INDIAN NATIONAL ACADEMY OF ENGINEERING

INAE Monthly E-News Letter Vol. VIII, Issue 1, January 1, 2017

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Message from the President

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From the Editor's Desk

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Purnendu Ghosh
Chief Editor of Publications

Message from the President

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On the eve of the New Year, I am delighted to express my warmest greetings to all our Fellows, Young Associates and their families and convey my best wishes to each one for a very happy, healthy, successful and productive New Year 2017. It is a matter of pride for us that all our Fellows have made very meaningful contributions during the last one year for the growth of the Academy, both in its activities and outreach. It has indeed helped the Academy in enhancing its visibility and stature in the engineering community, both at national and international levels. I take this opportunity to convey my sincere thanks and gratitude to all of you for your whole hearted support and cooperation.

Some of the major highlights of the year include the Engineers Conclave 2016, held at IIT Madras during Sept 1-3, 2016 which was inaugurated by Shri M Venkaiah Naidu, Hon'ble Minister for Urban Development, Housing & Urban Poverty Alleviation and Information & Broadcasting. The recommendations are being finalized for submission and follow up actions with the concerned Government Departments/agencies. A high level meeting was organized by the INAE, with the presence of the top executives from R&D, Academia and Industry to discuss various aspects of the realization of Regional Transport Civil Aircraft in the Country and to suggest a suitable mechanism for the same. I am happy to inform that we are able to converge on a possible mechanism for its realization and the recommendations have been finalized which will be shortly submitted to the concerned Government agencies in the Country.

INAE has been continuously striving to reach out to policy makers and in this connection several initiatives have been taken. The INAE-DST Consultative Committee has been constituted and has been meeting quarterly with the main aim of discussing and aligning the activities undertaken by INAE with the thrust areas of the Govt. of India. Similarly, the office of the Principal Scientific Advisor (PSA) to Govt. of India requested INAE to suggest suitable experts to interact with the Ministry of Commerce on specific areas, particularly for increasing the export of engineering products for enhancing their quality and reducing the costs. Two such interactive meetings have been held so far on the topics of Industrial Valves and Electric Motors in which INAE Fellows and other experts participated.

One of the important initiatives of INAE, at the behest of DST is to undertake the study on Clean Coal Technologies addressing the present status, the gap areas and the thrust research areas needed, which can be funded by the Government. Accordingly, INAE conducted two such meetings with the experts from all over the Country and deliberated in detail addressing all issues on Clean Coal Technologies relevant to the country. The outcome of these efforts is the identification of eleven research proposals covering various aspects of Clean Coal technologies and they have been submitted to DST for consideration during a recent meeting.

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INAE has recently launched a quarterly journal "INAE Letters" published by M/s Springer with the objective of providing a medium for the rapid publication of new research results and also invited short review articles across different domains of engineering and technology. The first issue of the Research Journal "INAE Letters" was released by the Shri M Venkaiah Naidu, Hon'ble Minister for Urban Development, Housing & Urban Poverty Alleviation and Information & Broadcasting on Sep 1, 2016 at IIT Madras, Chennai, during the Engineers Conclave 2016. Two issues of the Journal have been brought out so far and I seek your active contributions for the sustained continuity of the journal.

INAE Expert Pool was created with the aim of identifying domain experts in various disciplines of engineering. There has been an overwhelming response from the Fellows and Young Associates in uploading their particulars on the INAE Expert Pool website and many of the Government agencies have

expressed their willingness to utilize our Expert Pool for many of their initiatives. There is also a constant endeavour to seek the involvement of more Fellows in the activities of the Academy. Efforts are on to enhance the participation and involvement of the Sectional Committees. Greater emphasis is given to the Local Chapters and I am pleased to inform you that many of the Chapters have become quite active this year.

The INAE Annual Convention was held on Dec 8-9, 2016 at Space Applications Centre (SAC), Ahmedabad. The format of the Annual Convention is reshaped to make it more attractive to all our Fellows by introducing Plenary talks, Industry session, meetings of INAE Forums and also Sideline meeting with senior INAE Fellows to discuss the Way Forward for the Academy. This year, the proceedings of CAETS 2015 Convocation on "Pathways to Sustainability: Energy, Mobility and Healthcare Engineering" published by M/s Springer was also released.

It is heartening to note that in all these events a large number of INAE Fellows participated. The success of all major programmes and activities of INAE are attributed to the active involvement and keen interest shown by the Fellows. The knowledge, wisdom and eminence of our Fellows have helped us in achieving the desired goals. On behalf of INAE, I convey my sincere gratitude to all my Fellow colleagues in the Academy for their valuable contributions and look forward to have much greater and meaningful involvement and contributions in the forthcoming events and programmes being planned, this year too. We always welcome your valuable suggestions and look forward to your inputs and contributions to take the Academy to greater heights of excellence.

It is with great pleasure that I once again wish all our Fellows, Young Associates and their families, a very Happy New Year 2017 filled with joy, prosperity, peace, success and outstanding achievements in your future professional pursuits and endeavours.

Dr BN Suresh
President, INAE

From the Editor's Desk

Future of the future

One of the purposes of engineering is to bring changes; changes in the self and the society. One of the objectives of 'change' is to make it better. What we can do to better the image of INAE? We can do many things, like, establishing connectivity with the youth, and improving link with the policy makers. When we want to bring a change we ask ourselves all kinds of questions. It is easy to ask questions and also offer theoretical answers, but difficult is the implementation part. Here comes the role of responsibility. We may like to do many things, we may have many capable people to do it, but it is also important that these capable people assume responsibility. Responsibility is much more than popularity contest. 'Mine and go away' type of situations do not always serve the purpose. If one wants to make a change, it is important to involve the ones for whom the changes are intended. 'I am a part of the change' is an important feeling, be it the youth of the country, or the society at large. Biological hardware is very important, but social software is equally important.

Engineering and technology are the big contributors for the refinement of our everyday thinking. We can deliver, be it to the nation or to the self, only if we involve ourselves. One may ask, can't a country of 1.2 Billion people get back literally to 'zero'? Of course it can, if we somewhat dilute our optimism. If in certainty a certain amount of uncertainty is mixed, it leads to better end results. We want to become what we were. We love to say "there was no country like ours, no king like ours, no engineering like ours", but we lack the spirit and the confidence when we say that. One way is to involve the youth of the country in mainstream engineering. Prepare the young minds and future innovators who fit into the country's core values. The young generation wants to make a difference, and that is what engineering is all about.

What is the future of our future? Take a look:

Once a mysterious vastness frightened man.
To survive in the harsh world
Man evolved his capacity for thought.
He acquired knowledge of the self.
Man became 'fully born', 'fully awake' and 'fully human'.
Man became the ruler of the Earth.
Man now wants to rewrite the code of life.
Some call it 'insane arrogance'.
Let man be complete using 'fully' what he already has.

I wish you all a very happy 2017.

Purnendu Ghosh
Chief Editor of Publications

ACADEMY ACTIVITIES

Message from the President

From the Editor's Desk

INAE Annual Convention

The Annual Convention of the Indian National Academy of Engineering was held on Dec 8-9, 2016 at Space Applications Centre (SAC), Ahmedabad. The programme of this year's Annual Convention had a new format, wherein besides the Inaugural Session, technical presentations by newly elected Fellows and Young Engineer Awardees and the Awards Ceremony the following were held.

(a) Two Plenary Talks – one on a technical topic and one on a general topic
(b) Industry Session wherein two young entrepreneurs delivered talks on their start-ups
(c) Sideline meetings to include meetings of two INAE Forums
(d) A meeting of senior INAE Fellows to discuss the Way Forward of the Academy
(e) Release of CAETS 2015 Convocation on "Pathways to Sustainability: Energy, Mobility and Healthcare Engineering" Proceedings published by M/s Springer

The Annual Convention had a participation of 135 Fellows and 20 families besides 3 Foreign Fellows.

