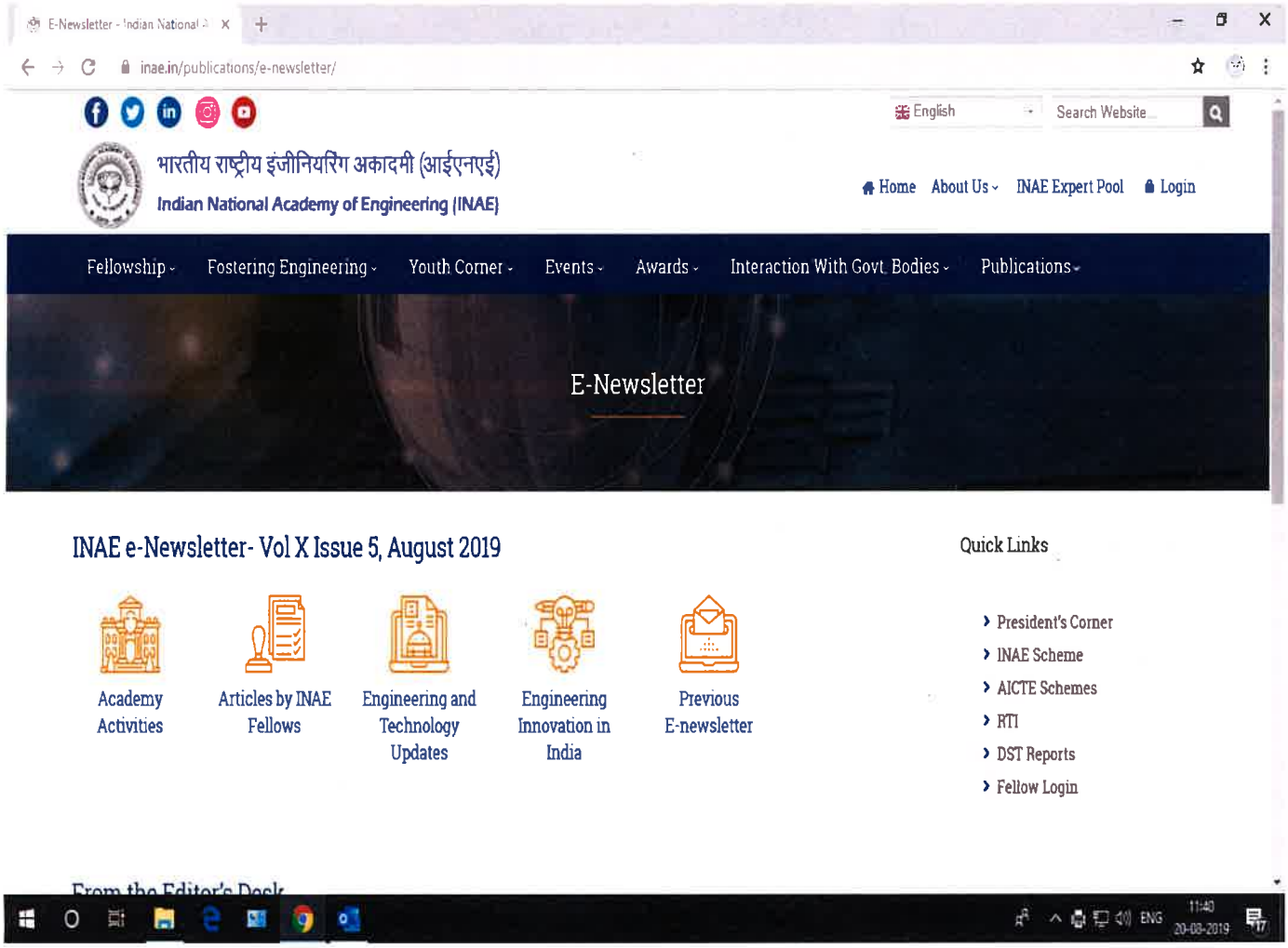
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From the Editor's Desk

CHANDRAYAAN-2

The fourth week of July 2019 turned out to be FEEL GOOD atmosphere for everybody in India. The school children, youth as well as the senior citizens alike were seen celebrating one of the greatest achievements scored by the Indian Space Research Organization (ISRO). The occasion has been the launching of Chandrayaan -2 on July 22nd 2019 at 14:43 hours from Satish Dhawan Space Centre located at Sriharikota in Andhra Pradesh.

Chandrayaan -2 comprised of three satellite missions combined into a single launch. It is composed of an orbiter, a lander (named Vikram) and a rover (named Pragyan). Chandrayaan -2 is a proud mission of ISRO with several scientific objectives incorporated. The mission is aimed at improving the understanding of the moon and explore the moon's south polar region; the region where no country has reached so far. It envisages the demonstration of soft landing of lander Vikram on moon and operate the rover Pragyan on the lunar surface, mapping of moon's surface to discover the origin and evolution of moon, to study the extent of water molecule distribution on and below lunar surface and in the tenuous lunar exosphere to address the origin of water on moon, and to determine lunar topography, mineralogy, surface chemical composition, thermal properties of lunar regolith and polar region, and the abundance of various elements etc. In order to fulfil several of the mentioned objectives Chandrayaan -2 is equipped with many payloads and special purpose instruments on orbiter, lander and rover.

India's launch vehicle, GSLV-MkIII (Geosynchronous Satellite Launch Vehicle Mark III) created a miracle by placing Chandrayaan -2 into the earth's orbit. The vehicle displayed a remarkable performance and gave a boost of 6000 Km to the space craft facilitating the reduction in the number of manoeuvres from originally planned six to five in the earth orbit. This enabled to save considerable amount of fuel. At the time of writing this editorial, ISRO has already accomplished successfully the fifth and final manoeuvre of Chandrayaan -2 in earth's orbit. It is further planned to carry out an important manoeuvre on August 14th when the spacecraft is expected to reach the highest point on the orbit around earth. This manoeuevre would enable the spacecraft to escape from the Gravitational influence of the Earth and places the spacecraft in translunar path for continuing its journey towards the moon until August 20, 2019, when the spacecraft will be injected into the lunar orbit. Chandrayaan -2 has been placed under ISRO Telemetry, Tracking and Command (Istrac) centre in Bangalore which utilizes its various ground stations and the deep space network stations for tracking support. Istrac provides appropriate commands to enable the spacecraft to reach the moon, for soft landing and unloading the rover. Vikram and Pragyan will be guided through every step.

Chairman of ISRO expressed confidence on soft landing of Vikram overcoming "the fifteen minutes of terror" which signifies the final moments prior to safe touch down. Every Indian is looking forward for this epoch making event and observing the foot-pads of Vikram on the lunar surface.

After the successful launch, Prime Minister of India joyfully pronounced that "The event will be etched in the annals of history. The launch of Chandrayaan -2 illustrates the prowess of our scientists and the determination of 130 Crore Indians to scale new frontiers of science. Every Indian is immensely proud to-day". With reference to usage of Indigenous systems in Chandrayaan-2, he appreciated, "Indian at heart, Indian in spirit. Efforts such as Chandrayaan -2 will further encourage our bright youngsters towards science, top quality research and innovation.

Several Fellows of INAE from different disciplines are very actively engaged in Chandrayaan -2 mission along with ISRO scientists and technologists. Congratulations to ISRO and everyone associated with the mission.

Prof. K. Bhanu Sankara Rao
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Pratt & Whitney Chair Professor
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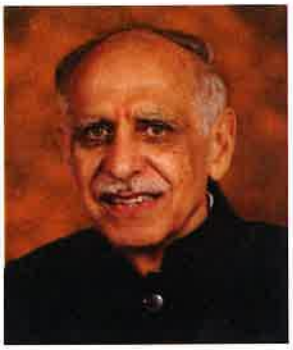
Obituary



Brig Rajan Minocha

Brig Rajan Minocha (Retd), Executive Director, Indian National Academy of Engineering (INAE) passed away on August 6, 2019 at New Delhi. He had served as Deputy Executive Secretary of INAE from 1st June 2012 to 31st July 2013 and thereafter assumed the office of Executive Director, INAE from 1st August 2013 onwards. Brig Minocha had specialized in Aerospace Engineering, in particular Helicopter Technologies and had earlier served in the Corps of Electronics and Mechanical Engineering (EME) of the Indian Army for 32 years. During his service in EME, he had made contributions in Maintenance of Aviation Assets of Indian Army and in planning and establishing the maintenance network for all Aviation assets held by Indian Army. He headed the team for technical evaluation of Bell & Eurocopter make helicopters, Searcher, Herons & Nishant UAVs and other technical & ground support equipment related to Aviation and planned for induction.

After an illustrious career in the Indian Army, Brig Rajan Minocha joined INAE in 2012. During his tenure as Executive Director, INAE, he had made significant contributions and played a supportive role to the Office Bearers of INAE and the Fellowship at large, in facilitating the institution of several novel and innovative engineering programmes and schemes, with the objective of promoting the growth of engineering and technology in the country. A few notable examples of achievements realized during his tenure are the conduct of Engineers Conclave; creation of the INAE Digital Platform, and institution of the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship. Brig Minocha was also instrumental in arranging the housing of INAE Office in the 6th Floor of SPAZE IT Park, Tower A, Gurgaon and later in acquiring the premises on the 9th Floor of the same building to locate the new INAE Digital Centre.

Appreciating the excellence of the INAE Fellowship as the engineering luminaries of the country, Brig Minocha helped in facilitating the interface of INAE with the Government Departments/Agencies, as directed by the leadership of INAE, with a view to recognition of the Academy as an Advisory Body, on policy issues. These initiatives have enriched the Academy and also helped in achieving new landmarks that have enhanced the visibility of the Academy at the National level.

The dedication, commitment and professional excellence shown by Brig Rajan Minocha were appreciated by the INAE Fellowship and the staff respected him as an able and dependable leader. The untimely demise of Brig Rajan Minocha is a loss not only to his family but also to the INAE family comprising the esteemed Fellowship and the staff of INAE Secretariat.

MAY GOD BLESS HIS SOUL TO REST IN PEACE

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.**

Workshop on the Report entitled, "URBAN TRANSPORTATION: *Challenges and Way Forward*"

A Workshop on the Report entitled, "URBAN TRANSPORTATION: Challenges and Way Forward", Prepared by the INAE Forum on Civil Infrastructure was held on 10 July 2019 at Metro Bhawan, New Delhi. The genesis of the event is highlighted as follows. The INAE Forum on Civil Infrastructure, set up in January, 2018, had planned to study three areas of great National concern – Traffic & Transportation, Housing, Water. A study was first taken up to assess the National status of URBAN TRANSPORTATION – the challenges being faced, and, the possible way forward to tackle these. A report on the study has been prepared by Prof. Mahesh Tandon, FNAE; Dr. Mangu Singh, FNAE; Prof. N. Raghavan, FNAE; Prof. P.K. Sikdar, FNAE; Prof. Prem Krishna, FNAE and, Dr. Satish Chandra, all of whom have experience of working in the subject area. The workshop was held to discuss the report with, as wide a representation as possible from amongst the stakeholders, in order to get their views/suggestions, before finalising the same. A copy of the *Executive Summary* was made available to the participants prior to the workshop.

Dr. Mangu Singh, FNAE, MD DMRC, kindly provided the support base for organising the workshop, and, it was held at the Metro Bhawan on July 10, 2019. Dr. V.K. Saraswat, FNAE, Member, Niti Aayog, kindly graced the inaugural session as the Chief Guest, and, Dr. Sanak Mishra, President INAE spared his valuable time to preside over it. Prof Prem Krishna, Chairman of the Forum, made a presentation on the *Background and Salient Aspects* of the Report. The session was well attended.

