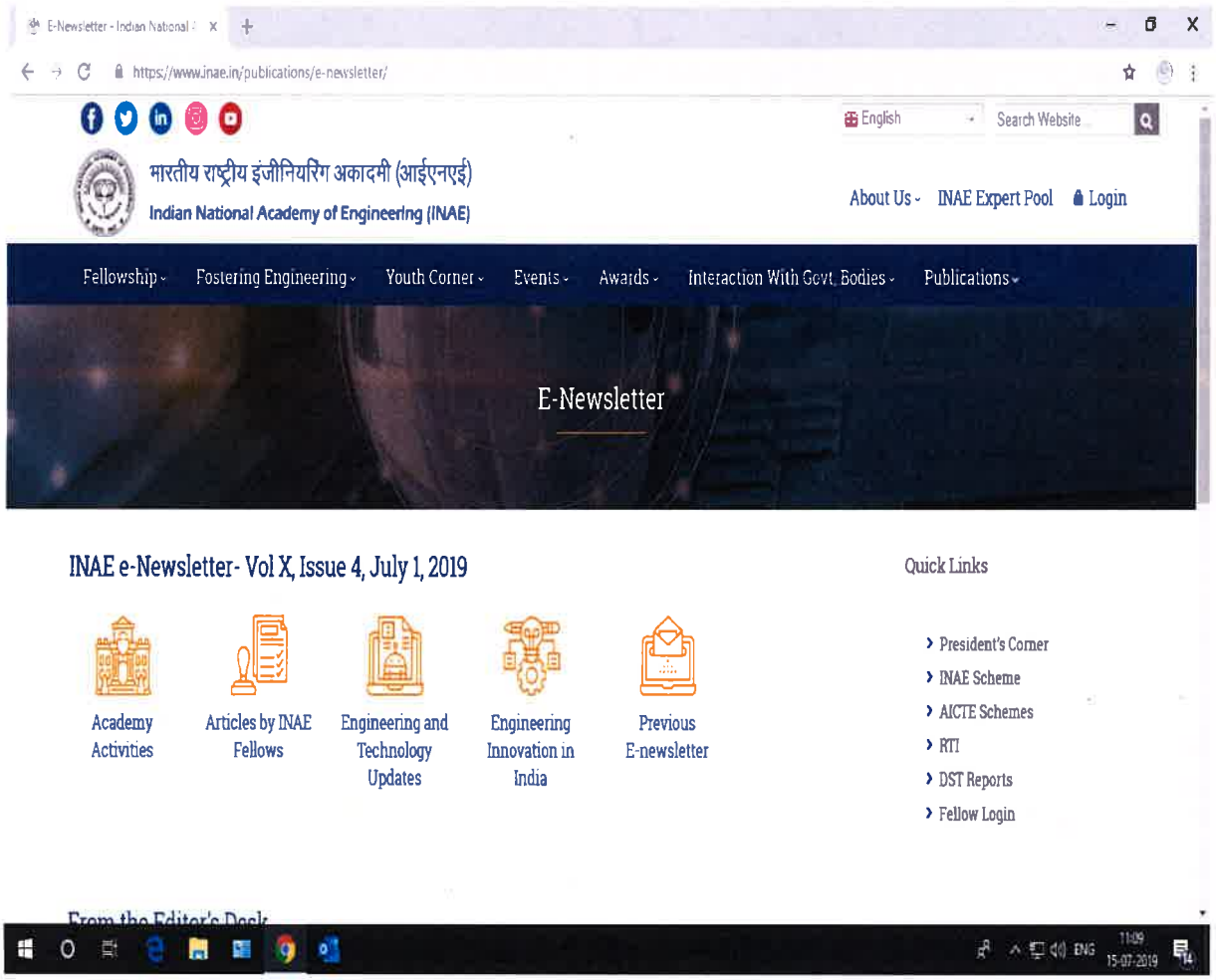
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From the Editor's Desk

ADDITIVE MANUFACTURING

In the recent past the manufacturing of the industrial products has undergone revolutionary changes due to the emergence of additive manufacturing (AM). AM is also being referred as 3D printing or digital manufacturing. Irrespective of the terminology used, AM is generally considered as the process of building parts by joining material layer by layer by employing computer-aided- design software or 3D object scanners. The CAD software directs hardware to deposit material layer by layer and creates the objects in the desired geometric shapes. This process is quite different from the traditional ways of creating an object where the excess material has to be removed by employing the fabrication processes such as machining, milling, carving and several other shaping methods. In general, AM creates a path to generate complex designs and produce objects which are of light weight but strong in nature. AM offers the flexibility in designing various components where the implementation of design concepts was considered to be impossible in the past. There are many industries which are in the verge of getting benefitted using AM techniques. There has been a notable success in manufacturing some critical parts used in jet engines and race cars. The demand for production of parts used in health care industry is souring up since the safety and efficacy of AM-built small parts is proven to a greater extent. In spite of recent success, it appears that the share of AM parts in global market is still very much less than 0.1%. There are several issues hindering the progress of AM towards adoption as well as mass production. Some of the issues which are needed immediate attention include (i) imitations in size, (ii) consistency in producing full density metal parts, (iii) variation in strength in different layers, (iv) non-availability of suitable powders of high purity, and (v) certification of parts. Currently, there is an opinion that the available AM systems may not be in a position to increase the rate of production when the demand for parts suddenly surges in. Furthermore, the technology to assess the quality and reliability of AM parts has not progressed to the level where the design and manufacturing process were advanced. In order to make AM techniques gain prominence, there is a need for the development of appropriate standards to address specific issues that arise during the course of process itself. The financial requirements for establishing machines and inspection facilities to ensure quality of products are considerable. Efforts are needed to reduce these costs to make AM more competitive compared to the traditional manufacturing processes. In the recent past, AM has caught up the attention of undergraduate and postgraduate students of mechanical, metallurgical, aeronautical, mechatronics and materials engineering disciplines in India and they are looking forward to pursue their research work in AM. It must be remembered that the success of AM would depend upon the development of well trained and skilled workforce. Creation of this skilled personnel, in this multi-disciplinary area, is a formidable task. Educational institutions shall design the courses and teach the students in AM design, processes, machines, science and technology of materials, quality assurance technologies and sensor development. In case of lack of expertise and capable faculty for teaching and research in a particular educational institution, the gap may be filled by inviting industry personnel as adjunct or visiting faculty and adopting modular concept of teaching a particular subject related to AM.

