INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

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INAE VISION 2020-2025

INAE VISION

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

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INAE Mission

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

Technology Roadmap

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Excellence in Engineering Education

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

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

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

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

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

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

4. World Class Infrastructure

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

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

5. Cyber-physical Systems

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

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

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

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

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ACADEMY ACTIVITIES

ACADEMY NEWS

INAE Annual Convention 2020

The INAE Annual Convention 2020 is being held Online during December 21-22, 2020 due to the unprecedented circumstances all over the world on account of COVID pandemic and the restrictions thereof which limit conduct of a physical Annual Convention. This is the first time that the Annual Convention of INAE is being held online. However, the programme is fairly similar to that of the normal Annual Convention held each year. The Annual Convention will be preceded by the INAE Governing Council Meeting being held online on December 19, 2020. The Programme of the Annual Convention can be viewed by clicking here ….

The Registration link has been provided on the INAE website and is given below to facilitate registration for the online INAE Annual Convention 2020.

https://inaeevent.in

INAE Webinar Series Programme subsequent to Annual Convention 2020

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

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

All INAE Fellows, Young Associates and awardees are requested to register for the online INAE Annual Convention 2020.

CAETS 2020 Annual Meetings and Symposium on "Engineering a Better World- Smart Society"

INAE is a Member-Academy of the International Council of Academies of Engineering and Technological Sciences (CAETS) and participates in its programmes/convocations of global concern at national/international levels. CAETS is committed to enhancing the contribution of science, technology and engineering in the world and its mission is to foster effective engineering and technological progress for the benefits of the societies of all countries. CAETS Annual Meetings and Symposium are organized by one of the Member Academies of CAETS each year, wherein all Member-Academies are invited to participate. This year, the National Academy of Engineering of Korea (NAEK) hosted the CAETS Annual Meetings and Symposium on "Engineering a Better World- Smart Society" held online from October 12-15, 2020. Dr Sanak Mishra, President INAE is a nominated Member of the CAETS Strategy Development Working Group and Member, CAETS Board of Directors. Experts from INAE Fellowship participated in various Committees and as nominated theme based speakers in the Symposium. Dr Sanak Mishra, President INAE, was requested to nominate an expert from INAE as a Speaker during one of the Technical Sessions of the CAETS 2020 Symposium on 'Climate Change Issues and Challenges in an Urban Environment' held online on October 14, 2020. Dr Sanak Mishra, President, INAE participated in the Board Meeting and the CAETS Council meeting which was held on October 15, 2020. The following experts from INAE Fellowship who were nominated as

Members of various Committees of CAETS pertaining to this year's event, participated in the respective meetings of the Committees as per details given below.

- **Dr Ajay Mathur**, FNAE, Director General TERI participated as a nominated Member from INAE in the CAETS Energy Committee Meeting held on October 12, 2020.

- **Mr Pradeep Chaturvedi**, FNAE, Vice-President, World Environment Foundation participated as a nominated Member from INAE in the CAETS Sustainable Development Goals Working Group Meeting held on September 29, 2020.

- **Dr Akhilesh Gupta, FNAE** and Adviser & Head, Climate Change Programme, SPLICE, DST participated as a nominated panellist from INAE in Technical Session 4 on "Climate Change Issues & Challenges" held on October 14, 2020.

- **Prof Kamala Krithivasan**, FNAE, Formerly Professor, IIT Madras participated as a nominated Member from INAE in the CAETS Diversity Working Group Meeting held on October 8, 2020.

- **Prof Amit Agrawal**, FNAE, Professor, IIT Bombay participated as a nominated Member from INAE in the CAETS COVID-19 Special Committee Meeting held on October 12, 2020.

- **Ms Alpa Sheth**, FNAE Managing Director, VMS Consultants Pvt Ltd, Mumbai participated as a delegate in the CAETS Symposium on "Engineering a Better World- Smart Society".

Subsequent to the event, the delegates from INAE were requested to forward brief reports based on their experience of participating in the CAETS 2020 Annual Meetings and Symposium and the reports received are given below.

Report by Dr Sanak Mishra, President, INAE

CAETS (Council of the Academies of Engineering and Technological Sciences) Convention- 2020
The National Academy of Engineering of Korea (NAEK) hosted the CAETS 2020 Convention in Seoul from 12 - 15 October. The technical sessions focused on" Engineering a Better World: Smart Society", and included sessions on Hyper-Connected Life and Sustainable Community. On account of COVID-19 epidemic, the convention was held online.

As the only Engineering Academy of India, INAE is a member of CAETS. The President of INAE, Dr. Sanak Mishra, currently serves as a member of the Executive Board of CAETS. In 2019 he was also appointed as a member of the newly established Strategy Development Working Group of the Board. During CAETS Convention in Seoul in October, 2020, Dr. Mishra attended and participated in the Board Meeting and the CAETS Council Meeting.

The Strategy Development Working Group is chaired by Tuula Teeri, IVA, Sweden, and comprises the following members: Oh-Kyong Kwon, NAEK; Sanak
Mishra, INAE; Hugh Bradlow, Australia; David Tomlinson, RAEng, England; Friedrich Wu, CAE, China; and Ruth David, Secretariat (support), USA. Prof. Teeri presented the Draft Strategic Plan report on behalf of the group which was followed by discussions and will be put up for approval of member academies by circulation. Dr. Mishra was thanked for his inputs to the draft plan.

In the Council Meeting of CAETS, INAE came for commendation for having taken out a major volume of literature on COVID-19 in the form of a special issue of the Transactions of INAE. It was pointed out that INAE is the only Academy which has done so. INAE was also mentioned in respect of its

contributions to the draft report of the Energy Committee and its active participation in the committees on Diversity and Sustainability.

Dr Sanak Mishra, President, INAE

Report by Mr Pradeep Chaturvedi

Consultation Meeting on 29 September, 2020 – 4.30 p.m.

CAETS Sustainability Group to meet the Sustainability Development Goals (SDG) meeting was organised by Royal Academy of Engineering, UK online on September 29,2020 at 4.30 P.M. IST. 18 persons participated in the meeting from 14 different country member committees. The meeting was conducted by Mr. Thermolinson, David of Royal Academy of Engineering.

He briefed members about the need, objectives and expectations from this CAETS Sustainability Working Group. He emphasised that the purpose of the working group is to share knowledge and best practice on how academies and engineering communities are influencing, communicating and overseeing national sustainability plans and broader SDG targets, with a view to developing CAETS level guidance, messaging or advice that can be fed into discussions around COP-26 in Glasgow in November 2021.

He identified the three focus topics as follows:

1. In what ways are Academies demonstrating leadership around sustainability and the SDGs at a national level?
2. How the vital roles of the engineering in delivering the SDGs is reflected in national sustainable development plans, and are their good examples of stewardship of these plans from the engineering community?
3. How the vital roles of the engineering in delivering the SDGs is reflected in national sustainable development plans, and are their good examples of stewardship of these plans from the engineering community?

He invited Mr. Shane McHugh to make an opening presentation on approach of the Sustainability Group under Royal Academy of Engineering, UK. He mentioned that the Academy has established a challenging high level goal of harnessing the power of engineering to build a sustainable global society and an inclusive UK economy that works for everyone. He further mentioned that the academy is focusing on sustainable economy, net zero policy in UK, engineering systems approaches to zero carbon objective, academy's net zero influencing and the positive response from UK government.

INAE Intervention

INAE was also requested to make a presentation on its efforts to support SDGs in India. In my presentation I had mentioned that NITI Aayog has the overall responsibility of implementation of SDGs in the country. The scientific and engineering inputs are being guided by the Department of Science and Technology. INAE works in close cooperation with both these agencies.

INAE has several committees like: Committee for Consultation with the Principal Scientific Advisor to the Government; Digital Platform Committee; Forum on Technology Foresight and Management; Forum on Engineering Intervention for Disaster Mitigation; Forum on Civil Infrastructure; and Forum on Energy.

All these committees have been taking into consideration various aspects of SDGs and the engineering input requirement at the national level and reflecting the same in their reports. INAE has also conducted important studies that have direct bearing of SDGs and these reports have been discussed with concerned official agencies and a number of them are found in the policy statement or implementation strategies. Some of them are given below:

- Engineering Interventions Necessary for Achieving 175 GW of Renewable Power by 2022
- Study on Clean and Green Energy in Urban Development
- Technologies for Overcoming Vulnerabilities during Pandemics.
- Study report on "Technologies for Healthcare Sector in India"
- Study report on "Water Resources Management"
- Study report on "Assessment of Civil Engineering inputs for Infrastructure Development – including Smart Cities"
- Study report on "Urban Transportation – Challenges and Way Forward"
- Reports on Technology Foresight and Management on topics of sustainable development.

As regards COVID-19 and its impact of communication delivery INAE has been supporting the digital platform for all communications. INAE also studied and brought out a special number focusing on Technologies to Mitigate the Effect of COVID-19.

INAE has prepared a White Paper on Technological Preparedness for Dealing with National Disruptions on request of the Principal Scientific Advisor to the Government of India for their consideration. The government appreciated the involvement of INAE in attaining SDGs.

Representatives of other member committees also made presentation on efforts of their academies. The Chairman informed that based on the discussion a presentation will be made at the forthcoming annual convention NAEK in October 2020.

