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From the Editor's Desk

Engineering of life

Life has a history of more than 4 billion years. It has existed at different levels, and the levels are organized in a hierarchical fashion. The situations life has faced at different levels and hierarchies, and the experience thus gained can be of significant importance in the management of an enterprise.

[Read more](#)

Purnendu Ghosh
Chief Editor of Publications

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Recent Activities

Second Call for nominations invited for INAE Innovator/Entrepreneur Award 2018

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

INAE e-Newsletter

e-Newsletter for March 2018

Forthcoming Activities

10th March (Sat)

First meeting of the Search-cum-Selection Committee for Abdul Kalam National Innovation Fellowship

28th March (Wed)

AICTE-INAE Programme Committee

ACADEMY ACTIVITIES

From the Editor's Desk

INAE Announcements

Nominations have been invited for the following:

- **Election to Fellowship:** Last Date for receipt of Nominations- **March 31, 2018**
- **Election to Foreign Fellowship:** Last Date for receipt of Nominations- **March 31, 2018**
- **INAE Innovator/Entrepreneur Award 2018:** Last Date for receipt of Nominations- **March 31, 2018**

From the Editor's Desk

Engineering of life

Life has a history of more than 4 billion years. It has existed at different levels, and the levels are organized in a hierarchical fashion. The situations life has faced at different levels and hierarchies and the experience thus gained can be of significant importance in the management of an enterprise.

"To become an embryo, you had to build yourself from a single cell. You had to respire before you had lungs, digest before you had a gut, build bones when you were pulpy, and form orderly arrays of neurons before you knew how to think." We are born before we are fully developed, and that's the reason we need years of intensive care before we can fend for ourselves. Tadpoles, on the other hand, are ready to swim, find food and evade predators the moment they are born. There is a message for organisations in this: Don't treat an organisation like a tadpole, treat it as a human being; give the organisation enough time to find food, fight predators, and learn swimming.

A reasonable guiding factor to deal with the complexity is that the system must be stable, and it must be able to survive amidst chaos and complexity. Survival, thus, dictates the level of complexity an organism or an organisation can withstand. Life becomes 'live' when atoms and molecules present therein follow a particular configuration and there is a certain relationship among them. When the desired link between structure and pattern is broken life becomes a lump. There are different ways to break these links. Besides the natural ways, life can become a lump as a result of mishaps, such as starvation and injury.

There is another kind of death in which cells die by committing suicide. They do it to ensure proper development of the remaining cells. If they remain in the system, the integrity of the organism gets spoiled. Thus, it is essential to remove them. The pattern of death is so orderly that the process is called 'programmed cell death', also known as 'apoptosis'. "Apoptosis is important for an organism to be able to eliminate unnecessary or damaged cells from its body as it has to generate healthy new cells. Moreover, aberrations in apoptosis are now believed to contribute to many common disorders..."

Programmed cell death (PCD) is a natural process and is essential for our survival. PCD encourages self-destruction of the damaged, diseased, or unwanted cells. Our hand has five fingers, and that is only possible because the cells that lived between them died when we were embryos. PCD ensures a constant turnover of cells in the gut lining and generates our skin's protective outer layer of dead cells. PCD also allows the body to eradicate destructive cells. If there was no PCD, we would face 'runaway cell replication', and that might lead to cancer.

A somewhat similar thing happens in organisations. New kills the old. Joseph Schumpeter called this 'creative destruction'. He argued that innovation replaces (destroys) the established enterprises and makes way for new enterprises. In this age of innovation, enterprises are running at the speed of Moore's law - "high cost to create, minimal cost to produce, and a winner -take-all environment." This scenario suggests that enterprises must take resources away from the losers, and reallocate them to the winners.

One might ask an interesting question - Why some 'built to last' enterprises tend to under-perform and a few 'upstarts' over-perform? In a discontinuous market, Peter Drucker called it 'the age of discontinuity', new entrants are showing promising results. The weak performers, if replaced, can yield better results for the organization. Innovations destroy obsolete technologies, only to be assaulted in turn by newer and more efficient rivals. An organisation can run, even when a part of it is closed. This is also possible in the case of living beings, but they being more integrated and complex, the chances of survival of remaining organisms are comparatively less likely.

From a life apart to life together is not easy. But then that is what engineering of life teaches us.



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Chief Editor of Publications

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- **INAE Innovator Entrepreneur Award 2018:** Last Date for receipt of Nominations- **March 31, 2018**
- **INAE Young Engineer Award:** Last Date for receipt of Nominations- **March 31, 2018**
- **Innovative Student Projects Award:** Last Date for receipt of Nominations- **July 7, 2018**

Abdul Kalam Technology Innovation National Fellowship

The second call for nominations for the year 2017-18 was announced for the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship, launched in the year 2017; to recognize, encourage and support translational research by Indian Nationals working in various capacities of engineering profession, in **public funded institutions in the country.**

The Fellowship is applicable to persons engaged in the engineering profession only. The nominee should have a minimum of 5 years' service left in the parent organization. The Fellowship amount is Rs 25,000/- per month in addition to salary being drawn. A Research Grant of Rs.15.00 lakh per annum, which can be utilized for engineering research and innovation activity including hiring of manpower, consumables, national and international travel for research purposes, chemicals, equipment, etc will also be provided. A maximum of 10 Fellowships will be awarded per year. The duration of the Fellowship will be initially for three years, extendable by upto two more years depending on the performance and the Fellowship can be held for a maximum of 5 years. The guidelines and nomination proforma for the subject Fellowship can be downloaded from INAE website www.inae.in

The nominees who had applied earlier, during the first call for nominations in the year 2017 were not eligible to apply again in the current year (i.e. 2017-18). The last date for the receipt of nominations for second phase of 2017-18 was Feb 20, 2018. The meeting of the Search-Cum- Selection Expert Committee for selecting the nominees for the second phase for the year 2017-18 is being held on March 10, 2018.