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ACADEMY ACTIVITIES

Announcements-Nominations have been invited for:

- **Abdul Kalam Technology Innovation National Fellowship:** Last Date for receipt of Nominations for the **first phase of 2019-2020 – August 10, 2019**

Abdul Kalam Technology Innovation National Fellowship

Indian National Academy of Engineering (INAE) and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) had launched the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship 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 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 and a Research Grant of Rs.15.00 lakh per annum will also be provided. An Overhead of Rs.1.00 lakh per annum will also be provided to the host institute. 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. Nominations are accepted for the Fellowship throughout the year. In addition, two calls for nominations are announced in each Financial Year. A soft copy of the nomination is required to be forwarded to INAE through email, followed by one ink signed original hard copy to be sent to INAE Office, Gurgaon through Speed Post/Courier.

The first call for nominations to be considered for the subject Fellowship, during the Financial Year 2019-2020 has been announced. All nominees who had applied in previous Financial Years are eligible to apply again once in response to either the first call or second call for nominations announced for the Financial Year 2019 - 2020. As per guidelines, a nominee may also apply again once in each subsequent Financial Year till he/she has a residual service of five years left in his/her parent organization. **The last date for the receipt of nominations to be considered in response to the first call for nominations for the Financial Year 2019- 2020 is August 10, 2019.**

The Thirteenth National Frontiers of Engineering (13NatFoE) Symposium

The Thirteenth National Frontiers of Engineering (13NatFoE) Symposium was organized by INAE jointly with IIT Bhubaneswar from May 31, 2019 to June 1, 2019 at IIT Bhubaneswar. The Inaugural Session of the two-day 13NatFoE Symposium was held on 31st May 2019 at IIT Bhubaneswar. Dr. Sanak Mishra, President, INAE was the Chief Guest and Prof. R.V. Raja Kumar, Director, IIT Bhubaneswar was the Guest of Honour. Prof. Indranil Manna, Vice -President, INAE and former Director, IIT Kanpur was also present at the Symposium. Prof Swarup Kumar Mahapatra, Dean-Continuing Education, Alumni Affairs and International Relations and Prof. S R Samantaray, Associate Professor, School of Electrical Sciences (SES) were the Coordinators of 13NatFoE Symposium.

The aim of the symposium was to bring together young and outstanding engineering professionals (aged~30-45 years) from the industry, universities, and research organizations to deliberate upon emerging and leading-edge research and development work in the domain of engineering and technology. Convening engineering professionals and technologists from various fields were provided a platform for brainstorming the contemporary and futuristic issues related to frontiers areas cross-disciplinary translational research and innovation. The overall purpose of the symposium was to interact and achieve synergy at distinctive scientific levels through presentations and discussions in the following four thematic areas: - Augmented Reality and Virtual Reality; Smart Grid; Advances in Materials and Manufacturing Technology and Next Generation Transportation Systems.

The speakers in their inaugural talks brought out very interesting points in their respective topics for meeting the pressing needs of the society. Prof. R.V. Rajakumar, Director, IIT Bhubaneswar during his Address emphasized the need for cross-disciplinary research and development to fulfil the needs of Industry. He touched upon the grand Science and Technology challenges facing the nation and the world

at large and talked about the importance of the thematic areas of Augmented Reality (AR) and Virtual Reality (VR), Artificial Intelligence (AI), Smart Grid, Next-Gen Grid, Micro & Additive Manufacturing, IOT and 5G Communication for serving the needs of the modern society. He then gave a brief overview of the research activities taking place in IIT Bhubaneswar in these areas. He advised the young engineers to come up with energy efficient systems, which will help in reducing the carbon footprint and pave the way for environment restoration and energy saving. He also informed the audience about the initiative of IIT Bhubaneswar in accurately estimating the pressure and wind-speed in collaboration with IMD before the arrival of the extremely severe cyclone, "FANI". He also thanked INAE for choosing IIT Bhubaneswar as the host of the 13thNatFoE Symposium. He complimented the Institute for hosting the event despite significant damage to the infrastructure caused by the cyclone, "FANI".

Dr. Sanak Mishra, President, INAE then delivered an interesting speech with emphasis on Research & Development and the role of INAE in nation building; which was very well received by the audience. He also ascertained that themes of the Symposium were well chosen, as they are in line with NITI Aayog's current projection of areas of national interest.

Dignitaries at the Inaugural Session

Prof RV Raja Kumar, Director, IIT Bhubaneswar presenting a Memento to Dr Sanak Mishra, President, INAE

About 60 professionals from various institutes and R&D labs, industries & start-ups attended the event and shared their contributions. A large number of research scholars and faculty members of IIT Bhubaneswar also attended the symposium and contributed in the organization of the symposium. The cross-functional interactions and networking between the participants from various domains of engineering in the Symposium allowed a larger perspective to the participants, and exposed them to some of the immediate needs of the society and also gave them an overview of research work happening in various parts of India.

Dr Sanak Mishra addressing the Audience

Prof Indranil Manna, Vice-President, INAE being presented a Bouquet in the Inaugural Session

The programme of the Symposium included 21 presentations by domain experts in the thematic areas and Plenary Talks by eminent speakers such as Prof. Ashok Jhunjhunwala, FNAE, Institute Professor, IIT Madras; Dr. Manish Gupta, FNAE, Co-founder and CEO, VideoKen; Shri. R.N, Nayak, FNAE, Former Chairman and Managing Director, Power Grid Corporation of India; Prof. Jayanta Mukhopadhyay, FNAE, IIT Kharagpur; Prof. S.A. Soman, FNAE, IIT Bombay; Prof. Rudra Pratap, FNAE, Centre for Nano Science and Engineering, Indian Institute of Science, Bangalore and Prof. M. Parida, Dept. of Civil Engineering, IIT Roorkee. The Symposium provided an excellent opportunity for sharing of novel ideas and for catalysing the start of collaborative research partnerships between brilliant young engineers and researchers from different sectors of the engineering profession.