Mr Pradeep Chaturvedi

Report on the Discussion of Working Group 'COVID-19 Special Committee' of CAETS

Hosted by: The National Academy of Engineering of Korea Online meeting, 12 October 2020

Prepared by: Dr. Amit Agrawal, FNAE, Professor, IIT Bombay

The *CAETS 2020 Annual Meeting and Symposium* was held in Seoul from 13-14 October 2020, hosted by The National Academy of Engineering of Korea. Most International participants attended the event online. The Annual Meeting was preceded by a discussion on the unfortunate situation created by the ongoing pandemic. A 'COVID-19 Special Committee' has been formed in view of the prevailing situation, to seek alternative solutions to restore a safe and healthy society from an engineering point of view and propose governmental policy.

This *COVID-19 Special Committee* comprises the following members:

• Youn Hee Choi (Chairman)
Senior Research Fellow, Korea Institute for Industrial Economics & Trade
• Byung Geon Rhee
CEO, SCM Lifescience Co., Ltd.
Chairman, Int'l Vaccine Institute (IVI) Korea Support Committee
• Kyu-sung Lee
Executive Vice President, SAMSUNG BIOLOGICS Co., Ltd.

• Byungjoo Park
Vice President, National Academy of Medicine of Korea (NAMOK)
• Jong-Gu Lee
Professor, Dept. of Family Medicine at Seoul National University College of Medicine
• Chungwon Lee
Ph.D., Bioengineering, Seoul National University
• Geoff Chase
Chair Professor, University of Canterbury
• Mohammed Homman
CEO, Vironova
• Hiedaki Koizumi
Distinguished Fellow, EAJ
• Amit Agrawal
Institute Chair Professor, Indian Institute of Technology Bombay

The first agenda of the Committee was to understand each country's quarantine experience and related engineering technologies. In this context, Prof. Amit Agrawal, INAE's nominee to the Committee made a presentation.

The following are the salient points from the presentation:

- The *Aarogya Setu App* helped track infections in the beginning of the pandemic and gave crucial time to the Indian government agencies to prepare for the worst
- The number of tests currently done in the country are about 7 times of the WHO's advise
- A clinically approved drug has been proposed as an option for treatment, while vaccine development is going on in the country
- The 'Transactions of INAE' brought out a Special Issue on 'Technologies for Fighting COVID-19', perhaps the first journal in the world to do this. Copies of the Special Issue have been shared with the Principal Scientific Advisor of India, and several other government bodies
- 49 technologies/solutions are described in the Special Issue, and the published articles have received good attention as evident from the large number of accesses for the articles
- INAE has identified some focus areas, and INAE is willing to collaborate with Academies from other countries in these focus areas and COVID-19 related issues
- As a lesson learnt, we should build capacity in 'good' times so that we are adequately prepared to tide over 'bad' times .
- The need to re-engineer the several technologies available in the country to address the pandemic situation was also emphasized
- As an example, the test kit developed by IIT Hyderabad, built for some other disease but re-engineered for detecting COVID-19, was mentioned
- It was proposed that the various International Academies could combine their expertise to study the dynamics of disease transmission, which may be climate and geography dependent, and find engineering solutions to mitigate/reduce the transmission of diseases.

The tenure of the Committee is till June 2022, and further deliberations and discussions on fighting the pandemic are expected to take place in future meetings.

Report by Ms Alpa Sheth

I would like to share my experience on the Session "Education for a Smart Society".

The three speakers in that session were from diverse backgrounds. One of them was an innovator of children's online learning software, another was from a national academy of technical sciences. The talks were good and on expected lines.

I was particularly impressed by the talk of the third speaker, Dr. Jian Wang, Chairman, Alibaba Group Technology Committee. Dr Wang has an interesting background- he has been a psychology professor for over ten years, a researcher at Microsoft Research Asia before joining Alibaba Group and rising to be its Chief Technology Officer and is currently involved in non-profit research. It is this eclectic career path that has given him the ability to frame things differently. He is also a compelling example of the case to be made that a good technological solution lies in the realm of a marriage of technology with humanities. It gives us the ability to frame issues differently - to ask different questions. Innovation happens with an out-of-box approach, with a new way of looking - which perhaps is not taught in engineering colleges.

His main thrust was that the current education has not and perhaps cannot catch up with what is happening out there in the world in real time. The current pace of growth and development requires a multidisciplinary approach while we still work in silos in engineering colleges. He also further mentioned that a non-profit organisation (which he is presently involved in- The City Brain Initiative) gives you the space and freedom to look at issues very differently.

Since I have a very similar way of looking at things and share his philosophy of transitioning into a not-for-profit position which unshackles you from a very narrow perspective of commercial profit, his talk resonated with me.

Ms Alpa Sheth

Report on the virtual meeting of CAETS Diversity working group held on Oct 8, 2020
From
Prof. Kamala Krithivasan

As suggested by president of INAE, I participated in the above-mentioned meeting.

The meeting started with a note from the convener. About 15 persons participated from different countries. Initially each person was given a minute or two for introduction and later about 5 minutes to mention about the activities of their academy. I mentioned the following points.

1. Women are being given more and more importance.
2. More nominations are sought after for fellowship and other awards from women.
3. This year 6 women were elected as fellows and also a foreign fellow.
4. On the whole, the fellows elected were from different age groups.
5. Women Engineer award was constituted and this year 3 women have been selected for the award, one from the academia, one from R&D, and one from industry.
6. Women fellows are made members of many committees to encourage their active participation and contribution.

The meeting ended with a thanking note.

Prof Kamala Krithivasan

INAE White Paper on Technological Preparedness for Dealing with National Disruptions

INAE prepared a White Paper on "Technological Preparedness for dealing with National Disruptions". Dr. B.N. Suresh, Immediate Past -President, INAE had prepared the base paper in this regard, with inputs from Dr. P.S. Goel, former President, INAE, Dr. Bhujanga Rao, FNAE and other domain experts from INAE Fellowship. The White Paper on "Technological Preparedness for dealing with National Disruptions" integrating all the inputs was compiled by Dr BN Suresh and forwarded to Shri Amitabh Kant, CEO, NITI Aayog; Dr VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, PSA to Govt. of India and Prof Ashutosh Sharma, Secretary, DST, Govt. of India with a request for an opportunity of consulting with them over a WebEx meeting to take this initiative forward. Positive response had been received from DST to take this initiative ahead.

In response to this initiative, NITI Aayog convened a meeting, through 'Video Conferencing' on 10th August 2020 to be chaired by Dr. VK Saraswat, Member, NITI Aayog to discuss the future course of action to implement the recommendations of the White Paper on **'Technological Preparedness for dealing with National Disruptions'**, with a view to take the initiative forward. Accordingly, the said meeting was attended by Dr. Sanak Mishra, President, INAE, Dr. BN Suresh, Immediate Past-President, INAE, Dr. PS Goel, Former President, INAE, Dr. VK Saraswat, Member, NITI Aayog; Shri Neeraj Sinha, Adviser (S&T) and Dr. Ashok A Sonkusare, Jt. Adviser (S&T), NITI Aayog and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE. The meeting was successfully concluded to arrive at an action plan to implement the recommendations suggested in the subject White Paper. It was suggested that an Apex Committee be constituted with member experts from INAE and NITI Aayog who would further identify Sub-committees to take up specific task envisaged to take this initiative to its logical conclusion. In the month of September 2020, INAE has requested NITI Aayog, DST, CSIR/DSIR, IMD, DRDO, DBT, ICMR, Coast Guard, ISRO, DAE to nominate representatives for the "Peer Committee" to progress the initiative. The Peer Committee has since been constituted and the first meeting of the Committee was held online on November 30, 2020 to progress this initiative.

Fellowship and Awards

- **Election of Fellows/ Foreign Fellows w.e.f. November 1, 2020**

The list of newly elected Fellows/Foreign Fellows w.e.f. November 1, 2020 has been uploaded on INAE website and can be viewed at the link given below.

https://www.inae.in/fellowship-youth-activities/fellowship/nomination-information

- **Life Time Contribution Award in Engineering 2020, Prof Jai Krishna & Prof SN Mitra Memorial Awards 2020, Outstanding Teachers Award 2020, INAE Woman Engineer of Award for the Year 2020, INAE Young Entrepreneur Award 2020 and INAE Young Engineer Award 2020**

The lists of Life Time Contribution Award in Engineering Awardees for the year 2020, Prof Jai Krishna & Prof SN Mitra Memorial Awardees for the year 2020, Outstanding Teachers Awardees for the year 2020, INAE Woman Engineer of Awardees for the Year 2020, INAE Young Entrepreneur Awardees 2020 and INAE Young Engineer Awardees 2020 have been uploaded on INAE website and can be viewed at the links given below.