Nominations invited for INAE Innovator Entrepreneur Award 2018

INAE had instituted the Innovator Entrepreneur Award last year with a view to encourage and recognize innovation and entrepreneurship among Young Engineers. Nominations for the subject Award are invited from Fellows/CEOs/Directors/Heads of industry, R&D organizations, Engineering institutions and Departments. The engineering innovations/inventions/concepts that have been actually realized and implemented in industry either in new processes or products would be given weightage. The award carries a **cash prize of Rs 2 lakhs** and the awardee/s would be conferred the same during the Awards Function to be held during the Annual Convention held in December, each year.

The guidelines along and the application proforma for the subject award can be downloaded from the INAE website www.inae.in. **The last date of receipt of nominations for the current year is March 31, 2018.**

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 February 2018

- Meeting held at Niti Aayog with Shri Amitabh Kant, CEO, Niti Aayog with INAE delegation led by Dr BN Suresh, President, INAE on Feb 1, 2018
- Joint Meeting of the INAE Editorial Committee and the Committee Constituted for Publication of the “Research Journal – INAE Letters” held on Feb 1, 2018 at INAE Gurgaon Office Chaired by Dr Purnendu Ghosh, Vice-President and Chief Editor of Publications, INAE
- AICTE-INAE Programme Committee Meeting held on Feb 2, 2018 at INAE Office, New Delhi Chaired by Dr Purnendu Ghosh, Vice-President, INAE
- Meeting of the INAE Forum on Infrastructure held on Feb 23, 2018 at INAE Office, New Delhi Chaired by Prof Prem Krishna, FNAE
- Steering Committee Meeting on Research Schemes/Proposals held on Feb 26, 2018 at INAE Office, Gurgaon Chaired by Dr Pradip, Vice-President, INAE

International Conferences/Seminars being organized by IITs/other Institutions

To view a list of International Conferences/Seminars being held in the month of March 2018 [click here](#).

Honours and Awards

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| 1. | <p>Dr TSR Prasada Rao, FNAE former Director, Indian Institute of Petroleum, Dehradun was bestowed the Life Time Achievement by Catalysis Society of India on 18th January 2018 at the 23rd Annual Catalysis Symposium held at Bangalore.</p> <p>Dr TSR Prasada Rao was also felicitated by Hon’ble Vice-President of India Shri. Venkaiah Naidu on Dec 9, 2017 at the Annual Meet of Andhra University Alumni Association (AAA) held at Andhra University, Visakhapatnam.</p> |
| 2 | <p>Dr CR Prasad, FNAE, Chairman & Managing Director, Everest Power Private Limited, Gurgaon was felicitated as “Illustrious Alumnus” by Sri Venkateswara College of Engineering Alumni Association at Tirupati on Jan 26, 2018.</p> |

News of Fellows

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|----|--|
| 1. | <p>Dr C. Ranganayakulu, FNAE, Scientist ‘H’/Outstanding Scientist (OS) and Group Director (ECS), Aeronautical Development Agency (ADA), Bangalore and Prof. K.N. Seetharamu, FNAE, Chair Professor in Thermal Engineering, Department of Mechanical Engineering, PES Institute of Technology, Bangalore have written a book on “Compact Heat Exchangers: Analysis, Design and Optimization using FEM and CFD Approach” which is being published by ASME-Wiley, UK Publishers and will be released in March 2018.</p> |
|----|--|

International Conference on Electrical, Electronics & Computer Science Engineering (ICEECSE-2018) on 3rd to 4th March 2018 at Pune,
<https://conferencealerts.com/show-event?id=194787>

International Conference on Innovations, Advances & Practices in Electrical Engineering (ICAPE 2018) on 8th to 9th March 2018 at Nagpur,
<https://conferencealerts.com/show-event?id=195576>

International Conference on Innovations in Electrical, Electronics, Power, Smart grids & Advanced Computing Technologies on 9th to 10th March 2018 at Hyderabad,
<https://conferencealerts.com/show-event?id=195557>

International Conference on Innovative Technology in, Chemical, Bioprocess, Textile, Mining Engineering (TECHNOVA-18) on 11th March 2018 at New Delhi,
<https://conferencealerts.com/show-event?id=197399>

2nd IEEE International conference on Electronics, Communication and Aerospace Technology (ICECA 2018) on 29th to 30th March 2018 at Coimbatore,
<https://conferencealerts.com/show-event?id=188854>