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions have become essential as with the world over technological changes in recent times these can impart relevant knowledge to the students in the engineering institutions, that is sustainable in the changing conditions. 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, academicians 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. Ashok Kumar Tripathy, DG, CPRI and Sr. Prof & Advisor, SIT	Silicon Institute of Technology, Bhubaneswar March 15-16,2019	Delivered lectures on "Basic Exposure from Academics to Industry". As per the feedback received from the engineering institute, the interaction of the industry expert with Faculty Members has helped them in directing research in the concerned fields. Further, the lectures of the DVP have given them exposure to real time challenges faced in Industry. The DVP has also given inputs for the development of curriculum for courses in the field of EEE.
Prof MR Madhav, Professor Emeritus and Visiting Professor, IIT Hyderabad and JNTUH	Vallurupalli Nageswara Rao Vignana Jyothi Institute of Engineering and Technology, Hyderabad. April 22-24, 2019	Delivered lectures on "Geotechnical Engineering - A Non-Mechanistic Perspective", "Landslides and Slope Stabilization" and "Stress Paths/State of Soils". As per the feedback received from the engineering institution, the inputs from the Visiting Professor have helped Faculty Members and students in revising problem statements in PG studies. The Visiting Professor has also helped in suggesting topics for future PG projects.
Dr Chaitanyamoy Ganguly, Retired Distinguished Scientist, DAE	Indian Institute of Engineering Science and Technology, Shibpur May14-16,2019	Delivered lectures on " Experimental Techniques for Evaluation of Thermo-Physical Properties of Advanced High Temperature Materials - Melting Point, Thermal Diffusivity, Coefficient of Thermal Expansion, Specific Heat and Thermal Conductivity", "Indentation Techniques for Evaluation of Hot Hardness, Creep, Fatigue and Fracture Properties of Advanced Materials" and "Clean Energy- the Future". As per the feedback

		from the engineering institution, the DVP has guided projects and also suggested introduction of a new course on "Energy Security and Environmental Protection". His lectures have also been beneficial for the Faculty Members and students of the Department as inputs for taking up R&D projects related to Nano Materials and Advanced Ceramics.

Important Meetings held during June 2019

- **INAE Finance Committee held on June 13, 2019 at INAE Office, Gurgaon**
- **Meeting of Selection Committee on Life Time Contribution Award; Prof. Jai Krishna/Prof SN Mitra Memorial Awards and Outstanding Teachers Awards held on June 13, 2019 at INAE Office, Gurgaon**
- **INAE Governing Council Meeting held on June 13, 2019 at INAE Office, Gurgaon**
- **Second Meeting of the Sectional Committees held on June 14, 2019 at INSA, New Delhi**
- **General Body Meeting of Fellows held on June 14, 2019 at INSA, New Delhi**
- **Meetings of INAE Forum on Civil Infrastructure held on June 13, 2019 and June 28, 2019 at New Delhi**

International/National Conferences/Seminars being organized by IITs/other Institutions
To view a list of International/ National Conferences/Seminars being held in the month of July 2019, click here.

Honours and Awards

1.	Prof R.P. Mohanty, FNAE Chief Consultant, SOA (Deemed to be University), Bhubaneswar, Formerly Vice-President, The Associated Cement Companies Ltd., Mumbai, Formerly Chair Professor, Dean and Advisor, ITM Group of Institutions, Navi Mumbai; Vice-Chancellor, Siksha 'O' Anusandhan University, Bhubaneswar; Former Senior Advisor, ICFAI Group, IFHE University, Hyderabad has been nominated by the National Council of Indian Institution of Industrial Engineering (IIIE), (NHQ Mumbai) as the National President for a period of 2 years (2019-2021).

News of Fellows

1.	Dr Purnendu Ghosh, Vice-President, INAE and Executive Director, Birla Institute of Scientific Research, Jaipur has authored a book titled "**FLOATING IMAGES**" published by Pothi Publishers. Some of his other books are: The rising sun, Neural suitcase, Ethics of the chair, Looking into the mirror, Magic of the morning sun, Biotechnology in India and Engineering of life and life technologies. A brief description of the book titled "**FLOATING IMAGES**" is as follows. During his journey, the author met various people. Some people/events made a mark on him. In this collection of poems, the author has interpreted his experiences about the intricacies of human nature. This book is about knowing the self, more than anything else.

2.	Dr Debabrata Das, FNAE, Visiting Professor, Former Head and Renewable Energy Chair Professor, Department of Biotechnology and Former Professor-in-Charge, P K Sinha Centre for Bioenergy, Indian Institute of Technology, Kharagpur has authored a book jointly with Ms Jhansi L. Varanasi titled **"Fundamentals of Biofuel Production Processes"** which will be published this year by CRC Press, Boca Raton, Florida, USA. Brief details of the book are given below. Focusing on fundamentals of biofuel production from renewable energy sources and biohydrogen production, this book offers a complete understanding of the bioconversion processes. Each chapter begins with a fundamental explanation for general readers and ends with in-depth scientific details suitable for expert readers. It discusses different types of production technologies covering basic concepts, production strategies, commercial usage, and advances. The book also: • Covers scale-up and case studies and energy and economic analysis of biofuel production processes • Presents information on biomethanation, bioethanaol, biobutanol, biohythane and biodiesel • Discusses microbial electrochemical processes. • Describes microorganisms, biochemical pathways, and molecular biological approaches in biofuel production processes • Discusses modelling and simulation of production processes Demonstrating a comprehensive overview of both research and practical applications, this book will be of interest to an interdisciplinary group of engineers and scientists working in the alternative energy field.

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.