L to R: Prof Prem Krishna, Dr VK Saraswat, Dr Sanak Mishra and Dr Pradip

Dr VK Saraswat being felicitated by Dr Mangu Singh

There were two Technical sessions, at which features of the report were presented and discussed. In the first session, chaired by Prof. S.S. Chakraborty, a presentation on *Organisational and Policy Issues* was made by Dr. Mangu Singh, and, Prof. Tandon, FNAE, presented his views on *'Infrastructure - Engineering Issues'*. The post lunch technical session, was chaired by Mr. Rakesh Chopra, former Member Engineering of the Indian Railways. Presentations were made by Dr. Satish Chandra, Director, Central Road Research Institute (CRRI), on *Multi-Modal Transport,* and, by Dr. Sikdar, FNAE on *ITS (Intelligent Transportation System.* Both sessions had very meaningful discussions. Valuable comments were made by the President INAE at the closing session. The purpose of the Workshop was well served and the inputs received will help to finalise the Report and take it forward.

Dr Sanak Mishra, President, INAE being felicitated by Dr Mangu Singh

Audience at the workshop

CAETS and International Conference on Engineering a Better World – Next 100 Years.
Global challenges were on the agenda when engineers and scientists from all over the world met at the CAETS Conference (Council of Academies of Engineering and Technological Sciences), organized by the Swedish Academy of Engineering Sciences (IVA). The meetings of CAETS Executive Board and the Conference were held during 24 – 28 June 2019 at Stockholm, Sweden. Dr. Sanak Mishra, President INAE and Member of the Executive Board of CAETS, Dr. Pradip, Vice President INAE and Mr. Pradeep Chaturvedi, Fellow INAE attended as official delegates.

Together with Ruth A. David, Secretary General of International Council of Engineering Science and Technological Sciences, CAETS, Prof. Tuula Teeri, Chair of CAETS and President of IVA, opened the annual CAETS conference at the City Conference Centre in Stockholm.

The fact that IVA hosted the event this year was no coincidence, as IVA– the world's first engineering sciences academy – turns 100 years old in 2019.

Welcoming the participants in the Conference, Prof. Tuula Teeri remarked: "My elder colleagues may disagree with me, but I think we have never before faced such great challenges in the world. However, we have probably said so for 100, 1,000 or 2,000 years, and we have always managed to solve the problems".

Mr. Ibrahim Baylan, Minister for Business, Industry and Innovation, Swedish Government, in his thought-provoking inaugural address emphasized the need to keep peoples' needs in mind. "All technology shifts have killed jobs, but they have also always created new jobs. We, therefore, need a society that helps people to go from old to new jobs, through vocational training, investments in research and development, education, and so forth." Interestingly, he illustrated the need to conceive of a world free of fossil fuels, with the example of steel and electric vehicles. He emphasized the need to develop fossil-fuel free steel.

The conference brought together 400 participants from all over the world, including delegates from 26 CAETS academies of engineering and 3 from Nigeria, New Zealand and Serbia that were elected as new members of CAETS.

Topics of Different Presentations

A number of international thinkers and experts in areas of great significance for the immediate future were invited to address the Conference.

For three days, the role of science, technology and engineering in meeting global societal challenges was in focus. To shed light on some of the most acute challenges facing the society and explore possible solutions, the Swedish Academy put together a cross-disciplinary program. That was really a unique way of conducting the conference. The conference turned out to be a meeting place for everyone working within or interested in science, technology, engineering and societal issues.

'Engineering a Better World: The Next 100 Years' was a Conference within the framework of the CAETS international network of academies of engineering sciences.

The Conference consisted of a series of sessions, each devoted to a specific topic of immediate concern. The first session reflecting 'Progress' included the opening presentation on 'The first 100 Years' which provided an overview of developments since the inception of the Swedish Academy. This session also included presentations on 'Internet – Engineering for Society'; and 'LIGO – Engineering for Science'.

The second session was entitled, 'Challenges' and it included presentations on 'Energy System of the Future – Evolution or Revolution'; 'Unequal Cities'; 'Antibiotic Resistance – a Multiple Systems Failure'; and 'Water as Leverage – from Risk to Reward'.

The third session was on 'Creative Chaos' which included presentations on 'Engineering the Climate'; 'Sustainable Transition Pathways for Plastics' and a Panel Discussion on: 'Future Health – Are New Business Models Required'?

The fourth session was on 'Digital Dawn', which included a presentation on 'Productivity and Performance in a Digital Age'. It covered the impact of technologies like AI and Machine Learning.

The fifth session on 'Effective Education' had presentations on: 'The Changing Face of Global Engineering Education and Logic', and 'Landscape of the 'Knowledge System – Implications for the Educational System'.

The session on 'Inclusive Infrastructure' included presentations on: 'The All-Embracing Transportation System'; 'Design and Engineering for Sustainability Transitions', and 'Society 5.0 – a Human-Centric Strategy'.

The Conference concluded with the panel discussions on 'Policy Advice for the Future' and 'Industry – Academy Collaboration for the Future'.

The Major Takeaways from the Conference

The major takeaways from the Conference are summarized below:

I. When considering the global challenges that we are facing today, it feels that they are graver than ever before. Then again, historical records from 100, 500 or 2000 years ago suggest that people have always felt that their current problems are the worst ever. And yet, humankind has always been able to put things right and the world has become progressively a better place, than before.

II. New, powerful technological solutions are the key to solving many of our current challenges but at the same time, the technology is perceived as a threat by many people in the turbulent labour markets. Many fears for the loss of their jobs and for losing control over their lives by technological advances like automation, robotics and artificial intelligence, have to be innovatively addressed.

Engineers like us will have to make efforts in convincing people that new technology will help us lead a better life. Otherwise they will be very vulnerable to demagogues declaring new technology is "wrong and dangerous".

III. One clear message from the speakers at the conference was that we will need to put people at the centre of all our efforts, engaging them in discussions and involve them in the decision-making process, concerning the effects and implementation of different emerging technologies.

The focus of our national development should not just be technology-driven but human-centred and based on the core values of openness, open to criticism, sustainability and inclusion.

Inequalities between regions, countries and citizens is a huge obstacle for reaching our climate goals. The fundamental issue will be to find a balance between the environmental and the social agendas.

IV. The world is becoming more complex, globalized and very difficult to grasp in its entirety. Our current economic models predicting future trends tend to fail to account for e.g. intangible assets important in the digital world. There are also long implementation and restructuring lags with the introduction of new technology before people experience long-lasting positive impacts, in their lives.

Inclusive innovation, collaboration and prosperity shared by all will be needed to overcome the obstacles of increasing fear about technology.

V. Due to the complexity and the scale of our challenges, what is needed in the world is perhaps first and foremost cooperation and sharing between scientists, engineers and the policy-makers – between scientists and engineers from different fields, and between scientists, engineers, the political decision-makers and the general public.

To solve our problems, we must learn to manage complex collaborations.

VI. We need to reach a common understanding of the problems we face and the ways in which they can be solved. The longer we argue, the more likely it will be that we reach unforeseen tipping points, which can't be reversed. The high speed of our development

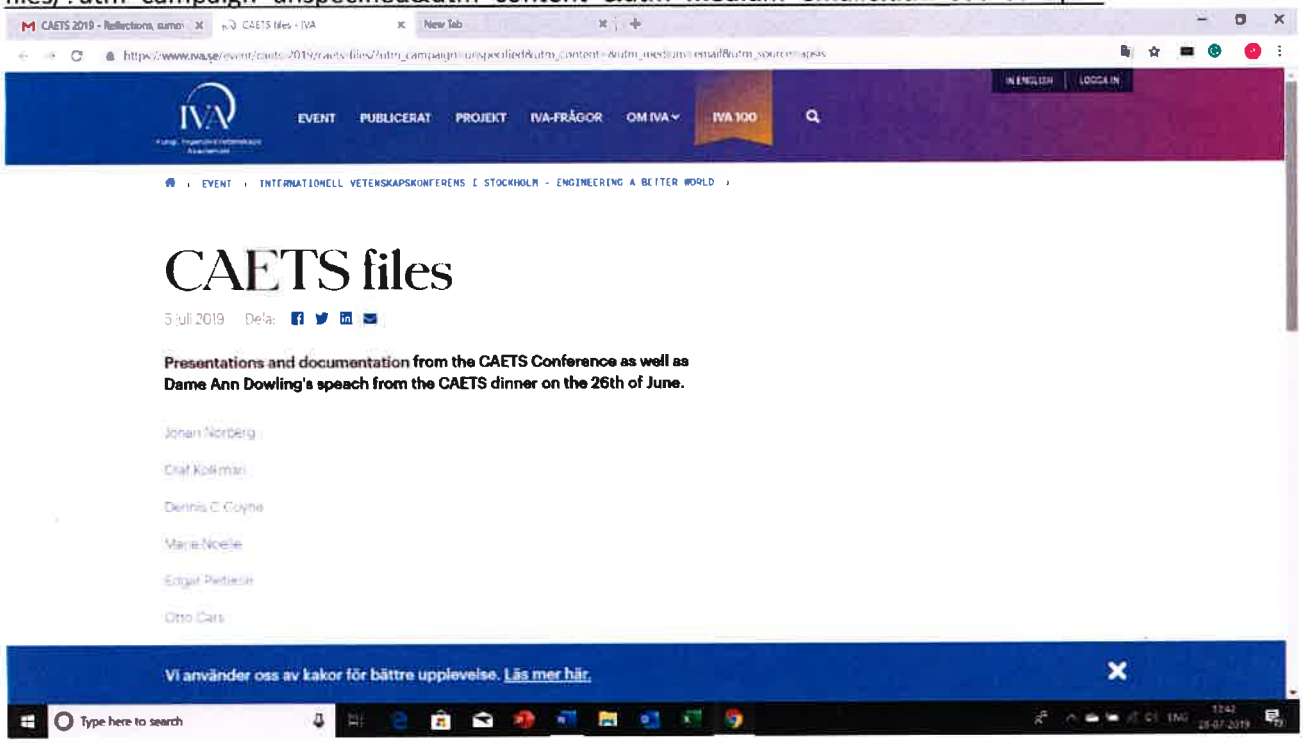
gives us genuine hope but only as long as our institutions are capable of changing, in response to the call of the times.

Tomorrow's leaders need to have a multidisciplinary, integrated approach, clarity of vision and a big focus on equality. Mentoring the future leaders who are inclusive and trained in necessary engineering skill sets that is, dealing with complexity, uncertainty and decision-making even in the face of a lack of complete scientific understanding of real-life problems, should be on our immediate agenda.

VII. The engineering academies must play a pro-active role and find ways and means to create appropriate linkages (and partnership, if possible) with the policymakers to be able to facilitate technology transitions – for example, today to renewable energy, electrification, digital transformation and a fossil-fuel free, people-centric public transportation. Another role the engineering academies must play is to inspire our next generation of emerging leaders to take up engineering as a profession and solve challenging problems facing us. Need for appropriate changes in our engineering education system including internships, increasing exposure to industry and enhancing academia-industry collaboration were also discussed as one of the key responsibilities of engineering academies.

IVA has made the copies of all the power-point presentations on the above-mentioned topics, available on their website. The readers are requested to download them directly from the link provided below:

https://www.iva.se/event/caets-2019/caets-files/?utm_campaign=unspecified&utm_content=&utm_medium=email&utm_source=apsis



Sideline Meetings with Member Academies

Indian (INAE) delegation held bilateral meetings with engineering academies of UK, France, Australia, Korea and Sweden. Possibilities of cooperation and collaboration with various academies were discussed. A review of past activities was undertaken and the possibilities of future strengthening of cooperation were discussed. The President, INAE emphasized in all meetings that programs that can proactively provide inputs to the government need to be emphasized. The President

also emphasized that mechanism for mutual exchange programs need to be developed on a reciprocal basis, to which all academies agreed.

