INAE e-Newsletter Vol. IX, Issue 1, Jan I, 2018

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From the Editor's Desk

FREEDOM IS TO LIVE HAPPILY

Freedom is to free the mind, and understand

The meaning of dignity, victory, identity

Freedom is to have opinion, and ask question

Freedom is to resist the unacceptable

Read more

Purnendu Ghosh
Chief Editor of Publications

Recent Activities

INAE Annual Convention held during December 15-16, 2017 at TCS, Chennai

Forthcoming Activities

(NatFOE) Symposium

From the Editor's Desk

INAE Annual Convention

The Annual Convention of the Indian National Academy of Engineering (INAE) was held on Dec 15-17, 2017 TCS, SIPCOT IT Park, Siruseri, Chennai. The Convention commenced with the Inaugural Session on Dec 15, 2017 during which Mr. K Ananth Krishnan, Executive Vice-President and Chief Technology Officer, TCS, Chennai delivered the Welcome Address. This was followed by the Presidential Address by Dr BN Suresh, President, INAE. The highlight of the event was the Address by the Chief Guest, Mr. N Chandrasekaran, Chairman, Tata Sons, Mumbai who with his enlightening and inspiring words enthralled the august audience comprising of Fellows of INAE, awardees, special invitees and delegates from TCS, Chennai. The Key-note Address was delivered by Mr. Rajesh Gopinathan, CEO, TCS which was followed by the Special Induction Ceremony of INAE Fellows from Industry by Dr. BN Suresh, President, INAE for those Fellows who could not be present at the Annual General Body meeting due to their pressing engagements. The citations were read out by Prof. Indranil Manna, Vice-President, INAE. A new interactive and user friendly INAE website was launched by Mr. N Chandrasekaran and Dr. BN Suresh at the end of

From the Editor's Desk

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Freedom is to free the mind, and understand

The meaning of dignity, victory, identity.

Freedom is to have opinion, and ask question.

Freedom is to resist the unacceptable.

Freedom is to unlearn, and to imprison.

Freedom is to go slow, on a fast track.

Freedom is to ride a bike, and no place to go.

Freedom is to live in a cage, like a free bird.

Freedom is to sit quietly near a little stream.

Freedom is to breathe fresh air, and drink clean water.

Freedom is to live a normal life.

HAPPY NEW YEAR !

Purnendu Ghosh
Chief Editor of Publications

ACADEMY ACTIVITIES

From the Editor's Desk

INAE Annual Convention

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The major scientific and engineering highlights of the Convention were the presentations by newly elected Fellows and Young Engineer Awardees. The presentations were held in two Parallel Sessions on Dec 15-16, 2017. The list of the technical presentations by Fellows and Young Engineers are given below.

Presentations by Newly Elected Fellows on Dec 15-16, 2017

Dr. Jayanta Chattopadhyay	-	Full scale component to miniature specimen tests and analysis – Some research findings on material and fracture mechanics issues
Prof. Ashok M Raichur	-	Towards development of better therapeutic delivery systems using engineered nanostructured materials
Mr. P Kunhikrishnan	-	Launch Complex System – The Way Forward
Prof. CS Desai	-	Mechanics, Physics and Philosophy of Materials: Constitutive Modeling with the Disturbed State Concept (DSC)
Prof. R Rengasamy	-	Process Systems Engineering - A key to Many Locks
Dr. SC Sharma	-	Indigenous Capacity Building for High Temperature Materials for Space
Dr. J Nayak	-	Indigenous Development and Commercialization of Fiber Optic Gyroscopes for Control and Navigation Applications- A Success Story
Prof. AR Mohanty	-	Acoustical Materials for Noise Control
Mr SK Soonee	-	Challenges of Evolving Indian Power Grid

Prof. Rangan Banerjee	-	Modelling of Energy Systems
Mr VVR Sastry	-	ABCD Technologies for career growth
Prof. Anil D Sahasrabudhe	-	Transformation of engineering education in India
Prof. Mahesh Kumar	-	Role of Microgrids in Current Energy Scenario of India and the World
Prof. Ravi Shankar	-	Engineering a supply chains for growth of our nation
Prof. GA Kottantharayil	-	Performance Losses in Photovoltaic Modules Operating in the Field
Mr. S Pandian	-	Indigenous design and development of state of the art industrial Hypersonic Wind Tunnel and Shock Tunnel
Mr. JD Patil	-	Contribution to development of Indigenous Defence Industry
Prof. PK Tewari	-	Low Carbon Desalination and Water Purification
Prof. P P Mujumdar	-	Urban Floods : An Evolving Engineering Challenge
Prof. Ligy Philip	-	Remediation of Contaminated Water, Soil and Aquifers
Dr. Indranil Chattoraj	-	Hydrogen effects in material degradation
Dr. Sriram K. Rajamani	-	Designing Robust Software: From Theory To Practice
Prof. Sunil Nath	-	An Engineering Approach to Biology at the Molecular Level
Prof. Laxmidhar Behera	-	The Robotic Intelligence - Challenges and Opportunities
Dr. Archana Sharma	-	Indigenous Development of Multi-Gigawatt Pulsed Power System and Applications
Dr. Akhilesh Gupta	-	Climate Change and Extreme Weather Events in India
Dr. Manav Bhatnagar	-	Feedback-Based Free-Space Optical Communication
Prof. Hema A Murthy	-	The importance of group delay functions in speech synthesis

Presentations by INAE Young Engineer Awardees/ INAE Innovator Entrepreneur Awardee on Dec 15-16, 2017

Dr. Praveen Kumar	-	Effect of Electric Field on Time-Dependent and Time-Independent Mechanical Properties of CNT Forests
Mr. Naimesh R Patel	-	Design and Development of Refocusing System For Indian High Resolution Imaging Satellites
Dr. Supreet Saini	-	'Predicting evolution of antibiotic resistance

Mr. Tanuj Jhunjhunwala **(INAE Innovator Entrep. Awardee)**		India's first Commercial and Indigenous Underwater Robotic inspection and Survey Solutions
Dr. Sandeep Anand	-	Non-invasive Techniques for Health Monitoring of Capacitor in Single Phase Solar Inverter
Dr. Aritra Hazra	-	Leveraging Formal Methods For Design Certification of Integrated Circuits: Beyond Functional Correctness
Dr. Sushmee Badhulika	-	Nanomaterials based low cost flexible and wearable electronics for healthcare
Dr. Arpita Patra	-	Multi-party Computation
Dr. Poonam Kumari	-	Three-Dimensional Solutions for Hybrid laminates Subjected to Arbitrary Boundary Conditions using Extended Kantorovich Method
Dr. Samaresh Das	-	Silicon Based Efficient Scalable Photodetectors and Gas Sensors

Award Function on Dec 15, 2017

The Grand Award Ceremony was held on the evening of December 15, 2017. Five theses at Doctoral level, Five Theses at Master's Level and 10 Projects at Bachelor's Level were conferred the Innovative Student Projects Award. Ten nomineeswere conferred the INAE Young Engineer Award 2017. Dr. Mandava Mohana Rao and joint awardees Mr Tanuj Jhunjunwala and Dr Vinay Kumar were conferred the INAE Innovator Entrepreneur Awards 2017

Prof Ganapati Panda and Prof S Narayanan were conferred the INAE Outstanding Teachers Award 2017.