Inaugural Session

Mr. Shailendra N. Roy, Chief Executive & Whole-Time Director, Larsen & Toubro Ltd was the Chief Guest and Shri AS Kiran Kumar, Chairman, Space Commission, Chairman, ISRO and Secretary, Department of Space was the Guest of Honour during the Inaugural Session on Dec 8, 2016. Mr. Tapan Misra, Director, Space Applications Centre delivered the Welcome Remarks. Dr BN Suresh, President, INAE delivered the Presidential Address. This was followed by the Address by the Chief Guest, Mr. Shailendra N. Roy and the Guest of Honour, Shri AS Kiran Kumar.

During the Inaugural Session, following were inducted into the Academy by the President, INAE and signed the Admission Register – Shri Senapathy 'Kris' Gopalakrishnan, Shri T.V. Narendran, Dr Uday Shankar Agarwal and Prof Cato Thomas Laurencin,

The CAETS 2015 Proceedings published by M/s Springer which contains papers based on the presentations during the CAETS 2015 Convocation on "Pathways to Sustainability: Energy, Mobility and Healthcare Engineering" hosted by INAE at New Delhi on Oct 13-14, 2015; was released by Dr BN Suresh, President, INAE. Dr Purnendu Ghosh, Chief Editor of Publications, INAE gave a brief background of the CAETS Proceedings prior to the release. Brig Rajan Minocha, Executive Director, INAE proposed the Vote of Thanks.

The major scientific and engineering highlights of the Convention were the presentations by newly elected Fellows and Young Engineer Awardees. The presentations were held in two Parallel Sessions on Dec 8-9, 2016. The list of the technical presentations by Fellows and Young Engineers are given below.

Presentations by Newly Elected Fellows on Dec 8-9, 2016

Prof. B Ravi	-	The Golden Spiral: Connecting Education, Research, Development and Application
Dr. C. Ranganayakulu	-	Development of Environmental Control Systems and Compact Heat Exchangers for Aerospace Applications

Mr. NM Dube	-	Extreme Tribology: Exploring Tribology testing for extremely Challenging Applications
Dr. Rahul Mitra	-	Development of composite materials for light-weight and high temperature structural applications
Mr. Vinay V Kulkarni	-	Industrialization of Software Development
Dr. Swades De	-	Protocols and Cross-Layer Optimizations for Green Communication Networks
Mr. Vivek Bhasin	-	R&D in Structural Integrity of Nuclear Components: Large Amplitude Cyclic Loads
Prof. PJ Narayanan	-	Recovering Three Dimensionality from Images
Dr. US Agarwal	-	Innovating in bulk industry
Prof. Baidurya Bhattacharya	-	Origins and Utility of Friction at small scales
Prof. DC Panigrahi	-	Field investigations, modelling and simulation studies for reducing the radiation dose levels in underground uranium mines in India
Dr. P.P. Mohanlal	-	Aerospace Inertial Sensors and Systems: Challenges
Dr. Saptarshi Basu	-	Droplets, Sprays and Flow in combustors: Insights into different spatio-temporal scales
Dr. Ashim Kumar Mukhopadhyay	-	Development and Industrial Scale Production of Structural Aluminium Alloys for Defence Applications
Prof. KVS Hari	-	Experiments in MIMO Signal Processing
Dr. R Muralidharan	-	Towards self reliance in high frequency devices
Prof. NS Raghuwanshi	-	Improved Agricultural Water Management Using Information Technology
Mr. BHVS Narayana Murthy	-	Missile Avionics : Design and Challenges
Prof. Yogesh M Joshi	-	Revising a phase behavior of aqueous suspension of Laponite ®
Prof. JB Joshi	-	Direct Numerical Simulation of Multiphase Systems : Applications to Flotation, Cromatographic Separation, Pyrolysis, Biomass Stove, Continuous Cooker, Technologies for CNT, Titanium and New Generation of Atomic Power Reactor
Prof. BG Fernandes	-	Power Electronic based PV solutions for Rural India
Prof. Chandra Venkataraman	-	Short Lived Climate Pollutants: Emissions and Impacts over India

Prof. Sampath Srinivasan	-	Electrochemical Devices: Sensors and Energy Systems
Dr. Hariharan Ramesh	-	Multi-disciplinary Engineering for Genomic Diagnosis

Presentations by INAE Young Engineer Awardees on Dec 8-9, 2016

Mr. Suresh Kumar	-	Breakthrough development in agricultural tractor Clutch and Driveline systems
Dr. Amartya Mukhopadhyay	-	Correlations between processing conditions, microstructure developments, dimensional aspects and phase transformations on the performance of engineering ceramics in advanced structural and electrochemical energy storage applications.
Dr. DV Pinjari	-	Cavitation Technology: A Sustainable Technology for Environmental Cause
Dr. Santanu Kapat	-	High-Performance, Energy-Efficient, EMI-Aware Mixed-Signal Dynamic Power Management Architectures
Dr. Sudib Kumar Mishra	-	Seismic Vibration Control using Super-elastic Base Isolation
Dr. Manisha B. Padwal	-	Atomization and Combustion of Gelled Propellants
Dr. Chandan Saha	-	Arithmetic circuit complexity: Lower bounds, De-randomization and Reconstruction
Dr. Uday Kumar Reddy B	-	Building Language and Compiler Technology for the Multicore Era

Awards Function on Dec 8 2016

The Grand Award Ceremony was held on the evening of December 8, 2016. Five theses at Doctoral level, Five Theses at Master's Level and 5 Projects at Bachelor's Level were conferred the Innovative Student Projects Award. Ten candidates were conferred the INAE Young Engineer Award 2016.

Dr. Sunitha K Nayar being conferred the Innovative Student Projects Award 2016 at Doctoral level by Dr BN Suresh, President, INAE

Dr Chandan Saha being conferred the INAE Young Engineer Award 2016 by Dr BN Suresh President, INAE

Dr SN Singh, Professor, Department of Electrical Engineering, Indian Institute of Technology Kanpur and Prof SK Sarangi, Director, National Institute of Technology Rourkela were conferred the INAE Outstanding Teachers Award 2016.

Prof SN Singh receiving the Outstanding Teachers Award 2016 from Dr BN Suresh, President, INAE

Prof SK Sarangi receiving the Outstanding Teachers Award 2016 from Dr BN Suresh, President, INAE

Dr. V. Adimurthy, ISRO Honorary Distinguished Professor and Prof VS Borkar, Department of Electrical Engineering, Indian Institute of Technology Bombay were conferred the Prof Jai Krishna Memorial Award and Prof SN Mitra Memorial Award 2016 respectively.

Dr V Adimurthy receiving the Prof Jai Krishna Memorial Award 2016 from Dr BN Suresh, President, INAE

Prof VS Borkar receiving the Prof SN Mitra Memorial Award 2016 from Dr BN Suresh, President, INAE

Dr PS Goel, Honorary Distinguished Professor, ISRO Hqrs. and Raja Ramanna Chair Visiting Professor, National Institute of Advanced Studies, Bangalore and Formerly Secretary, Ministry of Earth Sciences and Dr VK Aatre, formerly Scientific Adviser to the Raksha Mantri, Director General of Defence Research & Development Organization and Secretary Department of Defence R&D were conferred the Life Time Contribution Award in Engineering 2016.

Dr PS Goel receiving the Life Time Contribution Award in Engineering 2016 from Dr BN Suresh, President, INAE

Dr VK Aatre receiving the Life Time Contribution Award in Engineering 2016 from Dr BN Suresh, President, INAE

Sidelines Meeting held on Dec 8, 2016

A sideline meeting chaired by Dr. PS Goel, Past President, INAE was held on Dec 8, 2016 at SAC, Ahmedabad. The Agenda for the meeting was to discuss the methodology to engage INAE Fellowship in the activities being undertaken with various Ministries/Niti Aayog/PSA Office/TIFAC etc. towards providing technical inputs for engineering interventions in policy formulation.

Meetings of INAE Forums on Dec 8, 2016

Meetings of the INAE Forum on Engineering interventions for Disaster Mitigation Chaired by Dr RK Bhandari and INAE Forum on Indian Landscape of Advanced Structural Materials Chaired by Dr Debashish Bhattacharjee were held on the sidelines of the Annual Convention on Dec 8, 2016 at SAC Ahmedabad.