Civil Engineering

1. Suiker's Equations Prevent 3-D-Printed Walls from Collapsing or Falling Over



3D-printed materials commonly are soft and flexible during printing, leaving printed walls susceptible to collapse or falling over. Akke Suiker, professor in Applied Mechanics at Eindhoven University of Technology, had a Eureka moment and saw the solution to this structural problem. He developed a model with which engineers can now easily determine the dimensions and printing speeds for which printed wall structures remain stable. His formulae are so elementary that they can become commonplace in the fast growing field of 3D printing. Conventional concrete deposited in formwork typically is allowed to harden over period of several weeks. But 3D-printed concrete is not. With no supporting formwork, it almost immediately has to bear the weight of the subsequent layers of concrete that are printed on top of it. Everybody can feel the tension rising in their body as the structure gets higher. Is it already stiff and strong enough to add yet another layer on top? It is one of the most important issues in the new field of 3D printing. This issue was not part of the package of tasks of Professor Akke Suiker, who regularly saw the king-sized concrete printer of his university in action on the way to his office. Using his equations, Suiker is able to calculate how quickly he can lay down printing layers, given the material curing characteristics and wall dimensions -- of course without the structure collapsing. But he can also calculate how to make the structure with as little material as possible, and what the influence of structural irregularities is. Or what happens when he makes a wall slightly thicker or increases the material curing rate, or uses a completely different material. Or if the wall has a tendency just to fall over or also pulls the connecting structure with it. In the latter case, the consequential damage that occurs clearly is considerably greater. In fact, there are about 15 to 20 factors that one has to take into account, but because Suiker has conveniently scaled his equations, he was ultimately left with just five dimensionless parameters. Hence the problem is tackled with a very elegant and insightful model. When asked whether his results will be important for the field of 3D printing, Suiker is without doubt. "They should be. The insights provided by the model create essential basic knowledge for everyone who prints 3D structures. For structural designers, engineering firms but also, for example, for companies that print thin-walled plastic prostheses of small dimensions, because that is where my equations also apply." The first interest is already there: he has been invited by Cambridge University to give a seminar lecture about his work. Suiker validated his model with results of tests done with the 3D concrete printer at Eindhoven University of Technology. He developed a computer model at the same time as Suiker, with which he can also calculate the structural behaviour during the printing process, but based on the finite-element method. It is reassuring for both researchers that the results from their independently developed models mesh so well. Researcher Wolfs' model is different in terms of application. It works well for a detailed analysis of complex problems under specific printing conditions, but due to the purely numerical character and the requested computing time it is not so suitable for identifying the most important effects of the printing process, and for mapping out overall trends.

Source <https://www.sciencedaily.com/releases/2018/02/180214093847.htm>

2. New '4-D Goggles' Allow Wearers To Be 'Touched' By Approaching Objects

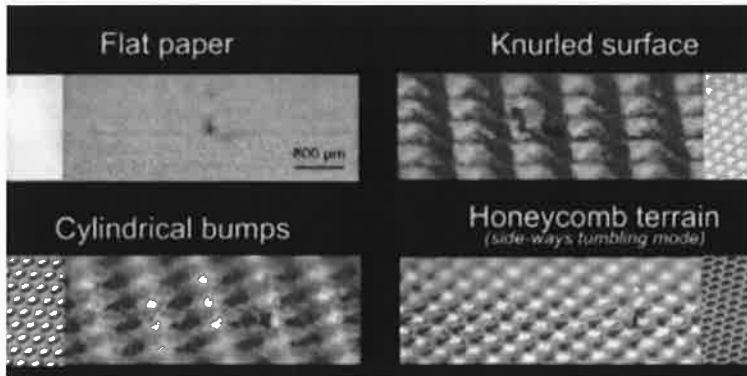


4-D goggles developed at UC San Diego.

A team of researchers at UC San Diego and San Diego State University has developed a pair of "4-D goggles" that allows wearers to be physically "touched" by a movie when they see a looming object on the screen, such as an approaching spacecraft. The device was developed based on a study conducted by the neuroscientists to map brain areas that integrate the sight and touch of a looming object and aid in their understanding of the perceptual and neural mechanisms of multisensory integration. But for the rest of us, the researchers said, it has a more practical purpose: The device can be synchronized with entertainment content, such as movies, music, games and virtual reality, to deliver immersive multisensory effects near the face and enhance the sense of presence. "We perceive and interact with the world around us through multiple senses in daily life," said Huang, the first author of the paper. "Though an approaching object may generate visual, auditory, and tactile signals in an observer, these must be picked apart from the rest of world, originally colourfully described by a researcher as a 'blooming buzzing confusion.' To detect and avoid impending threats, it is essential to integrate and analyze multisensory looming signals across space and time and to determine whether they originate from the same sources." In the researchers' experiments, subjects assessed the subjective synchrony between a looming ball (simulated in virtual reality) and an air puff delivered to the same side of the face. When the onset of ball movement and the onset of an air puff were nearly simultaneous (with a delay of 100 milliseconds), the air puff was perceived as completely out of sync with the looming ball. With a delay between 800 to 1,000 milliseconds, the two stimuli were perceived as one (in sync), as if an object had passed near the face generating a little wind. In experiments using functional Magnetic Resonance Imaging, or fMRI, the scientists delivered tactile-only, visual-only, tactile-visual out-of-sync, and tactile-visual in-sync stimuli to either side of the subject's face in randomized events. More than a dozen of brain areas were found to respond more strongly to lateralized multisensory stimuli than to lateralized unisensory stimuli, the scientists reported in their paper, and the response was further enhanced when the multisensory stimuli are in perceptual sync.

Source <https://www.sciencedaily.com/releases/2018/02/180208161918.htm>

3. All-Terrain Microbot Moves By Tumbling over Complex Topography



The "microscale magnetic tumbling robot," or TUM (microTUM), is about 400 by 800 microns, or millionths of a meter, smaller than the head of a pin.