International/National Conferences in July 2019

International Conference on Computational Intelligence and Data Engineering (ICCIDE-2019) Conference on 4th to 6th July 2019 at Hyderabad
https://conferencealerts.com/show-event?id=211457

2019 1st IEEE International Conference on Energy, Systems and Information Processing (IEEE ICESIP 2019 Conference on 4th to 6th July 2019 at Chennai
https://conferencealerts.com/show-event?id=208542

Int Conf on Innovative Trends in Mechanical, Electrical, Electronics, Civil Eng., Computer Science, and Info. Technology Conference on 6th July 2019 at New Delhi
https://conferencealerts.com/show-event?id=214440

3rd International Conference on Recent Research Emerging Trends in Materials & Mechanical Engineering (ICRRETMME-2019) Conference on 12th to 13th July 2019 at Bangalore
https://conferencealerts.com/show-event?id=212709

International Conference on "Innovations in Electrical and Electronics Engineering" (ICIEEE-2019) Conference on 26th to 27th July 2019 at Hyderabad,
https://conferencealerts.com/show-event?id=210786

International Conference on Intelligent Computing and Smart Communication Technologies Conference on 26th to 27th July 2019 at Hyderabad,
https://conferencealerts.com/show-event?id=212447

Civil Engineering

1. Diagnosing Urban Air Pollution Exposure with New Precision

A new review of studies on levels of urban exposure to airborne pollutants and their effects on human health suggests that advanced instrumentation and information technology will soon allow researchers and policymakers to gauge the health risks of air pollution on an individual level. In New York City alone, the economic impact of premature death from causes related to air pollution, including asthma and other respiratory conditions and cardiovascular complications, exceeds $30.7 billion a year. Globally, 4.2 million deaths per year are attributable to airborne pollution, making it the fifth-ranking mortality risk factor according to a 2015 study published in the Lancet. An interdisciplinary research team from New York University, led by Masoud Ghandehari, an associate professor in NYU Tandon's Department of Civil and Urban Engineering and the Center for Urban Science and Progress (CUSP), published a comprehensive review of recent efforts to assess the impact of air pollution exposure in cities. The work explains how data gleaned from environmental sensors mounted on buildings and lamp poles, as well as mobile and wearable sensors, were combined with information on socioeconomic status, commuting patterns, and lifestyle habits such as outdoor exercise to develop models of pollution exposures at the neighborhood level. Such studies were conducted in major urban centers, including New York City, Hong Kong, and San Francisco, and informed public policy on air pollution limits and climate action strategies. Yet the authors argue that advanced sensing and information technologies can be used to even greater advantage, offering the potential for far more granular assessments -- at the level of the individual. "One of the questions we want to answer is how different people experience pollution, and why?" Ghandehari said. He explained that population-level assessments overlook factors such as personal mobility -- including commuting by car, bus, bicycle, or on foot, and often do not consider indoor climate control conditions or life stage. For example, students and working adults are more mobile than older people and are therefore more exposed, while children experience lifelong adversities. Socioeconomic status is also a known factor for increased exposure to airborne pollutants as well as increased risk of asthma and cardiovascular disease. "People from all points on the economic spectrum live in polluted areas, yet they often have different health outcomes," Ghandehari said. "Using technology to study individual associations between air pollution and health outcomes -- rather than group associations -- will yield evidence-based arguments for change that would particularly impact individuals at higher risk of negative health impacts."

Source https://www.sciencedaily.com/releases/2019/05/190501114438.htm

2. Multi-Mobile Computing System Makes Apps Sharable on Multiple Devices

Computer scientists at Columbia Engineering have developed a new computing system that enables current, unmodified mobile apps to combine and share multiple devices, including cameras, displays, speakers, microphones, sensors, and GPS, across multiple smartphones and tablets. Called M2, the new system operates across heterogeneous systems, including Android and iOS, combining the functionality of multiple mobile systems into a more powerful one that gives users a seamless experience across the various systems. With the advent of bezel-less smartphones and tablets, M2 answers the growing demand for multi-mobile computing -- users can instead dynamically switch their Netflix or Spotify streams from their smartphones to a collection of other nearby systems for a larger display or better audio. Instead of using smartphones and tablets in isolation, users can combine their system's functionalities since they now can all work together. Users can even combine photos taken from different cameras and from different angles into a single, detailed 3D image. "Given the many popular and familiar apps out there, we can combine and mix systems to do cool things with these existing unmodified apps without forcing developers to adopt new set of APIs and tools," says Naser AlDuaij, the study's lead author. "We wanted to use M2 to target all apps without adding any overhead to app development. Users can even use M2 to run Android apps from their iPhones." The challenge for the team was that mobile systems are not only highly heterogeneous, but that heterogeneous device sharing is also difficult to support. Beyond hardware heterogeneity, there are also many diverse platforms and OS versions, with a wide range of incompatible device interfaces that dictate how software applications communicate with hardware. While different mobile systems have different APIs and low-level devices are vendor-specific, the high-level device data provided to apps is generally in a standard format. So AlDuaij took a high-level device data approach and designed M2 to import and export device data in a common format to and from systems, avoiding the need to bridge incompatible mobile systems and device APIs. This method enables M2 not only to share devices, but also to mix and combine devices of different types of data since it can aggregate or manipulate device data in a known format. "With M2, we are introducing device transformation, a framework that enables different devices across disparate systems to be substituted and combined with one another to support multi-mobile heterogeneity, functionality, and transparency," says AlDuaij. "We can easily manipulate or convert device data because it's in a standard format. For example, we can easily scale and aggregate touchscreen input. We can also convert display frames to camera frames or vice versa. M2 enables us to reinterpret or represent different devices in different ways." Among M2's device "transformations" are fusing device data from multiple devices to provide a multi-headed display scenario for a better "big screen" viewing or gaming experience. By converting accelerometer sensor data to input touches, M2 can transform a smartphone into a Nintendo Wii-like remote to control a game on another system. Eye movements can also be turned into touchscreen input, a useful accessibility feature for disabled users who cannot use their hands. For audio conferencing without having to use costly specialized equipment, M2 can be deployed on smartphones across a room to leverage their microphones from multiple vantage points, providing superior speaker-identifiable sound quality and noise cancellation. M2 can redirect a display to a camera so that stock camera apps can record a Netflix or YouTube video and can also enable panoramic video recording by fusing the camera inputs from two systems to create a wider sweeping view. "Doing all this without having to modify apps means that users can continue to use their favorite apps with an enhanced experience," AlDuaij says. "M2 is a win-win -- users don't need to worry about which apps would support such functionality and developers don't need to spend time and money to update their apps." Using M2 is simple -- all a user would have to do is to download the M2 app from Google Play or Apple's App Store. No other software is needed. One mobile system runs the unmodified app; the input and output from all systems is combined and shared to the app. The Columbia team has started discussions with mobile OS vendors and phone manufacturers to incorporate M2 technologies into the next releases of their products. With a few minor modifications to current systems, mobile OS vendors can make multi-mobile computing broadly available to everyone.