Annual General Meeting of Fellows on Dec 9, 2016

The 28th Annual General Meeting of Fellows was held on Dec 9, 2016. During the Induction Ceremony, the following were formally admitted into the Academy by the President, INAE and signed the Admission Register.

ES-I	Prof. Baidurya Bhattacharya, Shri Mangu Singh
ES-II	Mr. Vinay V Kulkarni, Prof. PJ Narayanan
ES-III	Dr. Saptarshi Basu, Dr. C. Ranganayakulu, Prof B Ravi, Shri NM Dube
ES-IV	Prof JB Joshi, Prof Yogesh M Joshi
ES –V	Prof BG Fernandes
ES-VI	Dr Neelesh B Mehta, Dr Swades De, Prof KVS Hari, Dr R Muralidharan
ES-VII	Dr PP Mohanlal, Mr. BHVS Narayana Murthy, Shri S Somanath
ES-VIII	Prof DC Panigrahi, Prof Rahul Mitra
ES-IX	Prof Chandra Venkataraman, Shri Vivek Bhasin
ES-X	Prof NS Raghuwanshi, Prof Sampat Srinivasan

During the AGM, a Brainstorming Session was held wherein Dr BN Suresh, President, INAE requested the Fellows to give their suggestions. A number of valuable suggestions were received on the methodology for engagement of INAE Fellows for providing inputs to DST, other Government Agencies and Policymakers.

Thereafter, presentations by Conveners of Sectional Committees I, V and IX to present the activities planned during the year 2017 were held.

Session on Plenary Talks on Dec 9, 2016

Two Plenary Talks – one on a technical topic and one on a general topic. **Mr. Rakesh Chopra**, formerly head of the Kashmir Railway Project, on Zonal Railway and formerly Member Engineering, Railway Board delivered the Plenary Talk on **"Challenges in J&K Rail Link"** on Dec 9, 2016. **Mr. Gaur Gopal Prabhu** of ISKON delivered a general talk on **"Ways to Happiness"**.

Industry Session held on Dec 9, 2016

During the Industry Session on Dec 9, 2016 lectures were delivered by two Start Up Entrepreneurs viz **Prof. Kavi Arya**, Associate Professor, Computer Science and Engineering Department, IIT Bombay and **Shri Parag Naik**, CEO Saankhya. Prof Kavi Arya is Principal Investigator of the e-Yantra Project that is popularizing "project based learning" using robotics in engineering colleges. Shri Parag Naik co-founded Saankhya and contributed to the product roadmaps and designing Saankhya architecture.

The Annual Convention ended with an organized tour for all participants on Dec 10, 2016 to Akshardham Temple and Gandhi Ashram.

Opening of Facebook and Twitter Accounts by INAE

The Department of Science and Technology (DST) has recommended enhancing Social Media Optimization through creation of Facebook and Twitter accounts. Accordingly a Facebook page and

Twitter Handle for INAE have been created. All INAE Fellows are requested to visit the page and post their comments, if any. The Facebook page of INAE can be viewed at https://www.facebook.com/pages/Indian-National-Academy-of-Engineering/714509531987607?ref=hl and Twitter handle at https://twitter.com/inaehq1

Research Journal -INAE Letters

INAE has recently launched a quarterly journal "INAE Letters" published by M/s Springer. 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. The first issue of the Research Journal "INAE Letters" was released by the Shri M Venkaiah Naidu, Hon'ble Minister for Urban Development, Housing & Urban Poverty Alleviation and Information & Broadcasting on Sep 1, 2016 at IIT Madras, Chennai during the sidelines of the Engineers Conclave 2016. Dr Purnendu Ghosh, Chief Editor of Publications, INAE and Executive Director, Birla Institute for Scientific Research, Jaipur is the Editor-in-Chief of INAE Letters. The website for the Research Journal "INAE Letters" to include facility for submission of papers online has also been launched. The soft copy of the INAE Letters can be viewed at the link http://www.springer.com/engineering/journal/41403

*(**L. to R.** Dr BN Suresh, President, INAE, Shri Vinay Sheel Oberoi, Secretary, HRD; Hon'ble Minister, Shri M Venkaiah Naidu and Prof Bhaskar Ramamurthi, Director, IIT Madras during the release of INAE Letters)*

Creation of Data for INAE Expert Pool

INAE Expert Pool was created with the aim of identifying domain experts in various disciplines of engineering. There has been a good response from the Fellows and Young Associates in uploading their particulars on the INAE Expert Pool website. The INAE Fellows and Young Associates who have not uploaded their particulars are requested to submit their profile details online at the link http://inae.in/expert-search/index.php/inae-members-form The details of the INAE expert Pool have since been shared with DST, TIFAC, Niti Aayog and Office of PSA. The creation of the website on Expert Pool has been appreciated by all the agencies and the data would be used by them in identifying suitable domain experts and to involve the experts in their activities.

Important Meetings held during December 2016

- **INAE Apex Committee Meeting on Dec 7, 2016**
- **INAE Governing Council Meeting on Dec 7, 2016**
- **Meeting of INAE Forum on Engineering Interventions for Disaster Mitigation on Dec 8, 2016**

- **Meeting of INAE Forum on Indian Landscape of Advanced Structural Materials on Dec 8, 2016**

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

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

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

Dr Jayanta Kumar Saha Deputy General Manager (Applications), Institute for Steel Development & Growth	Indian Institute of Engineering Sciences and Technology, Shibpur November 15-16, 2016	Delivered lectures on "Use of Stainless Steels and various codal provisions", "Sheet Metal and different metal coatings wrt Industrial usage", "Need for Applied Engineering in Metallurgical Engineering" and "Utilisation of Alloy Steels". Guided Projects, guided research paper which has been accepted in a reputed journal. According to the feedback from the institute the Industry Expert helped students to correlate the applications with theoretical knowledge. He is actively assisting skill development training programme for the final year students to develop an aptitude to serve in the industry.

International Conferences/Seminars being organized by IITs/other Institutions

To view a list of International Conferences/Seminars being held in the month of January 2017 click here.

Honours and Awards

1.	Dr CR Prasad, FNAE, former CMD, GAIL has received the Petrotech 2016 (Ministry of Petroleum & Natural Gas) Lifetime Achievement Award from the Hon'ble Finance Minister, Shri Arun Jaitely in Vigyan Bhavan, New Delhi in the presence of Mr. Dharmendra Pradhan, Minister of Petroleum & Natural Gas.

News of Fellows

1.	Prof Ponisseril Somasundaran, FNAE, LaVon Duddleson Krumb Professor of Mineral Engineering at Columbia University has been elected Fellow of the National Academy of Inventors, USA.

2	Prof SN Singh, FNAE, Department of Electrical Engineering, Indian Institute of Technology Kanpur has become IEEE Fellow w.e.f. 2017.
3	Prof Debatosh Guha, FNAE, Institute of Radio Physics and Electronics, University of Calcutta, Kolkata has been elected IEEE Fellow this year.
4	Prof Debabrata Das, FNAE, Department of Biotechnology, Indian Institute of Technology Kharagpur has co-authored a book on "Biohythane: Fuel for the Future" published by M/s. Pan Stanford Publishing Pte. Ltd, Singapore.
5.	The INAE report "Development of scientific recycling of end of life automobiles in India and the role of research and development", commissioned by the Office of the Principal Scientific Advisor to Government of India, and prepared by Captain N S Mohanram, FNAE (Principal Investigator) has started impacting government policy in a desirable direction. Based on the recommendation of the report, the Government is planning to enact an environment friendly law. According to a news item published in Hindustan Times, "The Government will soon make it mandatory for automakers and their agents to buy old and unroadworthy vehicles, and recycle them."