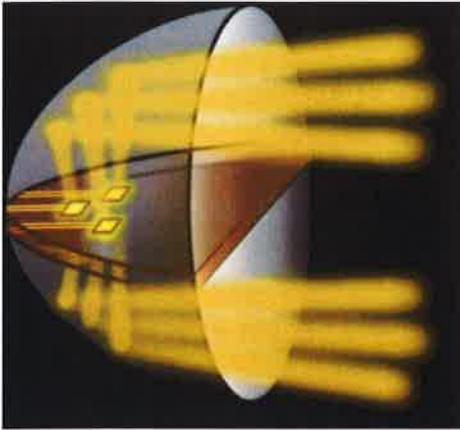
A new type of all-terrain microbot that moves by tumbling could help usher in tiny machines for various applications. The "microscale magnetic tumbling robot," or μ TUM (microTUM), is about 400 by 800 microns, or millionths of a meter, smaller than the head of a pin. A continuously rotating magnetic field propels the microbot in an end-over-end or sideways tumbling motion, which helps the microbot traverse uneven surfaces such as bumps and trenches, a difficult feat for other forms of motion. "The μ TUM is capable of traversing complex terrains in both dry and wet environments," said David Cappelleri, an associate professor in Purdue University's School of Mechanical Engineering and director of Purdue's Multi-Scale Robotics and Automation Lab. The flat, roughly dumbbell-shaped microbot is made of a polymer and has two magnetic ends. A non-magnetic midsection might be used to carry cargo such as medications. Because the bot functions well in wet environments, it has potential biomedical applications. "Robotics at the micro- and nano-scale represent one of the new frontiers in intelligent automation systems," Cappelleri said. "In particular, mobile microrobots have recently emerged as viable candidates for biomedical applications, taking advantage of their small size, manipulation, and autonomous motion capabilities. Targeted drug delivery is one of the key applications of these nano- and microrobots." Drug-delivery microbots might be used in conjunction with ultrasound to guide them to their destination in the body. Researchers studied the machine's performance when traversing inclines as steep as 60 degrees, demonstrating an impressive climbing capability in both wet and dry environments. "The ability to climb is important because surfaces in the human body are complex," Guix said. "It's bumpy, it's sticky." The ideal technology for many applications would be an untethered microrobot that is adaptable to various environments and is simple to operate. Microbots animated through magnetic fields have shown promise, Cappelleri said. While concepts explored thus far have required complex designs and microfabrication methods, the μ TUM is produced with standard photolithography techniques used in the semiconductor industry. The new paper focuses on the microrobot design, fabrication, and use of rotating magnetic fields to operate them in a strategy to negotiate complex terrains. One critical factor in the development of such microbots is the effect of electrostatic and van der Waals forces between molecules that are prevalent on the scale of microns but not on the macroscale of everyday life. The forces cause "stiction" between tiny components that affect their operation. The researchers modeled the effects of such forces. "Under dry conditions, these forces make it very challenging to move a microbot to its intended location in the body," Guix said. "They perform much better in fluid media." Because the tiny bots contain such a small quantity and surface area of magnetic material, it takes a relatively strong magnetic field to move them. At the same time, biological fluids or surfaces resist motion. "This is problematic because for microscale robots to operate successfully in real working environments, mobility is critical," Cappelleri said. One way to overcome the problem is with a tumbling locomotion, which requires a lower magnetic-field strength than otherwise needed. Another key to the bot's performance is the continuously rotating magnetic field. "Unlike the microTUM, other microscale robots use a rocking motion under an alternating magnetic field, where contact between the robot and the surface is continually lost and regained," Bi said. The microbot was tested on a dry paper surface, and in both water and silicone oil to gauge and characterize its capabilities in fluid environments of varying viscosity. Findings showed highly viscous fluids such as silicone oil limit the robot's maximum speed, while low-density media such as air limit how steep they can climb. The microTUM might be upgraded with "advanced adhesion" capabilities to perform drug-delivery for biomedical applications.

4. Tiny Membrane Key to Safe Drinking Water

Sydney's iconic harbour has played a starring role in the development of new CSIRO technology that could save lives around the world. Using their own specially designed form of graphene, 'Graphair', CSIRO scientists have supercharged water purification, making it simpler, more effective and quicker. The new filtering technique is so effective, water samples from Sydney Harbour were safe to drink after passing through the filter. "Almost a third of the world's population, some 2.1 billion people, don't have clean and safe drinking water," the paper's lead author, CSIRO scientist Dr Dong Han Seo said. "In Graphair we've found a perfect filter for water purification. It can replace the complex, time consuming and multi-stage processes currently needed with a single step." While graphene is the world's strongest material and can be just a single carbon atom thin, it is usually water repellent. Using their Graphair process, CSIRO researchers were able to create a film with microscopic nano-channels that let water pass through, but stop pollutants. As an added advantage Graphair is simpler, cheaper, faster and more environmentally friendly than graphene to make. It consists of renewable soybean oil, more commonly found in vegetable oil. Looking for a challenge, Dr Seo and his colleagues took water samples from Sydney Harbour and ran it through a commercially available water filter, coated with Graphair. Researchers from QUT, the University of Sydney, UTS, and Victoria University then tested and analysed its water purification qualities. The breakthrough potentially solves one of the great problems with current water filtering methods: fouling. Over time chemical and oil based pollutants coat and impede water filters, meaning contaminants have to be removed before filtering can begin. Tests showed Graphair continued to work even when coated with pollutants. Without Graphair, the membrane's filtration rate halved in 72 hours. When the Graphair was added, the membrane filtered even more contaminants (99 per cent removal) faster. "This technology can create clean drinking water, regardless of how dirty it is, in a single step," Dr Seo said. "All that's needed is heat, our graphene, a membrane filter and a small water pump. We're hoping to commence field trials in a developing world community next year." CSIRO is looking for industry partners to scale up the technology so it can be used to filter a home or even town's water supply. It's also investigating other applications such as the treatment of seawater and industrial effluents.