Sourcehttps://www.sciencedaily.com/releases/2019/06/190620100032.htm

3. New Unprinting Method Can Help Recycle Paper and Curb Environmental Costs

Study shows the benefits of removing toner with pulses of intense xenon light. Imagine if your printer had an "unprint" button that used pulses of light to remove toner, curbing environmental impacts compared with conventional paper recycling. A Rutgers-led team has created a new way to unprint paper that, unlike laser-based methods, can work with the standard, coated paper used in home and office printers. The new method uses pulses of light from a xenon lamp, and can erase black, blue, red and green toners without damaging the paper. "Our method makes it possible to unprint and then reprint on the same paper at least five times, which is typically as many times paper can be reused with conventional recycling. By eliminating the steps involved in conventional recycling, our unprinting method could reduce energy costs, pollution and greenhouse gas emissions," said study coauthor Rajiv Malhotra, an assistant professor in the Department of Mechanical and Aerospace Engineering in the School of Engineering at Rutgers University-New Brunswick. Conventional recycling of coated paper is a major contributor to climate change emissions, chemical pollution and energy use, according to the study. Extending the life of paper while avoiding these recycling steps would yield significant environmental benefits. The engineers' next steps are to further refine the method by testing additional toner colours on a wider range of paper types. Unprinting can be done with simple equipment and a wipe with a very small amount of benign alcohol, and the engineers are working to integrate unprinting with typical office and home printers.

Source https://www.sciencedaily.com/releases/2019/06/190626160310.htm

4. Superstrong, Reversible Adhesive That Works Like Snail Slime

If you've ever pressed a picture-hanging strip onto the wall only to realize it's slightly off-centre, you know the disappointment behind adhesion as we typically experience it: it may be strong, but it's mostly irreversible. While you can un-stick the used strip from the wall, you can't turn its stickiness back on to adjust its placement; you have to start over with a new strip or tolerate your mistake. Beyond its relevance to interior decorating, durable, reversible adhesion could allow for reusable envelopes, gravity-defying boots, and more heavy-duty industrial applications like car assembly. Such adhesion has eluded scientists for years but is naturally found in snail slime. A snail's epiphragm -- a slimy layer of moisture that can harden to protect its body from dryness -- allows the snail to cement itself in place for long periods of time, making it the ultimate model in adhesion that can be switched on and off as needed. In a new study, Penn Engineers demonstrate a strong, reversible adhesive that uses the same mechanisms that snails do. The breakthrough came one day when a researcher was working on another project that involved a hydrogel made of a polymer called polyhydroxyethylmethacrylate (PHEMA) and noticed its unusual adhesive properties. PHEMA is rubbery when wet but rigid when dry, a quality that makes it useful for contact lenses but also, as the team discovered, for adhesives. When PHEMA is wet, it conforms to all of the small grooves on a surface, from a tree trunk's distinct ridges to the invisible microporosity of a seemingly smooth wall. This conformal contact is what allows PHEMA to stick to a surface. Alone, this ability to conform to cavities is not enough to make a good adhesive. What really matters is what happens when the material begins to dry. As PHEMA dries, it becomes as rigid as a plastic bottle cap, but, uniquely, it doesn't shrink. Instead, the material hardens into the cavities, fastening itself securely to the surface. "When materials dry, they usually shrink. If it shrinks from the surface, it no longer wants to conform to the microcavities and it'll pop out," says a researcher. "Our PHEMA adhesive doesn't pop out. It stays conformal. It remembers the shape even when it's dry and rigid." These properties that helped the team identify PHEMA as a unique candidate for reversible, strong adhesion are the same properties found in a snail's epiphragm. On a sunny day, a snail's slimy epiphragm, initially wet, conforms to the surface it's on and hardens, barricading the snail from the dry environment and holding the snail firmly in place. At night, when the environment becomes moist, the epiphragm softens, allowing the snail to move freely again. That reversibility between wet flexibility and dry adhesion is what the researchers wanted to put to the test with PHEMA. The team ran several tests on their PHEMA hydrogel, evaluating its ability to hold weight and the time it takes for water to infiltrate the adhesive and reverse its grip. They found that PHEMA acted remarkably similar to the snail epiphragm. It was very strong, but its hold was easily broken when it got wet. "When it's conformal and rigid, it's like super glue. You can't pull it off. But, magically, you can rewet it, and it slips off effortlessly," they said. "Additionally, PHEMA doesn't lose its strong adhesion when scaled up. Usually, there's a negative correlation between adhesion strength and size. Since PHEMA is not dependent on a fragile structure, it doesn't have that problem." To demonstrate just how durable their PHEMA adhesive is, one of lab members volunteered to suspend himself from a harness held up only by a postage-stamp-sized patch of their adhesive; the material easily held the weight of an entire human body. Based on the lab tests, the team determined that, although PHEMA may not be the strongest adhesive in existence, it is currently the strongest known candidate available for reversible adhesion. With that kind of power, the snail-slime adhesive could have a big impact on the scientific field as well as in industry. The research team sees durable, reversible adhesives like the PHEMA hydrogel as having massive potential for household products, robotics systems, and industrial assembly. "Car assembly uses adhesives, and, you can imagine, if there are any mistakes putting parts together, the adhesive is set and the parts are ruined," a researcher says. "A car is pretty big. Usually they don't glue things together until the last step, and you need a room-sized oven to host the car and cure the adhesives. An adhesive that's strong and reversible like PHEMA could completely change the process of car assembly and save money because mistakes wouldn't be so costly."