Recipients of Life Time Contribution Award in Engineering 2020

https://www.inae.in/life-time-contribution-award-in-engineering

Recipients of Prof Jai Krishna & Prof SN Mitra Memorial Awards 2020

https://www.inae.in/professor-jai-krishna-and-professor-sn-mitra-memorial-awards

Recipients of INAE Outstanding Teachers Award 2020

https://www.inae.in/inae-outstanding-teachers-award-awards

Recipients of INAE Woman Engineer of the Year Award 2020

https://www.inae.in/women-engineer-of-year-award/

Recipients of INAE Young Entrepreneur Award 2020

https://www.inae.in/inae-innovator-entrepreneur-award

Recipients of INAE Young Engineer Award 2020

https://www.inae.in/inae-young-engineer-award-2018

INAE Webinar Series

INAE in the year 2020, launched a Webinar Series on topics encompassing all sectors and disciplines of engineering and technology. In continuation of INAE Webinar Series, as part of Webinar series, it's 8th Webinar was held on **"700 MWe Indian Pressurized Heavy Water Reactor"** on **Tuesday 13th October 2020 at 11:00 AM to 12:30 PM** over WebEx Event Centre which was coordinated by INAE Mumbai Chapter. This Session was coordinated by **Dr R B Grover, FNAE, Co-Convener, INAE Mumbai Chapter, and Emeritus Professor, Homi Bhabha National Institute, Mumbai. The** Speaker for the session was **Shri A K Balasubrahmanian, Director (Technical) Nuclear Power Corporation of India Limited, Mumbai.** A webinar on **"Flight demonstration of Indigenous hypersonic air-breathing cruise vehicle"** was also held on 10th November 2020 from 5 pm onwards, through INAE Webinar Series, under the auspices of the INAE Mumbai Chapter.

Report on the lecture on 700 MWe Indian Pressurized Heavy Water Reactor

A lecture on 700 MWe Indian Pressurized Heavy Water Reactor (PHWR) was delivered by Shri A.K. Balasubrahmanian, Director (Technical), Nuclear Power Corporation of India Limited (NPCIL) to INAE members on October 13, 2020. Dr. R.B. Grover, Member, Atomic Energy Commission was moderator for this lecture. The lecture was broadcast live through Cisco Webex platform as a webinar. NPCIL, a public sector enterprise, under the Department of Atomic Energy (DAE), is solely responsible for design, construction and operation of water-cooled nuclear power plants (NPP) in India.

The lecture was perfectly timed, as the first unit of 700 MWe PHWR achieved the first controlled chain reaction on July 22, 2020. While introducing Indian nuclear power programme, the lecture focused on pressurized heavy water reactor technology, which is the mainstay of Indian nuclear power programme. Currently, India is operating 22 NPPs, of which 18 are PHWRs, two units are boiling water reactors and pressurized heavy water reactors each. The operating PHWRs are of 220 MWe and 540 MWe capacities and after gaining design, construction and operation experience of these units, the latest design is of 700 MWe capacity.

The speaker described Indian journey of PHWRs i.e. how from the first unit, which was constructed in collaboration with Canada; the country has kept on adding to the design and safety of subsequent units. After achieving standardization in 220 MWe PHWRs, for economy of scales 540 MWe PHWRs were designed, of which two units are in operation. Realizing that the reactor core of 540 MWe has potential to generate higher fission power, ensuring safety margin, it was decided to design a reactor of higher fission power using the same core. This endeavour culminated in the design of a reactor with 2166 MW thermal power and 700 MW electrical output. The talk emphasized that over the years, NPCIL / DAE and the Indian industry have achieved complete 'atmanirbharta' in this technology.

Shri Balasubrahmanian then focused on the main design and safety features of 700 MWe PHWRs. He informed that many first of a kind (FOAK) system are introduced in the design and design extension conditions are explicitly addressed through design and accident management programme. With all the safety features, design of 700 MWe PHWRs provides assurance that with containment remaining intact, even for the worst postulated accident, there is no need to relocate public from the neighbourhood of 700 MWe NPPs.

PHWRs have coolant channels, feeders, headers and steam generators constituting core flow path. Since PHWRs have a positive coefficient of void reactivity, in order to limit this positive reactivity, 700 MWe PHWR has adopted a concept of interleaving of feeders, so as to distribute voids uniformly in core in the postulated accident of loss of coolant. This configuration is introduced for the first time in any PHWR in the world. In the design of plant buildings, nuclear buildings are supported on a common raft for improved structural performance, particularly under seismic conditions. PHWRs require regular fuel loading and in order to handle increased fuel handling load, a Mobile Transfer Machine is introduced for new and spent fuel transfer. This initiative is aimed at operational ease, less maintenance and surveillance efforts and lower man-rem burden during operation and maintenance.

In 700 MWe PHWRs, to ensure that local power remains within limits and thereby to maintain fuel safety, a new protection in the form of regional over power trip is introduced on both shutdown systems.

In NPPs, one of the important postulated events is station blackout, which involves simultaneous loss of off-site and on-site power supplies. To handle this situation, a new system called passive decay heat removal system is introduced, which while ensuring natural circulation through thermosyphoning, preserves steam generator inventory. This system is in addition to the systems used in operating PHWR units for handling station blackout.

In containment design, initiatives are taken to reduce leakage by way of providing steel liner on the inner containment. For containment pressure and radioactivity management, containment spray system is provided.

Capability of handling design extension conditions is enhanced with provisions of passive hydrogen recombination units, containment filtered venting system and by making provisions to introduce cooling water in important plant systems from outside reactor building to address situation of unavailability of designed onsite power and water supplies.

At present, six units of 700 MWe PHWRs are under construction/commissioning. For rapid capacity addition through 700 MWe units, Government of India has accorded administrative approval and financial sanction for ten more units to be implemented in Fleet Mode. For meeting the timeline of this ambitious plan, NPCIL has adopted standardization of design, utilizing 3D integrated engineering environment, standardized procurement specifications and going for bulk procurement of multiple units.

After the comprehensive presentation, Shri A.K.Balasubrahmanian answered questions of the participants covering a wide area viz. design, safety analysis, procurement and project implementation.

Report on the INAE webinar presentation on "Flight demonstration of Indigenous hypersonic air-breathing cruise vehicle"

A webinar on the above topic was held on 10th November 2020 from 5 pm onwards, on the INAE's national platform, under the auspices of the INAE Mumbai Chapter. This was the Chapter's fourth webinar in the series. The speaker was Prof Debasis Chakraborty, formerly of DRDO and currently the Director of the Centre for Propulsion Technology at IIT Bombay (and concurrently a Professor in the Aerospace department of the Institute). Prof Chakraborty has been intimately involved with the development which culminated in the recent demonstration of the hypersonic air-breathing cruise vehicle. The webinar was moderated by Prof A. K. Suresh, Co-Chair, INAE Mumbai chapter.

Starting with the intense determination of the two brothers Orville and Wilbur Wright at Kitty Hawk, North Carolina, and their success, the aspiration of flying at higher and higher speed in the atmosphere has led the mankind to a position where it is possible to conceive of aircrafts flying at speeds more than few times that of sound in air. When the flight is in hypersonic regime (M_∞ >5.0), the burning of fuel must occur at supersonic speeds inside the combustor to allow the possibility of heat addition and minimise the total pressure loss and so, thrust loss. In turn, this allows propulsive efficiency of the hypersonic systems to be brought up to meaningful values and also contribute to reduced vehicle size and weight. The success of efficient design of such a transatmospheric hypersonic vehicles depends largely on the proper choice of the propulsion system which is capable of producing large thrust, demanded by the system. This type of vehicle uses supersonic combustion ramjet (scramjet) propulsion system.

The development of hypersonic air-breathing cruise vehicle has tremendous applications in high-speed transport, space access, national defence, etc. It is attractive for military operations and can provide significant payoff for offensive strike against time critical, hardened, deeply buried and heavily defended targets due to its longer range, shorter response time and enhanced effectiveness. Its reduced tracking by ground based radars compresses enemy's decision-making window, effectively enabling the hypersonic attacker to get inside an adversary's command, control, and battle management cycle.

Although, various countries including USA, Russia, China, UK, France and India are in the race to develop hypersonic airbreathing cruise vehicles; only a few practical flight tests of these vehicles have been conducted worldwide so far. Extensive R&D efforts are continuing for the design and testing of scramjet combustors for hypersonic vehicles. The flight trial of hypersonic air-breathing cruise vehicle (X-51) by USA for 210 sec duration is close to hypersonic weaponization program. Russia and China are also claiming the successful demonstration of hypersonic air breathing cruise missile; but no information is available in the open literature. Recently, on September 7, DRDO, India has successfully test flown a vehicle integrated hydrocarbon fueled scramjet engine (cruise vehicle) in an autonomous mode. The cruise vehicle is put atop a solid rocket booster (launch vehicle) and carried to 32 Km altitude at Mach 6 conditions. The heat shield fairings which protected the cruise vehicle from aerodynamic heating during ascent phase were separated and the hydrocarbon fueled scramjet engine was ignited. The vehicle flown in power-on condition for 24 seconds before plunging into the sea. While developing this vehicle, number of complex technologies including aero-thermodynamics configuration design & testing, CFD capabilities, panel separation dynamics, hypersonic air intake characterization, scramjet Combustor design, hot structure design, split composite airframes, coatings, material characterization etc. were developed indigenously. The maiden flight demonstration has proved these complex technologies and design tools for the development of hypersonic air breathing vehicles and put India in the league of the few advanced nations which possesses this complex technology.

In his lecture, Prof. Debasis Chakraborty explained different air-breathing propulsion systems (turbojet, ramjet and scramjet) applicable in different flight regimes and compared their performances. He mentioned that different solid fuel ramjet and liquid fuel ramjet missiles are developed indigenously and deployed at different parts of the country to safeguard the territorial integrity of the country. The advantage of hypersonic missile and world scenario of its development were briefly mentioned. He described in detail the use of high-fidelity numerical simulations (CFD techniques) for solving the panel separation dynamics and scramjet combustor design. In the absence of full-scale testing facility in our country to simulate such high-speed flow features, the design was mainly carried out through CFD simulations. Store Separation Dynamic (SSD) suite comprising of grid-free CFD solver and 6 Degree of Freedom (DOF) trajectory program was indigenously developed and used to design the separation events of nose panel and cylindrical panel separations of HSTDV vehicle. To compare the computed result, a ground test was planned in a long-range sledge facility which can only simulate the flight dynamic pressure not the flight Mach Number. Very good comparison of the simulation result for ground test condition with test data give confidence to the designer to rely on the CFD results for ensuring safe separation of the panels in the flight.