Source <https://www.sciencedaily.com/releases/2018/02/180214181846.htm>

5. Powerful LED-Based Train Headlight Optimized For Energy Savings

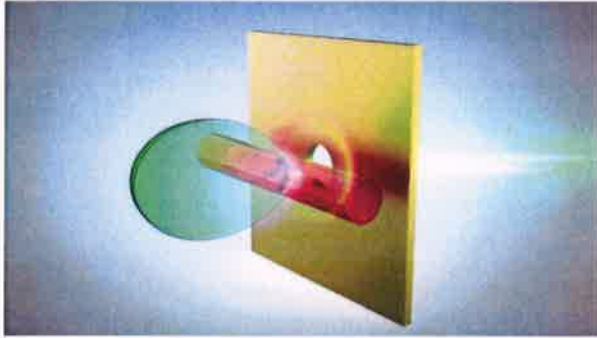


A new train headlight design uses two half-circular parabolic, or cup-shaped, aluminized reflectors with high-efficiency LEDs placed in the plane where the two reflectors come together. Combining the strong beams from each reflector generates the light intensity necessary to meet safety guidelines.

Researchers have designed a new LED-based train headlight that uses a tenth of the energy required for headlights using conventional light sources. If operated 8 hours every day, the electricity savings of the new design would reduce emissions of the greenhouse gas carbon dioxide by about 152 kilograms per year. Train headlights not only illuminate the tracks ahead, they also play an important role in rail transportation. Because trains are difficult to stop, the headlights must be visible from a distance far enough away to give people or vehicles on the tracks ample time to move out of the way. Traditional train headlights, which use incandescent or halogen bulbs, are bright enough to meet safety regulations but are not very energy efficient because most of the energy powering the light is converted into heat rather than visible light. In addition to requiring less energy, LEDs also last longer and are smaller and more rugged than traditional light sources. "Some LED headlight products sold on the market are designed with many LEDs that have outputs that overlap in large sections. These designs waste a lot of energy," said Wei-Lun Liang of the Micro Optics Device Laboratory, who was instrumental in designing the new train headlight. "Our research showed that electricity use can be reduced by focusing on the best way to distribute the LED energy equally." The researchers report a new train headlight design based on ten precisely positioned high efficiency LEDs. The design uses a total of 20.18 Watts to accomplish the same light intensity as an incandescent or halogen lamp that uses several hundred watts. The new headlight can also be dimmed by turning off some of the LEDs to avoid blinding waiting passengers when the train passes a platform, for example. Much like those used for cars, train headlights typically combine a light source with a parabolic, or cup-shaped, reflective surface that focuses the emitted light into a beam. Although LEDs are a great option for saving energy, the most energy-efficient LEDs emit smaller spots of light. For this reason, the researchers had to combine the small outputs of multiple high-efficiency LEDs into a larger circular output to create a beam large enough to use as a train headlight. The researchers' goal was a headlight that would provide light 1.25 times the brightness required by U.S. federal regulations. These regulations require train headlights to have a peak intensity of at least 200,000 candelas and illuminate a person at least 800 feet in front of the headlight. Positioning the LEDs to save energy came with several challenges. The researchers had to be careful to overlap the LED outputs just enough to create a large beam, but not so much that more LEDs, and thus more energy, would be needed. Also, the LEDs must be placed far enough from each other for heat to dissipate to prevent circuit damage. Positioning the LEDs To create a high-efficiency train headlight, the researchers used two half-circular parabolic aluminized reflectors. When used together, the strong beams from each reflector combine to generate the light intensity necessary to meet federal guidelines. This design also simplified placement of the circuits needed to power the LEDs because they could be housed in the horizontal divider separating the reflectors. To determine where to place the LEDs in the reflectors, the researchers first estimated the best location of each LED and then used a series of tests and simulations to fine-tune the final position for each LED based on its corresponding illumination pattern. The researchers point out that headlights typically use a complete parabolic reflector surface. The researchers are now working to turn their design into a commercial product. Even though the new design exhibits low power consumption, it still generates some waste heat. Before the design can be commercialized the researchers will need to develop and test a heat dissipation system for the new headlight.

Electronics and Communication Engineering

6. The Future of Wireless Communications is Terahertz

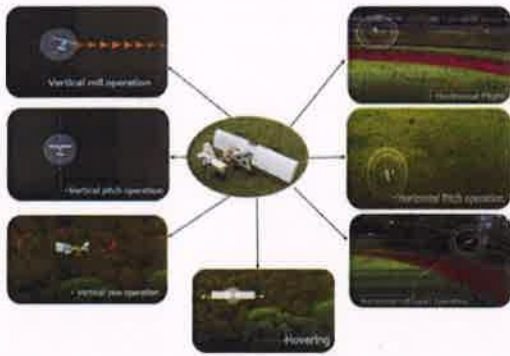


Electrical and optical engineers in Australia have designed a novel platform that could tailor telecommunication and optical transmissions. They experimentally demonstrated their system using a new transmission wavelength with a higher bandwidth capacity than those currently used in wireless communication. Here, a schematic of the problem: Aperture in a metallic screen with a dielectric fiber placed on top acting as a magnetic dipole emitter when excited by a wave incident on the aperture.

