resolution 3D imaging of human vision with the mantis shrimp's capability to simultaneously detect multiple wavelengths of light. Endoscopes with 3D imaging capability can help surgeons precisely locate diseased tissue. Adding fluorescence imaging can make cancerous tissue light up for easier removal or highlight critical parts of the anatomy that need to be avoided during surgery. Researchers have demonstrated the new multimodal endoscope. Although this is an early demonstration, the new endoscope is designed to directly replace existing endoscopes without requiring clinicians to learn how to use a new instrument. "Existing fluorescence 3D endoscopes require surgeons to switch working modes during operation to see the fluorescence images," said Shi. "Because our 3D endoscope can acquire visible and fluorescent 3D images simultaneously, it not only provides more visual information but can also greatly shorten the operation time and reduce risks during surgery." Although it could be used for any endoscopic procedure, the researchers designed the new multimodal endoscope for robotic surgery systems. These systems help increase the precision and accuracy of minimally invasive procedures and can help surgeons perform complicated tasks in confined areas of the body. For robotic surgery, the enhanced visual information provided by the new endoscope could help a surgeon who may be in a different room from the patient clearly distinguish various types of tissue in the surgical field. "Although today's robotic surgical systems require the surgeon to be close by, robotic surgery based on this multimodal 3D endoscope might one day allow surgeons to remotely perform procedures in faraway locations," said Shi. "This could help solve the problem of uneven distribution of medical resources and benefit people who live in areas with relatively poor medical conditions." The new multimodal endoscope achieves high-resolution 3D imaging using two optical systems to form a binocular design much like that of human eyes. However, in this case, the optical design can accommodate both visible light like human eyes and the near-infrared wavelengths required for fluorescence imaging. This light is detected by a sensor inspired by the compound eyes of mantis shrimp, which not only detect multispectral information but also recognize polarized light. The sensor detects multiple parts of the electromagnetic spectrum by using pixels with different spectral and polarization responses. To obtain high-quality 3D images, the binocular optical system must have two optical systems with exactly the same parameters. "This places stringent requirements on the processing accuracy of optical components," said Shi. "We were able to accomplish this accuracy using precision optical processing and combined this with chip-based spectroscopy technology to make this multimodal 3D endoscope possible." To test the new endoscope, the researchers analyzed its resolution, fluorescence imaging capability and ability to simultaneously obtain 3D images with near-infrared and visible color information. The endoscope performed well and achieved a resolution as high as 7 line pairs per millimeter with visible light -- the same as the best 3D endoscopes used today -- and 4 line pairs per millimeter under near-infrared illumination. They then used the endoscope to acquire visible color and near-infrared Fluorescence images of three concentrations of indocyanine green. This near-infrared fluorescent label is approved by the FDA and used to label tumor tissues. Although the three samples could not be distinguished by the human eye, they could be clearly distinguished using the multimodal 3D endoscope. The researchers also tested the endoscope's 3D imaging performance by using it to image a toy with many crisscross parts. The endoscope was able to produce 3D images that did not cause eye fatigue, even after a long period of viewing. The researchers plan to use the 3D endoscope to perform additional biological and clinical imaging. They also plan to incorporate more wavelengths and the ability to sense polarization to provide even more visual information.

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ENGINEERING INNOVATION IN INDIA

IIT Guwahati Students' Startup 'Develops' Multilingual App for Farmers to Manage Crops

Students of IIT Guwahati and alumni of NIT Silchar and Dibrugarh Universities in Assam have developed a multi-lingual smartphone application, AgSpeak, for farmers to manage their crops. The agri-tech start-up which is free for small farmers has been developed with the goal of optimising in-farm productivity through Artificial Intelligence (AI), a press release issued by IIT, Guwahati said. This application will help the farmers in making decisions and managing farm activities by the click of a single button on their smartphone or computer. IIT Director Prof T G Sitharam said that it is a matter of immense pride that "our students are working to bring out a state-of-the-art technology for the farmers of our country". 'AgSpeak' is multilingual and has an option of Assamese and this feature is a first among all the agri-tech applications available in the market, the release said. The application considers up to 20 local crop parameters which are key indicators of their health like temperature, rainfall, sunlight hours, soil health status, among others, to alert farmers about probable crop threats in advance and suggest best practices to tackle the problems, hence optimising the resources used and maximising productivity. The app along with the Internet of Things (IOT) hardware has been tested for the past three months with 500 farmers and two tea estates and some of the major breakthroughs were precise prediction about blights in potatoes, tea mosquito bug along with water stress in winter crops which are a major concern for farmers and can cause major crop damages, if not controlled in time, the release said. Nearly 250 farmers have already been provided hands on training in utilising the full potential of the app and its user friendliness and multilingual features make it extremely easy for farmers to use. Major commercial users of the product include commercial plantation farms like tea gardens, lemon orchards and grape vineyards. AgSpeak is free for small farmers and there is a system for in-app purchases like soil testing and agri-doctor consultation. Besides, the IOT devices can be rented on monthly /yearly basis by commercial farms to further enhance precision farm management, the release said. The start-up has been co-founded by Siddhartha Bora (NIT Silchar alumnus), Manik Mittal (IIT Guwahati student), Akash Sharma (IIT Guwahati student), Nitin Chauhan (IIT Guwahati student), Dhritiman Talukdar (NIT Silchar alumnus), and Kookil Pran Goswami (Dibrugarh University alumnus).

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