CFD also played an important role to develop the hydrocarbon fueled scramjet combustor for the HSTDV vehicle. The numerical tools for reacting flow simulation were validated extensively by comparing existing experimental data available in open literature. The effect of grid, turbulence model and other physical and chemical models in the results were systematically studied and the numerical tool was employed in the exercise. Various flow field variables obtained from the reacting numerical simulations were closely examined and performance parameters were optimized. The geometry arrived through CFD simulation not only solved the severe thermal problems of the fuel injection struts but gave very good performance of the scramjet combustor which was adequate to overcome the drag to ensure cruise mission. The simulation results match very well with the experimental data obtained from connect-pipe mode test and free-jet test facilities. End – to -end simulation (employing non-reacting simulation in vehicle outer surface and intake and the reacting simulation in the combustor) at different angles of attacks, altitudes, equivalence ratios provided all aero-propulsive performance parameters required for mission design.

The speaker stressed the need to have exhaustive validation of the numerical tools before putting into design studies and mentioned that numerical techniques have become very much matured to handle any challenging complex problem. The recent flight trial of HSTDV has provided very good confidence in the self-reliance (Atmanirbhar) in hypersonic technologies. The presentation was concluded with the presentation of flight video of HSTDV.

Transactions of the Indian National Academy of Engineering, An International Journal of Engineering and Technology

INAE had launched a quarterly journal "INAE Letters" published by M/s Springer in the year 2016. The objective of the journal is to provide a medium for rapid publication of new research results and invited short review articles across different domains of engineering science and technology. In the year 2020 the title of the Journal was changed to **"Transactions of Indian National Academy of Engineering – An International Journal of Engineering and Technology**" and has become a full-fledged journal to include full Research Papers and Review Articles besides short communications. The Transactions of INAE publishes original research papers, contributed and invited reviews on the topics related to Civil Engineering, Computer Engineering and Information Technology, Mechanical Engineering, Chemical Engineering, Electrical Engineering, Electronics and Communication Engineering, Aerospace Engineering, Mining, Metallurgical and Materials Engineering, Energy Engineering, Industrial Engineering, Interdisciplinary Engineering, Nano Science and Technology, and related fields such as applied Mathematics, Applied Physics, Applied Chemistry and computational Biology.

The latest issue of the **Transactions of the Indian National Academy of Engineering-Volume 5, Issue 4, December 2020** has been brought out. There are 16 articles in this issue which can be viewed at the link given below.

https://link.springer.com/journal/41403/volumes-and-issues/5-4

Special Issue of Transactions of the Indian National Academy of Engineering - Volume 5, Issue 2, June 2020 on "Technologies for Fighting COVID-19"

The Special Issue of Transactions of the Indian National Academy of Engineering - Volume 5, Issue 2, June 2020 on "Technologies for Fighting COVID-19" was published and is available on INAE website, as well as in open access domain on Springer website. The articles in the issue may be downloaded either through the log in facility provided to INAE Fellows or by copying the link given below in your internet browser.

https://link.springer.com/journal/41403/5/2

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INTERNATIONAL/NATIONAL CONFERENCES/SEMINARS BEING ORGANIZED BY IITS/OTHER INSTITUTIONS

International Conference on Biomedical Eng. Bioscience Bioinformatics Biochemistry Cancer Biology Molecular (BCM-20) Online event on 20th to 20th December 2020 at Delhi, New Delhi
https://conferencealerts.com/show-event?id=231302

International Conference on Interdisciplinary Cyber Physical Systems on 28th to 29th December 2020 at Chennai,
https://conferencealerts.com/show-event?id=229818

34th World Conference on Applied Science, Engineering and Technology on 29th to 30th December 2020 at Goa
https://conferencealerts.com/show-event?id=225716

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

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NEWS OF FELLOWS

1.	Prof Sameer Khandekar, FNAE and Prof K Muralidhar, FNAE of IIT Kanpur have authored a new book entitled "Drop Dynamics and Dropwise Condensation on Textured Surfaces" published by Springer Nature as a part of the Mechanical Engineering Series of Advanced Texts. The book announcement can be seen by clicking on the link given below: https://www.springer.com/gp/book/9783030484606
2.	Dr. Debabrata Das, FNAE, Visiting Professor and Former Head and Renewable Energy Chair Professor, Department of Biotechnology; Former Professor-in-Charge, P K Sinha Center for Bioenergy, Indian Institute of Technology, Kharagpur has co-authored a new book titled "Industrial Biotechnology" which will be published by M/s. Taylor & Francis, USA early 2021. He hopes that this book will be very useful to the undergraduate/postgraduate students in Biotechnology / Biochemical Engineering / Chemical Engineering / Applied microbiology / Environmental Biotechnology.

INAE ON FACEBOOK AND TWITTER

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

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

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

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OBITUARIES

Dr Faqir Chand Kohli

(March 19, 1924 - November 26, 2020)

An exceptionally talented engineer, an institution builder, a mentor par excellence and a visionary, Dr Faqir Chand Kohli devoted his whole life to the cause of Indian engineering education, research and industry.

Born on March 19,1924 in Peshawar in the Northwest Frontier Province (NWFP) of the then undivided India, Mr Kohli, after topping the matriculation examination in Peshawar, joined the famous Government College, Lahore for higher studies. Graduating with BSc (honours) in Physics in 1944 and being a university gold medallist, he was selected by the Government of NWFP for a scholarship to study Electrical Engineering at Queens University in Canada. Subsequently he went to MIT, USA for a Masters in Power Engineering. After completing his MS at MIT, the young, enthusiastic FC Kohli, was trained in power system operations at Ebasco International Corporation, New York, Connecticut Valley Power Exchange, Hartford and New England Power Systems, Boston, before returning to India in 1951. He joined the Tata Electric Company where he helped set up a load dispatching system to manage systems operations and went on to become its deputy general manager in 1967. He and his team created for Tata Electric, a stable power supply system and later in 1968, ahead of all but four utilities in the USA, installing a Westinghouse computer to control the operations of its power grid. Dr. Kohli was thus ahead of many others in utilizing the power of computers and he had the expertise and the confidence to be an important part of the impending digital revolution (what we call the digital transformation today) ahead.

Impressed by his outstanding accomplishments at Tata Electric, Mr. JRD Tata, the then chairman of Tata Sons and Mr. PM Agarwala, the then Director of Tata Consultancy Services (then a division of Tata Sons) persuaded Dr Kohli, the then Deputy General Manager at Tata Electric to join TCS as General Manager in 1969. He rose to become its Director in Charge in 1974 and superannuated in 1996 as its Deputy Chairman. One of the most often-quoted statement about him is that FC Kohli-led TCS, converted software development from an artisan-like activity to an assembly line of a software factory.

As described eloquently by Mr. S Ramadorai in his book, “The TCS Story”, along with a team of young engineers like Mr. Ramadorai (who joined TCS in 1972) and Mr. S. Mahalingam (who joined TCS in 1970), Dr. Kohli innovated on all fronts and created a new business model, a new IT services business which under the then prevailing conditions in India, necessitated working for clients abroad.

It is to the credit of Dr. Kohli, that starting with literally a handful of engineers at TCS in 1969, he mentored a whole generation of engineers in IT services who went on to contribute and lead the growth of IT Services industry in the country. Dr. Kohli is very appropriately called the father of Indian IT services industry.

Because of his close friendship with Prof PK Kelkar, the then principal of VJTI in Mumbai, Dr. Kohli got an opportunity to teach systems engineering, his favourite topic, at VJTI in the fifties. Later on, through his close association with Prof Kelkar who was there at IIT Bombay and later as the founding director of IIT Kanpur, Dr. Kohli played an important role in the development and growth of both these world-class engineering institutions, particularly the growth of computer science research and education in India. Dr Kohli recruited in TCS, most of the very first batch of students who had completed the Master’s in Computer Science at IIT Kanpur.

Dr. Kohli was extremely passionate about creating the world-class teaching institutions for developing professional leaders in engineering who in his vision, will be needed to transform India. India has no business to be poor, he used to say. Even after his retirement from active service, he in his capacity as

the chairman, Board of Governors (2004-2018), devoted his time and energy to nurturing the College of Engineering, Pune which resulted in a multi-fold increase in the number of faculty with PhD degrees (many of them obtained their PhD from IITs, while working at CoEP) as well as a multi-fold increase in the number of graduate students, working towards Master's and PhD degrees.

Dr. Kohli also pioneered the concept of computer- based functional literacy and in fact with the help of his colleagues at TCS, developed the software tool to realize the dream of achieving 100% adult literacy in local Indian languages.

Dr. Kohli had the firm conviction that for India to become a leader in IT services, we must develop a new engineering discipline of "software engineering", which must learn from mature engineering disciplines like manufacturing. He always emphasised the need to build the computer hardware industry in India.