Dr. Sanak Mishra, Dr. Pradip and Mr. Pradeep Chaturvedi with the Korean Delegation at CAETS Conference, June 2019, Stockholm, Sweden

Discussion with RAEng UK focused on cooperation in the areas of smart city, artificial intelligence, climate change and sustainable development.

Discussion with NATF, France focused on the need to identify a few thrust areas where funding possibilities could be geared up. Some of the areas identified included energy, smart grids, artificial intelligence (especially applied to agriculture and health) and urban sewage treatment.

Discussion with Korean Academy included a review of the forthcoming INAE – NAEK Workshop on "High Temperature Material and System Engineering for Aerospace, Power Generation and Defence Industry" being organized at Hyderabad during July 15-17, 2019. The areas for cooperation for future cooperation discussed were artificial intelligence, robotics, IOT and automotive manufacturing including electric vehicles.

Discussion with ATSE, Australia, emphasized on identifying areas of mutual interest. Delegation of ATSE explained that the framework of Indo-Australian Inter-Governmental Fund has indicated health technologies, biotechnologies and medical device technologies as some of the preferred programs.

Discussion with the President of the Swedish Academy indicated a strong desire and an opportunity to collaborate with IVA, especially in the areas of knowledge, entrepreneurship, business development and motivation for young engineers. Swedish Academy also showed keen interest in having an agreement with INAE.

CAETS Meetings

The CAETS Executive Board met on 24 June 2019 and was attended by Dr. Sanak Mishra, President, INAE. Subsequently CAETS Council meeting was organized on June 27, 2019 and was attended by Dr. Sanak Mishra, President, INAE and Dr. Pradip, Vice President, INAE. Highlights of the meeting was that three more engineering academies, namely from New Zealand, Serbia and Nigeria were inducted into CAETS. The next CAETS meeting, that is, CAETS 2020, will be held in Seoul, South Korea during June 22-25, 2020, hosted by NAEK. The theme of CAETS 2020 is "Engineering A

Better World – Smart Society". The Engineering Academy of Argentina will host the CAETS 2021 during Dec 21-25, 2021 and the theme of the conference will be "The Future of Energy" with special emphasis on training of human resources to lead the transition to a Renewable Energy Future. The venue of CAETS 2022 has also been decided and it will be Paris, hosted by the French Academy of Engineering in March 2022. The meeting also included formal presentations by the CAETS working committees on various themes – namely on Energy, Engineering Education, Communicating with Public (particularly the next generation), and on Diversity and Inclusion.

3rd INAE-NAEK Workshop on "High Temperature Materials and System Engineering for Aerospace, Power Generation and Defense Industry" held on 15-17th July 2019 at Hyderabad.
The above workshop was attended by 65 delegates (12 Korean and 53 Indian). All the participants for the workshop were invited. The Indian delegates were composed of the scientists and technologies who steered the programmes earlier in Aerospace, Power Generation and Defense Industry, the people who are currently leading and associated young researchers and technologists. The total number of invited papers are 24 and were organized in five sessions. A separate session was organized to give an opportunity for interactions among the participants and to work out collaborative research projects between the institutions.

Dignitaries on Dais in the Inaugural Session

Welcoming of Head of Korean Delegation

Lighting of the Lamp by Dignitaries

Group Photograph of Delegates

High temperature materials constitute a very important element of the current as well as emerging programmes of the Defense Research and Development Organization (DRDO) in India. Gas turbine and defense materials development is capital and technology incentive and takes a long gestation period to establish. In order to attain the maturity in the creation of multifunctional high temperature materials and their processing technologies and to develop further on that basis require continuity in production that should be guaranteed through multiple and concurrent aero engine and other defense programmes. An eco-system that supports R&D, iterative trails to test the fruits of R&D on production scale, and adoption for production if found viable are essential to complete indigenization of aero engine and other materials involved in defense systems along with the processing technologies in the long run. **Dr. S.V. Kamat, Director General, Naval Systems and Materials, gave an overview on the DRDO Perceptive of High Temperature Materials**. He has described the usage of various materials in gas turbine engines and various other defense systems and pointed out the current challenges looming around the development of high temperature materials and the manufacturing technologies to be adopted. He brought out clearly the various factors to be considered in the development of high temperature materials depending on the systems and their operating conditions. He emphasized the role of advanced polycrystalline and single crystal superalloys, thermal barrier coatings on superalloys, the usage of Gamma TiAl in aero engine. He has explained the potential usage of Titanium Matrix-SiC fibre, Ceramic Matrix (SiC-SiC fibre), and refractory metal-

intermetallic (Nb-silicides) composites in aero engine and defense systems. He has pointed out the exploration of additive manufacturing processes for the fabrication of rotating components in aero engine and defense systems. He has foreseen a greater role for the Materials Genome Initiative and enumerated the challenges associated with its implementation.

Presentation by Dr Dinesh Srivastava

Presentation by a Korean Delegate

Dr. Inho Kim of Agency for Defense Development has presented a brief overview on Defense Science & Technology Strategy and Priorities in Korea. It is the only government funded R&D organization which has been performing its mission as a core agency for ROK security in Korea. The strategy and priorities for defense S&T based on future weapon systems and technology requirement was discussed. The DMTD (Defense Materials Technology Directorate) in ADD has many S&T programs related to the materials for defense applications such as ceramics, metals, and composites including high temperature materials. The progress on an international cooperation project in defense material research area between ROK and INDIA launched on high hardness armor material between ADD and DMRL has been presented.

The Indian Space Research Organization (ISRO) is currently engaged in the development of Reusable Launch Vehicles (RLVs), Air Breathing Propulsion (ABP) technology and missions like Two Stage To Orbit (TSTO) and Single Stage To Orbit (SSTO). The design and realization of these advanced space missions are governed largely by operational limits of available high temperature materials. The material sensitive architecture of these missions is expected to fulfil a combination of conflicting requirements to meet severe environmental conditions during ascent, orbital and atmospheric re-entry phases. ISRO has undertaken technology development programme for a variety of high temperature materials which addresses to the requirements of various heat flux regions of these space vehicles. It includes thermal protection systems, ceramic matrix-based composites, ultra-high temperature ceramics, thermal barrier and high emissivity coatings, high temperature adhesives and engineering technologies to enable induction of these materials for intended applications. **The presentation by Dr. S.C. Sharma from Vikram Sarabhai Space Centre , Trivandrum on "High Temperature Materials for Indian Space Programme" enumerated the entire gamut of activities taking place in ISRO in the materials development beginning from lab scale developments and scaling-up of the process-technologies till their qualification for practical use.**

A Case Study on Application of the Systems Engineering in the Korea Space Launch Vehicle II Project has been presented by Junyouk Jang, Il Sang Yoo, Young Soon Jang of Korea Aerospace Research Institute (KARI). In South Korea, the KSLV-II (Korea Space Launch Vehicle II) project is in progress to develop the space launch vehicle capable of launching 1.5-ton satellite into a SSO (Sun Synchronous Orbit) and to acquire related technology. It is a large-scale and complex development project required a systematic approach. Space systems engineering is defined that the art and science of developing an operable system capable of meeting mission requirements within

imposed constraints including (but not restricted to) mass, cost and schedule. A case study on application of the systems engineering in the KSLV-II project has been presented.

The aeropropulsion R&D activities related to high temperature materials in Korea Aerospace Research Institute were presented by Dr. Inyoung Yang. He has presented briefly the component-level research that has been undertaken on gas turbine engines, high-speed air-breathing engines, and electric- or hybrid-powered propulsion systems. In case of the gas turbine engine, KARI is doing component-level design, analysis and test researches, as well as system-level controls design and engine performance test researches. Regarding the high-speed air-breathing engine, KARI has carried out research on the gas-fuelled and liquid-fuelled supersonic combustor and scramjet engine, as well as combined cycle engines such as air turbo ramjet and rocket-based combined cycle engine. Regarding the electric- or hybrid-powered systems, KARI succeeded to develop electric-powered systems, and currently evolving onto the hybrid propulsion system. He has described the supersonic test facilities available at KARI and about the thermal protection system for space plane.

Reduced activation ferritic–martensitic (RAFMs) steels are potential candidate structural materials for first wall and test blanket modules (TBMs) of International Thermonuclear Experimental Reactor (ITER) which is under construction in France. India has developed INRAFM steel for the construction of its own TBM. The INRAFM steel was designed by altering the chemical composition of the conventional Mod.9Cr -1Mo ferritic-martensitic steel, with substitution of W and Ta for Mo and Nb respectively, in order to promote rapid decay of radioactivity after irradiation. Very low ductile-brittle transition temperature was achieved in this steel by adopting pure alloying elements, controlling residual and tramp elements to very low levels and by using vacuum induction melting and vacuum arc refining process. Fabrication of TBM by high heat input fusion welding processes such as shielded metal arc (SMA) and tungsten inert gas (TIG) welding processes develop a wider heat affected zone (HAZ) in ferritic-martensitic steels and generate an inhomogeneous microstructure in the HAZ, resulting in a marked variation in mechanical properties across the weld joint. Premature failures have been reported quite often in the ferritic-martensitic steel weld joints, due to the pronounced localization of creep deformation and cracking at the parent metal/HAZ interface; these are classified as Type IV cracking failures. In the light of these observations, electron beam welding (EBW) and friction stir welding (FSW) processes have been explored. The usage of FSW process in the fabrication of 12 mm thick INRAFM steel has been successfully demonstrated and optimized various parameters associated with FSW. The necessary post weld heat treatments for restoring the optimum microstructure for creep resistance and impact toughness have been described. **The paper by M.Vijaya Lakshmi, K.V. Rajulapati, K. Bhanu Sankara Rao and G. M. Reddy gave important details of "New Joining Technology (FSW) for Creep Resistant Ferritic-Martensitic Steels for Conventional and Nuclear Energy Systems".**

Prof. Dipankar Banerjee of IISc Bangalore presented an illuminating lecture on Intermetallics and Related Alloys. He described that a combination of lightweight and heat tolerance has driven the development of intermetallic and related alloys. Nevertheless, their inherent brittle behaviour has limited successful alloy development to only a few examples. Against this background he gave examples of the research work conducted in the past and being pursued currently which directed towards the development of intermetallics as well as alloys of Ni and Co that utilize the properties of intermetallics in precipitation hardening for applications at high temperatures. He touched upon the topics that include production of cast superalloys, and the role of micro segregation, incipient melting, origin of porosity, γ / γ' eutectic, blocky carbides and fine carbides. He has pointed out the need for modeling of fault energies, control of misfit, partitioning of various elements in γ / γ' in the design of Ni and Co-based superalloys.

Polycarbosilane (PCS), an organosilicon polymer has been of great interest as precursor for silicon carbide for different high-end applications such as structural material like SiC fibers, C/SiC and SiC/SiC composites in aerospace vehicles. **"Indigenous Technologies for Synthesis of Polycarbosilane, PIP based C/SiC Composites and SiC Fibers" has been dealt in detail by Suresh Kumar et.al from Defence Materials and Stores Research and Development Establishment**

(DMSRDE), Kanpur. This presentation summarized the research and development work conducted at DMSRDE to establish the synthesis and characterization of PCS, fabrication of C/SiC composite using the indigenous PCS precursor and SiC fibers. Indigenous PCS of select molecular weight was melt spun into PCS fibers and the fibers were cured under flowing air up to 200°C. The cured PCS fibers were pyrolyzed up to 1300°C under argon atmosphere. The SiC fibers were characterized using SEM, XRD, XPS, TEM, HRTEM and EPMA techniques for their microstructure, composition and crystalline phases. Details of the processes, results and micro-structure of the C/SiC composites and SiC fibers were presented. In addition, the feasibility of C/SiC composite components fabrication has also been highlighted.