Prof Ganapati Panda being conferred the INAE Outstanding Teachers Award 2017 by Dr BN Suresh, President, INAE

Prof S Narayanan being conferred the INAE Outstanding Teachers Award 2017 by Dr BN Suresh, President, INAE

Prof K Chattopadhyay and Prof SC Dutta Roy were conferred the Prof Jai Krishna Memorial Award and Prof SN Mitra Memorial Award 2017 respectively.

Prof K Chattopadhyay being conferred the Prof Jai Krishna Memorial Award 2017 by Dr BN Suresh, President, INAE

Prof SC Dutta Roy being conferred the Prof SN Mitra Memorial Award 2017 by Dr BN Suresh, President, INAE

Mr Azim Hasham Premji and Prof TK Ghose were conferred the Life Time Contribution Award in Engineering 2017. However, both awardees could not attend the Award function for receiving the Award.

Mr Azim Hasham Premji **Prof TK Ghose**

Life Time Contribution Award in Engineering Awardees 2017

Annual General Meeting of Fellows on Dec 16, 2017

The 27th Annual General Meeting of Fellows was held on Dec 16, 2017. During the Induction Ceremony, the following were formally admitted into the Academy by the President, INAE and signed the Admission Register.

Fellows/Foreign Fellows

Mr. N Chandrasekaran, Mr. Atul Sobti, Mr. Narayanaswamy Venkataramani, Prof. PP Mujumdar, Prof. Ligy Philip, Prof. CS Desai, Prof. Hema A Murthy, Dr. Sriram K Rajamani, Prof. L Sunil Chandran, Prof. AR Mohanty, Prof. R Gnanamoorthy, Dr. Jayanta Chattopadhyay, Mr. Jayant Damodar Patil, Dr. Dasharath Ram, Dr. N Ravichandran, Prof. Sushanta Mitra, Prof. GD Yadav, Prof. Raghunathan Rengasamy, Prof. PK Tewari, Dr. NV Choudary, Mr. AN Deshpande, Prof. Mahesh Kumar, Prof. Laxmidhar Behera, Dr. Archana Sharma, Mr. SK Soonee, Prof. R. Sarathi, Prof. Anil Kottantharayil, Dr. Manav Bhatnagar, Mr VVR Sastry, Prof. PR Kumar, Mr. S Pandian, Dr. Jagannath Nayak, Mr. P Kunhikrishnan, Prof. Ashok M Raichur, Dr. Indranil Chattoraj, Dr. SC Sharma, Prof. Rangan Banerjee, Mr. Kuljit Singh Popli, Prof. Ravi Shankar, Prof. Sunil Nath, Prof. Anil D Sahasrabudhe, Dr. Akhilesh Gupta and Prof. JN Reddy.

INAE Young Associates

Mr. Naimesh R Patel, Dr. Supreet Saini, Dr. Poonam Kumari, Dr. Aritra Hazra, Dr. Arpita Patra, Dr. Sandeep Anand, Dr. Mayank Shrivastava and Dr. Samaresh Das.

Dr. BN Suresh then briefed the House on some of the important activities carried out by INAE since the last General Body Meeting. During the Brainstorming Session, Dr. BN Suresh, President, INAE requested the Fellows to give their suggestions. This was followed by the Presentations by Conveners of Sectional Committees highlighting the activities planned for the next one year. The presentations by Conveners/Members of the Sectional Committee-V (Electrical Engineering) and Sectional Committee-VII (Aerospace Engineering) on the activities planned during the year 2018 by Sectional Committees were made.

Sideline Meetings held on Dec 15-16, 2017

A Round Table Discussion meeting of selected Fellows was held on Dec 15, 2017 at TCS chaired by Dr. PS Goel, Past-President, INAE during which a Concept Paper on "Outcome of Engineer's Conclave" and " Make in India: How to make it happen" were discussed and deliberated.

Plenary Talks

Two enlightening Plenary talks were delivered during the INAE Annual Convention 2017. The First Plenary Talk was delivered by Padma Vibhushan Sangita Kalanidhi Dr Umayalpuram K Sivaraman on "Voyage of Mrudangam" who also gave a brief demonstration on the Mrudangam. The Second Plenary Talk was delivered by Shri S Somanath, Director, LPSC, Trivandrum on "Engineering Challenges in Development of High Thrust Cryogenic Engine"

Special Talk

A Special Talk was delivered by Mr. K Ananth Krishnan, Executive Vice-President & CTO, TCS on "TCS Research and Innovation Highlights" on Dec 15, 2017 wherein he gave a brief overview of the research and innovation activities undertaken by TCS, Chennai.

Cultural Programme

There was an entertaining musical cultural programme on Dec 15, 2017 during which engineers of TCS sang entertaining songs and played instrumental music which was appreciated by all.

Industry Session

An Industry Session was held on Dec 16, 2017 which featured Lectures by winners of INAE Innovator Entrepreneur Award as under

• Dr. Vinay Kumar	- Next Generation Bio-sensing for Diabetes, Chronic Kidney Disease, Anaemia & Malnutrition
• Dr. Mandava Mohana Rao	- Design and Development of 420 kV Gas Insulated Switchgear (GIS)

Sideline Meetings of INAE Forums

The meetings of the INAE Forum on Energy Chaired by Dr Ajay Mathur and Forum on Engineering education, chaired by Prof Prem Vrat were held on Dec 16, 2017 on the sidelines of the INAE Annual Convention. The meetings were attended by the Members of the Forums and the special invitees.

The photographs of the INAE Annual Convention can be viewed at the link given below

https://drive.google.com/open?id=1tGKYMsIQg6cC-MpGiDe8l1KRFpXJTJXn

Abdul Kalam Technology Innovation National Fellowship

The first cut of the Abdul Kalam Technology Innovation National Fellowship have been conferred on the following three nominees by the Search-cum-Selection Expert Committee w.e.f Jan 1, 2018.

1) Prof Sirshendu De, Department of Chemical Engineering, Indian Institute of Technology, Kharagpur
2) Prof Krishnan Balasubramanian, Department of Mechanical Engineering, Indian Institute of Technology Madras
3) Prof GK Ananthasuresh, Department of Mechanical Engineering, Indian Institute of Science, Bangalore

Annals of INAE

The soft copy of the Annals of the INAE Volume XIV, April 2017 containing the text of the lectures delivered by Life Time Contribution Awardees; newly elected Fellows of the Academy and INAE Young Engineer Awardees 2016 has been uploaded on INAE website under the Publications sub-head. The same can be downloaded from the link given below

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

All INAE Fellows are requested to visit and follow the above to increase the visibility of INAE in Social media.