IEEE and SERB sponsored International Conference on Wireless Smart System Technologies (WiSST 2017) on Jan 5-7, 2017 at Kovilpatti, Tamil Nadu
http://www.conferencealerts.com/show-event?id=179626

7th IEEE International Advanced Computing Conference on Jan 5-7, 2017 at Hyderabad, Telangana
http://www.conferencealerts.com/show-event?id=169711

International Conference on Recent Advancements in Engineering & Technology-2017 on Jan 12, 2017 at Bangalore, Karnataka
http://www.conferencealerts.com/show-event?id=180120

6th International Conference on "Engineering & Technology, Computer, Basic & Applied Sciences" (ECBA- 2017) on Jan 13-14, 2017 at New Delhi
http://www.conferencealerts.com/show-event?id=176074

International Conference on Recent Research in "Mechanical, Electrical, Electronics, Civil, Computer Science and Information Technology" (MECIT-2017) on Jan 22, 2017 at New Delhi
http://www.conferencealerts.com/show-event?id=178658

International Conference on Chemical, Environmental Bioprocess, Textile, Mining, Material and Metallurgical Engineering (CEBTME - 2017) on Jan 22, 2017 at New Delhi
http://www.conferencealerts.com/show-event?id=178614

To fight Power-cuts, do not agitate. Install rooftop solar panels

Maj Gen Surjit Singh

The scourge of power cuts

Unscheduled power cuts can ruin an industry. While loss of productivity and idle manpower are the obvious consequence, there are processes in which material gets wasted, and machines suffer damage. The larger industrialists are forced to install 'standby' Diesel generating sets at enormous cost. Farmers are unable to irrigate their fields, and most of them have no means to run their tube-wells. They suffer in silence. The lay citizen is hit the hardest during the long Indian summer. On a sultry day, when the power cut occurs, they are unable to run their air-conditioners, and that leaves them fuming in anger.

In India, generation and distribution of electricity is largely controlled by the government. The tariff and availability of electricity turn into a political issue, and the fortunes of politicians are often decided by their ability to assure reliable power supply. When they are unable to keep their promises, people take to the streets and agitate.

Some recent technological developments have made it possible for us to solve the problem by helping ourselves. The price of the photo-voltaic cells has been dropping exponentially, and it has now become economically viable to install roof-top panels to bridge the gap between the supply and demand of power. I am reminded of a zarathustraquote which reads as under:

"To fight the darkness do not draw your sword.Light a candle."

We might soon be able to say, "To fight power cuts, do not agitate politically. Install roof-top solar panels!"

In praise of the Sun

The sun gives us light and energy. There would be no life on the earth if the Sun did not rise, day after day, without a single day's rest. People of many civilizations have worshiped the Sun as God since times immemorial. But during the tropical summer, it emerges with brutal fierceness and saps life. Productivity drops to an abysmal low, and those who can afford it, escape to the mountains for a bit of cool air. A hundred odd years ago, air-conditioners were invented, and the rich acquired a new device to save themselves from the fury of '*suryadevata*'. In due course, the price of air conditioners dropped and even the middle class could afford to buy them. The flip side of this phenomenon was that we did not have the electric power needed to run these cooling devices. Power cuts, scheduled and unscheduled, ensued. People felt '*powerless*' and invented nasty swear words to express their anguish. The gap between supply and demand began to widen and, soon, this became a political issue.

The light radiated by Sun can now be economically converted into electricity, and the system is so simple that you can install it on your own rooftop. I have done it and the details of my system are given below.

Functioning of a PV system

A solar PV power plant converts sunlight into electricity. It does so without any moving parts (unless it has a tracking system) and without generating either noise or pollution. A solar PV system can be installed at any un-shaded location such as on rooftops of buildings, car parking sheds, empty land, or even on top of canals and roads. A typical rooftop solar PV system for a household is between 1-10kW. A solar PV system consists of the following key components.

1. Solar PV array (group of modules)
2. Solar inverter
3. Battery
4. Interconnecting devices (junction box, cables, distribution box)

Picture of the PV system installed in our house are given below:

This is a 2 Kwp system. There are eight modules.

Some fundamental principles

The PV array consists of solar modules interconnected with each other. The modules convert the energy from sunlight, are held on structures made of galvanized iron, mild steel or aluminum and

are inclined at a horizontal tilt, facing either south or east-west. The modules are designed to generate power at either 12 or 24 volt. Inverter models can differ in their input voltage requirements in the range of 12 to 1,000 volt. A junction box connects the modules in series or parallel to achieve the optimum voltage required by the inverter.

Solar modules produce direct current (DC). Almost all electrical appliances in India, however, require alternating current (AC) to operate. The function of converting DC to AC is carried out by the inverter. In the case of a battery backup system, the inverter is also connected to the batteries and is responsible for managing the charging and discharging of the batteries.

The output point of the inverter is connected to the distribution box, which consists of a meter, fuse, a miniature circuit breaker (MCB), and load connections. Cables connect the solar modules, junction boxes, inverters and distribution boxes.

The capacity of the solar PV system depends on the amount of electricity (kWh) required per day by a consumer and the shadow and obstruction free space available on the rooftop. For example, a 2 kWp load operating for 10 hours requires a PV system of 5 kWp. Further, 1 kWp of solar PV requires 10 sq. meters of shadow free area. Therefore, a 5 kWp system would require 50 sq. m. In addition, if the consumption occurs during non-sunshine hours (6:00 pm to 6:00 am) or in case the consumption is not uniformly sufficient throughout the day, batteries to store energy must be added.

Another factor, which affects the system design, is the timing of electricity consumption. For example, residential consumers in Chandigarh have a peak demand during the morning (6:00 am – 10:00 am) and evening (6:00 pm – 10:00 pm). These are not peak sunshine hours (10:00 am – 4:00 pm). Residential demand tends to be lower during the day as household members become engaged in daily activities, mostly outside the house (e.g. adults going to work and children going to school). Thus, the peak power production of a PV system does not match the peak demand of residential consumers. For industrial and commercial consumers, on the other hand, solar generation coincides more closely with peak demand as most of these sites operate through the day.

Solar PV systems could be sized to not exceed the load demand during the day. If they are larger, and solar power is being generated that exceeds consumption at that point in time, wastage can be avoided by storing the excess power. Alternatively, excess power could be injected into the grid. In this case, metering would be required to measure energy transactions between the PV system and the grid.

The need to resurrect DC appliances and gadgets

Electricity first came in the form of 'Direct Current' and even as late as 1960, we were on DC. It was generated locally and distributed by the municipalities. There was no 'grid' system. Around that time, it became necessary to transmit power over long distances, and that is when the AC arrived. In the beginning, we used electricity mainly for lights, fans and radios. There were very few gadgets at that time. The AC counterpart of these devices appeared in the markets, and some smart manufacturers came up with AC/DC devices, which could operate on both forms of power.

Solar arrays have added another dimension to this process. The panels produce DC, ranging from 12 to 48 volts. A large number of our domestic appliances like computers, music systems and mobile phones operate on DC. The new LED lights need DC, and batteries of ALL devices need to be charged. We are likely to waste a lot of power and money in the process of converting DC to AC and re-converting it to DC for our appliances. Time has come to give a fresh look to the entire energy scene. When the panels become sufficiently efficient, it is possible that we shall revert to 'distributed' generation. Several households might actually become 'net-free' (they may be able to

generate ALL the power they need from solar panels or a hybrid of solar and wind power). In such cases, the power will be stored in DC batteries, and therefore they would best served by DC appliances. It may be noted that the automobiles, aircraft and even the railways operate exclusively on DC.

Rooftop solar PV with storage

Storage in solar PV systems is required to provide stable backup power when the solar energy is not available (at night) or not adequate to meet the entire load demand. Solar energy is an intermittent source of power. The power generation can vary with a change in sunshine due to, for example, a sudden cloud cover. Batteries can be used to store solar power to safeguard against a short-term fall in solar power generation. Intermittency can also be avoided by connecting the solar PV system to the grid. In this case the grid provides the extra energy at times of inadequate sunshine.