Dr. LEE Yoonjoo of Korea Institute of Ceramic Engineering and Technology, Jinju, described "The sintering behavior of SiC-bulk derived from polycarbosilane with organic-inorganic conversion process". Polycarbosilane is a typical ceramic precursor of polymer derived ceramic (PDC) technique. It was originally developed for producing SiC fiber, but as a SiC precursor it has been used in various applications such as high surface area ceramics, catalyst supporter, ceramic thin film, fabrication of CMC, etc. In order to obtain a high-quality ceramic by PDC technique, it is important to control the crystal size and densification as well as the purity of the SiC with understanding of the overall organic-inorganic conversion mechanism. In the case of polycarbosilane, the polymer converted to SiC through curing – pyrolysis – crystallization process, and the nucleation of SiC is accompanied by additional reactions such as graphitization and secondary thermal decomposition. The process conditions at each step influences on the element content, and it affects the crystal growth and densification of SiC. A critical review of the characteristic phenomena at each step of process, and the effect of Si, C, and O elements on sintering of SiC has been presented.

Dr. Manyoung LEE of Agency for Defense Development, Korea, presented a review on "High Temperature Ceramic Matrix Composites in Defense". Ceramic matrix composites (CMCs) have been widely used for structural materials in various fields. Especially, fibre reinforced CMCs (e.g. C/C, C/SiC, and SiC/SiC) have been world-widely researched and more advanced because of their unique characteristics which are the high strength and heat-resistance properties and have been naturally to be focused to the fields which are the aerospace, atomic energy, other industries needed for heat protection as well as the defense. Out of these representative CMCs, the life time of C/SiC composite in high temperature circumstance up to about 2000°C is longer than that of C/C composite and the service temperature is higher than that of SiC/SiC composite. In view of this, the C/SiC composite has a host of possibility and applicability for military and has a potential to be more fabricated. Dr. Lee briefly introduced the C/SiC composite and its manufacturing processes, and Korean research work in the development of C/SiC composites.

MIDHANI, Hyderabad produces various grades of special steels, superalloys and Titanium alloys suitable for the high temperature applications especially in the areas of aerospace, power and defence. Some of the important superalloys developed in Midhani include SuperNi 742, Superni115, Superni 750 MW, Superni 617CC, Superni 718 (IN 718), Superco 605 (IN 605) etc. In addition to Superalloys having high temperature applications. MIDHANI has also developed various grades of titanium and steels such as Titan 26 (IMI 685), Titan 44 (Beta 21 S) and 17-4 PH, 347 MN, 9Cr1Mo, 10-1-1 respectively. All these materials were manufactured by surmounting the major challenges comprising of narrow range of chemical composition, reduction in presence of trace elements, casting the sound ingot, hot working without flow instability, optimization of thermo mechanical processing parameters, achieving the required microstructure and specified mechanical properties. **Dr. S.K. Jha presented the "Advances in Processing of High Temperature Materials in MIDHANI".**

Dr. G. Padmanabham*, D.Srinivasa Rao, R. Vijay and Ravi N.Bathe of* International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, **presented an overview on "Advanced Materials and Manufacturing Process for High Temperature Applications" with special reference to the activities on-going at their Centre.** Research results on Oxide Dispersion Strengthened steels of different types and their application in fast reactors and AUSC plants have been presented. The recent advances in the development of ODS- Iron Aluminides

have been highlighted. The efforts of ARCI on the development of thermal spray, electrolytic and vapor deposition coatings were described. The progress on Laser Arc Hybrid Welding and Laser Cladding and fabrication of components by Metal Additive Manufacturing were described. The repair and refurbication of aerospace components, extension of life of power plant systems, the development of Ceramics such as spinel and silicon carbide conducted at ARCI have been presented.

Prof Indranil Manna, Vice-President, INAE; Professor, IIT Kharagpur and former Director, IIT Kanpur gave an excellent overview on Laser Surface Engineering (LSE). In addition to covering the fundamental aspects associated with LSE, he explained in detail the LSE of Ti-Alloys with Si/Al, pulsed laser deposition of ceramic coatings, Graded microstructure development in IN-718 Superalloy and application of LSE for hardening, melting, alloying and cladding. He emphasized that LSE offers advantages of obtaining meta stable phases, stable microstructure and attaining of attractive combination of properties which were not possible by conventional equilibrium processing. He has touched upon ceramic to metal graded surface composite that may allow designing tailored properties.

Dr. Seyoung Kim (Korea Institute of Energy Research) presented an overview of the current status of Korea's ceramic composite research projects. A combustor for regenerative cooling type scramjet engine using fiber reinforced ceramic composite material was developed by Korea. A flow path was formed inside the CMC combustor and the performance was tested by exposing it to actual combustion environment. In addition, the efforts made for developing a sealant for air tightness maintenance of a fitting part for injecting fuel into the CMC regeneration cooling channel and a study conducted for micropore interception of the CMC material were presented. The pressure of the fuel injected for regeneration cooling was set to about 40 bar, and the design structural analysis of the CMC flow path and the actual pressure resistance test were performed together.

Functional requirements of speed, range, lethality, flexibility and survivability of defense systems depend heavily on numerous materials and material systems that are closely integrated to make up the structure of the vehicle and its propulsion system. In addition to functionality, choice of materials influence the life-cycle cost of vehicles and is therefore a key factor in deciding its affordability. Realization of very high speed aerospace vehicles, such as supersonic and hypersonic vehicles, is possible only if materials having sufficient strength and oxidation resistance at very high temperatures, coupled with resistance to thermal shocks are developed. **Dr. V.V. Satya Prasad explained briefly the advances made at DMRL in the development of ultra-high temperature materials for futuristic high speed aero-space vehicles.** He has informed that the DMRL has developed technology to prepare Carbon fibre reinforced silicon carbide (C_f-SiC) composites using CVI-CVD process in the form of panels and a few selected shapes by optimizing process parameters such as fibre volume fraction and fibre interface coating. These composites have been characterized for various mechanical and thermal properties like tensile and flexural strength (both at room temperature and high temperature), fracture toughness, thermal conductivity etc. In addition, DMRL has also developed technology for synthesizing ZrB_2 powder up to 5 kg scale and for preparing ZrB_2-SiC (UHTC) composites in the form of discs up to 150mm diameter. These composites exhibited consistency in room temperature flexural strength, oxidation resistance and strength retention after exposure to 1500C. The niobium based Cb 752 (Nb-10W-2.5 Zr) alloy is particularly suitable for very high temperature applications as it exhibits adequate strength even at 1400°C. Preparation of this alloy is a very challenging task in view of the differences in the densities and melting temperatures of Nb, W and Zr. The feasibility of preparing this alloy in the form of ingots up to 100 mm diameter and thermo-mechanical processing of the ingots to produce sheets of 5 mm thickness has been established at DMRL.

"Fabrication and testing of ultra-high temperature ceramic (UHTC) materials for TPS application" was narrated by Dr. Sea-Hoon Lee of Korea Institute of Materials Science, Changwon. In order to fabricate ablation resistant UHTC matrix composites, the investigations conducted on powder synthesis, dispersion, shaping, densification, coating process and ablation testing have been explained. The methods to synthesize nano-UHTC powders and liquid precursors having controlled size, shape, size distribution, chemical composition and purity were developed.

Nano powder synthesis of ZrC, ZrB_2, HfB_2 was conducted by innovative processes. Highly concentrated UHTC slurries up to 57vol% were successfully fabricated. Ultra-fine (200 – 300 nm) and homogeneously distributed UHTC-SiC nano composites were successfully fabricated. The UHTC material showed excellent ablation resistance on ablation testing at 2000-2800°C using oxy-acetylene torch, arc-jet plasma wind tunnel and hybrid rocket. The maximum bending strength of the C_f/HfC-SiC UHTC-CMC was 280MPa. The material did not lose its strength after the thermal shock test at 1500°C. The thermal shock resistance of the UHTC was clearly improved by the fabrication of the CMC. Oxy-acetylene Torch Test, Arc-Jet Plasma Wind Tunnel Test and Rocket Motor Tests were successfully conducted.

Dr. A. K. Maiti of BHEL R&D Hyderabad dealt on "Thermal Barrier Coatings (TBC) for Gas Turbine Components". Thermal barrier coatings (TBCs) perform an important function as heat resistant layer for component, such as gas turbine parts operating at elevated temperature. Typical examples are turbine blades, combustion liners, transition pieces and nozzles. TBCs have made possible the increase in operating temperature of gas turbines by protecting the underlying metallic body from damage by surrounding heat. TBC is normally a two-layer structure of bond coat and top coat. Bond coat is usually made of alloy (Ni/CoCrAlY) whereas the standard top coat is made of yttria stabilized zirconia (YSZ). YSZ is preferred because of its high melting point and thermal expansion coefficient. Incidentally YSZ top coats are not suitable as TBC beyond 1000^0 C. Advanced ceramic material like lanthanum/gadolinium zirconate are preferred and used as top coat for high temperature gas turbines. Bond coat and top coat material is deposited by plasma spray process (atmospheric/vacuum). Plasma spray process is normally used for depositing ceramic powder. EBPVD (Electron beam physical vapour deposition) is also used for depositing ceramic layer (YSZ). EBPVD process produces columnar grain whereas plasma spray gives lamellar grain structure. Columnar grains are better than lamellar grains due to high shock resistance but the process of EBPVD are not preferred commercially due to its high operating cost. Plasma spray is more popular due to it low cost and simplicity. The efforts of BHEL in developing TBC coatings and their characterization have been presented in detail.

Dr. D. Srivastava, presented the role of Nuclear fuel Complex, Hyderabad in "Manufacturing of Materials and Structural Components for various types of Reactors". NFC has mandate to develop and manufacture structural components and fuel assemblies required for all the operating Nuclear Power Reactors as well as future advanced reactors in India. The Complex is engaged in the manufacture of various Zirconium alloy reactor core structurals like Pressure Tubes, Calandria Tubes, Garter Springs, Reactivity Mechanism Assemblies for the Pressurized Heavy Water Reactors (PHWRs) and Square Channels for the Boiling Water Reactors (BWRs). The type of structural elements varies with different types of reactors i.e., PHWR, BWR and the Breeders etc. The expertise gained in manufacturing Fast Breeder Test Reactor (FBTR) sub-assemblies was successfully translated to develop technologies required for manufacturing core sub-assemblies and components required for the forthcoming 500 MWe Prototype Fast Breeder Reactor (PFBR) at Kalpakkam. NFC had also manufactured a variety of seamless tubes for strategic applications to meet the requirements of DAE, Space and Defense. Various high temperature materials developed and their processing for application in experimental High Temperature Reactor have been mentioned.

"Current status of high temperature nuclear materials development for future nuclear reactor system applications" has been explained by Dr. Tae Kyu Kim of Korea Atomic Energy Research Institute, Daejeon. As a long-term national research project, high temperature nuclear materials are being developed at the Korea Atomic Energy Research Institute (KAERI) to improve the safety of nuclear reactor systems in the future. In case of the pressurized water reactor (PWR), the R&D activities are focused on the accident tolerant fuel (ATF) and 3D printing technology. Different grades of SA508 are used for pressure vessels, main stream line material and secondary piping. The R&D activities on the high-temperature nuclear materials for future nuclear reactor systems have been summarized as ferritic-martensitic (FM) steels such as Gr91/Gr92 steels for steam generators, T92 for cladding, HT9 for fuel sub-assembly and oxide dispersion strengthened (ODS) alloys for fast reactors. HT 9 duct was processed by VIM+ESR and fabricated by hot piercing. The VHTR which operates

between 700-950°C will have ceramic coated pebbles, graphite core, and Alloy 800H and Inconel 617 for heat exchanger piping. SiC/SiC composites will be used for some internal structures.