Source https://www.sciencedaily.com/releases/2019/06/190617164703.htm

5. Antennas of Flexible Nanotube Films an Alternative for Electronics

Antennas made of carbon nanotube films are just as efficient as copper for wireless applications, according to researchers at Rice University's Brown School of Engineering. They're also tougher, more flexible and can essentially be painted onto devices. The Rice lab researchers of chemical and biomolecular engineering tested antennas made of "shear-aligned" nanotube films. The researchers discovered that not only were the conductive films able to match the performance of commonly used copper films, they could also be made thinner to better handle higher frequencies. The results detailed advance the lab's previous work on antennas based on carbon nanotube fibers. The lab's shear-aligned antennas were tested by an engineer at the National Institute of Standards and Technology (NIST) facility in Boulder, Colorado, who carried out the research and has since founded a company to further develop the material. At the target frequencies of 5, 10 and 14 gigahertz, the antennas easily held their own with their metal counterparts, he said. "We were going up to frequencies that aren't even used in Wi-Fi and Bluetooth networks today, but will be used in the upcoming 5G generation of antennas," he said. The lead researcher noted that other researchers have argued that nanotube-based antennas and their inherent properties have kept them from adhering to the "classical relationship between radiation efficiency and frequency," but the Rice experiments with more refined films have proved them wrong, allowing for the one-to-one comparisons. To make the films, the Rice lab dissolved nanotubes, most of them single-walled and up to 8 microns long, in an acid-based solution. When spread onto a surface, the shear force produced prompts the nanotubes to self-align, a phenomenon the Pasquali lab has applied in other studies. The researcher said that although gas-phase deposition is widely employed as a batch process for trace deposition of metals, the fluid-phase processing method lends itself to more scalable, continuous antenna manufacturing. The test films were about the size of a glass slide, and between 1 and 7 microns thick. The nanotubes are held together by strongly attractive van der Waals forces, which give the material mechanical properties far better than those of copper. The researchers said the new antennas could be suitable for 5G networks but also for aircraft, especially unmanned aerial vehicles, for which weight is a consideration; as wireless telemetry portals for downhole oil and gas exploration; and for future "internet of things" applications. "There are limits because of the physics of how an electromagnetic wave propagates through space," they said. "We're not changing anything in that regard. What we are changing is the fact that the material from which all these antennas will be made is substantially lighter, stronger and more resistant to a wider variety of adverse environmental conditions than copper."

Sourcehttps://www.sciencedaily.com/releases/2019/06/190610130117.htm

6. Shell Increases Versatility of Nanowires

Nanowires promise to make LEDs more colourful and solar cells more efficient, in addition to speeding up computers. That is, provided that the tiny semiconductors convert electric energy into light, and vice versa, at the right wavelengths. A research team at the German Helmholtz-Zentrum Dresden-Rossendorf (HZDR) has managed to produce nanowires with operating wavelengths that can be freely selected over a wide range -- simply by altering the shell structure. Fine-tuned nanowires could take on several roles in an optoelectronic component. That would make the components more powerful, more cost-effective, and easier to integrate. Nanowires are extremely versatile. The tiny elements can be used for miniaturized photonic and electronic components in nanotechnology. Applications include optical circuits on chips, novel sensors, LEDs, solar cells and innovative quantum technologies. It is the free-standing nanowires that ensure the compatibility of more recent semiconductor technologies with conventional silicon-based technologies. Since contact to the silicon substrate is tiny, they surmount typical difficulties in combining different materials. For their study, which lasted several years, the Dresden researchers first set about growing nanowires from the semiconductor material gallium arsenide on silicon substrates. The next step involved enclosing the wafer-thin wires in another layer of material to which they added indium as an additional element. Their goal: the mismatched crystal structure of the materials was intended to induce a mechanical strain in the wire core, which changes the electronic properties of gallium arsenide. For instance, the semiconductor bandgap becomes smaller and the electrons become more mobile. To magnify this effect, the scientists kept adding more indium to the shell, or increased the shell's thickness. The result went way beyond expectations. "What we did was take a known effect to extremes," explained the leader of the study. "The seven percent of strain achieved was tremendous." At this level of strain, the researchers had expected to see disorders occurring in the semiconductors: in their experience, the wire core bends or defects arise. The researchers believe that the special experimental conditions were the reason for the absence of such disorders: First, they grew extremely thin gallium arsenide wires -- around five thousand times finer than a human hair. Second, the team managed to produce the wire shell at unusually low temperatures. Surface diffusion of atoms is then more or less frozen, forcing the shell to grow evenly around the core. The team of researchers reinforced their discovery by conducting several independent series of measurements at facilities in Dresden, as well as at the high-brilliance X-ray light sources PETRA III in Hamburg and Diamond in England. The extraordinary results led the researchers to undertake further investigations: "We shifted our focus to the question of what triggers the extremely high strain in the nanowire core, and how this can be used for certain applications," they recollected. "Scientists have been aware of gallium arsenide as a material for years, but nanowires are special. A material may exhibit completely new properties at the nanoscale." The researchers realized that the high strain let them shift the bandgap of the gallium arsenide semiconductor to very low energies, making it compatible even for wavelengths of fiber-optic networks. A technological milestone. After all, this spectral range could previously only be achieved via special alloys containing indium, which caused a number of technological problems due to the material mix. High-precision methods are required to produce nanowires. Four years ago, a special system was installed at HZDR for this purpose: the molecular beam epitaxy laboratory. The self-catalyzed growth of nanowires from beams of atoms or molecules is achieved in the lab; the beams are directed onto silicon substrates in ultra-high-vacuum.

Source https://www.sciencedaily.com/releases/2019/06/190626133729.htm

7. PSLV-C46 Takes Off Successfully with India's Earth Observation Satellite

PSLV-C46 is the 48th mission of PSLV and the 14th flight in 'core-alone' configuration (without the use of solid strap-on motors).

Satellite 'RISAT-2B' will enhance India's surveillance capabilities in the sky and help track and tackle hostile activity, such as infiltration or gathering of militants. The Indian Space Research Organisation (ISRO's) workhorse PSLV-C46, carrying RISAT-2B, a radar-imaging earth observation satellite, took off successfully from the Sriharikota space port in May 2019. After a successful countdown, the rocket was launched from the the Satish Dhawan Space Centre, Sriharikota, near Chennai. About 15 minutes into flight, the rocket placed RISAT-2B into an orbit of about 555 km. Stating that he was extremely happy to announce that PSLV-C46 has successfully injected RISAT-2B in precise orbit, Isro chairman Dr K Sivan said with this mission, the PSLV rocket had crossed the landmark of lofting of 50 tonnes since it started flying. Adding that the PSLV satellite has put into orbit 350 satellites, he said, "The rocket had a piggy back payload, the indigenously developed Vikram computer chip that will be used in the future rockets." PSLV-C46 is the 48th mission of PSLV and the 14th flight in 'core-alone' configuration (without the use of solid strap-on motors). This is the 72nd launch vehicle mission from SDSC SHAR, Sriharikota and 36th launch from the First Launch pad. PSLV, in its 48th mission, carried the 615-kg RISAT-2B into an orbit of 555 km at an inclination of 37 degrees, Isro officials said. The application would help agriculture and forestry and also support disaster management initiatives. The launch also marks the resumption of a vital ring of Indian all-seeing radar imaging satellites after seven years. Isro officials said that in the coming months, over six satellites will be launched to form a constellation of space-based radars offering a comprehensive vigil over the country. These satellites can serve as the eyes of the nation from about 500 km in space. These satellites work like a light-dependent camera that cannot perceive hidden or surreptitious objects in cloudy or dark conditions. They are equipped with an active sensor, the synthetic aperture radar (SAR), so they can sense or 'observe' Earth in a special way from space day and night, rain or cloud. Radar imaging satellites are also used for crop estimation, because the main kharif crop growing season is in May-September, when it rains and gets cloudy. These satellites deliver data extensively for forestry, soil, land use and geology and are extremely useful during floods and cyclone as well.