Another application of storage is to protect against grid outages. During an outage it is possible that solar generation is inadequate to meet the load demand (e.g. if it occurs outside sunshine hours). In such a case, the stored energy can be utilized to provide a stable output of power. If the grid condition is good and power outages are rare, batteries would probably be avoided as they add about 25 % to the system cost. Batteries also need to be replaced every three to five years. Since we do not experience long power cuts in Chandigarh, batteries need not be an essential part of the PV system

Rooftop solar PV array with net metering

There are two common ways in which owners of kW-scale rooftop solar PV plants can be compensated for feeding electricity into the grid: FiTs and net metering. For FiTs, solar power generated and fed into the grid is measured through a separate meter and then given a price (the FiT) through which the owner is compensated for the electricity generated. The advantage is, that the price for solar power and the amount of solar power generated can be determined independently. This method is useful where either the cost of solar power far exceeds the cost of grid power and/or where the generation of solar power far exceeds the on-site consumption needs. A risk is the potential for fraud through channeling non-solar power through the solar meter and thus inflating the amount of power for which the – usually high – solar FiT is paid. A household-level FiT is offered in, for example, Germany.

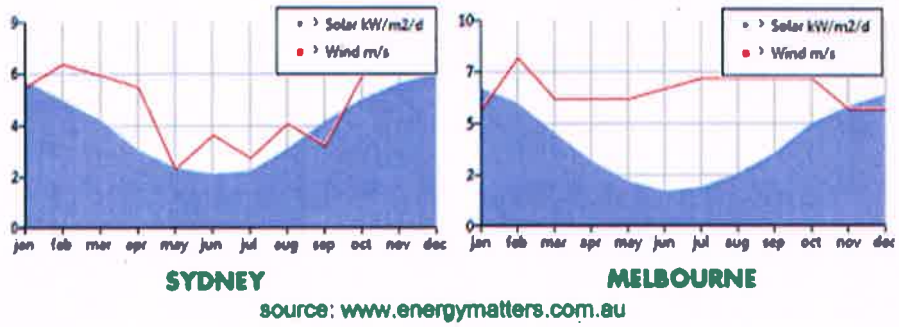
Under net metering, on the other hand, conventional electricity and solar electricity are traded at the same tariff. The billing in this case is based on the net energy imported (energy consumed minus energy generated and fed into the grid). In case more energy is generated than consumed, the utility can adjust the excess in a future billing period (this would be akin to "banking" the power), rather than giving a monetary compensation, as in the case of FiTs. However, over the long term, the amount of solar power that can be generated and monetized through net metering will be limited by the amount of power consumed, where, at most, the consumer can feed as much power back into the grid as he draws from the grid so that the electricity bill is "zero". Net metering is popular in, for example, the USA and Japan

The Central Electricity Agency (CEA) has initiated steps to set standards and guidelines for the integration of solar PV systems into the grid. A report on grid connectivity of solar PV is under formulation at the CEA. A draft is to be shared with the public for comments by end-June. The CEA's move is based on its acknowledgement that decentralized solar PV can play a key role in bridging the country's energy deficit and is set to take off now. During our interactions with senior officials at the CEA, we were told that "solar PV is the future for this country, and we have to make sure that there are standards and guidelines in place to support its integration with the grid". Various

metering arrangements covering grid interaction of a PV system with battery, without battery, with different load battery back-ups, with different load DG back-ups, and with DG and battery back-up combinations, have been laid down in the draft report.

The economics of Rooftop Solar Systems

The conversion efficiency of solar panels has been improving during the last ten years, and the prices are gradually diminishing. In my case I had to erect a steel structure to obtain sunshine all through the day. This added to the cost, a bit. In normal circumstances, a system should cost Rs one lac per Kwp capacity. Larger systems are cheaper because the power controller price drops. It is my estimate that a 5 Kwp system can be erected at a cost of under Rs 4 lakhs. The quantum of power generated varies with the seasons. During winter, the days are short and the sun is at a low angle. Consequently, the power generated in a day may be less than one-third of the yield during the summer. On a day when the sky is overcast, the power generated may drop to as little as 15% of the capacity. A study done on the seasonal variation carried out by the Australians is given below.



source: www.energymatters.com.au

Please remember that in Australia, Jun-July is winter. Notice the seasonal pattern of solar power. Consequently, the capacity is based on the annual yield of a system.

Estimate of power expected and ROI

As per the current estimate, that a 1 Kwp system can produce 1300 to 1750 Kwh of energy during the year. Thus I can expect to sell about 3,200 units of power out of my 2 Kwp system. The current rate is Rs 8.51 per unit for those who have not sought subsidy from the government. Thus, on my investment of about Rs 2.15 lakhs I can hope for a return of over Rs 27,000 per year. There being very little maintenance cost (other than cleaning the panels periodically), the ROI works out to more than 12%. This is better than the yield on fixed deposit in banks.

Routine Maintenance

There being no moving parts and no deterioration with time, operation of the solar system entails norunning expenses. Just about the only thing which you need to do is to clean the panels whenever dust forms on them or raindrops settle on their surface. For that, we have erected a ladder and steps to access the panels.

Our system was 'commissioned' on 18 Jan 2016. The sky was overcast, and so during the first five days, we got very little power. But after clouds left, we started getting 5 to 6 units of power.

The future of solar power in India

From whatever I have observed and read, India is at the 'take off' stage in the field of solar power. If the current events are any indication, solar panels are likely to become as common as mobile phones.

An incidental advantage of installing a rooftop system is that it **cools** the house, since the solar panels absorb heat.

According to some estimates solar power is expected to grow from 18 to 20,000 MW by 2022. This is a massive growth, by any standard!

The Timeline

I started this project on 11 Sep 2015, and estimated that I would be able to commission the system by 15 Oct 2015, since I had gone into considerable detail. In actual fact, it took three months longer. The electricity board created some hassles while clearing the design and they took unduly long in certifying the meter. I really do not blame them because they were new to the game themselves. My contractor *claimed* to have installed several systems, but they were in a different configuration (where the power is used to charge the user's own inverter) and therefore the government grid did not come in. So all in all, we were all breaking new ground. However, by the time I finished, it became clear to us that for small rooftop solar systems, government approval of the design of the structure is not necessary. As a result of the noise we made, orders have been issued that rooftop solar systems up to 5 Kwp do not need government sanction. In my view, we will proceed much faster if *all* controls are removed. In the NDA, we were taught that, '*The best government is the one that governs the least*'

Tailpiece

Solar power systems are coming. No one, not even our infamous bureaucracy, can stop them. *The need of the hour is that many of us should install them and talk about our experiences*. These systems will succeed the most in cases where the system can operate on DC. And if it can be used at the very time it is generated, the cost gets slashed. I am told that a student of IIT Bombay has designed a bicycle where the traction of the pedals is assisted by a solar module. In all probability, he is using a dc motor, which draws power the moment it is generated. So he neither needs a battery nor an inverter. And, of course, he needs no sanction from the government!

With a little more sophistication, this concept can be used for short distance commuting. There can be no better solution to pollution.

And finally, I am tempted to insert a picture I downloaded from the Internet. It depicts a pre-historic young man trying to 'tame' the Sun. It was not possible then, but appears to have become technological possibility, now.

Acknowledgement

I wish to place on record my debt of gratitude to my life-long friend, Wing Commander J Thomas, VM for his valuable inputs for this paper.