Electrical and optical engineers in Australia have designed a novel platform that could tailor telecommunication and optical transmissions. Collaborating scientists from the University of New South Wales in Sydney and Canberra, the University of Adelaide, the University of South Australia and the Australian National University experimentally demonstrated their system using a new transmission wavelength with a higher bandwidth capacity than those currently used in wireless communication. These experiments open up new horizons in communication and photonics technology. Optical fibers are the frontrunners in fast data transmission, with data encoded as microwave radiation. Microwave radiation is a type of electromagnetic radiation with longer wavelengths, and therefore lower frequencies, than visible light. Current microwave wireless networks operate at a low gigahertz frequency bandwidth. In our current digital age that demands speedy transmission of large amounts of data, the limitations of microwave bandwidths become more increasingly more apparent. In this study, scientists examined terahertz radiation, which has shorter wavelengths than microwaves and therefore has higher bandwidth capacity for data transmission. Furthermore, terahertz radiation provides a more focused signal that could improve the efficiency of communication stations and reduce power consumption of mobile towers. "I think moving into terahertz frequencies will be the future of wireless communications," said Shaghik Atakaramians, an author on the paper. However, scientists have been unable to develop a terahertz magnetic source, a necessary step to harness the magnetic nature of light for terahertz devices. The researchers investigated how the pattern of terahertz waves changes on interaction with an object. In previous work, Atakaramians and collaborators proposed that a magnetic terahertz source could theoretically be produced when a point source is directed through a subwavelength fiber, a fiber with a smaller diameter than the radiation wavelength. In this study, they experimentally demonstrated their concept using a simple setup -- directing terahertz radiation through a narrow hole adjacent to a fiber of a subwavelength diameter. The fiber was made of a glass material that supports a circulating electric field, which is crucial for magnetic induction and enhancement in terahertz radiation. "Creating terahertz magnetic sources opens up new directions for us," Atakaramians said. Terahertz magnetic sources could help the development of micro- and nanodevices. For example, terahertz security screenings at airports could reveal hidden items and explosive materials as effectively as X-rays, but without the dangers of X-ray ionization. Another advantage of the source-fiber platform, in this case using a magnetic terahertz source, is the proven ability to alter the enhancement of the terahertz transmissions by tweaking the system. "We could define the type of response we were getting from the system by changing the relative orientation of the source and fiber," Atakaramians said. Atakaramians emphasized that this ability to selectively enhance radiation isn't limited to terahertz wavelengths. "The conceptual significance here is applicable to the entire electromagnetic spectrum and atomic radiation sources," said Shakraam Afshar, the research director. This opens up new doors of development in a wide range of nanotechnologies and quantum technologies such as quantum signal processing.

Source <https://www.sciencedaily.com/releases/2018/02/180206115340.htm>

7. Aerial Vehicle Flying Freely With Independently Controlled Main Wings



Aerial vehicle with independently controlled wings demonstrates the capability in executing vertical and horizontal flight modes, as well as vertical take-off and landing.

Professor Dongsoo Har and his team in Cho Chun Shik Graduate School of Green Transportation in Korea Advanced Institute of Science and Technology (KAIST) lately developed an aerial vehicle that is able to control the main wings separately and independently. Aerial vehicles in a typical category have main wings fixed to the body (fuselage) in an integrated form. Shape of main wings, namely airfoil, produces lift force, thanks to aerodynamic interaction with air, and achieves commensurate energy efficiency. Yet, it is difficult for them to make agile movements due to the large turn radius. Banking the aerial vehicle that accounts for eventual turn comes from the adjustment of small ailerons mounted on the trailing edge of the wings. Aerial vehicles in another typical category gain thrust power by rotating multiple propellers. They can make agile movements by changing speed of motors rotating the propellers. For instance, pitch (movement up and down along vertical axis) down for moving forward with quadcopters is executed by increased speed of two rear rotors and unchanged or decreased speed of two front rotors. Rotor represents revolving part of motor. However, they are even less energy-efficient, owing to the absence of lift force created by wings. Taking these technical issues of existing types of aerial vehicles into account, his team designed the main wings of the aerial vehicle to be controlled separately and independently. Actual flight of the aerial vehicle carrying out all possible types of flight modes is shown in the accompanying image. Nsphere drone facilitates controlling the tilting angles of main wings and thus the direction of thrust power created by motors on the leading edge of main wings. Additional motor at the tail of Nsphere drone provides extra lifting force when trying vertical take-off and offers extra thrust power, by tilting the motor upward, while flying forward. Nsphere drone can change flight mode in the air from vertical to horizontal and vice versa. Due to the ability in rotating wings as well as changing the direction of thrust power come by the tail motor, the Nsphere drone with independently controlled wings can take off and land vertically without runway and auxiliary equipment. Someone might say that it is similar to aerial vehicles that have tilt rotors attached to fixed wings for vertical take-off and landing. However, advantage of Nsphere drone is the ability in tilting each main wing entirely, thereby changing angle of attack of each wing. Angle of attack indicates the angle between the oncoming air or relative wind and a reference line on the aerial vehicle or wing. In general, lift force is affected by the angle of attack. Therefore, Nsphere drone can freely control the amount of lift force gained by each wing. This allows agile movements of Nsphere drone in the horizontal flight mode. Nsphere drone can fly like a copter type aerial vehicle in the vertical flight mode, and like a fixed-wing type aerial vehicle in the horizontal flight mode. The trial to separate main wings entirely from the fuselage is very challenging. The separation of the main wings is realized by using supports that hold the main wings. One support penetrates both wings and two separate supports grab wings individually. It is also possible to apply this technology to large size aerial vehicle by including the fuselage as a part of the support for tilting wings. Part of the fuselage can be redesigned and integrated with main wings, taking plug-in structure to be coupled to the main fuselage and to stand thrust and air pressure. Nsphere drone controls each wing independently according to target flight mode. The output of the control is sensed by sensors installed in Nsphere drone and undergoes an adjustment process until desired flight operation is achieved. Through this operational process, the Nsphere drone can make agile movements in ways that might not be attained by other aerial vehicles. The team expects that the Nsphere drone, which is able to acquire energy efficiency, swiftness and speed, can be adopted for short and mid-distance air traffic delivery. Nsphere drone can be used for various fields, including airway transportation, military aerial vehicles, surveillance, general safety management, and logistics delivery services.