Important Meetings held during December 2017

- **Meeting of INAE -DST Consultative Committee Meeting held on Dec 11, 2017**

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

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

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

Dr. BC Pai CSIR Emeritus Scientist	Government College of Engineering, Tirunelveli Sep 26-27, 2017	Delivered lectures on "Fracture in Engineering Materials", "Importance of Manufacturing & Methods", "Additive Manufacturing" and "Additive Manufacturing". Guided four theses and identified new areas for research. According to the feedback from the faculty coordinator, the students posed queries which were addressed satisfactorily by the visiting professor. It was expressed that more interactions with industry experts are needed to enhance research contributions and improve interaction between academia and industry.

Dr Jayanta Kumar Saha Deputy General Manager (Applications) Institute for Steel Development & Growth	Indian Institute of Engineering Sciences and Technology, Shibpur Nov 3-4, 2017	Delivered lectures on "Corrosion Protection of Steel by Metal Coating", "Usage of Reinforcement bars with respect to Corrosion Protection", "Grades & Usage of Stainless Steel" and " "Exposure to Automobile grades of Steels". Co -Guided project on "Performance Evaluation of different types of Reinforcement bars with respect to Corrosion Protection ". Planned to take more projects. According to the feedback from the engineering college the talk of the visiting professor helped the students to correlate applications with theoretical knowledge.
	Department of Mechanical engineering, Jadavpur University Nov 4 & Nov 28, 2017	Delivered lectures on "Usage of Structural Steel for Construction" and 'Practical ways to control corrosion for steel". According to the feedback from Engineering College, the lectures of industry expert could help students correlate applications with theoretical knowledge.
Dr Chaitanyamoy Ganguly Retired Distinguished Scientist, DAE	School of Nuclear Studies and Applications, Jadavpur University, Kolkata Nov 6-7, 2017	Delivered Lectures on "Basics of Nuclear Fission Reactor & Related Nuclear Fuels Technology Part I". According to the feedback from engineering college, the DVP programme is useful and should be linked to research guidance and also with long term visits.
Dr. Suvankar Ganguly, Principal Scientist, R&D Division, TATA Steel Ltd.	Department of Mechanical Engineering, Jadavpur University Nov 14, 2017	Delivered lecture on "Heat Transfer in continuous casting mould: Mathematical modeling perspective".
Mr. Nawal Kishore Gupta Former Deputy Director LPSC/ISRO	Madhav Institute of Technology & Science, Gwalior Nov 1-6, 2017 and Nov 10-15, 2017	Delivered lectures on "Fundamental of rocket propulsion", "Calculation of engine parameters", "Calculation of engine parameters", "Solid Propellants", " Liquid Propellants", "Rocket Staging", " Rocket Flight performance" and Tutorial -I&II. According to the feedback from college faculty coordinator, with the help of the industry expert a new subject has been introduced as elective in Semester V.

International Conferences/Seminars being organized by IITs/other Institutions

To view a list of International Conferences/Seminars being held in the month of January 2018 click here.

Honours and Awards

1.	Dr S Venkata Mohan, FNAE, CSIR-IICT, Hyderabad has been conferred with Environmental Engineering Design Award 2017 by the National Design and Research Forum (NDRF) of the Institute of Engineers, India (IEI) for his outstanding contributions in the field of Engineering Design during the 32nd Indian Engineering Congress on 21st December 2017 held at Chennai. He has also been conferred with SERB-IGCW 2017 Award for the technology developed to produce sustainable Biohydrogen from waste (with a cash prize of Rs.1.00 Lakhs) by Science and Engineering Research Board (SERB), Department of Science and Technology (DST) & Green ChemisTree Foundation during a function organized on 5th October 2017 in Mumbai .
2	Dr. Ing. B.V.A.Rao, FNAE, Adjunct Faculty, NIAS, National President, IIPE was conferred the 2017 Medal of Excellence in Engineering Education by World Federation of Engineering Organizations (WFEO) . This Medal was received by him at the Indian Engineering Congress of IEI held at Chennai on 22nd Dec 2017 directly from the hands of Dr. Marlene Kanga, President of WFEO. Further details may be viewed at the link given below You can click on the following link also to read more about this http://www.wfeo.org/awards/

News of Fellows

1.	Prof. S.N. Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani, Rajasthan has reviewed the Indian Edition of the book Biochemistry written by T.A. Brown of University of Manchester, UK. He has written the Preamble and contributed chapter-wise practice tutorial numerical problems with solutions of the book published by Viva Books, New Delhi by arrangement with Scion Publishing Ltd., UK. He delivered invited lectures at IMS Engineering College, Ghaziabad on 4th August,2017. The Fourth Edition of his book "Process Biotechnology Fundamentals" is in press to be published by Viva Books, New Delhi in 2018."
2	Mr Ajay Narayan Deshpande, FNAE, who is Director (Technical) in Engineers India Limited, a Navratna PSE, has taken over as Chairman & Managing Director (additional charge) of EIL from 1st November, 2017. Mr Deshpande, who joined the company as a Management Trainee in 1979, has achieved the unique distinction of making a career progression from the entry level to the highest level in the company's hierarchy. Mr Deshpande has also been elected as Fellow by the Indian Institute of Chemical Engineers in this year (2017)
3	Dr S Venkata Mohan, FNAE, BEES, CSIR-IICT, Hyderabad has been elected as Fellow of Andhra Pradesh Akademi of Sciences (FAPAS) effective from Nov 7, 2017 for his contributions to Environmental Engineering.
4	Prof. Prem Vrat, PhD, FNAE, FNASc., Pro-Chancellor; Professor of Eminence and Chief Mentor, The NorthCap University, Gurgaon participated in a panel discussion during the Pulse Program of DD Rajya Sabha TV on the issue of the Engineering Education Crisis. The program may be viewed at the link given below https://youtu.be/MXGKqlXgLJk
5.	Dr. Vishweshwaraiah Prakash, FINAE, Director Research, Innovation and Development at JSS MVP, Mysore and Formerly Director, CFTRI, Mysore has been elected as the Vice President of International Union of Nutritional Sciences (IUNS) for the period 2017 – 2021 in the IUNS

	Congress held at Buenos Aires during October 2017. He has also been elected as Scientific Chair for the International Union of Food Science & Technology (IUFoST) for the period 2018 – 2020".