Along with Mr. JRD Tata and Mr. Nani Palkhivala, Dr. Kohli created, with Prof EC Subbarao as the founding director and nurtured for the next two decades, a world-class applied research centre, the Tata Research Development and Design Centre (TRDDC) as a division of TCS, to "apply existing knowledge for the benefit of our industry and our people"- in Mr. JRD Tata's own words, which became the charter of TRDDC.

Dr. Kohli insisted that the design should be part of this R&D centre and that is how the R&D centre was named, TRDDC. TRDDC was created to provide innovative solutions to the industry at the interface of IT and different engineering domains as well as to create professional leaders who are integrators in the true sense – most importantly who, by their professional conduct and work, earn respect from their peers, both in the industry as well as in the academia. It is easier said than done but that is the true hallmark of a mentor – challenge your teammates all the time and help them rise to their full potential and become problem-solvers for the industry and the society at large.

Under the leadership of Prof Kesav Nori, who headed the software engineering group, TRDDC realized Dr Kohli's dream of enabling the software industry to grow on the lines of manufacturing industry with their own automation tools and the model-engineering framework – truly pioneering efforts for the Indian IT Services industry. His insistence on design, systems engineering and developing human resources having both domain as well as software engineering skill-sets, was a vision, which is yet to be realized but it is still worth pursuing even today.

He was also passionate about transforming our villages with their own sources of electricity. One of the very first initiative, taken up by TRDDC, in the early 80's was to develop and demonstrate the biomass-based electricity for Indian villages so that they need not depend on the central grid.

For his pioneering efforts on engineering education, research and his outstanding contributions to the industry, Dr. Kohli was honoured both in India and abroad. To name a few, Dr. Kohli was bestowed with Padma Bhushan by the President of India in the year 2002. He is the proud recipient of the IEEE Founders Medal (2012) and Indian National Academy of Engineering (INAE)'s highest honour, the coveted INAE Lifetime Contribution Award in Engineering (2000).

Dr. Kohli passed away on November 26, 2020. We convey our heartfelt condolences to Mrs. Swarn Kohli and all the members of Kohli family.

May God bless his soul to Rest in Peace

Written by: Dr Pradip, Vice-President, INAE

Prof Roddam Narasimha
(July 20, 1933 – December 14, 2020)

Prof Roddam Narasimha, FNAE born on July 20, 1933 passed away on December 14, 2020.

Prof Roddam Narasimha was Formerly Director, NAL, Bangalore and Formerly Director, National Institute of Advanced Studies, Bangalore. He was a distinguished Aerospace scientist and was the first student of Satish Dhawan. He had contributed to some of India's major scientific programmes, including the Indian Space Research Organisation (ISRO) and the Light Combat Aircraft (LCA). He obtained the equivalent of an ME in 1955 and an MSc by research in 1957 from the Indian Institute of Science (IISc), and his PhD from Caltech in 1961.

Prof Narasimha, as a member of several high level advisory committees of the Govt of India (National Security Advisory Board and the Scientific Advisory Committee to the Prime Minister and Cabinet, Member of the Space Commission etc) and as a distinguished academic, policy maker and administrator had hugely contributed to the promotion of the practice of engineering & technology and the related sciences, particularly in the field of aerospace and atmospheric sciences, and their application to solving problems of national importance. He had also provided valuable inputs for the promotion of aerospace technologies, aerospace education, aerospace R&D and industry in the country. In Karnataka, the Government of Karnataka had often consulted him on various technology issues concerning the state, and he had been closely associated with the initiation and progression of several major aerospace programmes such as LCA Tejas, Small Civil aircraft HANSA, SARAS and later RTA feasibility studies etc in Bangalore based organisations such as ADA, ISRO, CSIR-NAL, DRDO, IISc etc.

Honoured with the country's second and third highest civilian awards, the Padma Vibhushan in 2013 and the Padma Bhushan in 1987 respectively, Professor Narasimha was also the recipient of the Bhatnagar Prize and the 2008 Trieste Science Prize. In recognition of his outstanding engineering career marked by pathbreaking research in Fluid Dynamics, significant contributions to National Aerospace Technology Development and his leadership role in promoting of science and technology in the country, INAE conferred its Life Time Contribution Award in Engineering for the year 2003 on Prof Roddam Narasimha.

Hon’ble Prime Minister Shri Narendra Modi condoled the demise of aerospace scientist Professor Roddam Narasimha and offered condolences to his family. He said that Professor Narasimha was an outstanding scientist, passionate about leveraging the power of science and innovation for India's progress. Hon’ble President Shri Ram Nath Kovind has said the demise of eminent aerospace scientist Roddam Narasimha is a huge loss to the world of science and technology. He conveyed condolences to his family and his associates.

May God bless his soul to Rest in Peace

With inputs from Dr AR Upadhya, FNAE

Prof AK De
(November 2, 1925 -October 30, 2020)

Prof AK De, FNAE born on November 2, 1925 passed away on October 30, 2020.

Prof AK De, FNAE former Director, IIT Bombay and former Chairman, AERB had made significant research contributions in the field of Mechanical Engineering and as an educationist and

institution builder. He had the distinction of being the first Chairman of the Atomic Energy Regulatory Board (AERB) and during his tenure several codes of practices were issued and guides and standards were prepared for the safe functioning of nuclear installations and radiation facilities. He also served as Director of the Central Mechanical Engineering Research Institute, Durgapur. During his brief stint with DRDO, Prof De made significant contributions in prioritisation of defence equipment for development, futuristic studies for defence need and development of Main Battle Tank, *Arjun*. As Director, IIT Bombay he was recognized for establishment of Post-Graduate Programs and for reforms to enhance the quality of education. As a recognition of his deep commitment and dedicated service to the cause of science, technical education and research, IIT Bombay conferred on him the title of Emeritus Professor in 1988.

May God bless his soul to Rest in Peace

Maj Gen JC Ahluwalia (Retd)
(July 7, 1927 - November 30, 2020)

Maj Gen JC Ahluwalia, FNAE born July 7, 1927 passed away on November 30, 2020.

Maj Gen JC Ahluwalia (Retd) served in the Indian Army for over thirty years where he was commandant of an Army Base Workshop responsible for repair and overhaul of Electronics, Radar and Missile Guided and Power equipment. As the Managing Director of the Gujarat Communication and Electronics Ltd (GCEL), Baroda his signal contributions were to provide U-matic Colour Video Cassette Recorders, Edit Control units and cameras for Doordarshan in electronics news gathering and field production for the first time in India for colour broadcasts during ASIAD in 1982. In addition, he was instrumental in equipping the civil and defence airports with Instrument Landing Systems, Weather forecasting through Telemetric Data Collection Platforms for the Indian Meteorological Department and turn-key project of Flood Forecasting for the river Yamuna through 22 microwave communication links. Maj Gen JC Ahluwalia (Retd) made significant and dedicated contributions while serving as Executive Secretary, INAE and later as Adviser, INAE.

May God bless his soul to Rest in Peace

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. Copolymer Helps Remove Pervasive PFAS Toxins from Environment

Researchers have demonstrated that they can attract, capture and destroy PFAS -- a group of federally regulated substances found in everything from nonstick coatings to shampoo and nicknamed "the forever chemicals" due to their persistence in the natural environment. Using a tunable copolymer electrode, engineers from the University of Illinois at Urbana-Champaign captured and destroyed perfluoroalkyl and polyfluoroalkyl substances present in water using electrochemical reactions. The proof-of-concept study is the first to show that copolymers can drive electrochemical environmental applications, the researchers said. "Exposure to PFAS has gained intense attention recently due to their widespread occurrence in natural bodies of water, contaminated soil and drinking water," said Xiao Su, a professor of chemical and biomolecular engineering who led the study in collaboration with civil and environmental engineering professors Yujie Men and Roland Cusick. PFAS are typically present in low concentrations, and devices or methods designed to remove them must be highly selective toward them over other compounds found in natural waters, the researchers said. PFAS are electrically charged, held together by highly stable bonds, and are water-resistant, making them difficult to destroy using traditional waste-disposal methods. "We have found a way to tune a copolymer electrode to attract and adsorb -- or capture -- PFAS from water," Su said. "The process not only removes these dangerous contaminants, but also destroys them simultaneously using electrochemical reactions at the opposite electrode, making the overall system highly energy-efficient." To evaluate the method, the team used various water samples that included municipal wastewater, all spiked with either a low or moderate concentration of PFAS. "Within three hours of starting the electrochemical adsorption process in the lab, we saw a 93% reduction of PFAS concentration in the low concentration spiked samples and an 82.5% reduction with a moderate concentration spiked samples, which shows the system can be efficient for different contamination contexts -- such as in drinking water or even chemical spills," Su said. Based on concepts first proposed in Su's previous work with arsenic removal, the process combines the separation and reaction steps in one device. "This is an example of what we call processes intensification, which we believe is an important approach for addressing environmental concerns related to energy and water,"

Source https://www.sciencedaily.com/releases/2020/10/201029115816.htm

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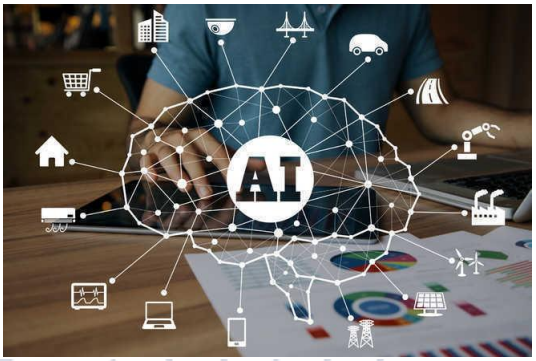
Computer Engineering and Information Technology