Source https://www.business-standard.com/article/current-affairs/pslv-c46-takes-off-successfully-with-india-s-earth-observation-satellite-119052200107_1.html

8. A New 'Golden' Age for Electronics?

Materials that shrink when heated -- changing colour from black to golden -- could save expensive electronics from heat damage. One way that heat damages electronic equipment is it makes components expand at different rates, resulting in forces that cause micro-cracking and distortion. Plastic components and circuit boards are particularly prone to damage due to changes in volume during heating and cooling cycles. But if a material could be incorporated into the components that compensates for the expansion, the stresses would be reduced and their lifetime increased. Everybody knows one material that behaves like this: liquid water expands when it freezes and ice contracts when it melts. But liquid water and electronics don't mix well -- instead, what's needed is a solid with "negative thermal expansion" (NTE). Although such materials have been known since the 1960s, a number of challenges had to be overcome before the concept would be broadly useful and commercially viable. In terms of both materials and function, these efforts have only had limited success. The experimental materials had been produced under specialized laboratory conditions using expensive equipment; and even then, the temperature and pressure ranges in which they would exhibit NTE were well outside normal everyday conditions. Moreover, the amount they expanded and contracted depended on the direction, which induced internal stresses that changed their structure, meaning that the NTE property would not last longer than a few heating and cooling cycles. A research team at Nagoya University has succeeded in overcoming these materials-engineering challenges. The researchers worked on rare earth element samarium and its sulfide, samarium monosulfide (SmS), which is known to change phase from the "black phase" to the smaller-volume "golden phase." The problem was to tune the range of temperatures at which the phase transition occurs. The team's solution was to replace a small proportion of samarium atoms with another rare earth element, giving Sm1-xRxS, where "R" is any one of the rare earth elements cerium (Ce), neodymium (Nd), praseodymium (Pr) or yttrium (Y). The fraction x the team used was typically 0.2, except for yttrium. These materials showed "giant negative thermal expansion" of up to 8% at ordinary room pressure and a useful range of temperatures (around 150 degrees) including at room temperature and above. Cerium is the star candidate here because it is relatively cheap. The nature of the phase transition is such that the materials can be powdered into very small crystal sizes around a micron on a side without losing their negative expansion property. This broadens the industrial applications, particularly within electronics. While the Nagoya University group's engineering achievement is impressive, how the negative expansion works is fascinating from a fundamental physics viewpoint. During the black-golden transition, the crystal structure stays the same but the atoms get closer together: the unit cell size becomes smaller because the electron structure of the samarium atoms changes and makes them smaller -- a process of intra-atomic charge transfer called a "valence transition" or "valence fluctuation" within the samarium atoms. More specifically, in the black (lower temperature) phase, the electron configuration of the samarium atoms is (4f)6, meaning that in their outermost shell they have 6 electrons in the f orbitals (with s, p and d orbitals filled); while in the golden phase the electronic configuration is (4f)5(5d)1 -an electron has moved out of a 4f orbital into a 5d orbital. Although a "higher" shell is starting to be occupied, it turns out -- through a quirk of the Pauli Exclusion Principle -- that the second case gives a smaller atom size, leading to a smaller crystal size and negative expansion. But this is only part of the fundamental picture. In the black phase, samarium sulfide and its doped offshoots are insulators -- they do not conduct electricity; while in the golden phase they turn into conductors (i.e. metals). This is suggesting that during the black-golden phase transition the band structure of the whole crystal is influencing the valance transition within the samarium atoms. The Nagoya University-led group's achievement is one of engineering, not pure physics. In a certain temperature range -- the temperature range in which the intended device operates, typically an interval of dozens of degrees or more -- the volume needs to gradually decrease with a rise in temperature and increase as the temperature falls. Of course, the volume expansion on cooling during a phase transition is a common case for many materials. However, if the volume changes in a very narrow temperature range, there is no engineering value. The present achievement is the result of material engineering, not pure physics" says the team leader. Perhaps it even heralds a new "golden" age for electronics.

Source https://www.sciencedaily.com/releases/2019/06/190625133443.htm

9. Researchers Take Two Steps Towards Green Fuel

An international collaboration led by scientists at Tokyo University of Agriculture and Technology (TUAT), Japan, has developed a two-step method to more efficiently break down carbohydrates into their single sugar components, a critical process in producing green fuel. The breakdown process is called saccharification. The single sugar components produced, called monosaccharides, can be fermented into bioethanol or biobutanol, alcohols that can be used as fuel. "For a long time, considerable attention has been focused on the utilization of homogenous acids and enzymes for saccharification," said Eika W. Qian, professor in the Graduate School of Bio-Applications and Systems Engineering at the Tokyo University of Agriculture and Technology in Japan. "Enzymatic saccharification is seen to be a reasonable prospect since it offers the potential for higher yields, lower energy costs, and it's more environmentally friendly." The use of enzymes to break down the carbohydrates could actually be hindered, especially in the practical biomass such as rice straw. A byproduct of rice harvest, rice straw consists of three complicated carbohydrates: starch, hemicellulose and cellulose. Enzymes cannot approach hemicellulose or cellulose, due to their cell wall structure and surface area, among other characteristics. They must be pre-treated to become receptive to the enzymatic activity, which can be costly. One answer to the cost and inefficiency of enzymes is the use of solid acid catalysts, which are acids that cause chemical reactions without dissolving and becoming a permanent part of the reaction. They're particularly appealing because they can be recovered after saccharification and reused. Still, it's not as easy as swapping the enzymes for the acids, according to Qian, as the carbohydrates are non-uniform. Hemicellulose and starch degrade at 180 degrees Celsius and below, and if the resulting components are heated further, the sugars produced discompose and are converted to other byproducts. On the other hand, degradation of cellulose only happens at temperatures of 200 degrees Celsius and above. That's why, in order to maximize the resulting yield of sugar from rice straw, the researchers developed a two-step process -- one step for the hemicellulose and another for the cellulose. The first step requires a gentle solid acid at low temperatures (150 degrees Celsius and below), while the second step consists of harsher conditions, with a stronger solid acid and higher temperatures (210 degrees Celsius and above). Overall, the two-step process not only proved effective, it produced about 30 percent more sugars than traditional one-step processes. "We are now looking for a partner to evaluate the feasibility of our two-step saccharification process in rice straw and other various materials such as wheat straw and corn stoke etc. in a pilot unit," Qian said. "Our ultimate goal is to commercialize our process to manufacture monosaccharides from this type of material in the future."