International Conference on Mechanical Engineering on Jan 4-6, 2018 at Kolkata, West Bengal, https://conferencealerts.com/show-event?id=186507

International Conference on Innovations in Mechanical Engineering on Jan 5-6., 2018 at Hyderabad, Telangana,
https://conferencealerts.com/show-event?id=191601

17th International Conference on Embedded Systems & 31st International Conference on VLSI Design on Jan 6-10, 2018 at Pune, Maharashtra,
https://conferencealerts.com/show-event?id=187954

International Conference on New Frontiers in Engineering, Science & Technology on Jan 8-12, 2018 at New Delhi,
https://conferencealerts.com/show-event?id=182236

International Conference on Power Engineering and Renewable Energy on Jan 20-21, 2018 at Mumbai,
https://conferencealerts.com/show-event?id=194260

International Conference on Electrical Electronics and Computer Science Engineering (ICEECSE) on Jan 20-21, 2018 at New Delhi,
https://conferencealerts.com/show-event?id=193956

International Conference on Vehicle Engineering, Design and Simulation and Validation Methods on Jan 27-28, 2018 at Bengaluru,
https://conferencealerts.com/show-event?id=194261

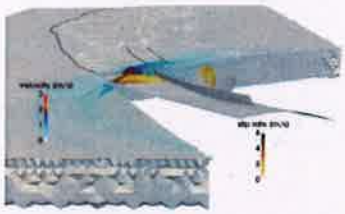
Civil Engineering

1. New Method to Rapidly Measure Magnitude of Giant Quakes

Scientists have developed a new gravity-based approach to quickly estimate the magnitude of very large earthquakes. At present, scientists use seismic waves from a rupture to work out the scale of the event. However, a new analysis of the 2011 Tohoku earthquake in Japan by researchers from Paris Diderot University in France and California Institute of Technology in the US shows that changes in gravity can give more rapid information. After an earthquake, there is an instantaneous gravitational disturbance that could be recorded before the seismic waves that seismologists can detect. In a study, researchers have managed to observe these weak signals related to gravity and to understand where they come from. Since they are sensitive to the magnitude of earthquakes, these signals may play an important role in the early identification of the occurrence of a major earthquake. Earthquakes brutally change the equilibrium of forces on Earth and emit seismic waves whose consequences can be devastating. However, these same waves also disturb the Earth's field of gravity, which produces a different signal. This is particularly interesting with a view to fast quantification of tremors, because it moves at the speed of light, unlike tremor waves, which propagate at speeds between three and 10 kilometres per second, researchers said. Seismometers at a station located 1,000 km from the epicentre may potentially detect this signal more than two minutes before the seismic waves arrive, they said. First, the scientists observed these signals on the data from about 10 seismometers located between 500 and 3,000 km from the epicentre of the 2011 Japanese earthquake (magnitude 9.1). The researchers then demonstrated that these signals were due to two effects. The first is the gravity change that occurs at the location of the seismometer, which changes the equilibrium position of the instrument's mass. The second effect, which is indirect, is due to the gravity change everywhere on Earth, which disturbs the equilibrium of the forces and produces new seismic waves that will reach the seismometer. Taking account of these two effects, the researchers have shown that this gravity-related signal is very sensitive to the earthquake's magnitude, which makes it a good candidate for rapidly quantifying the magnitude of strong earthquakes. The future challenge is to exploit this signal for magnitudes below about eight to 8.5, because below this threshold, the signal is too weak relative to the seismic noise emitted naturally by Earth, and dissociating it from this noise is complicated, researchers said.

Source https://timesofindia.indiatimes.com/world/New-method-to-rapidly-measure-magnitude-of-giant-quakes/articleshow/61915910.cms

2. Largest, Longest Multiphysics Earthquake Simulation Created to Date



Using LRZ's SuperMUC supercomputer, a joint research team from the Technical University of Munich and Ludwigs-Maximilians-Uni Munich were able to create the largest multiphysics simulation of an earthquake and tsunami. This image shows rupture propagation and the resulting seismic wave field during 2004 Sumatra-Andaman earthquake.

Just before 8:00 a.m. local time on December 26, 2004, people in southeast Asia were starting their days when the third strongest recorded earthquake in history ripped a 1,500-kilometer tear in the ocean floor off the coast of the Indonesian island of Sumatra. The earthquake lasted between 8 and 10 minutes, and lifted the ocean floor several meters, creating a tsunami with 30-meter waves that devastated whole communities. Despite major advancements in earthquake monitoring and warning systems over the last 50 years, earth scientists were unable to predict it because relatively little data exists about such large-scale seismological events. In order to more fully understand these events, a team of researchers from the Ludwig-Maximilians-Universität Munich (LMU) and Technical University of Munich (TUM) is using supercomputing resources at the Leibniz Supercomputing Centre (LRZ) to better understand these rare, extremely dangerous seismic phenomena. The team strives for "coupled" simulations of both earthquakes and subsequent tsunamis. It recently completed its largest earthquake simulation yet. Using the SuperMUC supercomputer at LRZ, the team was able to simulate 1,500 kilometers of non-linear fracture mechanics -- the earthquake source -- coupled to seismic waves traveling up to India and Thailand over a little more than 8 minutes of the Sumatra-Andaman earthquake. Through several in-house computational innovations, the team achieved a 13-fold improvement in time to solution. Earthquakes happen as rock below Earth's surface breaks suddenly, often as a result of the slow movement of tectonic plates. One rough predictor of an ocean-based earthquake's ability to unleash a large tsunami is whether plates are grinding against one another or colliding head-on. If two or more plates collide, one plate will often force the other below it. Regions where this process occurs are called subduction zones and can host very large, shallowly dipping faults -- so called "megathrusts." Energy release across such huge zones of weakness tends to create violent tsunamis, as the ocean floor rises a significant amount, temporarily displacing large amounts of water. Until recently, though, researchers doing computational geophysics had great difficulties simulating subduction earthquakes at the necessary level of detail and accuracy. When researchers simulate an earthquake, they use a computational grid to divide the simulation into many small pieces. They then compute specific equations for various aspects of the simulation, such as generated seismic shaking or ocean floor displacement, among others, over "time steps," or simulation snapshots over time that help put it in motion, much like a flip book. The finer the grid, the more accurate the simulation, but the more computationally demanding it becomes. In addition, the more complex the geometry of the earthquake, the more complex the grid becomes, further complicating the computation. To simulate subduction earthquakes, computational scientists have to create a large grid that can also accurately represent the very shallow angles at which the two continental plates meet. This requires the grid cells around the subduction area to be extra small, and often slim in shape. Unlike continental earthquakes, which have been better documented through computation and observation, subduction events often happen deep in the ocean, meaning that it is much more difficult to constrain a simulation by ground shaking observations and detailed, reliable data from direct observation and laboratory experiments. Furthermore, computing a coupled, large-scale earthquake-tsunami simulation requires using data from a wide variety of sources. Researchers must take into account the seafloor shape, the shape and strength of the plate boundary ruptured by the earthquake and the material behaviour of Earth's crust at each level, among other aspects. The team has spent the last several years developing methods to more efficiently integrate these disparate data sources into a consistent model. To reduce the enormous computing time, the team exploited a method called "local time stepping." In areas where the simulations require much more spatial detail, researchers also must "slow down" the simulation by performing more time steps in these areas. If the team had to run its entire simulation at a uniform small-time step, it would have required roughly 3 million individual iterations. However, only few cells of the computational grid required this time step size. Major parts could be computed with much larger time steps, some requiring only 3000 time steps. This reduced the computational demand significantly and led to much of the team's 13-fold speedup. This advancement also led to the team's simulation being the largest, longest first-principles simulation of an earthquake of this type.