The efficiency of conventional fossil-fired thermal power plants is a strong function of temperature and pressure. The need to reduce CO_2 emissions has provided an additional incentive to increase efficiency. More recently the interest has been evinced in the development of Advanced Ultra Super Critical (AUSC) Power Plants in India. Three major institutions (IGCAR, Kalpakkam, BHEL and NTPC) are involved in development of materials and AUSC Power Plant System Engineering. Several Indian Educational institutions and reputed research laboratories are also participating in the characterization of mechanical properties and development of welding technologies. **Dr. K. Laha of AUSC Mission Directorate, Noida has made a detailed presentation on identifying, evaluating, and qualifying the materials needed for the fabrication of various components to be used in the construction of 800 MW AUSC power plant**, the design of which is nearing completion. The Indian AUSC power plant is envisaged to operate with maximum steam temperature of 710 °C at 310 bar with plant efficiency more than 46 %. High temperature and pressure steam in AUSC plant needs better creep resistance material than ferritic steels (T91 and T92) used in USC power plant. Austenitic stainless steel (Sanicro 25) and nickel base superalloy (Inconel 740) are considered for super heater and reheater tubes. Selection of the material among the different alternatives (Super 304H and Inconel 617) are based on the detailed creep strength and economic consideration. Inconel 617 and 740 both are qualified for headers and main pipes. Inconel 740 is preferred over Inconel 617 because of its higher creep rupture strength coupled with higher fatigue strength. Induction bending process for fabrication of the Inconel 740 pipes is being addressed. Key components of turbine are: Casing to contain and regulate steam flow; Bolts to integrate both halves of casings; and Rotor and Blade to extract the steam energy and convert into mechanical energy. In Indian AUSC, both the casing and rotor of HP and IP turbine will be welded ones. Complicated structure of the casing is produced by casting. In inner casing of AUSC, welded Inconel 625 / G911 steel will be used against G911 ferritic steel in USC. Establishment of welding technology for the dissimilar weld joint between alloy 625 and G911 is being persuaded. Bolts for integrity of both halves of casing will be Inconel 718 against alloy X9 in USC for higher stress relaxation resistance. The rotor is of welded Inconel alloy 617 / E911 ferritic steel in AUSC against E911 steel in USC. Large diameter (≈ 1 meter) rotor will produced by forging process, bringing grain size inhomogeneity and hence mechanical properties. Welding process development of the dissimilar (625/E911) rotor is a key technology and is in the process of development. For LP turbine, an ultra-super clean NiCrMoV steel (control on P, Sn, Mn) will be used for both rotor and casing to minimize temper embrittlement at high temperatures. The materials selected for stationary and rotatory blades and valves have also been highlighted.

Dr. R. Sankarasubramanian and Dr. A. Venugopal Rao of DMRL Hyderabad dealt on "Role of Artificial Intelligence / Machine Learning and Integrated Computational Materials Engineering (ICME) in Materials Discovery". Materials discovery is a rate controlling step in the design of new engineering structures. It is essential that materials design be incorporated as part of engineering design of structures and systems so that maximum benefit is realised. However, this seems to be extremely difficult task because the physics of behaviour of engineering materials is extremely complex; features at several length scales and various phenomena occurring over several time scales control their properties and performance. Traditional materials development relies on trial-and-error based experimentation. This approach is laborious and time taking. Availability of affordable computing systems combined with advances in modelling and simulation in terms of reliable software and efficient algorithms, have started changing this scenario. Using the above ecosystem, ICME has recently emerged as a new discipline as a means to accelerate materials discovery. Further, the availability of extensive data accumulated over decades of research combined with the emergence of Artificial Intelligence (AI) has opened up extensive scope for accelerating discovery of newer materials. In this presentation, efforts of DMRL in making use of ICME-based approach for designing newer nickel-based superalloys have been elaborated. The prospect of incorporating AI-based approach in the design and processing of superalloys and in the aero engine turbine disc manufacturing by powder metallurgy were discussed.

"Application of digital and artificial intelligence technology to improve the energy efficiency and availability of existing thermal power plants" has been presented by Dr. Seog Hyeon Ryu, Advisor of Doosan Heavy Industries & Construction, Korea. In-service, power generation

facilities maintain normal functions through periodic overhaul and maintenance, but it is difficult to avoid decreasing the thermal efficiency and availability to some extent as the operation time increases. This presentation highlighted an early warning solution for power plant, boiler combustion optimization solution and boiler tube management system (BTMS) based on digital and artificial intelligence technology. It has been mentioned that, PreVision developed by Korea for early warning has two big features: detecting fault signs via prediction technology using sensor data and diagnosing the same for root cause analysis. These can help avoid unplanned plant outages by using prediction and diagnosis solutions. Optimizing the boiler furnace's combustion is effective at improving its thermal efficiency and reducing the fossil power plant's emissions. The artificial neural networks (ANN)-generated combustion model is applied to the particle swarm optimization (PSO) algorithm to explore the boiler's input values to optimize the combustion. The BTMS provides functions for predicting and managing the temperature distribution and lifetime of the tubes based on applying the boiler's design information, real-time operation information, and fuel information.

Prof. Hyochoong BANG of Korea Advanced Institute of Science and Technology, presented A Case Study on Space Education Initiatives by Cubesat. In this talk, recent university space activities in Korea are introduced in particular Cubesat program. The Cubesat is being considered as a new game changer in space education and innovative technology. KAIST) launched a 2kg size Cubesat into space with some success story in 2017. The program has significant impact on young generation by providing new opportunities. Korean government strongly supported university Cubesat initiatives. This talk generated attention with possibility of collaboration in Cubesat between India and Korea in the near future.

Prof. Vinay K Dadhwal, Indian Institute of Space Science and Technology, Trivandrum, gave a detailed presentation of Space Education Initiatives in India. Space education in India covers a very large canvas of science, technology and applications. The areas that address space education include astronomy and astrophysics, heliophysics, planetary science, astrobiology, to a number of engineering branches such as aerospace and avionics with inclusion of material science and technology, communication and optical engineering and earth science, geomatics and geodesy, positioning and navigation. Education opportunities in India for above disciplines were presented especially the leading institutions. Major centres focusing on PhD research and training in relevant areas of space are Physical Research Laboratory, Ahmadabad (estd. 1944), Indian Institute of Remote Sensing, Dehradun (estd.1966 as Indian Photointerpretation Institute), Space Physics Laboratory (1968, under VSSC), National Atmospheric Research Laboratory, Gadanki (estd 1992 as National Mesosphere-Stratosphere-Troposphere Radar Facility NMRF). These organizations independently and through programs such as establishment of Space Technology Cells in IITs by ISRO, RESPOND program and a number of recent initiatives have been significant in spreading the space education through research and training. Most significant initiative of ISRO in the field of education has been establishment of Indian Institute of Space Science and Technology (IIST) in 2007. IIST is a deemed-to-be university under the Indian education system and offers undergraduate, post-graduate and doctoral degrees in relevant disciplines.

The research focus at IIST is both on (a) space relevant discipline-wise areas with particular emphasis on gap areas identified by ISRO and (b) conceptualize and realize space projects to provide system engineering experience to students, researchers and faculty. Recent such project on an ARIS (Advanced Retarding Potential Analyses for Ionospheric Studies) launched on PS4-OP on 1 april 2019 on PSLV C45 and would also fly shortly again PS4-OP on PSLC-C48. It has proven successful and its variants have been accepted to fly on upcoming ISRO missions to Mars (MON-2) and Venus. IIST has established a Small Spacecraft and Payload Centre (SSPACE) which currently is working on one in-house cubesat (AHAN) and two international collaborative small spacecraft projects, namely InspireSat-1 (with University of Colorado) and AAReST (with Caltech USA and University of Surrey, UK). IIST has designed various subsystems, including OBC, cold gas thrusters, EPS, flight software and all will be flown on ISRO vehicles in next 1-2 years. Ongoing international collaborations were presented.

A letter of appreciation has since been received from President, NAEK which can be viewed by clicking here .....

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Engineers Conclave 2019

The **Seventh Engineers Conclave-2019 (EC-2019) is being held jointly with Bharat Electronics Limited (BEL) on Sep 19-21, 2019 at BEL, Bangalore.** INAE had taken an initiative of organizing an annual mega event of engineers as "Engineers Conclave" since 2013 jointly with major Engineering Organizations/Strategic Departments/Institutions/Industry on rotation basis. The objective of the Engineers Conclave is to provide a platform for engineers from allied fields to meet, deliberate and recommend right engineering solutions to some of the pertinent issues of national importance. Each conclave has two themes, one specific to the host department and other specific to some social problem where engineering intervention is desired. The two themes for the Engineers Conclave 2019 are "**Defence Technology & Innovation**" and "**Transformation of Rural India Using Digital Technologies**", which have been chosen keeping in view the current National Priorities and interest. All INAE Fellows and Young Associates have been invited to participate in the Engineers Conclave 2019.

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions over technological changes have become essential in recent times, so that relevant knowledge that would be sustainable in the changing conditions can be imparted to the students in the engineering institutions. While industries could gain by using the academia's knowledge base to improve the industry's cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, 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. Jaiteerth R Joshi Scientist 'G', Defence Research and Development Laboratory, Hyderabad	BV Raju Institute of Technology, Narsapur, Telangana March 23-24, 2019	Delivered lectures on "Electrochemical Migration (ECM); Dye Penetrant Test and Ultrasonic Testing: In Depth View", and held discussions on research with faculty members. According to the feedback received from the faculty coordinator of the engineering college, the scheme helped both students and faculty to enhance their skills. The students were helped in making prototypes using advanced welding technologies.
Prof. KG Narayankhedkar Professor (Mechanical	Atharva College of Engineering,	Delivered lectures on " Outcome Based Education - Innovation in Educational Activities" and

Engineering) and Dean (Planning), IIT Bombay; Director, VJIT, Mumbai	Malad, Mumbai April 25-27, 2019 June 14, 26-27, 2019 Vishwakarma Institute of Technology, Pune April 17-19 ,2019	"Examination Reforms - Assessment Drives Learning". According to the feedback received from the engineering college, the DVP is helping in examination reforms based on outcome-based learning. Delivered lectures on "Long Term and Short-Term Research goals for Effective B.E. Projects", "B.E. Projects relevant to Industry". According to the feedback from engineering college, the scheme is excellent and helps faculty members in research project and other academic activities. Delivered lecture on "Technical Paper Writing in Scopus Listed and UGC Approved Journals", "Examination Reforms in Purview of Outcome-Based Education" and "Course Outcomes & Programme Outcomes (CO-PO) Attainment, Direct and Indirect Methods". According to the feedback received from the faculty coordinator of the engineering college, the interactions with the DVP have been beneficial for PG students and faculty members to understand importance of examination reforms.
Prof. S Sreenivasa Murthy, Formerly Professor, IIT Delhi	Dayananda Sagar College of Engineering, Bengaluru May 7-8, 2019	Delivered lectures on "Overview of Electric Vehicles and Review on Special Machines and Drives". He discussed regarding project for National Institute of Wind Energy (NIWE) on Micro Grid.
Dr Chaitanyamoy Ganguly, Retired Distinguished Scientist, DAE	Dr. MN Dastur School of Materials Science and Engineering, Indian Institute of Engineering Science and Technology, Shibpur, June 24-26,2019	Delivered lectures on "Prospects and Challenges for Indian Industries vis - a - vis Energy & Environment", "Radiation Sterilization of Sewage Sludge and Recycling as Manure-Case Study at Ahmedabad Municipality Corporation" and "Indentation Techniques for Evaluation of Creep, Fatigue & Fracture Toughness of Materials". As per the feedback from the engineering college, the DVP has made deep impact on the students and has encouraged them to take up energy and environment related research topics for further studies. He has also proposed changes in the curriculum. The visits by DVP have been very productive.