2. IIT-M Develops AI Model to Process Text in 11 Indian Languages



The Indian Institute of Technology Madras (IIT-M) said in September 2020, its faculty and AI4Bharat have developed an artificial intelligence (AI) models and datasets to process texts in 11 Indian languages.AI4Bharat is a platform for building AI solutions for problems of relevance to India. According to IIT-M, its researchers and AI4Bharat released AI models and datasets for the following languages: Tamil, Hindi, Malayalam, Telugu, Kannada, Punjabi, Bengali, Odia, Assamese, Gujarati, and Marathi. The multilingual AI models and datasets developed through this initiative will provide the essential building blocks to students, faculty, startups and industry to work on the Indian language tools and push the frontiers of technology. The faculty have made these cutting-edge resources open-source and completely free of cost, which can be accessed by anyone. These models are freely available and can be downloaded from a Github repository (https://indicnlp.ai4bharat.org/). Elaborating on this initiative, Mitesh M. Khapra, Assistant Professor, Department of Computer Science and Engineering, said: "We have a very rich diversity of languages in our country. As we move towards a digital economy, our languages must find a space online. This requires a lot of innovation in creating input tools, datasets, and AI models for Indian languages." For example, imagine a learner who posts a question on an e-learning platform in Tamil or Hindi or any other numerous Indian regional languages. There is a need for tools that can automatically process such questions written in the Indian languages and classify them into specific topics. "While such tools are available for English and other foreign languages, there are hardly any tools for Indian languages and this is the critical gap that we are trying to address through this initiative. These models are available free of cost as we want the entire country to benefit from them," added Khapra. AI4Bharat is an initiative co-founded by Khapra and Pratyush Kumar from IIT Madras and works to solve India specific problems in a community-driven, open-sourced manner. Speaking about the technology behind this initiative, Anoop Kunchukuttan, a volunteer at AI4Bharat and the lead researcher on this project, said: "We have an urgent responsibility to take the rapid advances of AI and make them accessible to the common man. One way of achieving this is to improve the interactions between humans and machines. That is where the field of Natural Language Processing (NLP) comes in. NLP is a branch of AI that deals with the interaction between computers and humans using natural language." For the past year, a team of researchers comprising students, faculty and volunteers from IIT Madras and AI4Bharat worked on collecting data and training powerful models for processing text written in Indian languages. The models take advantage of the similarities between Indian languages to make efficient use of data.

Source https://www.tribuneindia.com/news/science-technology/iit-m-develops-ai-model-to-process-text-in-11-indian-languages-144969

Mechanical Engineering

3. This White Paint Keeps Surfaces Cooler Than Surroundings, Even Under Direct Sunlight

Scientists have developed a white paint that cools below the temperature of its ambient surroundings even under direct sunlight. Their research demonstrates a radiative cooling technology that could be used in commercial paints, that could be less expensive to manufacture, and that passively reflects 95.5% of sunlight that reaches its surface back into outer space. In contrast, commercial "heat rejecting paints" currently on the market only reflect 80%-90% of solar irradiation and cannot achieve below-ambient temperatures. During the summer months and in regions with warm climates, most buildings rely on conventional air conditioning systems to transfer heat from the inside environment to the outdoors. These systems require energy, emit excess heat that transforms cities into "heat islands," and contribute to the climate crisis. But while scientists have sought to develop radiative cooling paints since the 1970s, previously developed paints have not been capable of reflecting enough sunlight to function as viable, commercializable alternatives to traditional air conditioners. "It is a persistent task to develop a below-ambient radiative cooling solution that offers a convenient single-layer particle-matrix paint form and high reliability," says Xiulin Ruan, a professor at the School of Mechanical Engineering at Purdue University in Indiana and an author of the study. "This is critical to the wide application of radiative cooling and to alleviate the global warming effect." To develop a commercially applicable radiative cooling paint, Ruan and colleagues used calcium carbonate fillers, an earth-abundant compound, instead of standard titanium dioxide particles, since the fillers have large band gaps (energy differences between the valence electron band and the bottom of the conduction electron band) that help minimize the amount of ultraviolet light the paint absorbs. The researchers also leverage a high particle concentration of 60%, which boosts sunlight scattering, as well as a broad particle size distribution instead of a single particle size for efficient broadband scattering. To demonstrate how well these modifications enhanced the paint's radiative cooling abilities, the researchers performed cooling tests in West Lafayette, Indiana over a two-day period. The paint sample remained 10 degrees C below ambient temperature at night and at least 1.7 degrees C below the temperature of the ambient surroundings when the Sun was at its zenith. (The cooling power was shown to exceed 37W/m2 under direct sun.) Ruan and his team then performed a second test in which part of a pattern was painted with the novel paint while another part was painted using a commercial white paint of the same thickness. An infrared camera revealed that the calcium carbonate-based acrylic paint was able to maintain a lower temperature under direct sunlight than its commercial counterpart. Ruan expects that the technology may benefit a wide range of industries, including residential and commercial buildings, data centers, warehouses, food storage, automobile, outdoor electrical equipment, military infrastructures, and utility vehicles. The paint may be applied directly to buildings to reducing cooling costs. Since the paint lacks metallic components, telecommunication companies may use it to prevent outdoor equipment from overheating, an important step toward enabling a 5G network. Next, the researchers plan to perform long-term reliability studies to test the paint's resistance to ultraviolet light exposure, dust, surface adhesion, water, and detergent in order to ensure its function as a commercial product.

Source https://www.sciencedaily.com/releases/2020/10/201021112358.htm

Chemical Engineering

4. Sensors Driven by Machine Learning Sniff-Out Gas Leaks Fast

A new study confirms the success of a natural-gas leak-detection tool pioneered by Los Alamos National Laboratory scientists that uses sensors and machine learning to locate leak points at oil and gas fields, promising new automatic, affordable sampling across vast natural gas infrastructure. "Our automated leak location system finds gas leaks fast, including small ones from failing infrastructure, and lowers cost as current methods to fix gas leaks are labour intensive, expensive and slow," said Manvendra Dubey, the lead Los Alamos National Laboratory scientist and coauthor of the new study. "Our sensors outperformed competing techniques in sensitivity to detecting methane and ethane. In addition, our neural network can be coupled to any sensor, which makes our tool very powerful and will enable market penetration."The Autonomous, Low-cost, Fast Leak Detection System (ALFaLDS) was developed to discover accidental releases of methane, a potent greenhouse gas, and won a 2019 R&D 100 award. ALFaLDS detects, locates and quantifies a natural gas leak based on real-time methane and ethane (in natural gas) and atmospheric wind measurements that are analyzed by a machine-learning code trained to locate leaks. The code is trained using Los Alamos National Laboratory's high resolution plume dispersion models and the training is finessed on-site by controlled releases. Test results using blind releases at an oil and gas well-pad facility at Colorado State University in Fort Collins, Colorado, demonstrated that the ALFaLDS locates the engineered methane leaks precisely and quantifies their size. This novel capability for locating leaks with high skill, speed and accuracy at lower cost promises new automatic, affordable sampling of fugitive gas leaks at well pads and oil and gas fields. ALFaLDS's success in locating and quantifying fugitive methane leaks at natural gas facilities could lead to a 90 percent reduction in methane emissions if implemented by the industry. ALFaLDS used a small sensor, which makes it ideal for deployment on cars and drones. The Los Alamos team is developing the sensors that were integrated with a mini 3D sonic anemometer and the powerful machine-learning code in these studies. However, the code is autonomous and can read data from any gas and wind sensors to help find leaks fast and minimize fugitive emissions from the vast network of natural gas extraction, production and consumption. With this integration, ALFaLDS offers a revolutionary approach for oil and gas service providers in leak detection, to non-profit organizations surveying the issue, and to national laboratories and academia researching natural gas production.

SOURCE https://www.sciencedaily.com/releases/2020/10/201029105038.htm

Electrical Engineering

5. Predictive Model Reveals Function of Promising Energy Harvester Device

A small energy harvesting device that can transform subtle mechanical vibrations into electrical energy could be used to power wireless sensors and actuators for use in anything from temperature and occupancy monitoring in smart environments, to biosensing within the human body. Engineers at Rensselaer Polytechnic Institute developed a predictive model for such a device, which will allow researchers to better understand and optimize its functionalities. "Sooner or later these harvesters will replace batteries, reducing associated environmentally hazardous waste and maintenance costs," said Diana-Andra Borca-Tasciuc, a professor of mechanical, aerospace, and nuclear engineering at Rensselaer, who led this research effort. This most recent work builds upon research that Borca-Tasciuc's lab published in the Journal of Micromechanics and Microengineering in 2016. At that time, the team created and tested an energy harvesting device made of silicon both in the lab and on a vibrating HVAC duct. The device was able to convert mechanical energy into electricity, as hoped, but at the time, the team wasn't able to fully explain its experimental results, which exceeded expectations. This new model answers those questions and will allow the researchers to optimize the device in order to generate more power. A key finding, Borca-Tasciuc said, was when Li realized that parts of the device deform after mechanical impact -- which is triggered by vibrations. Li then created a predictive model using a series of equations that represent the dynamics of the device by modeling its mass coupled with the movement of a series of springs. These motion equations were critical to determining how vibrational motion translates to voltage. According to this paper, the predictions shown by the model were consistent with experimental results that the team previously gathered. "This model laid a solid foundation for parametric study and helps to push the boundaries of output power through design optimization," Li said. "The high-power device developed by our group, together with its accurate analytical model, is an advancement of energy harvesting and will enable silicon-based autonomous green power supply at a microscale in the near future."