Source https://www.sciencedaily.com/releases/2017/11/171113111046.htm

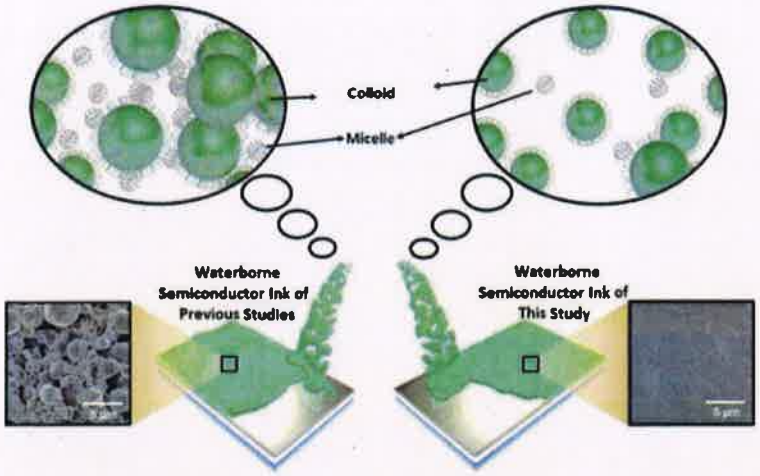
3. Inspecting Rotor Blades with Thermography and Acoustic Monitoring

Static testing of the trailing edge of a rotor blade. Acoustic emission sensors were able to detect and locate all defects.

Wind turbines have a design life of 20 years. The rotor blades must be regularly inspected at least once every four years to verify their structural integrity. But the problem with inspecting offshore installations is that access is only possible when wind and weather conditions permit. This makes it very difficult to plan inspection visits. In the Thermoflight research project, Fraunhofer scientists are working together with industrial and research partners to investigate alternative inspection methods. The use of offshore drones equipped with thermal imaging cameras in combination with acoustic monitoring systems could potentially improve maintenance efficiency and help reduce downtime. Continuous structural health monitoring (SHM) of rotor blades contributes significantly to the overall cost-efficiency of wind energy turbines. When the rotor is turning, the blade tips can reach a speed of 300 to 350 km/h. Rotor blades deliver their best aerodynamic performance when the boundary layer of wind flows smoothly over the airfoil without causing wake effects. Even the slightest surface damage can generate turbulence, resulting in lower efficiency. For a wind turbine, this means diminished output, less cost-effective operation, and a shorter service life. The extreme conditions out at sea cause materials to degrade much faster than on land. Specific stress factors include greater exposure to UV radiation, high wind speeds and salt-laden air. The industrial climbers who carry out the regular inspections check for signs of delamination and other forms of damage by tapping on the structure and examining its visual appearance. The poor accessibility of offshore wind farms and the unpredictability of maritime weather conditions make it difficult to plan the deployment of maintenance teams, with a corresponding impact on operating costs. A typical example is the case in which inspection workers are repeatedly called out but then sent home again because the weather window is too short to permit high-altitude work. Wind farm operators are therefore looking for alternative structural health monitoring methods that are equally as reliable as regular inspections by industrial climbers. In two parallel approaches, the researchers goal is to reduce wind turbine downtime and perform maintenance with fewer personnel. One approach involves the use of drones in combination with mobile thermography technology; the other employs an acoustic emission monitoring system. The acoustic emission measuring system integrated in the rotor blade serves as an early warning system by detecting internal damage, for example at the root of the rotor blade. The thermal imaging camera, on the other hand, detects surface damage, such as that caused by rain erosion. Fraunhofer IWES is optimizing the non-destructive acoustic emission monitoring system for the inspection of rotor blades. Acoustic emission and piezoelectric sensors are attached to the inner surface of the rotor blades in structurally relevant areas -- especially at known weak points. The measurement computing device that collects and analyzes the sensor data is integrated in the rotor hub. The acoustic emission measuring system has already delivered convincing results during lab tests in the institute's rotor-blade testbed facility. During static rotor blade and fatigue tests, the researchers were able to identify numerous types of damage including adhesive and inter-fiber fractures, damage to web-flange joints, cracks in the trailing edge of rotor blades, and faulty bonding in the blade root area. The next step is to test the system under real-life conditions. The acoustic emission measuring system is an efficient and reliable means of continuously monitoring very large structures. As soon as the sensors detect and localize a potential defect, appropriate measures can be initiated. Depending on the type of damage and its location, a closer, external inspection of the rotor blade could, for example, be carried out using a thermal imaging camera. Structural defects cause friction which in turn generates heat. The heat flow in the material can be detected by means of thermal imaging. In this project, a passive thermography technique is employed in which heat flow measurements are based on the intrinsic heat of the object under test or on differences in temperature due to the natural diurnal cycle. The new challenge is to adapt this proven technique to the requirements of offshore installations. By attaching thermal imaging cameras to drones, it is possible to detect subsurface defects in composite materials, including delamination, inclusions, faulty bonding in the loadbearing web-flange joints, and shrinkage cavities. Under operational load, such defects deep inside the rotor blade, if not detected and dealt with in good time, can provoke more serious structural damage and eventually lead to a total breakdown. Deutsche WindGuard Engineering GmbH has already successfully completed initial lab tests of the thermography system.

Source https://www.sciencedaily.com/releases/2017/12/171201104724.htm

4. Eco-friendly waterborne semiconductor inks using surfactant



This is a comparison of the waterborne semiconductor ink of this study and that of. This is a comparison of the waterborne semiconductor ink of this study and that of the previous studies.