Source https://www.sciencedaily.com/releases/2019/06/190614094636.htm

10. The First AI Universe Sim Is Fast and Accurate

For the first time, astrophysicists have used artificial intelligence techniques to generate complex 3D simulations of the universe. The results are so fast, accurate and robust that even the creators aren't sure how it all works. "We can run these simulations in a few milliseconds, while other 'fast' simulations take a couple of minutes," says study co-author Shirley Ho, a group leader at the Flatiron Institute's Centre for Computational Astrophysics in New York City. "Not only that, but we're much more accurate." The speed and accuracy of the project, called the Deep Density Displacement Model, or D^3M for short, wasn't the biggest surprise to the researchers. The real shock was that D^3M could accurately simulate how the universe would look if certain parameters were tweaked -- such as how much of the cosmos is dark matter -- even though the model had never received any training data where those parameters varied. Computer simulations like those made by D^3M have become essential to theoretical astrophysics. Scientists want to know how the cosmos might evolve under various scenarios, such as if the dark energy pulling the universe apart varied over time. Such studies require running thousands of simulations, making a lightning-fast and highly accurate computer model one of the major objectives of modern astrophysics. D^3M models how gravity shapes the universe. The researchers opted to focus on gravity alone because it is by far the most important force when it comes to the large-scale evolution of the cosmos. The most accurate universe simulations calculate how gravity shifts each of billions of individual particles over the entire age of the universe. That level of accuracy takes time, requiring around 300 computation hours for one simulation. Faster methods can finish the same simulations in about two minutes, but the shortcuts required result in lower accuracy. The researchers honed the deep neural network that powers D^3M by feeding it 8,000 different simulations from one of the highest-accuracy models available. Neural networks take training data and run calculations on the information; researchers then compare the resulting outcome with the expected outcome. With further training, neural networks adapt over time to yield faster and more accurate results. After training D^3M, the researchers ran simulations of a box-shaped universe 600 million light-years across and compared the results to those of the slow and fast models. Whereas the slow-but-accurate approach took hundreds of hours of computation time per simulation and the existing fast method took a couple of minutes, D^3M could complete a simulation in just 30 milliseconds. D^3M also churned out accurate results. When compared with the high-accuracy model, D^3M had a relative error of 2.8 percent. Using the same comparison, the existing fast model had a relative error of 9.3 percent. D^3M's remarkable ability to handle parameter variations not found in its training data makes it an especially useful and flexible tool, a researcher says. In addition to modeling other forces, such as hydrodynamics, the team hopes to learn more about how the model works under the hood. Doing so could yield benefits for the advancement of artificial intelligence and machine learning, they say.

Source https://www.sciencedaily.com/releases/2019/06/190626133800.htm

Engineering Innovation in India

The Technology and Significance of India's Indigenous Hypersonic Cruise Missile

The Hypersonic Technology Demonstrator Vehicle has been in development under India's DRDO for over a decade, and the test flight on June 12, 2019 marked a landmark achievement in airborne ballistics and reusable rockets.

India's Defence Research and Development Organisation (DRDO) conducted the first on-field test last month of its ambitious project to build a hypersonic unmanned scramjet cruise missile. The Hypersonic Technology Demonstrator Vehicle (HSTDV) has been in the making for a very long time, this marked the first real-world test of the hypersonic vehicle using a reusable solid booster first stage. The significance of the HSTDV is enormous on both security and technological grounds. Security-wise, a hypersonic cruise missile can be key in taking out hostile airborne attacks, giving the Air Force an edge in terms of launching offenses of their own. It is also a technological feat that can be incorporated into other areas such as sweeping surveillance tasks, all the while being energy efficient in operation. This is where the technology comes in. The HSTDV is an unmanned scramjet, designed to eventually reach production target of Mach 6.5 (2,229.5 metres per second) speeds at an altitude of 32,500 metres. This would give the cruise missile a total flight impact distance of nearly 45km, within impact time of just 20 seconds. The key areas of technological emphasis in this project include hypersonic propulsion, wind transmission with minimal drag loss, enhancing aerodynamics, and refining the scramjet engine. The HSTDV uses a solid rocket launch booster for initial propulsion, following which combustion takes place in the anterior scramjet engine. The engine takes in an inflow of air particles, and compresses them inside a combustion chamber without slowing them down, thereby producing thrust that is further helped along by the side fins that aerodynamically amplify the thrust. It is this mechanism that is deemed imperative in giving the cruise missile hypersonic speeds. The double-wall engine is built using a Niobium alloy, which has a high thermal latency, and can therefore withstand the high combustion temperature and pressures inside the engine chamber. While this is only the prototype design, DRDO engineers have stated before that they intend to test the HSTDV at up to Mach 12. Assuming that impact range remains constant, the HSTDV will increase its impact range by 1.8x, if such speeds can be achieved. This will be a new straw in the hat for India and its quest for equipping its offensive and defensive arsenal with ballistic cruise missiles. A weapon to the tune of the HSTDV can be lethal even in non-warfare cases, and the technology itself can be path-breaking. If the combustion model is harnessed, it may, in fact, lead up to commercial usage designs, which in turn can aid areas such as reusable spaceflight and more efficient commercial cargo transmission. The first test has been claimed to have been a success by DRDO officials, as per radar data, marking a successful start to the quest for hypersonic engineering that began nearly two decades ago.

Source https://www.news18.com/news/tech/technology-and-significance-of-indias-indigenous-hypersonic-cruise-missile-2184097.html