8. Engineers Develop Smart Material That Changes Stiffness When Twisted or Bent

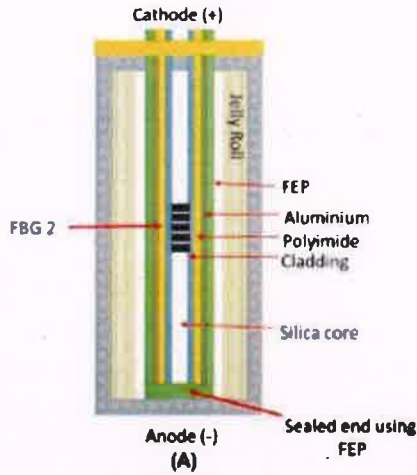


Examples of the new smart material; left to right: A flexible strip; a flexible strip that stiffened when twisted; a flexible strip transformed into a hard composite that can hold up a weight.

A new smart and responsive material can stiffen up like a worked-out muscle, say the Iowa State University engineers who developed it. Stress a muscle and it gets stronger. Mechanically stress the rubbery material -- say with a twist or a bend -- and the material automatically stiffens by up to 300 percent, the engineers said. In lab tests, mechanical stresses transformed a flexible strip of the material into a hard composite that can support 50 times its own weight. This new composite material doesn't need outside energy sources such as heat, light or electricity to change its properties. And it could be used in a variety of ways, including applications in medicine and industry. Iowa State startup funds for Thuo and Bartlett supported development of the new material. Thuo's Black & Veatch faculty fellowship also helped support the project. Development of the material combined Thuo's expertise in micro-sized, liquid-metal particles with Bartlett's expertise in soft materials such as rubbers, plastics and gels. The researchers found a simple, low-cost way to produce particles of undercooled metal -- that's metal that remains liquid even below its melting temperature. The tiny particles (they're just 1 to 20 millionths of a meter across) are created by exposing droplets of melted metal to oxygen, creating an oxidation layer that coats the droplets and stops the liquid metal from turning solid. They also found ways to mix the liquid-metal particles with a rubbery elastomer material without breaking the particles. When this hybrid material is subject to mechanical stresses -- pushing, twisting, bending, squeezing -- the liquid-metal particles break open. The liquid metal flows out of the oxide shell, fuses together and solidifies. "You can squeeze these particles just like a balloon," Thuo said. "When they pop, that's what makes the metal flow and solidify." The result, Bartlett said, is a "metal mesh that forms inside the material." Thuo and Bartlett said the popping point can be tuned to make the liquid metal flow after varying amounts of mechanical stress. Tuning could involve changing the metal used, changing the particle sizes or changing the soft material. In this case, the liquid-metal particles contain Field's metal, an alloy of bismuth, indium and tin. But Thuo said other metals will work, too. "The idea is that no matter what metal you can get to undercool, you'll get the same behavior," he said. The engineers say the new material could be used in medicine to support delicate tissues or in industry to protect valuable sensors. There could also be uses in soft and bio-inspired robotics or reconfigurable and wearable electronics. The Iowa State University Research Foundation is working to patent the material and it is available for licensing. "A device with this material can flex up to a certain amount of load," Bartlett said. "But if you continue stressing it, the elastomer will stiffen and stop or slow down these forces." And that, the engineers say, is how they're putting some muscle in their new smart material.

Source <https://www.sciencedaily.com/releases/2018/02/180214145846.htm>

9. New Tech for Commercial Lithium-Ion Batteries Finds They Can Be Charged 5 Times Fast



This is a lithium battery temperature sensor.