A research team of Energy Science and Engineering at DGIST has developed a technology to produce environmentally friendly water-borne semiconductor inks using surfactant, which is additives that mix substances of different properties and a component of soap. Polymer semiconductors are carbon compounds showing the electrical properties of semiconductors. It has been highlighted as a next-generation material of wearable smart devices, etc. not only because they are flexible and light in weight, but also they can be processed in a wide area a low cost through the solution process. However, there is an issue that it causes significant environmental pollution as toxic organic solvents are used in the process. Despite the limitations, the research team has developed a semiconductor surface control technique using surfactants for environmentally friendly semiconductor manufacturing processes that do not use toxic organic solvents and has produced water-borne semiconductor inks. In the study, the newly developed waterborne semiconductor ink of the research team has small colloidal particles and less surfactant micelles compared to the waterborne semiconductor inks in the previous studies. As a result, it has a relatively flat surface than the conventional waterborne semiconductor inks. The black and white image in the figure shows the comparison of the surface of the thin film made with the waterborne semiconductor ink developed in this study and conventional one. According to the research team, the technique is expected to be applied in various electronic devices such as P-type and N-type transistors as well as PN diodes, complementary inverters, photodiodes as high-quality thin films. Professor Chung stressed the significance of the study by stating "This research has fundamentally solved the environmental pollution problem generated during the production of organic semiconductor, which is spotlighted as the core material of wearable electronic devices. We have developed a source technology that can disperse various semiconductor materials into water through the simple chemical modification. We expect that it can be used in various optoelectronic devices ranging from transistors to solar cell, composite circuit, and image sensor."

Source https://www.sciencedaily.com/releases/2017/11/171127105929.htm

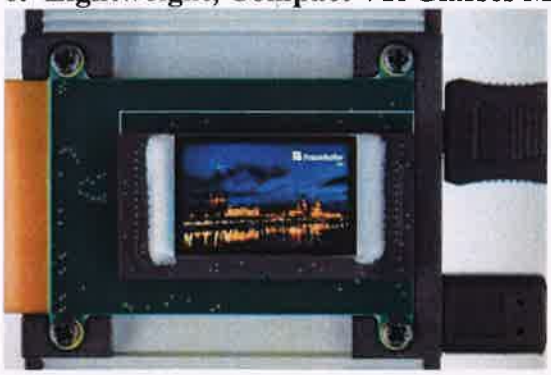
5. In first, 3-D printed objects connect to WiFi without electronics

UW engineers have developed the first 3-D printed plastic objects that can connect to other devices via WiFi without using any electronics. The 3-D printed attachment above can sense how much laundry soap is being used -- and automatically order more when the bottle is running low.

Imagine a bottle of laundry detergent that can sense when you're running low on soap -- and automatically connect to the internet to place an order for more. University of Washington researchers are the first to make this a reality by 3-D printing plastic objects and sensors that can collect useful data and communicate with other WiFi-connected devices entirely on their own. With CAD models that the team is making available to the public, 3-D printing enthusiasts will be able to create objects out of commercially available plastics that can wirelessly communicate with other smart devices. That could include a battery-free slider that controls music volume, a button that automatically orders more cornflakes from Amazon or a water sensor that sends an alarm to your phone when it detects a leak. "Our goal was to create something that just comes out of your 3-D printer at home and can send useful information to other devices," said co-lead author and UW electrical engineering doctoral student Vikram Iyer. "But the big challenge is how do you communicate wirelessly with WiFi using only plastic? That's something that no one has been able to do before." To 3-D print objects that can communicate with commercial WiFi receivers, the team employed backscatter techniques that allow devices to exchange information. In this case, the team replaced some functions normally performed by electrical components with mechanical motion activated by springs, gears, switches and other parts that can be 3-D printed -- borrowing from principles that allow battery-free watches to keep time. Backscatter systems use an antenna to transmit data by reflecting radio signals emitted by a WiFi router or other device. Information embedded in those reflected patterns can be decoded by a WiFi receiver. In this case, the antenna is contained in a 3-D printed object made of conductive printing filament that mixes plastic with copper. Physical motion -- pushing a button, laundry soap flowing out of a bottle, turning a knob, removing a hammer from a weighted tool bench -- triggers gears and springs elsewhere in the 3-D printed object that cause a conductive switch to intermittently connect or disconnect with the antenna and change its reflective state. Information -- in the form of 1s and 0s -- is encoded by the presence or absence of the tooth on a gear. Energy from a coiled spring drives the gear system, and the width and pattern of gear teeth control how long the backscatter switch makes contact with the antenna, creating patterns of reflected signals that can be decoded by a WiFi receiver. "As you pour detergent out of a Tide bottle, for instance, the speed at which the gears are turning tells you how much soap is flowing out. The interaction between the 3-D printed switch and antenna wirelessly transmits that data," said senior author and Allen School associate professor Shyam Gollakota. "Then the receiver can track how much detergent you have left and when it dips below a certain amount, it can automatically send a message to your Amazon app to order more." The team from the UW Networks & Mobile Systems Lab 3-D printed several different tools that were able to sense and send information successfully to other connected devices: a wind meter, a water flow meter and a scale. They also printed a flow meter that was used to track and order laundry soap, and a test tube holder that could be used for either managing inventory or measuring the amount of liquid in each test tube. They also 3-D printed WiFi input widgets such as buttons, knobs and sliders that can be customized to communicate with other smart devices in the home and enable a rich ecosystem of "talking objects" that can seamlessly sense and interact with their surroundings. Using a different type of 3-D printing filament that combines plastic with iron, the team also leveraged magnetic properties to invisibly encode static information in 3-D printed objects -- which could range from barcode identification for inventory purposes or information about the object that tells a robot how to interact with it. "It looks like a regular 3-D printed object but there's invisible information inside that can be read with your smartphone," said Allen School doctoral student and co-lead author Justin Chan.

Source https://www.sciencedaily.com/releases/2017/12/171205130115.htm

6. Lightweight, Compact VR Glasses Made Possible by Large-Area Microdisplays



Thanks to a cleverly designed system concept and modern design methodology, the new OLED microdisplay achieves a resolution of 1920 x 1200 pixels.