Important Meetings held during July 2019

- **Meeting of INAE Forum on Civil Infrastructure held on July 6, 2019 at New Delhi**
- **Meeting of INAE Forum on Technology Foresight and Management held on July 18, 2019 at INAE Office, Gurgaon**

- **Selection Committee Meeting for Shortlisting of Nominations to be called for presentations for the Innovative Student Projects Award 2019 held on July 19, 2019 at INAE Office, Gurgaon**

- **Meeting of INAE Young Entrepreneur Award Committee for Shortlisting of Nominations to be called for Presentations for INAE Young Entrepreneur Award 2019 held on July 19, 2019 at INAE Office, Gurgaon.**

- **Meeting of INAE Forum on Engineering Interventions for Disaster Mitigation held on July 26, 2019 at INAE Office, Gurgaon.**

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 August 2019, click here.

Honours and Awards

1.	Prof Ganti Prasada Rao, FNAE Member UNESCO-EOLSS Joint Committee, Abu Dhabi, UAE has been honoured as Distinguished Alumnus of Indian Institute of Technology Kharagpur; Notable Alumni of Jawaharlal Nehru Technological University (JNTU), Kakainada and also a Notable Alumni of Maharajah's College, Vizianagaram, all three institutions of higher learning that he attended after his schooling.
2.	Dr Ravindra Gettu, FNAE, Dean, Industrial Consultancy & Sponsored Research and Prof. V.S. Raju Chair Professor, Department of Civil Engineering, Indian Institute of Technology Madras, Chennai has been elected as a Foreign Member of the Russian Academy of Engineering.

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

NAEK The National Academy of Engineering of Korea

President Sanak Mishra
Indian National Academy of Engineering
Unit No. 604-609, 6th Floor, Tower A,
Sector 49, Shona Road, Gurgaon – 122018

July 25, 2019

Dear President Sanak Mishra,

On behalf of the National Academy of Engineering of Korea, I am writing this letter to express sincere appreciation to you and Indian National Academy of Engineering, as well as MIDHANI, for the great organizing of our workshop and warm hospitality to our delegations last week in Hyderabad.

I heard that our workshop was so productive and successful; thanks to your delicate consideration for the invitation, the participants could make a more intimate network with each other. Additionally, I am delighted that INAE and NAEK discussed concrete ways to cooperate at the end of the workshop. I hope our workshop can serve as a platform to generate a technological innovation between two countries.

I believe there are other areas for further development of the topic like ICT, so next year in Seoul, we can discuss about it in detail. I sincerely hope to continue our relationship and look forward to our next workshop.

Thank you again for your commitments and supports of this workshop, and please convey our thanks and best wishes to all INAE members.

Sincerely yours,

Oh-Kyong KWON

President
National Academy of Engineering of Korea

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International/National Conferences in August 2019

International Conference on Chemical Environmental Bioprocess Textile Mining Material & Metallurgical Engineering (CEBTME-2019) Conference on 10th August 2019 at New Delhi
https://conferencealerts.com/show-event?id=216045

International Conference on Computer Science E-Learning Information & Communication Technology (CSIT– 2019) Conference on 10th August 2019 at New Delhi
https://conferencealerts.com/show-event?id=216046

International Conference on Innovative Research in Electrical, Electronics and Communication Technology (ECT – 2019) Conference on 10th August 2019 at New Delhi,
https://conferencealerts.com/show-event?id=216047

International Conference on Electrical, Electronics and Computer Science Technology (ICEECST) Conference on 10th to 11th August 2019 at Pune, Maharashtra
https://conferencealerts.com/show-event?id=216870

7th International Conference on Innovations in Computer Science & Engineering, ICICSE-2019 Conference on 16th to 17th August 2019 at Hyderabad, Telangana
https://conferencealerts.com/show-event?id=209206

International Conference on Manufacturing, Material Science and Engineering Conference on 16th to 17th August 2019 at Hyderabad, Telangana
https://conferencealerts.com/show-event?id=214309

Intelligent Energy Management Electric Power, Robotics and Automation Conference on 26th to 28th August 2019 at Kolkata, West Bengal
https://conferencealerts.com/show-event?id=210244

World Congress on Biotechnology and Health Care Summit - 2019 Conference on 28th to 29th August 2019 at Bangalore
https://conferencealerts.com/show-event?id=211942

Civil Engineering

1. New High-Definition Satellite Radar Can Detect Bridges at Risk of Collapse from Space

Researchers from the NASA Jet Propulsion Laboratory (JPL) and the University of Bath have developed a satellite-based early warning system that could spot tiny movements in bridges that indicate they could collapse. Combining data from a new generation of satellites with a sophisticated algorithm, the monitoring system could be used by governments or developers to act as a warning system ensuring large-scale infrastructure projects are safe. The team of experts led by NASA's JPL and engineers from Bath verified the technique by reviewing 15 years of satellite imagery of the Morandi Bridge in Genoa, Italy, a section of which collapsed in August 2018, killing 43 people. The review showed that the bridge did show signs of warping in the months before the tragedy. Dr Giorgia Giardina, Lecturer in the University's Department of Architecture and Civil Engineering, said: "The state of the bridge has been reported on before, but using the satellite information we can see for the first time the deformation that preceded the collapse. "We have proved that it is possible to use this tool, specifically the combination of different data from satellites, with a mathematical model, to detect the early signs of collapse or deformation." While current structural monitoring techniques can detect signs of movement in a bridge or building, they focus only on specific points where sensors are placed. The new technique can be used for near-real time monitoring of an entire structure. Jet Propulsion Laboratory Lead author Dr Pietro Milillo said: "The technique marks an improvement over traditional methods because it allows scientists to gauge changes in ground deformation across a single infrastructure with unprecedented frequency and accuracy. "This is about developing a new technique that can assist in the characterisation of the health of bridges and other infrastructure. We couldn't have forecasted this particular collapse because standard assessment techniques available at the time couldn't detect what we can see now. But going forward, this technique, combined with techniques already in use, has the potential to do a lot of good." This is made possible by advances in satellite technology, specifically on the combined use of the Italian Space Agency's (ASI) COSMO-SkyMed constellation and the European Space Agency's (ESA's) Sentinel-1a and 1b satellites, which allows for more accurate data to be gathered. Precise Synthetic Aperture Radar (SAR) data, when gathered from multiple satellites pointed at different angles, can be used to build a 3D picture of a building, bridge or city street. Dr Giardina added: "Previously the satellites we tried to use for this research could create radar imagery accurate to within about a centimetre. Now we can use data that is accurate to within a millimetre -- and possibly even better, if the conditions are right. The difference is like switching to an Ultra-HD TV -- we now have the level of detail needed to monitor structures effectively. "There is clearly the potential for this to be applied continuously on large structures. The tools for this are cheap compared to traditional monitoring and can be more extensive. Normally you need to install sensors at specific points within a building, but this method can monitor many points at one time." The technique can also be used to monitor movement of structures when underground excavations, such as tunnel boring, are taking place. "We monitored the displacement of buildings in London above the Crossrail route," said Dr Giardina. "During underground projects there is often a lot of data captured at the ground level, while fewer measurements of structures are available. Our technique could provide an extra layer of information and confirm whether everything is going to plan."

Source https://www.sciencedaily.com/releases/2019/07/190709141305.htm

2. Flexible User Interface Distribution for Ubiquitous Multi-Device Interaction

KAIST researchers have developed mobile software platform technology that allows a mobile application (app) to be executed simultaneously and more dynamically on multiple smart devices. Its high flexibility and broad applicability can help accelerate a shift from the current single-device paradigm to a multiple one, which enables users to utilize mobile apps in ways previously unthinkable. Recent trends in mobile and IoT technologies in this era of 5G high-speed wireless communication have been hallmarked by the emergence of new display hardware and smart devices such as dual screens, foldable screens, smart watches, smart TVs, and smart cars. However, the current mobile app ecosystem is still confined to the conventional single-device paradigm in which users can employ only one screen on one device at a time. Due to this limitation, the real potential of multi-device environments has not been fully explored. A KAIST research team from the School of Computing, in collaboration scientists from the State University of New York at Buffalo, have developed mobile software platform technology named FLUID that can flexibly distribute the user interfaces (UIs) of an app to a number of other devices in real time without needing any modifications. The proposed technology provides single-device virtualization, and ensures that the interactions between the distributed UI elements across multiple devices remain intact. This flexible multimodal interaction can be realized in diverse ubiquitous user experiences (UX), such as using live video steaming and chatting apps including YouTube, LiveMe, and AfreecaTV. FLUID can ensure that the video is not obscured by the chat window by distributing and displaying them separately on different devices respectively, which lets users enjoy the chat function while watching the video at the same time. In addition, the UI for the destination input on a navigation app can be migrated into the passenger's device with the help of FLUID, so that the destination can be easily and safely entered by the passenger while the driver is at the wheel. FLUID can also support 5G multi-view apps -- the latest service that allows sports or games to be viewed from various angles on a single device. With FLUID, the user can watch the event simultaneously from different viewpoints on multiple devices without switching between viewpoints on a single screen. The team implemented the prototype of FLUID on the leading open-source mobile operating system, Android, and confirmed that it can successfully deliver the new UX to 20 existing legacy apps. "This new technology can be applied to next-generation products from South Korean companies such as LG's dual screen phone and Samsung's foldable phone and is expected to embolden their competitiveness by giving them a head-start in the global market." said a lead researcher.

Source https://www.sciencedaily.com/releases/2019/07/190719102148.htm

3. How to Ice-Proof the Next Generation of Aircraft

35,000 feet is standard cruising altitude for a commercial jet airplane, but at those lofty heights the air temperature plummets below -51 degrees Celsius and ice can easily form on wings. To prevent ice formation and subsequent drag on the aircraft, current systems utilize the heat generated by burning fuel. But these high-temperature, fuel-dependent systems cannot be used on the proposed all-electric, temperature-sensitive materials of next-generation aircraft. As scientists are searching for new anti-icing methods, physicists from Northwestern Polytechnical University in China and Iowa State University have taken a different approach. They have showed that equipment important in controlling landing and takeoff can double-up as icing control. "Current anti-icing methods are not suitable for next-generation aviation systems based on the new aviation technologies," said a researcher. "We have found an excellent way to control the icing on these new aircraft." It depends on plasma actuators. Plasma actuators are a special type of short electrical circuit. When a high voltage is applied across the two electrodes, it causes the particles of air above it to ionize, forming a plasma, and inducing a flow, or wind. This plasma flow over the actuator has been previously manipulated to control the aerodynamics of aircraft wings, altering the lift and drag for landing and takeoff (known as flow control applications). But plasma actuators don't just release an induced wind. "When applying a high voltage, most is converted into heat and the rest is converted into an induced flow or ionic wind over the actuator, so the plasma actuator has both aerodynamic and heat effects," said Meng. "By coupling the aerodynamic and thermal aspects of the plasma actuator, we have provided a completely new method for efficient icing and flow control." The plasma control team of Northwestern Polytechnical University first realized the effect of plasma actuators on icing in 2012, when an ice cube placed in the discharge area of the plasma exciter quickly melted. To further demonstrate the mechanism of plasma ice protection, the team has designed incredibly thin, surface dielectric barrier discharge plasma actuators and mounted them on a 3D-printed plastic NACA 0012 airfoil. Three configurations of actuators were installed in order to investigate how different aerodynamics impacted ice formation. Then high-speed cameras, alongside infrared thermal imaging and particle scattering lasers, were used to visualize how the induced flow and thermal output interacted. Tests were conducted in still air conditions as well as inside an icing wind tunnel, where cold particles of air were fired at the airfoil. The team found that thermal and flow dynamics are inextricably interlinked for all three actuators. The plasma actuators placed perpendicular to the airfoil surface were the most effective at transferring heat along the wing, completely preventing ice formation. By comparing heat transfer and flow between the different designs, the team concluded that the optimal design needs to generate as much heat locally, while also mixing well with the incoming airflow. "This could be used to design an effective anti-icing system at low enough temperatures to prevent stress on the composite material design of next-generation aircraft," said researchers. The conventional anti-icing technique uses air as hot as 200 degrees Celsius to vaporize the water droplets, and composite material cannot afford such high temperatures. But the plasma icing control can stop the supercool droplets forming ice on the surface of the vehicle without temperatures as high, which is good for the composite materials. The research team's proposal to use plasma actuators as anti-icers was a "surprise" for fluid mechanics experts. The team admits that they are just at the beginning of this research and that they still need to find out how thermal and flow effects are linked, and how exactly they work together to dissipate supercooled droplets from a wing's surface.