Researchers at WMG at the University of Warwick have developed a new direct, precise test of Lithium-ion batteries' internal temperatures and their electrodes potentials and found that the batteries can be safely charged up to five times faster than the current recommended charging limits. The new technology works in-situ during a battery's normal operation without impeding its performance and it has been tested on standard commercially available batteries. Such new technology will enable advances in battery materials science, flexible battery charging rates, thermal and electrical engineering of new battery materials/technology and it has the potential to help the design of energy storage systems for high performance applications such as motor racing and grid balancing. If a battery becomes over heated it risks severe damage particularly to its electrolyte and can even lead to dangerous situations where the electrolyte breaks down to form gases than are both flammable and cause significant pressure build up. Overcharging of the anode can lead to so much Lithium electroplating that it forms metallic dendrites and eventually pierce the separator causing an internal short circuit with the cathode and subsequent catastrophic failure. In order to avoid this, manufacturers stipulate a maximum charging rate or intensity for batteries based on what they think are the crucial temperature and potential levels to avoid. However until now internal temperature testing in a battery has proved either impossible or impractical without significantly affecting the batteries performance. Manufacturers have had to rely on a limited, external instrumentation. This method is obviously unable to provide precise readings which has led manufacturers to assign very conservative limits on maximum charging speed or intensity to ensure the battery isn't damaged or worst case suffers catastrophic failure. However researchers in WMG at the University of Warwick have been developing a new range of methods of that allows direct, highly precise internal temperature and "per-electrode" status monitoring of Lithium-ion batteries of various formats and destination. These methods can be used during a battery's normal operation without impeding its performance and it has been tested on commercially available automotive-class batteries. The data acquired by such methods is much more precise than external sensing and the WMG have been able to ascertain that commercially available lithium batteries available today could be charged at least five times faster than the current recommended maximum rates of charge. "This technology is ready to apply now to commercial batteries but we would need to ensure that battery management systems on vehicles, and that the infrastructure being put in for electric vehicles, are able to accommodate variable charging rates that would include these new more precisely tuned profiles/limits" said researchers. The technology the WMG researchers have developed for this new direct in-situ battery sensing employs miniature reference electrodes and Fibre Bragg Gratings (FBG) threaded through bespoke strain protection layer. An outer skin of fluorinated ethylene propylene (FEP) was applied over the fibre, adding chemical protection from the corrosive electrolyte. The result is a device that can have direct contact with all the key parts of the battery and withstand electrical, chemical and mechanical stress inflicted during the batteries operation while still enabling precise temperature and potential readings. "This method gave us a novel instrumentation design for use on commercial cells that minimises the adverse and previously unavoidable alterations to the cell geometry. The device included an in-situ reference electrode coupled with an optical fibre temperature sensor. We are confident that similar techniques can also be developed for use in pouch cells" said the researchers.

10. New Malleable 'Electronic Skin' Self-Healable, Recyclable



A section of "e-skin."

University of Colorado Boulder researchers have developed a new type of malleable, self-healing and fully recyclable "electronic skin" that has applications ranging from robotics and prosthetic development to better biomedical devices. Electronic skin, known as e-skin, is a thin, translucent material that can mimic the function and mechanical properties of human skin. A number of different types and sizes of wearable e-skins are now being developed in labs around the world as researchers recognize their value in diverse medical, scientific and engineering fields. The new CU Boulder e-skin has sensors embedded to measure pressure, temperature, humidity and air flow, said Assistant Professor Jianliang Xiao, who is leading the research effort with CU Boulder chemistry and biochemistry Associate Professor Wei Zhang. It has several distinctive properties, including a novel type of covalently bonded dynamic network polymer, known as polyimine that has been laced with silver nanoparticles to provide better mechanical strength, chemical stability and electrical conductivity. "What is unique here is that the chemical bonding of polyimine we use allows the e-skin to be both self-healing and fully recyclable at room temperature," said Xiao. "Given the millions of tons of electronic waste generated worldwide every year, the recyclability of our e-skin makes good economic and environmental sense." Many people are familiar with the movie *The Terminator*, in which the skin of film's main villain is "re-healed" just seconds after being shot, beaten or run over, said Zhang. While the new process is not nearly as dramatic, the healing of cut or broken e-skin, including the sensors, is done by using a mix of three commercially available compounds in ethanol, he said. Another benefit of the new CU Boulder e-skin is that it can be easily conformed to curved surfaces like human arms and robotic hands by applying moderate heat and pressure to it without introducing excessive stresses. "Let's say you wanted a robot to take care of a baby," said Zhang. "In that case you would integrate e-skin on the robot fingers that can feel the pressure of the baby. The idea is to try and mimic biological skin with e-skin that has desired functions." To recycle the skin, the device is soaked into recycling solution, making the polymers degrade into oligomers (polymers with polymerization degree usually below 10) and monomers (small molecules that can be joined together into polymers) that are soluble in ethanol. The silver nanoparticles sink to the bottom of the solution. "The recycled solution and nanoparticles can then be used to make new, functional e-skin," said Xiao.

Source <https://www.sciencedaily.com/releases/2018/02/180209170717.htm>

India's Fastest Supercomputer 'Pratyush' Established at Pune's IITM



Christened 'Pratyush', meaning the sun, the High Performance Computing (HPC) facility has been established at the Indian Institute of Tropical Meteorology (IITM), Pune.

Hon'ble Union Minister for Science and Technology Dr Harsh Vardhan dedicated India's fastest and first 'multi-petaflops' supercomputer to the nation in January 2018. Petaflops is a measure of a computer's processing speed. Christened 'Pratyush', meaning the sun, the High Performance Computing (HPC) facility has been established at the Indian Institute of Tropical Meteorology (IITM), Pune, and will be a national facility for improving weather and climate forecasts, an IITM release said. While inaugurating the facility, the minister said that it would be India's number one HPC facility in terms of peak capacity and performance. The IITM release added that the facility would help the country with better forecasts in terms of monsoon, extreme events, tsunamis, cyclones, earthquakes, air quality, lightning, fishing, hot and cold waves, flood and drought among others. This facility will also be used in coordination with the Indian Meteorological Department (IMD) and other weather monitoring institutes, to evolve better weather monitoring practices and an improved weather forecasting system. This is India's second HPC unit. The first unit, installed at National Centre for Medium Range Weather Forecasting (NCMRWF), Noida, assist weather agencies in providing daily forecasts. These supercomputers will help weather analysis reach international standards, and attain improved predictions and warnings of natural disasters.

Source <http://indianexpress.com/article/technology/tech-news-technology/indias-fastest-supercomputer-established-at-punes-iitm-5017530/>