VR glasses are increasingly popular, but they have usually been heavy and oversized -- until now. Large-area microdisplays are expected to change that, because they make it possible to produce ergonomic and lightweight VR glasses. The new OLED displays now reach very high frame rates and achieve extremely high resolutions with "extended full HD." The image is crystal clear, and you feel as if you are really walking through the incredible worlds that your VR glasses are conjuring up around you. Until now, however, these glasses have usually been rather heavy and bulky. That is mainly due to the display, which is the key component in every pair of VR glasses. Commercially available VR glasses generally use displays designed for the smartphone market. These displays are cheaply available and employ simple optics to provide a wide field of view. The disadvantage is that they produce pixelated images because of their limited resolution and insufficient pixel density. Modulating LCD and LCOS microdisplays are also used. These are not self-illuminating, however, i.e. an external light source is necessary. In order to produce VR glasses that are light and ergonomic, some manufacturers are therefore already focusing on OLED microdisplays. These are based on organic light-emitting diodes, which are integrated onto a silicon chip and are self-illuminating. As a result, they are energy-efficient and yield very high contrast ratios >10,000:1. In addition, the fact that there is no need for a backlight means that they can be constructed in a simpler fashion, with fewer optical components. Another advantage is the fast switching speed of OLEDs, which is around a few microseconds as against milliseconds in the case of LCDs. This enables high frame rates as well as achieve high frame rates as well as to employ special modulation processes to improve the perceived image. As part of the EU's LOMID project -- an acronym for large cost-effective OLED microdisplays and their applications -- researchers at the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP in Dresden have been collaborating with partners from industry to develop innovative OLED microdisplays that significantly outperform others currently on the market. Within LOMID, Fraunhofer FEP is responsible for designing the integrated circuit on the silicon chip, creating OLED proto- types, and coordinating the whole project. What is so special about the microdisplays that are being developed within the project? One answer to that is their resolution: they achieve extended full HD, which means they have a resolution of 1920 x 1200 pixels (WUXGA). The diagonal screen size is about one inch, and the frame rate is around 120 Hertz. That means 120 images are displayed every second, which makes movements in the virtual world seem very fluid indeed. Two components make up the microdisplay: a silicon chip to control the pixels, and an OLED. This OLED consists of several organic layers, which are monolithically integrated on silicon wafers. The microdisplay's resolution and frame rate are set by the chip with the help of its integrated circuit. However, the really innovative feature is the type of circuit that is used. The researchers have already made their first prototype. Further prototypes are due to follow by the middle of 2018. Industry partners involved in the project have already indicated their interest in converting this microdisplay into a marketable product in the near future. In this respect, the use of OLED microdisplays is by no means limited to VR glasses -- even though this may well be the largest market in the mid-term. OLED microdisplays are also suitable for other products such as augmented-reality (AR) glasses or view finders in cameras. The underlying technology of CMOS-integrated light emitters (and any detectors) also has potential uses in other market segments such as optical metrology and identification, or optogenetics. Especially with regard to microdisplays in consumer-facing augmented-reality glasses, the researchers still see some yet unresolved challenges that they wish to tackle in the future. These challenges include: very high levels of luminance and efficiency (which will necessitate removing the colour filters used until now, and replacing these with directly structured emitters); a high yield for a large (chip) area; curved surfaces for more compact optics; circular micro-display panels; irregular pixel arrays at even higher pixel density; integrated eye-tracking; and transparent substrates.

Source https://www.sciencedaily.com/releases/2017/12/171201104730.htm

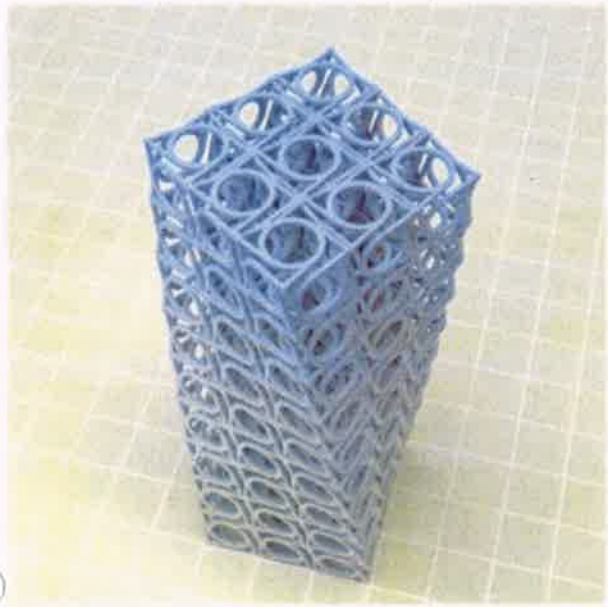
7. ISRO satellite imagery to be used for monitoring suspicious vessels along India's coastline

ISRO satellite imageries will soon monitor suspicious vessels and boats venturing into seas as part of the fortification of the country's coastal security, the home ministry said. The Indian Space Research Organisation (ISRO) will provide 1,000 transponders by March next year as part of the coastal security ring, being set up to thwart terrorist attacks on the lines of the 26/11 Mumbai carnage.

For boats under 20 metres, satellite monitoring has been proposed, a senior home ministry official said. India has strengthened the coastal security after the 2008 terror attacks in Mumbai which claimed 166 lives. So far, 19.74 lakh fishermen have enrolled for biometric identity cards and of whom, 18.60 lakhs have been issued identity cards. For monitoring of boats, automatic identification system would be installed in all boats above 20 metres, while colour coding of boats was being undertaken by coastal states and Union Territories for easier monitoring in the high seas and on the International Maritime Boundary Line, the official said. India has a coastline of 7,516 km running through Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal and the Union Territories of Daman and Diu, Lakshadweep, Puducherry and Andaman and Nicobar Islands. Standard operating procedures (SOPs) were developed for dealing with the breach of the International Maritime Boundary Line and SOPs were issued for upgrading security in non-major ports and single point mooring facilities, another official said. The SOPs were issued to coastal states and Union Territories for better coordination among stakeholders, coastal mapping started in states for entering terrain details, coastal and local police stations, bomb disposal facilities, ports railway stations, bus stands, fishing villages and fish landing points, the official said. Security of the coastline is vital for the country as there are nuclear stations, missile launching centres, defence and oil installations along the coast. India's long coastline presents a variety of security concerns that include landing of arms and explosives at isolated spots on the coast, infiltration/ex-filtration of anti-national elements, use of the sea and off-shore islands for criminal activities, smuggling of consumer and intermediate goods through sea, the official said. Absence of physical barriers and the presence of vital industrial and defence installations also enhance the vulnerability of the coasts to illegal cross-border activities, the official said.

Source http://www.firstpost.com/tech/news-analysis/isro-satellite-imagery-to-be-used-for-monitoring-suspicious-vessels-along-indias-coastline-4227071.html

8. Metamaterial with a Twist -Three-dimensional material converts linear compression forces into a rotation movement



Towers of up to 500 chiral cubic structures rotated around their axis under load. Achiral structures do not exhibit this behavior.

Using 3-D printers for the microrange, researchers of KIT have succeeded in creating a metamaterial from cubic building blocks that responds to compression forces by a rotation. Usually, this can only be achieved by transmission using a crankshaft, for instance. The sophisticated design of bars and ring structures and the underlying mathematics are now presented in the latest issue of Science. "If a force is exerted from above onto a material, the latter deforms in various ways. It may be bulged, compressed, or bent," says Martin Wegener, Professor of the Institute of Applied Physics and Director of the Institute of Nanotechnology of KIT. "According to the valid rules of mechanics, however, it will not rotate," he adds. His staff member Tobias Frenzel and colleagues, however, have now succeeded in designing a filigree cubic structure that reacts to loading by a rotation around its axis. "By means of a computer simulation, we first developed a design with this new mechanical property that has not been described so far," Frenzel, the first author of the study, explains. "Our calculations revealed that the desired behavior is shown by a complex chiral structure, i.e. a structure that cannot be mapped to its mirror image, similar to the left and the right hand." The filigree cubes calculated by Frenzel and his team consist of bars and rings that are connected to each other in a certain pattern. "The arms that connect the ring structures with the corners of the cube move vertically downwards under load. This movement leads to a rotation of the rings," Frenzel explains. "These rotation movements, in turn, transmit forces to the corners of the horizontal planes of the cube, such that the complete structure starts to twist around its axis." Then, the team produced towers of the above cubic structures of variable sizes, strengths, and pieces using a 3-D microprinting method established at KIT. The edge length of the cubes ranged from 100 to 500 µm. The researchers built towers of 4 to 500 cubes and 2 mm height. To check their theory, they also built towers of achiral cubes, i.e. cubes that can be mapped to their mirror image. The scientists found that towers assembled from chiral blocks started to rotate around their axis under the impact of force. "We measured a rotation by up to two degrees per percent of deformation," Frenzel says. The towers made of achiral cubic structures did not exhibit this rotation. The researchers also found that the stiffness of the towers increased with the number of cubes, although the dimensions of the individual components decreased proportionally. According to Tobias Frenzel, there is still a far way to go to application. Work was inspired by the team's previous studies of elastic "invisibility cloaks." These might be used to buffer shock waves of earthquakes or divert them around historic buildings.