Source https://www.sciencedaily.com/releases/2019/04/190401133032.htm

4. Eco-Friendly Composite Catalyst and Ultrasound Removes Pollutants from Water

A research team of Korea Institute of Science and Technology's Water Cycle Research Centre has developed a wastewater treatment process that uses a common agricultural byproduct to effectively remove pollutants and environmental hormones, which are known to be endocrine disruptors. The sewage and wastewater that are inevitably produced at any industrial worksite often contain large quantities of pollutants and environmental hormones (endocrine disruptors). Because environmental hormones do not break down easily, they can have a significant negative effect on not only the environment but also the human body. To prevent this, a means of removing environmental hormones is required. The performance of the catalyst that is currently being used to process sewage and wastewater drops significantly with time. Because high efficiency is difficult to achieve given the conditions, the biggest disadvantage of the existing process is the high cost involved. Furthermore, the research done thus far has mostly focused on the development of single-substance catalysts and the enhancement of their performance. Little research has been done on the development of eco-friendly nanocomposite catalysts that are capable of removing environmental hormones from sewage and wastewater. The KIST research team utilized biochar, which is eco-friendly and made from agricultural byproducts, to develop a wastewater treatment process that effectively removes pollutants and environmental hormones. The team used rice hulls, which are discarded during rice harvesting, to create a biochar that is both eco-friendly and economical. The surface of the biochar was coated with nano-sized manganese dioxide to create a nanocomposite. The high efficiency and low cost of the biochar-nanocomposite catalyst is based on the combination of the advantages of the biochar and manganese dioxide. The KIST team used the hydrothermal method, which is a type of mineral synthesis that uses high heat and pressure, when synthesizing the nanocomposite in order to create a catalyst that is highly active, easily replicable, and stable. It was confirmed that giving the catalyst a three-dimensional stratified structure resulted in the high effectiveness of the advanced oxidation process (AOP), due to the large surface area created. When used under the same conditions in which the existing catalyst can remove only 80 percent of Bisphenol A (BPA), an environmental hormone, the catalyst developed by the KIST team removed over 95 percent in less than one hour. In particular, when combined with ultrasound (20kHz), it was confirmed that all traces of BPA were completely removed in less than 20 minutes. Even after many repeated tests, the BPA removal rate remained consistently at around 93 percent. A researcher of KIST's Water Cycle Research Center said, "The catalyst developed through this study makes use of a common agricultural byproduct. Therefore, we expect that additional research on alternative substances will lead to the development of catalysts derived from various types of organic waste biomass." Another researcher said, "We have high hopes that future studies aimed at achieving process optimization and increasing removal rates will allow for the development an environmental hormone removal system that is both eco-friendly and low-cost."

Source https://www.sciencedaily.com/releases/2019/07/190719135546.htm

5. On the Way to Printable Organic Light Emitting Diodes

Organic light-emitting diodes are components that no longer consist of compounds containing the semiconducting material gallium, but of so-called organic compounds in which carbon is a main component. Compared to conventional light-emitting diodes, however, the luminosity and lifetime of OLEDs are currently lower, which is why they represent a current field of research. Scientists at the MPI-P, Germany have now developed a new OLED concept. Nowadays, OLEDs consist of various wafer-thin layers. Some layers are used to transport charges, while others are used to efficiently introduce electrons into the active layer in which light is generated. Thus, current OLEDs can easily consist of five to seven layers. The researchers have now developed an OLED which consists only of one single layer that is supplied with electricity via two electrodes. This simplifies the production of such OLEDs and paves the way for printable displays. With their first prototype, the Mainz scientists were able to show that they can generate a brightness of the emitted light of 10,000 candela/square meter with a voltage of only 2.9 volts -- this corresponds to about 100 times the luminosity of modern screens. Achieving such high luminosity at this low voltage is a record for current OLEDs. The researchers were also able to measure an external efficiency of 19%, which means that 19% of the electrical energy supplied is converted into light that comes out in direction of the viewer. Also, with this value, the OLED prototype can compete with current OLEDs consisting of five or even more layers. In continuous operation, the researchers were able to measure a so-called LT50 lifetime of almost 2000 hours at a brightness equivalent to ten times that of modern displays. Within this time, the initial luminosity has dropped to 50% of its value. The scientists hope that their newly developed single-layer concept -- i.e. the reduced complexity of OLEDs -- will contribute to the identification and improvement of the processes responsible for the reduction in lifetime. The scientists are using a light-emitting layer based on so-called "Thermally Activated Delayed Fluorescence" (TADF). This physical principle has been known for several decades, but became the focus of OLED research about 10 years ago, when an efficient conversion of electrical energy into light was demonstrated in Japan. Since then, researchers have been working to produce TADF-based OLEDs, as these do not require expensive molecular complexes containing rare-earth metals that are being used in current OLEDs.

Source https://www.sciencedaily.com/releases/2019/07/190710121605.htm

6. AI Radar System That Can Spot Miniature Drones 3 Kilometers Away

Researchers from DGIST, Republic of Korea announced last month, that their research team in the Collaborative Robots Research Centre developed a radar system that can detect sub-miniature drones that are 3km away. Since last year, a research team has devoted itself into building a combat system using drones and training specialized personnel by forming a drone unit to strengthen its defence capability. Since 2014, DGIST's research team has continuously been working on R&D of a drone detection radar system based on a super-resolution algorithm and developed Korea's first radar system that can detect drones 200m away for the first time in 2016. Through continuous research, the team successfully developed a world-class radar system that can detect sub-miniature phantom drones flying in the sky over 3km. The research team designed the drone detection radar system to operate between 12GHz and 18GHz, and applied super-resolution radar signal processing technology to locate drones accurately by applying an AESA radar1 technology to increase the maximum detection distance of radar. Furthermore, the radar system can identify and detect drones more clearly in real-time by integrating 'GANs (Generative Adversarial Networks'2 -based drone cognition technology, which has been drawing attention as next generation deep learning algorithm. What is noteworthy is that hardware components such as the transmissio, transmission antenna, receiving unit, receiving antenna, and signal processing platform inside the radar detection system were developed 100% jointly with Korean small and medium-sized companies, which can help create high-added values of regional industries. A Senior researcher in the DGIST Collaborative Robots Research Centre said "This research achievement is a result of cooperation with Korean companies to develop radar hardware and our focus on the development of a unique radar signal processing algorithm for detection, tracking, and identification of drones. We will strive harder to enhance the reputation of domestic radar technologies in the global market by changing the market spectrum led by overseas companies." The research team is currently discussing the issue of drone detection radar technology transfer to Korean and overseas defence industries.

1. AESA (Active Electronically Scanned Array) Radar: Can transmit and receive electromagnetic signals independently because the radar modules in the radar antenna have individual semiconductor amplification and phase shifters.
2. 2 GANs (Generative Adversarial Networks): A next generation's deep learning AI algorithm that produce data through self-teaching with small data due to its cardio-nerve network structure.

Source https://www.sciencedaily.com/releases/2019/07/190718085310.htm

7. Neural Lander' uses AI to land drones smoothly

Landing multi-rotor drones smoothly is difficult. Complex turbulence is created by the airflow from each rotor bouncing off the ground as the ground grows ever closer during a descent. This turbulence is not well understood nor is it easy to compensate for, particularly for autonomous drones. That is why takeoff and landing are often the two trickiest parts of a drone flight. Drones typically wobble and inch slowly toward a landing until power is finally cut, and they drop the remaining distance to the ground. At Caltech's Center for Autonomous Systems and Technologies (CAST), artificial intelligence experts have teamed up with control experts to develop a system that uses a deep neural network to help autonomous drones "learn" how to land more safely and quickly, while gobbling up less power. The system they have created, dubbed the "Neural Lander," is a learning-based controller that tracks the position and speed of the drone, and modifies its landing trajectory and rotor speed accordingly to achieve the smoothest possible landing. "This project has the potential to help drones fly more smoothly and safely, especially in the presence of unpredictable wind gusts, and eat up less battery power as drones can land more quickly," says Soon-Jo Chung, Bren Professor of Aerospace in the Division of Engineering and Applied Science (EAS) and research scientist at JPL, which Caltech manages for NASA. Deep neural networks (DNNs) are AI systems that are inspired by biological systems like the brain. The "deep" part of the name refers to the fact that data inputs are churned through multiple layers, each of which processes incoming information in a different way to tease out increasingly complex details. DNNs are capable of automatic learning, which makes them ideally suited for repetitive tasks. To make sure that the drone flies smoothly under the guidance of the DNN, the team employed a technique known as spectral normalization, which smooths out the neural net's outputs so that it doesn't make wildly varying predictions as inputs/conditions shift. Improvements in landing were measured by examining deviation from an idealized trajectory in 3D space. Three types of tests were conducted: a straight vertical landing; a descending arc landing; and flight in which the drone skims across a broken surface -- such as over the edge of a table -- where the effect of turbulence from the ground would vary sharply. The new system decreases vertical error by 100 percent, allowing for controlled landings, and reduces lateral drift by up to 90 percent. In their experiments, the new system achieves actual landing rather than getting stuck about 10 to 15 centimeters above the ground, as unmodified conventional flight controllers often do. Further, during the skimming test, the Neural Lander produced a much a smoother transition as the drone transitioned from skimming across the table to flying in the free space beyond the edge. Besides its obvious commercial applications, the new system could prove crucial to projects currently under development at CAST, including an autonomous medical transport that could land in difficult-to-reach locations (such as a gridlocked traffic). "The importance of being able to land swiftly and smoothly when transporting an injured individual cannot be overstated," says Morteza Gharib, Hans W. Liepmann Professor of Aeronautics and Bioinspired Engineering; director of CAST; and one of the lead researchers of the air ambulance project.