Source https://www.sciencedaily.com/releases/2020/10/201029115820.htm

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Electronics and Communication Engineering

6. Breakthrough Quantum-Dot Transistors Create a Flexible Alternative to Conventional Electronics

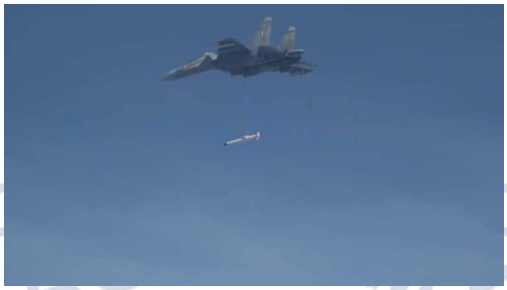
Researchers at Los Alamos National Laboratory and their collaborators from the University of California, Irvine have created fundamental electronic building blocks out of tiny structures known as quantum dots and used them to assemble functional logic circuits. The innovation promises a cheaper and manufacturing-friendly approach to complex electronic devices that can be fabricated in a chemistry laboratory via simple, solution-based techniques, and offer long-sought components for a host of innovative devices. "Potential applications of the new approach to electronic devices based on non-toxic quantum dots include printable circuits, flexible displays, lab-on-a-chip diagnostics, wearable devices, medical testing, smart implants, and biometrics," said Victor Klimov, a researcher. For decades, microelectronics has relied on extra-high purity silicon processed in a specially created clean-room environment. Recently, silicon-based microelectronics has been challenged by several alternative technologies that allow for fabricating complex electronic circuits outside a clean room, via inexpensive, readily accessible chemical techniques. Colloidal semiconductor nanoparticles made with chemistry methods in much less stringent environments are one such emerging technology. Due to their small size and unique properties directly controlled by quantum mechanics, these particles are dubbed quantum dots.

A colloidal quantum dot consists of a semiconductor core covered with organic molecules. As a result of this hybrid nature, they combine the advantages of well-understood traditional semiconductors with the chemical versatility of molecular systems. These properties are attractive for realizing new types of flexible electronic circuits that could be printed onto virtually any surface including plastic, paper, and even human skin. This capability could benefit numerous areas including consumer electronics, security, digital signage and medical diagnostics. A key element of electronic circuitry is a transistor that acts as a switch of electrical current activated by applied voltage. Usually transistors come in pairs of n- and p-type devices that control flows of negative and positive electrical charges, respectively. Such pairs of complementary transistors are the cornerstone of the modern CMOS (complementary metal oxide semiconductor) technology, which enables microprocessors, memory chips, image sensors and other electronic devices. The first quantum dot transistors were demonstrated almost two decades ago. However, integrating complementary n- and p-type devices within the same quantum dot layer remained a long-standing challenge. In addition, most of the efforts in this area have focused on nanocrystals based on lead and cadmium. These elements are highly toxic heavy metals, which greatly limits practical utility of the demonstrated devices. The team of Los Alamos researchers and their collaborators from the University of California, Irvine have demonstrated that by using copper indium selenide ($CuInSe_2$) quantum dots devoid of heavy metals they were able to address both the problem of toxicity and simultaneously achieve straightforward integration of n- and p-transistors in the same quantum dot layer. As a proof of practical utility of the developed approach, they created functional circuits that performed logical operations. The innovation that Klimov and colleagues are presenting in their new paper allows them to define p- and n-type transistors by applying two different types of metal contacts (gold and indium, respectively). They completed the devices by depositing a common quantum dot layer on top of the pre-patterned contacts. "This approach permits straightforward integration of an arbitrary number of complementary p- and n-type transistors into the same quantum dot layer prepared as a continuous, un-patterned film via standard spin-coating," said Klimov.

Source https://www.sciencedaily.com/releases/2020/10/201029142040.htm

Aerospace Engineering

7. India Test-Fires Rudram 1, its First Anti-Radiation Missile to Kill Enemy Radars



India in October 2020 successfully test-fired Rudram 1, the tactical anti-radiation missile that the Indian Air Force can launch from its Sukhoi-30MKI fighter jets to take down enemy radars and surveillance systems. The missile has a launch speech of up to 2 Mach, twice the speed of sound, people familiar with the matter said. The Defence Research and Development Organisation developed the new generation weapon. It was tested at the interim test range Balasore, off the coast of Odisha in the Bay of Bengal. This would allow the IAF's strike aircraft to carry out their mission unhindered effectively. "This test demonstrates the capability of an Anti-Radiation Missile with large stand-off ranges," a second official said. The New Generation Anti-Radiation Missile, or NGARM, is integrated on Su-30MKI fighter aircraft. Its range depends on the height at which the fighter jet is flying. It can be launched from a height ranging from 500 metres to 15 km and can hit radiation emitting targets within a range of 250 km. Rudram 1 was successfully test-fired from a Sukhoi-30MKI fighter jet at about 10.30 am on October 9, 2020. All radars and Electro Optical Tracking System tracked the launch and point of impact. The tactical, air-to-surface anti-radiation missile is equipped with a passive homing head that tracks sources of radiation of a wide range of frequencies. It can lock into a target not only before launch but also after it has been launched. The missile is comparable to the tactical air-to-surface missile AGM-88E Advanced Anti-Radiation Guided Missile that was inducted by the US Navy only in 2017 and can engage relocatable Integrated Air Defence targets and other targets equipped with shutdown capability. This means that if the enemy shuts down the radar after the missile is launched, it will still hit the target. Rudram 1, India's new generation anti-radiation missile is integrated with Sukhoi-30 MKI. Defence Minister Rajnath Singh tweeted his congratulations to the DRDO team that developed the supersonic-capable missile that can be launched at speeds ranging from 0.6 Mach to 2 Mach. "The New Generation Anti-Radiation Missile (Rudram-1) which is India's first indigenous anti-radiation missile developed by DRDO for Indian Air Force was tested successfully today at ITR, Balasore. Congratulations to DRDO & other stakeholders for this remarkable achievement," Rajnath Singh said on Twitter.

Source https://www.hindustantimes.com/india-news/india-test-fires-rudram-1-its-first-anti-radiation-missile-to-take-down-enemy-radars/story-SYP6qWQOXmZrK7ViSPG54K.html

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Mining, Metallurgical and Materials Engineering

8. Face Mask Aims to Deactivate Virus to Protect Others

In the pandemic, people wear face masks to respect and protect others -- not merely to protect themselves, says a team of Northwestern University researchers. With this in mind, the researchers developed a new concept for a mask that aims to make the wearer less infectious. The central idea, which received support from the National Science Foundation through a RAPID grant, is to modify mask fabrics with anti-viral chemicals that can sanitize exhaled, escaped respiratory droplets. By simulating inhalation, exhalation, coughs and sneezes in the laboratory, the researchers found that non-woven fabrics used in most masks work well to demonstrate the concept. A lint-free wipe with just 19% fiber density, for example, sanitized up to 82% of escaped respiratory droplets by volume. Such fabrics do not make breathing more difficult, and the on-mask chemicals did not detach during simulated inhalation experiments. "Masks are perhaps the most important component of the personal protective equipment (PPE) needed to fight a pandemic," said Northwestern's Jiaxing Huang, who led the study. "We quickly realized that a mask not only protects the person wearing it, but much more importantly, it protects others from being exposed to the droplets (and germs) released by the wearer."Where there is an outbreak of infectious respiratory disease, controlling the source is most effective in preventing viral spread," said Haiyue Huang, a 2020 Ryan Fellowship Awardee. "After they leave the source, respiratory droplets become more diffuse and more difficult to control." Although masks can block or reroute exhaled respiratory droplets, many droplets (and their embedded viruses) still escape. From there, virus-laden droplets can infect another person directly or land on surfaces to indirectly infect others. Huang's team aimed to chemically alter the escape droplets to make the viruses inactivate more quickly. To accomplish this, Huang sought to design a mask fabric that: (1) Would not make breathing more difficult, (2) Can load molecular anti-viral agents such as acid and metal ions that can readily dissolve in escaped droplets, and (3) Do not contain volatile chemicals or easily detachable materials that could be inhaled by the wearer. After performing multiple experiments, Huang and his team selected two well-known antiviral chemicals: phosphoric acid and copper salt. These non-volatile chemicals were appealing because neither can be vaporized and then potentially inhaled. And both create a local chemical environment that is unfavourable for viruses. "Virus structures are actually very delicate and 'brittle,'" Huang said. "If any part of the virus malfunctions, then it loses the ability to infect." Huang's team grew a layer of a conducting polymer polyaniline on the surface of the mask fabric fibers. The material adheres strongly to the fibers, acting as reservoirs for acid and copper salts. The researchers found that even loose fabrics with low-fiber packing densities of about 11%, such as medical gauze, still altered 28% of exhaled respiratory droplets by volume. For tighter fabrics, such as lint-free wipes (the type of fabrics typically used in the lab for cleaning), 82% of respiratory droplets were modified. Huang hopes the current work provides a scientific foundation for other researchers, particularly in other parts of the world, to develop their own versions of this chemical modulation strategy and test it further with viral samples or even with patients. "Our research has become an open knowledge, and we will love to see more people joining this effort to develop tools for strengthening public health responses," Huang said. "