Source https://www.sciencedaily.com/releases/2017/12/171201104606.htm

9. Switchable Solar Window Developed

Thermochromic windows capable of converting sunlight into electricity at a high efficiency have been developed by scientists at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). Relying on such advanced materials as perovskites and single-walled carbon nanotubes, the new technology responds to heat by transforming from transparent to tinted. As the window darkens, it generates electricity. The colour change is driven by molecules (methylamine) that are reversibly absorbed into the device. When solar energy heats up the device, the molecules are driven out, and the device is darkened. When the sun is not shining, the device is cooled back down, and the molecules re-absorb into the window device, which then appears transparent. A scientist at NREL holds a piece of glass that is split between transparent and opaque. The NREL-developed demonstration device allows an average of 68 percent of light in the visible portion of the solar spectrum to pass through when it's in a transparent, or bleached, state. When the window changes color -- a process that took about 3 minutes of illumination during testing -- only 3 percent is allowed through the window. Existing solar window technologies are static, which means they are designed to harness a fraction of the sunlight without sacrificing too much visible light transmission needed for viewing or the comfort of building occupants. "There is a fundamental tradeoff between a good window and a good solar cell," said Lance Wheeler, a scientist at NREL. "This technology bypasses that. We have a good solar cell when there's lots of sunshine and we have a good window when there's not." The proof-of-concept paper established a solar power conversion efficiency of 11.3 percent. "There are thermochromic technologies out there but nothing that actually converts that energy into electricity," Wheeler said. He is the lead author of the paper, "Switchable Photovoltaic Windows Enabled by Reversible Photothermal Complex Dissociation from Methylammonium Lead Iodide." In testing under 1-sun illumination, the 1-square-centimeter demonstration device cycled through repeated transparent-tinted cycles, but the performance declined over the course of 20 cycles due to restructuring of the switchable layer. Ongoing research is focused on improving cycle stability. The path to commercialization of the technology was explored last year during a two-month program called Energy I-Corps. Teams of researchers are paired with industry mentors to learn what customers want of the technology and develop viable ways to reach the marketplace. Lance Wheeler and Robert Tenent, the program lead for window technology at NREL and co-author on the paper, teamed up to develop a market strategy for a product they called SwitchGlaze. The effort was funded by the Emerging Technologies program within the Department of Energy's Building Technologies Office. Wheeler said the technology could be integrated into vehicles, buildings, and beyond. The electricity generated by the solar cell window could charge batteries to power smartphones or on-board electronics such as fans, rain sensors, and motors that would open or close the windows as programmed.

Source https://www.sciencedaily.com/releases/2017/11/171128120153.htm

Interdisciplinary Engineering and Special Fields

10. 3-D-Printed Prosthetic Implants Could Improve Treatment For Hearing Loss

This is a size comparison between 3-D printed prosthesis implant and a penny.

Researchers using CT scans and 3-D printing have created accurate, custom-designed prosthetic replacements for damaged parts of the middle ear, according to a study being presented today at the annual meeting of the Radiological Society of North America (RSNA). The technique has the potential to improve a surgical procedure that often fails because of incorrectly sized prosthetic implants, researchers said. Hearing works partly through the transmission of vibrations from the ear drum to the cochlea, the sensory organ of hearing, via three tiny bones in the middle ear known as ossicles. Ossicular conductive hearing loss occurs when the ossicles are damaged, such as from trauma or infection. Conductive hearing loss can be treated through surgical reconstruction using prostheses made from stainless steel struts and ceramic cups. The surgery, which generally involves tailoring a prosthesis for each patient in the operating room, is plagued by high failure rates. "The ossicles are very small structures, and one reason the surgery has a high failure rate is thought to be due to incorrect sizing of the prostheses," said study author Jeffrey D. Hirsch, M.D., assistant professor of radiology at the University of Maryland School of Medicine (UMSOM) in Baltimore. "If you could custom-design a prosthesis with a more exact fit, then the procedure should have a higher rate of success." Dr. Hirsch and colleagues studied 3-D printing as a way to create customized prostheses for patients with conductive hearing loss. The technology has been used successfully to solve a number of other medical prosthesis problems, including in the areas of joint replacement and facial reconstruction surgery. The researchers removed the middle linking bone in the ossicular chain from three human cadavers and imaged the structures with CT. They employed an inexpensive 3-D printer to create prostheses to restore continuity for each of the middle ears. The prostheses were made from a resin that hardens when exposed to ultraviolet laser light. Each of the prostheses had unique measurements. Four surgeons then performed insertion of each prosthesis into each middle ear, blinded to the bone from and for which each was designed. The researchers then asked the surgeons to match each prosthesis to its correct source. All four surgeons were able to correctly match the prosthesis model to its intended temporal bone -- the bone containing the middle and inner parts of the ear. The chances of this occurring randomly are 1 in 1,296, according to Dr. Hirsch. "This study highlights the core strength of 3-D printing -- the ability to very accurately reproduce anatomic relationships in space to a sub-millimeter level," Dr. Hirsch said. "With these models, it's almost a snap fit." The results suggest that commercially available CT scanners can detect significant anatomic differences in normal human middle ear ossicles, and that these differences can be accurately represented with current 3-D printing technology. More significantly, surgeons are able to detect these differences, which should not only increase the likelihood of a proper fit, but also decrease surgical time, according to Dr. Hirsch. The next step in the research, Dr. Hirsch said, is to create prostheses out of biocompatible materials. The researchers are also looking at a different approach that would combine the 3-D-printed prostheses with stem cells. "Instead of making the middle ear prosthesis solid, you could perforate it to be a lattice that allows stem cells to grow onto it," Dr. Hirsch said. "The stem cells would mature into bone and become a permanent fix for patients with hearing loss."

Source https://www.sciencedaily.com/releases/2017/12/171201091012.htm