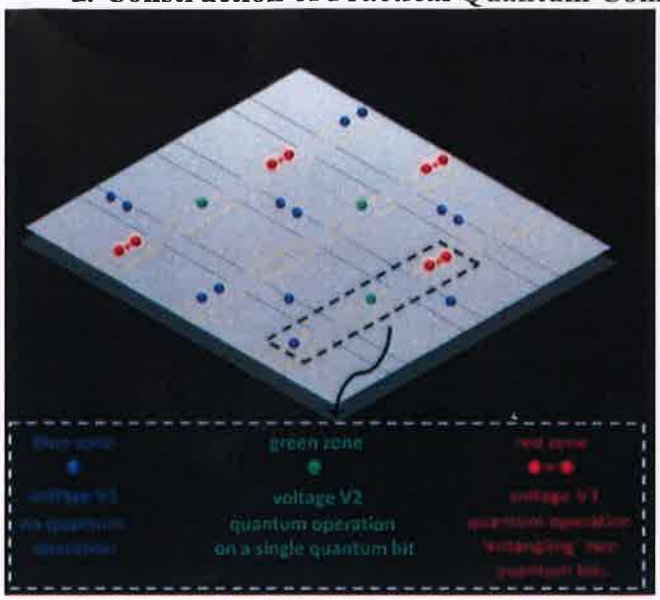
Civil Engineering

1. New Laser Scanning Test to Assess Fire-Damaged Concrete

Engineering research at The University of Nottingham, UK and Ningbo, China (UNNC) has found laser scanning is a new and viable structural safety technique to detect the damaging effects of fire on concrete. Concrete is the most extensively used construction material worldwide with an average global yearly consumption of $1m^3$ per person. Fire is one of the most serious potential risks to many concrete structures such as bridges, tunnels and buildings. While concrete is known to be a material with high fire-resistance, capable of retaining much of its load-bearing capacity; its physical, chemical and mechanical properties do undergo severe modifications when subjected to high temperatures. A significant loss in strength occurs when concrete is heated above 300°C. A structural safety assessment provides information needed to evaluate the residual bearing capacity and durability of fire-damaged concrete structures. They are also used to propose the appropriate repair methods or to decide if demolition is needed. There are several conventional on-site and off-site techniques for assessing fire-damaged concrete. Some on-site methods include visual inspections of colour change and physical features whereas off-site methods involve invasive tests such as core drilling or lab-based techniques, however all methods have their merits and drawbacks. The researchers studied the use of terrestrial laser scanning (TSL) as a non-destructive way to assess and detect fire-damaged concrete in a structural safety appraisal. They said: "Scanning can be done at a distance, which improves site safety. Scanning is also quick, with millions of points measured in a few seconds and spatial resolution acquired in short time. This is advantageous for engineering structures considering their scale or magnitude." 'A non-destructive technique for health assessment of fire-damaged concrete elements using terrestrial laser scanning' was developed by them. The study investigated the influences of scanning incidence angle and distance on the laser intensity returns. Concrete colour change was also studied. Data was collected and interpreted on unheated and heated concrete to establish the baseline condition of the material. Study experiments were carried out in a controlled laboratory and used two-phase shift terrestrial laser scanners (Leica HDS7000 and FARO Focus 120) to scan the concrete specimens before heating and then after they were cooled again. The concrete specimens were heated in a furnace to elevated temperatures of up to 1,000°C as the temperature attained is an important factor in assessing fire-damaged concrete. To assess colour change in the heated concrete, specimen images were captured using the M-Cam attached to the Leica HDS7000 laser scanner. A flatbed scanner (HP Scanjet G2410) was also used to scan heated concrete surfaces and capture images. It is these images that were used for analysis due to their better resolution. During the experiments, the measurement of the incidence angles for the concrete blocks was found to vary with distance. As the scanning distance increased, the incidence angle decreased and both scanners used showed the same trend. "The measurement of the scanning incidence angles from the various distances was found to be wavelength independent for both scanners and this is a promising factor in terms of developing standardised analysis tools for the incidence angle although several scanners need to be tested," said researchers. They said: "A comparative analysis of the laser intensity for heated and unheated concrete showed that the recorded intensity values for heated concrete are higher than those of unheated concrete. In fact, the laser intensity values of heated concrete showed a remarkable increase in the concrete exposure temperatures from 250°C to 1,000°C. "Such a correlation between the intensity and the exposure temperature is of cardinal importance in assessing the condition and extent of damage to concrete. This finding implies it could be possible to use laser intensity to detect the state of concrete whether it has been heated or not." The study has also shown that RGB data improves the visual identification of features and provides a rough idea of the concrete condition after a fire. Laser scanners have an advantage in that most of them have either an internal or external camera that can be used to capture concrete images if good resolution can be achieved. "Although the laser scanners used have different wavelengths, the results demonstrated the feasibility of using TLS as an approach to assessing levels of fire-damaged concrete and provide an understanding of the condition of concrete in relation to the strength changes of concrete when it is heated to elevated temperatures," said a researcher.

Source https://www.sciencedaily.com/releases/2016/12/161212105306.htm

2. Construction of Practical Quantum Computers Radically Simplified

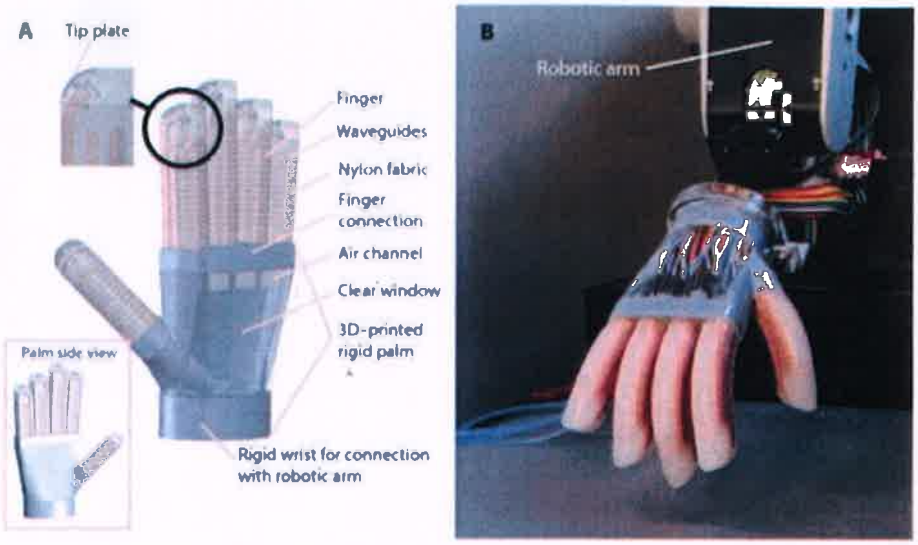


A trapped-ion quantum computer would consist of an array of X-junctions with quantum bits formed by individual ions that are trapped above the surface of the quantum chip (shown in grey). Individual quantum bits are manipulated simply by tuning voltages as easy as tuning a radio to different stations. Applying voltage V1 results in no quantum operation (blue zones), applying voltage V2 results in a quantum operation on a single quantum bit (green zones), applying voltage V3 results in a quantum operation 'entangling' two quantum bits (red zones). An arbitrary large quantum computer can be constructed based on this simple-to engineer approach.

Scientists at the University of Sussex have invented a ground-breaking new method that puts the construction of large-scale quantum computers within reach of current technology. Quantum computers could solve certain problems -- that would take the fastest supercomputer millions of years to calculate -- in just a few milliseconds. They have the potential to create new materials and medicines, as well as solve long-standing scientific and financial problems. Universal quantum computers can be built in principle -- but the technology challenges are tremendous. The engineering required to build one is considered more difficult than manned space travel to Mars -- until now. Quantum computing on a small scale using trapped ions (charged atoms) is carried out by aligning individual laser beams onto individual ions with each ion forming a quantum bit. However, a large-scale quantum computer would need billions of quantum bits, therefore requiring billions of precisely aligned lasers, one for each ion. Instead, scientists at Sussex have invented a simple method where voltages are applied to a quantum computer microchip (without having to align laser beams) -- to the same effect. Professor Winfried Hensinger and his team also succeeded in demonstrating the core building block of this new method with an impressively low error rate at their quantum computing facility at Sussex. He said: "This development is a game changer for quantum computing making it accessible for industrial and government use. We will construct a large-scale quantum computer at Sussex making full use of this exciting new technology." Quantum computers may revolutionise society in a similar way as the emergence of classical computers. A researcher in the Ion Quantum Technology Group said: "Developing this step-changing new technology has been a great adventure and it is absolutely amazing observing it actually work in the laboratory."