Source https://www.sciencedaily.com/releases/2019/05/190524130220.htm

8. X-Ray Mapping Enhances Potential of Lightweight Magnesium

A world-first study led by Monash University has discovered a technique and phenomenon that can be used for creating stronger, lightweight magnesium alloys that could improve structural integrity in the automobile and aerospace industries. Researchers from Monash University, CSIRO and Chongqing University discovered a pattern of alloying element segregation in twin boundaries by using atomic-resolution X-ray mapping at much lower electron voltage. Engineers are constantly seeking strong, lightweight materials for use in cars, planes and in high-speed vehicles to improve fuel efficiency, aerodynamics, speed and weight load. The finding is significant, as the deformation of lightweight magnesium during thermomechanical processes and applications prevents those alloys from being used more widely in place of steel. It also has implications for other light alloys such as aluminium and titanium. "Lightweight magnesium has tremendous potential for energy-efficient and environmentally-friendly applications. But the segregation in these materials is prone to electron beam damage," lead author Professor Jian-Feng Nie, from Monash University's Department of Materials Science and Engineering, said. "The electron beam damage is most severe when segregated solute atoms become a single atomic column. This impacts the formability, deformation behaviour and tension-compression strength of wrought magnesium products. "We demonstrated that it's possible to solve this difficulty by using atomic-resolution X-ray mapping at a much lower accelerating voltage of electrons [120kV] instead of 300kV, which is commonly used. "We further discovered that the new segregation pattern increases the boundary pinning effect by more than 30 times, and switches the migration mechanism of the twin boundary from the commonly accepted mode to a new one." The researchers used a magnesium alloy comprising neodymium and silver as part of their study. This alloy contains superior mechanical properties at both ambient and elevated temperatures. They found significant improvements in shear stress, by 33 times, and elastic strain limit occurred when the twin boundary was populated with neodymium and silver. The increased charge density between silver and neodymium with the magnesium indicated a stronger bond and strengthening of the twin. As force is applied, the magnesium is pushed towards the neodymium and away from the silver -- creating a stronger, lightweight alloy. "Our work demonstrates that the atomic-scale analysis of the structure and chemistry of solute segregation in metallic alloys with complex compositions is now possible," Professor Nie said.

Source https://www.sciencedaily.com/releases/2019/07/190719102107.htm

Energy Engineering

9. Engineers Develop Chip That Converts Wasted Heat to Usable Energy

It's estimated that as much as two-thirds of energy consumed in the U.S. each year is wasted as heat. Take for example, car engines, laptop computers, cell phones, even refrigerators, that heat up with overuse. Imagine if you could capture the heat they generate and turn it into more energy. University of Utah mechanical engineering associate professor Mathieu Francoeur has discovered a way to produce more electricity from heat than thought possible by creating a silicon chip, also known as a "device," that converts more thermal radiation into electricity. Researchers have previously determined that there is a theoretical "blackbody limit" to how much energy can be produced from thermal radiation (heat). But Francoeur and his team have demonstrated that they can go well beyond the blackbody limit and produce more energy if they create a device that uses two silicon surfaces very close together. The team produced a 5mm-by-5mm chip (about the size of an eraser head) of two silicon wafers with a nanoscopic gap between them only 100 nanometers thick, or a thousandth the thickness of a human hair. While the chip was in a vacuum, they heated one surface and cooled another surface, which created a heat flux that can generate electricity. The concept of creating energy in this manner is not unique, but Francoeur and his team have discovered a way to fit the two silicon surfaces uniformly close together at a microscopic scale without touching each other. The closer they are to each other, the more electricity they can generate. "Nobody can emit more radiation than the blackbody limit," he said. "But when we go to the nanoscale, you can." In the future, Francoeur envisions that such technology could be used to not only cool down portable devices like laptops and smartphones but also to channel that heat into more battery life, possibly as much as 50% more. A laptop with a six-hour charge could jump to nine hours, for example. The chips could be used to improve the efficiency of solar panels by increasing the amount of electricity from the sun's heat or in automobiles to take the heat from the engine to help power the electrical systems. They could also be designed to fit in implantable medical devices such as a pacemaker that would not require replaceable batteries. Another benefit is such technology can help improve the life of computer processors by keeping them cool and reducing wear and tear, and it will save more energy otherwise used for fans to cool the processors. It also could help improve the environment, Francoeur argued. "You put the heat back into the system as electricity," he said. "Right now, we're just dumping it into the atmosphere. It's heating up your room, for example, and then you use your AC to cool your room, which wastes more energy."

Source https://www.sciencedaily.com/releases/2019/07/190710103145.htm

10. Fiber-Optic Vibration Sensors Could Prevent Train Accidents

New accelerometers would enable all-optical sensing networks that continuously monitor for train or track problems. Researchers have developed new sensors for measuring acceleration and vibration on trains. The technology could be integrated with artificial intelligence to prevent railway accidents and catastrophic train derailments. "Each year, train accidents lead to severe injuries and even deaths," said research team leader Hwa-yaw Tam, from The Hong Kong Polytechnic University. "Our fiber accelerometers could be used for real-time monitoring of defects in the railway track or the train to pinpoint problems before an accident occurs." The devices can detect frequencies more than double that of traditional fiber-optic accelerometers, making them suitable for monitoring wheel-rail interactions. The durable sensors include no moving parts and work well in the noisy and high-voltage environments found in railway applications. "In addition to railway monitoring, these new accelerometers can be utilized in other vibration monitoring applications, for example, structural health monitoring for buildings and bridges and vibration measurements of aircraft wings," said a researcher. For more than 15 years, the researchers have been working on condition-monitoring systems that use an all-optical sensing network to continuously monitor critical railway components. These systems can help replace inefficient and costly scheduled railway maintenance routines with predictive maintenance based on actual conditions. Systems developed by the researchers have been installed in Hong Kong and Singapore. "An all-optical sensing network has many advantages as it is immune to electromagnetic interference, has long transmission distance and the sensors don't require electricity," said a researcher of the team. "However, there is a need for fiber-optic sensors that are optimized to measure different parameters in railway systems." The fiber-optic accelerometers typically used in condition-monitoring systems are based on fiber Bragg gratings (FBGs) and cannot be used to detect vibrations higher than 500 Hz. Although this is adequate for most railway applications it can't be used to measure the wheel-rail interactions that are an important source of track wear. To overcome this problem, the researchers designed a new fiber-optic accelerometer that uses a special optical fiber known as a polarization-maintaining photonic crystal fiber that is coiled into the shape of a disc only 15 millimeters in diameter. The coiled fiber is glued between a stainless-steel substrate and a cylindrical mass block. When a vibration occurs, the mass block will press on the coiled fiber at a frequency matching that of the vibration. This external force causes the wavelength of light in the fiber to shift in a measurable way. "This interferometric configuration uses changes in the light inside the fiber to acquire precise information about the vibrations," said a team member. "Installing these accelerometers on the undercarriage of an in-service train allows them to monitor vibrations that would indicate defects in the track. They can also be used to detect problems in overhead lines used to power trains." After thoroughly testing prototypes of the new accelerometer in the laboratory, the researchers carried out a field test by installing the device on an in-service train. They also installed an FBG-based accelerometer and a piezoelectric accelerometer for comparison. They found that the new fiber accelerometer detected acceleration in a manner similar to the piezoelectric accelerometer. However, piezoelectric sensors require expensive shielded cables to reduce the effects of electromagnetic interference noise. Because the FBG-based accelerometer can't operate well at high frequencies, noise concealed some of the useful vibration information. Their results showed that our new accelerometers perform considerably better than existing accelerometers used for monitoring acceleration in trains. In this work, the researchers used a commercial polarization-maintaining photonic crystal fiber. They have since designed and fabricated a new type of fiber with smaller outer diameters, lower bending losses and higher birefringence, all of which would allow them to build a smaller accelerometer with even higher sensitivity. "These new accelerometers could open new sensing and monitoring possibilities by providing data that supports implementation of artificial intelligence in the railways industry," said a researcher. "Although railway monitoring is a good example of how fiber-optic sensing can be combined with artificial intelligence, we believe this combination is also promising for a number of other industries and applications."

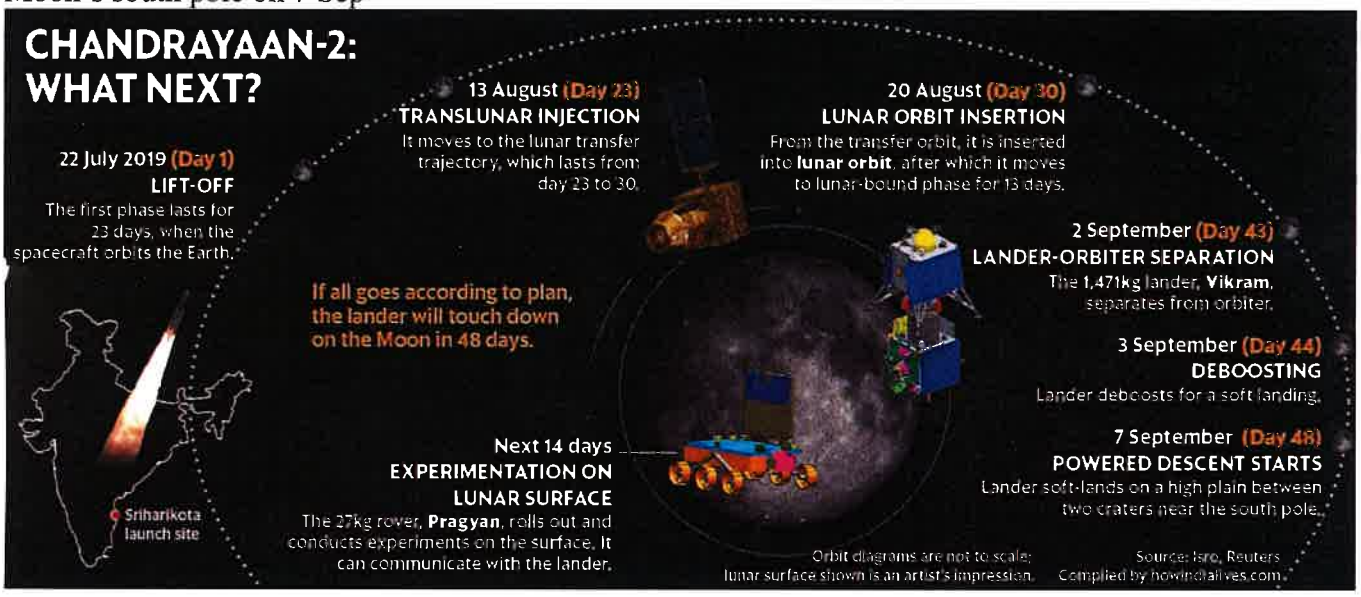
Source https://www.sciencedaily.com/releases/2019/07/190717122617.htm

Engineering Innovation in India

India's Ambitious Moon Mission Chandrayaan 2 Lifts Off

Chandrayaan 2 launch: The mission will take nearly two months to complete

Chandrayaan 2, India's high-profile lunar mission, lifted off from Sriharikota in Andhra Pradesh on July 22, 2019. The 3,850 kg Chandrayaan 2, a three-component spacecraft comprising an orbiter, lander and rover, will explore the unchartered lunar south pole. The mission comes 11 years after ISRO's successful first lunar mission Chandrayaan 1 that made history by making more than 3,400 orbits around the moon and was operational for 312 days till August 29, 2009. Chandrayaan-2's success will make India the fourth country after the US, Russia and China to pull off a soft landing on the moon. ISRO's budget is less than 20 times that of USA's NASA. The success of the mission would be a giant boost for India's space plans. Chandrayaan-2 weighing 3.8 tonnes is extremely cost-effective, with a total estimated cost of ₹978 crore. Isro successfully launches India's most ambitious mission Chandrayaan-2; spacecraft will attempt to land a rover near the Moon's south pole on 7 Sep



India's most challenging mission till date, Chandrayaan-2 marks the first time an Indian space mission is being led by women scientists. Ms Muthayya Vanitha, who has been working with the space agency for more than three decades, has helmed the mission from the start as a project director. An electronic systems engineer, Ms Vanitha was also associated with Isro's Mars mission. After the successful launch, the mission will be carried forward by mission director Ms Ritu Karidhal, who will navigate the module towards the Moon.

Source https://www.ndtv.com/india-news/isro-to-launch-chandrayaan-2-at-2-43-pm-today-live-updates-2073186