Source https://www.sciencedaily.com/releases/2020/10/201029142017.htm

Energy Engineering

9. New Battery Tech Can Charge Electric Cars up to 90% in 6 Minutes

A team of South Korean researchers have developed a faster charging and longer lasting battery material that can juice up electric cars up to 90 per cent in just six minutes. Unlike conventional cars that use internal combustion engines, electric cars are solely powered by lithium ion batteries, so the battery performance defines the car's overall performance. However, slow charging times and weak power are still barriers to be overcome. The research teams of professor Byoungwoo Kang and Dr Minkyung Kim from Pohang University of Science and Technology, along with professor Won-Sub Yoon at Sungkyunkwan University proved for the first time that high power can be produced by significantly reducing the charging and discharging time without reducing the particle size. "The conventional approach has always been a trade-off between its low energy density and the rapid charge and discharge speed due to the reduction in the particle size," said Kang. For fast charging and discharging of Li-ion batteries, methods that reduce the particle size of electrode materials were used so far. However, reducing the particle size has a disadvantage of decreasing the volumetric energy density of the batteries. To this, the research team confirmed that if an intermediate phase in the phase transition is formed during the charging and discharging, high power can be generated without losing high energy density or reducing the particle size through rapid charging and discharging, enabling the development of long-lasting Li-ion batteries. Using the synthesis method developed by the research team, one can induce an intermediate phase that acts as a structural buffer that can dramatically reduce the change in volume between the two phases in a particle. In addition, it has been confirmed that this buffering intermediate phase can help create and grow a new phase within the particle, improving the speed of insertion and removal of lithium in the particle, the researchers noted. As a result, the Li-ion battery electrodes synthesised by the research team charged up to 90 per cent in six minutes and discharged 54 per cent in 18 seconds—a promising sign for developing high-power Li-ion batteries. "This research has laid the foundation for developing Li-ion batteries that can achieve quick charging and discharging speed, high energy density, and prolonged performance," a researcher said.

Source https://www.tribuneindia.com/news/science-technology/new-battery-tech-can-charge-electric-cars-up-to-90-in-6-minutes-161373

10. IIT Madras Researchers Develop Anti-Bacterial, Biodegradable Food Wrapping Material

Researchers at Indian Institute of Technology (IIT), Madras have developed a food wrapping material which is not only anti-bacterial but also biodegradable. According to the team which has also filed a patent for the wrapper, their product can tackle two major problems - prevent packaged food contamination by bacteria as well as reduce the plastic waste generated in the environment when disposing of the wrappers. "Our idea was to design a food wrap that will address two major issues--solid waste and food contamination during storage due to bacterial growth. We have developed a biodegradable wrapping material with in-built anti-bacterial activity to prevent bacterial growth in stored food. The anti-bacterial compound should be safe for consumption as it is approved by the authorities and does not cause any toxicity," said Mukesh Doble, Professor, IIT's Department of Biotechnology. "The wrapping material we have developed also degrades at various environmental conditions with the rate of degradation varying from 4 to 98 per cent in 21 days. The wrapping material degraded rapidly in moist conditions when compared to dry ones. Hence, our wrapper is eco-friendly and can play a major role in plastic waste reduction," he added. The films developed by researchers were made with polymeric blends containing starch, polyvinyl alcohol, cyclic beta glycans (CBG). The composition was optimised to achieve the best film with a smooth texture, flexibility, uniform thickness and good clarity. "Our anti-bacterial coated polymer wrapper was used for wrapping paneer, meat and chicken and its performance was tested. Samples were placed in 4 degrees Celsius and 30 degrees Celsius for 10 days and tested for the effect of the coating on reducing the bacterial growth with respect to the uncoated wrapper," said Puja Kumari, a research scholar at IIT Madras. "Our study found that 99.999 per cent reduction in bacterial colonies was observed in food samples wrapped with our anti-bacterial wrap and stored at 30 degrees Celsius for 10 days when compared with a plain wrapper. This study also suggests that our anti-microbial wrapper can, to some extent overcome, the reduced availability of cold storage units. Paneer is known to have a very low shelf life (less than 7 days) and hence extending its shelf life is a major advantage," she added. The researchers also found that the wrapping material degraded at various environmental conditions with the rate of degradation varying from 4 to 98 per cent in 21 days. The material degraded rapidly in a moist condition when compared to dry ones.

Source https://www.tribuneindia.com/news/science-technology/iit-madras-researchers-develop-anti-bacterial-biodegradable-food-wrapping-material-154701

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ENGINEERING INNOVATION IN INDIA

Hyderabad Adding Muscle to India's Armed Forces

From designing, developing and manufacturing missile and communication systems, Hyderabad has continued to power India’s defence dreams.

DRDO Labs-ANURAG: Advanced Numerical Research and Analysis Group: Works on advanced computing concepts, including hardware, software, numerical analysis and algorithmic studies for DRDO and armed forces.

Defence Electronics Research Laboratory (DERL): Works on electronic and communications intelligence, radar and communication jamming systems covering radar and communication frequency bands on ships, submarines, helicopters, aircraft, airborne PODs and static installations.

Advanced Systems Laboratory: Focus on design, development and flight evaluation of missile systems and is working on solid propulsion technologies, composites, aerospace mechanisms, mission design and studies, guidance design and control systems.

Defence Research & Development Laboratory (DRDL): Responsible for design and development of missile systems and technologies that are deployed on land, underwater, sea, and air. Working on technologies required for missiles and strategic systems.

Research Centre Imarat: The premier lab of Dr APJ Abdul Kalam Missile Complex, DRDO, spearheads R&D in avionics systems. Carries out R&D in technologies of control engineering, inertial navigation, Imaging Infrared seekers, RF Seekers & Systems, On-board Computers and Mission Software.

BrahMos Aerospace: All the missile subsystems being fabricated at work centres in India and Russia are delivered at BIC where they are integrated and checked. The Brahmos supersonic cruise missile has range up to 290 km.

Defence Metallurgical Research Laboratory (DMRL): Responsible for development of advanced metallic and ceramic materials, and related processing technologies, for various critical defence applications

MINISTRY OF DEFENCE PSUS

Mishra Dhatu Nigam (Midhani): Develops, produces and supplies various super alloys, special steels, materials to defence, and other strategic sectors for nuclear, aeronautical and space applications.

Bharat Dynamics Ltd (BDL): Serves as manufacturing base for guided missiles and allied defence equipment. Produced the 1st generation Anti -Tank Guided Missile (ATGM) - the French SS11B1. Has two manufacturing units in Telangana – one at Kanchanbagh and second at Bhanu in Sangareddy district.

Ordnance Factory Medak: One of the 41 factories under the Ordnance Factory Board, the unit in Sanga Reddy district produces infantry combat vehicles, bullet proof vehicles, hulls and turrets for Main Battle Tank (Arjun) and Armour Amphibious Dozar, Rocket Launchers (Pinaka), among others.

PRIVATE PLAYERS

Astra Rafael Comsys: The JV between India's Astra Microwave Products Ltd and Israel's Rafael Advanced Defense Systems Ltd, develops, produces and integrates high-end digital communication systems, including a range of technologies and products like SDR, ESM technology and Cognitive Radio. Making BNet SDR for IAF.

Kalyani Rafael Advanced Systems: JV between Kalyani Group and Israel's Rafael Advanced Defense Systems, is India's first private sector missile subsystems manufacturing facility. Working on $100 million order to make 1000 units of Barak 8 MR-SAM missile kits for supply to BDL for further integration.

Adani Elbit Advanced Systems India: JV between Adani Group and Elbit of Israel set up to make components for Hermes 900 medium altitude, long endurance UAVs and also make Hermes 480 UAVs.

Zen Technologies: Develops training equipment, simulators and allied defense equipment, including smart firing ranges for defence as well as police forces.

Tata Advanced Systems – Adibhatla: Assembles and manufactures missile systems & sub-systems, radar systems and subsystems, command & control systems, aerospace & aero structures, unmanned aerial systems, optronic systems through multiple subsidiaries and joint ventures. Working on key defence programmes like Indian Navy's surface surveillance radar programme and 3D C/D Band Radar, as well as IAF's high power radar. Also making Aquilon mini UAV for Indian Army.

HELA Systems: The JV between TASL & Israel's ELTA Systems Ltd provides radar, communications, electronic warfare, homeland and surveillance systems and solutions to Indian defence forces.

NOVA Integrated Systems: A wholly owned subsidiary of TASL, NOVA serves as a hub for design, development and production of defence electronics systems such as command posts, combat management systems, radars and electro-optic products like night devices.

Tata Boeing Aerospace: The TASL-Boeing JV makes fuselages and additional structures for AH-64 Apache attack helicopters for Indian Army. Also makes crown and tail cone assembly for Boeing's Indian configuration of CH-47F Chinook helicopters ordered by IAF.

Cyient Solutions & Systems: JV between Cyient & Israel's BlueBird Aero Systems made SpyLite mini UAV systems for high altitude surveillance for Indian Army.

Source https://timesofindia.indiatimes.com/india/hyderabad-adding-muscle-to-indias-armed-forces/articleshow/78474137.cms

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