Source https://www.sciencedaily.com/releases/2016/12/161202103416.htm

3. New Robot Has a Human Touch

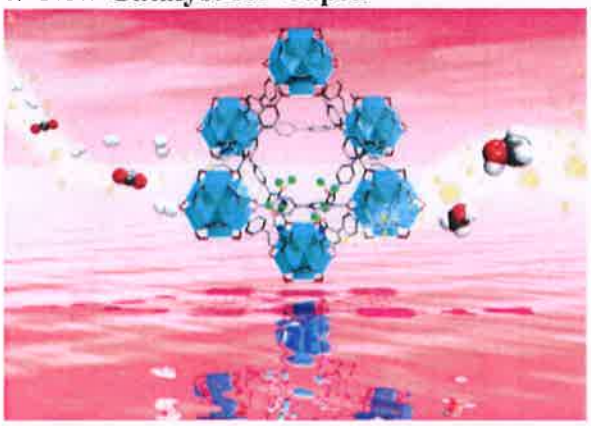


(A) Schematic of hand structure and components; (B) image of the fabricated hand mounted on a robotic arm with each finger actuated at ΔP = 100 kPa.

Most robots achieve grasping and tactile sensing through motorized means, which can be excessively bulky and rigid. A Cornell University group has devised a way for a soft robot to feel its surroundings internally, in much the same way humans do. A group led by Robert Shepherd, assistant professor of mechanical and aerospace engineering and principal investigator of Organic Robotics Lab, has published a paper describing how stretchable optical waveguides act as curvature, elongation and force sensors in a soft robotic hand. The Optoelectronically Innervated Soft Prosthetic Hand via Stretchable Optical Waveguides has been developed by them. "Most robots today have sensors on the outside of the body that detect things from the surface," a researcher said. "Our sensors are integrated within the body, so they can actually detect forces being transmitted through the thickness of the robot, a lot like we and all organisms do when we feel pain, for example." Optical waveguides have been in use since the early 1970s for numerous sensing functions, including tactile, position and acoustic. Fabrication was originally a complicated process, but the advent over the last 20 years of soft lithography and 3-D printing has led to development of elastomeric sensors that are easily produced and incorporated into a soft robotic application. Shepherd's group employed a four-step soft lithography process to produce the core (through which light propagates), and the cladding (outer surface of the waveguide), which also houses the LED (light-emitting diode) and the photodiode. The more the prosthetic hand deforms, the more light is lost through the core. That variable loss of light, as detected by the photodiode, is what allows the prosthesis to "sense" its surroundings. "If no light was lost when we bend the prosthesis, we wouldn't get any information about the state of the sensor," Shepherd said. "The amount of loss is dependent on how it's bent." The group used its optoelectronic prosthesis to perform a variety of tasks, including grasping and probing for both shape and texture. Most notably, the hand was able to scan three tomatoes and determine, by softness, which was the ripest.

Source https://www.sciencedaily.com/releases/2016/12/161212134605.htm

4. New Catalyst for Capture and Conversion of Atmospheric Carbon Dioxide



This is an artist's conception of a catalyst (light blue and gray framework) capable of capturing CO_2 (red and gray molecules on left side) and, along with hydrogen (white molecules) converting it to methanol (red, gray and white molecules on the right).

Research at the University of Pittsburgh's Swanson School of Engineering focused on developing a new catalyst that would lead to large-scale implementation of capture and conversion of carbon dioxide (CO_2). Principal investigator is Karl Johnson, the William Kepler Whiteford Professor in the Swanson School's Department of Chemical & Petroleum Engineering. The work on Catalytic Hydrogenation of CO_2 to Methanol in a Lewis Pair Functionalized MOF builds upon previous research that identified the two main factors for determining the optimal catalyst for turning atmospheric CO_2 into liquid fuel. The research was conducted using computational resources at the University's Center for Simulation and Modeling. "Capture and conversion of CO_2 to methanol has the potential to solve two problems at once - reducing net carbon dioxide emissions while generating cleaner fuels," Dr. Johnson explained. "Currently, however, it is a complex and expensive process that is not economically feasible. Because of this, we wanted to simplify the catalytic process as much as possible to create a sustainable and cost-effective method for converting CO_2 to fuel - essentially to reduce the number of steps involved from several to one." Johnson and his team focused on computationally designing a catalyst capable of producing methanol from CO_2 and H_2 utilizing metal organic frameworks (MOFs), which potentially provide pathway for a single-process unit for carbon capture and conversion. The MOFs could dramatically reduce the cost of carbon capture and conversion, bringing the potential of CO_2 as a viable feedstock for fuels closer to reality. "Methanol synthesis has been extensively studied because methanol can work in existing systems such as engines and fuel cells, and can be easily transported and stored. Methanol is also a starting point for producing many other useful chemicals," Dr. Johnson said. "This new MOF catalyst could provide the key to close the carbon loop and generate fuel from CO_2, analogously to how a plant converts carbon dioxide to hydrocarbons."

Source https://www.sciencedaily.com/releases/2016/12/161207124105.htm

5. Capturing the Energy of Slow Motion

Low-frequency mechanical energy harvesting could provide as much as 40 percent of the power requirements for next generation smartphones and tablets.

A new concept in energy harvesting could capture energy that is currently mostly wasted due to its characteristic low frequency and use it to power next-generation electronic devices. In a project funded by electronics giant Samsung, a team of Penn State materials scientists and electrical engineers has designed a mechanical energy transducer based on flexible organic ionic diodes that points toward a new direction in scalable energy harvesting of unused mechanical energy in the environment, including wind, ocean waves and human motion. Devices to harvest ambient mechanical energy to convert to electricity are widely used to power wearable electronics, biomedical devices and the so-called Internet of Things (IoT) -- everyday objects that wirelessly connect to the internet. The most common of these devices, based on the piezoelectric effect, operate most efficiently at high frequency, greater than 10 vibrations per second. But at lower frequencies their performance falls off dramatically. "Our concept is to specifically design a way to turn low-frequency motion, such as human movement or ocean waves, into electricity," said Qing Wang, professor of materials science and engineering, Penn State. "That's why we came up with this organic polymer p-n junction device." Called an ionic diode, their device is composed of two nanocomposite electrodes with oppositely charged mobile ions separated by a polycarbonate membrane. The electrodes are a polymeric matrix filled with carbon nanotubes and infused with ionic liquids. The nanotubes enhance the conductivity and mechanical strength of the electrodes. When a mechanical force is applied, the ions diffuse across the membrane, creating a continuous direct current. At the same time, a built-in potential that opposes ion diffusion is established until equilibrium is reached. The complete cycle operates at a frequency of one-tenth Hertz, or once every 10 seconds. For smart phones, the mechanical energy involved in touching the screen could be converted into electricity that can be stored in the battery. Other human motion could provide the energy to power a tablet or wearable device. "Because the device is a polymer, it is both flexible and lightweight," Wang said. "When incorporated into a next-generation smart phone, we hope to provide 40 percent of the energy required of the battery. With less demand on the battery, the safety issue should be resolved." "The peak power density of our device is in general larger than or comparable to those of piezoelectric generators operated at their most efficient frequencies" said researchers. They focused on device integration and performance. "Right now, at low frequencies, no other device can outperform this one. That's why I think this concept is exciting," Wang said.

Source https://www.sciencedaily.com/releases/2016/12/161215105505.htm

6. Super-Flexible Liquid Crystal Device for Bendable and Rollable Displays

Wearable information terminals (left) and large rollable-screen TV (right) are made using super-flexible LC technology covering large areas, with high-resolution at low-cost.

Researchers at Tohoku University have developed a super flexible liquid crystal (LC) device, in which two ultra-thin plastic substrates are firmly bonded by polymer wall spacers. The team, led by Professor Hideo Fujikake of the School of Engineering, hopes the new organic materials will help make electronic displays and devices more flexible, increasing their portability and all round versatility. New usage concepts with flexibility and high quality display could offer endless possibilities in near-future information services. Previous attempts to create a flexible display using an organic light-emitting diode (OLED) device with a thin plastic substrate were said to be promising, but unstable. The plastic substrates are poor gas-barriers for oxygen and water vapour, and the OLED materials can seriously be damaged by their gasses. As for flexible OLEDs, there has also been no device fabrication technology established so far for large-area, high-resolution and low-cost displays. To overcome these challenges, Fujikake's research team decided to try making existing LC displays flexible by replacing the conventional thick glass substrates, which are both rigid and heavy, with the plastic substrates, because LC materials do not deteriorate even for poor gas barrier of flexible substrates. Flexible LC displays have many advantages, such as established production methods for large-area displays. The material itself, which is inexpensive, can be mass produced and shows little quality degradation over time. However, in conventional flexible LC displays, one important problem remains. The gap of plastic substrates (100 μm thick) sandwiching an LC layer becomes non-uniformed when the LC device is bent, causing the display image to be distorted. In their study, Fujikake's team developed a super-flexible LC device by bonding two ultra-thin transparent polyimide substrates (10 μm thick approximately) together, using robust polymer wall spacers. The ultra-thin transparent substrate is made using the coating and debonding processes of a polyimide solution supplied by Mitsui Chemicals. The result is a flexible sheet, similar to food-wrapping cling film. The substrate has the attractive features of heat resistance, and the ability to form fine pixel structures, including transparent electrodes and colour filters. The refractive index anisotropy is extremely small, making wide viewing angles and high contrast ratio possible. The polymer wall spacers bonding substrates are formed by irradiating a twisted-alignment LC layer including monomer component with patterned ultra-violet light through single thin substrate. While the substrate gap is more variable as the substrate thickness is decreased, the stabilization of ultra-thin substrates becomes possible by small pitch polymer walls. The research team also demonstrated that the device uniformity is kept without breaking spacers even after a roll-up test to a curvature radius of 3mm for rollable and foldable applications. The above research results show that LC displays with large-area, high-resolution and excellent stability can be as flexible as OLED displays. The super-flexible LC technology is applicable to mobile information terminals, wearable devices, in-vehicle displays and large digital signage. Moving forward, the team plans to form image pixels and soften the peripheral components of polarizing films, and a thin light-guide sheet for backlight.

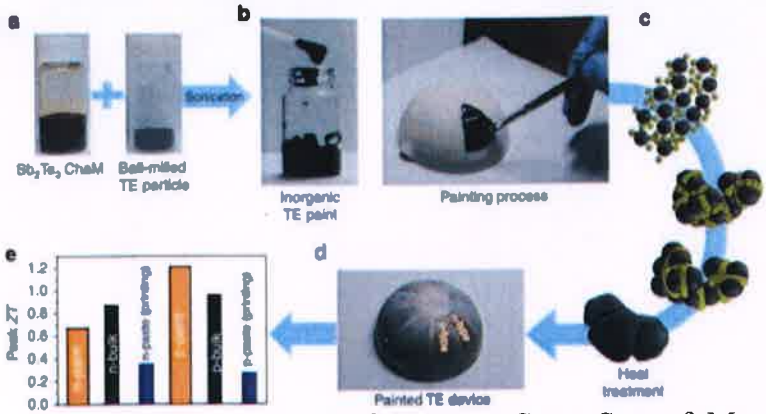
Source https://www.sciencedaily.com/releases/2016/12/161209111928.htm

7. India Puts Remote Sensing Satellite RESOURCESAT-2A into Orbit

India on Dec 7, 2016 morning successfully put into orbit its own earth observation satellite Resourcesat-2A in a text book style. "Today we had a successful launch of RESOURCESAT-2A to provide three tier imaging data. The satellites solar panels were deployed. The launch was perfect," A S Kiran Kumar, Chairman, Indian Space Research Organisation (ISRO), said soon after the launch. Mr Kumar said that for the first time a camera was put on the rocket, and as a result the launch of the satellite and the deployment of solar panels were seen. Around 10.25 a.m. the PSLV-XL variant rocket standing 44.4 metres tall and weighing 321 ton tore into the morning skies with fierce orange flames at its tail. Gathering speed every second, the rocket raced towards the heavens amidst the cheers of the ISRO officials and the media team assembled at the port in Sriharikota. At the rocket mission control room, Indian space scientists at ISRO were glued to their computer screens watching the rocket escaping the Earth's gravitational pull. Around 18 minutes into the flight, the rocket slung the 1,235 kg Resourcesat-2A into an 817 km polar sun synchronous orbit. The PSLV rocket is a four stage/engine rocket powered by solid and liquid fuel alternatively. According to ISRO, Resourcesat-2A is a follow on mission to Resourcesat-1 and Resourcesat-2, launched in 2003 and 2011 respectively. The new satellite Resourcesat-2A is intended to continue the remote sensing data services to global users provided by it two predecessors. The RESOURCESAT-2A carries three payloads which are similar to those of the earlier two Resourcesat's. They are a high resolution Linear Imaging Self Scanner (LISS-4) camera operating in three spectral bands in the Visible and Near Infrared Region (VNIR) with 5.8 m spatial resolution and steerable up to 26 degree across track to achieve a five day revisit capability. The second payload is the medium resolution LISS-3 camera operating in three-spectral bands in VNIR and one in Short Wave Infrared (SWIR) band with 23.5 m spatial resolution. The third payload is a coarse resolution Advanced Wide Field Sensor (AWiFS) camera operating in three spectral bands in VNIR and one band in SWIR with 56 m spatial resolution. The satellite also carries two Solid State Recorders with a capacity of 200 Giga Bits each to store the images taken by its cameras which can be read out later to ground stations. The mission life of Resourcesat-2A is five years.

Source http://www.ndtv.com/india-news/indias-pslv-rocket-with-resourcesat-2a-lifts-off-1634941

8. Thermoelectric Material Made in Paintable Liquid Form

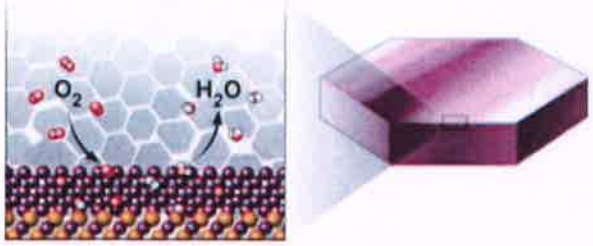


Schematics illustrate the fabrication of painted thermoelectric devices.

A new study, led by Professor Jae Sung Son of Materials Science and Engineering at UNIST has succeeded in developing a new technique that can be used to turn industrial waste heat into electricity for vehicles and other applications. In their study, the team presented a new type of high-performance thermoelectric (TE) materials that possess liquid-like properties. These newly developed materials are both shape-engineerable and geometrically compatible in that they can be directly brush-painted on almost any surface. Scientists hope that their findings will pave the way to designing materials and devices that can be easily transferred to other applications. The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice versa. This effect can be used either for heating or for cooling, such as in small cooling systems, automotive cooling systems, as well as waste heat recovery system for ships. In addition, the thermoelectric generator modules used in these devices are configured as rectangular parallelepipeds. The output power of thermoelectric generators depends on device engineering minimizing heat loss, as well as inherent material properties. According to the research team, the currently existing liquid-like TE materials have been largely neglected due to the limited flat or angular shape of devices. However, considering that the surface of most heat sources where these planar devices are attached is curved, a considerable amount of heat loss is inevitable. To address this issue, the research team presented the shape-engineerable thermoelectric painting technique where they directly brush TE paints onto the surface of heat sources to produce electricity. Using this technique, one can now easily achieve electricity via the application of TE paints on the exterior surfaces of buildings, roofs, and cars. Scientists hope that their findings will pave the way to designing materials and devices that can be easily transferred to other applications. To show the feasibility of the currently proposed technology, they also fabricated TE generators through painting TE paints on flat, curved and large-sized hemispherical substrates, demonstrating that it is the most effective means of heat energy collection from any heat sources with exceedingly high output power density of 4.0/mW/cm^2, which is the best value among the reported printed TE generators. "By developing integral thermoelectric modules through painting process, we have overcome limitations of flat thermoelectric modules and are able to collect heat energy more efficiently." said Professor Son. "Thermoelectric generation systems can be developed as whatever types user want and cost from manufacturing systems can also be greatly reduced by conserving materials and simplifying processes.." "Our thermoelectric material can be applied any heat source regardless of its shape, type and size." said Professor Son. "It will place itself as a new type of new and renewable energy generating system."

Source https://www.sciencedaily.com/releases/2016/12/161208125916.htm

9. Scientists Boost Catalytic Activity for Key Chemical Reaction in Fuel Cells



Schematic diagram of the oxygen reduction reaction (reduction of O2 into H2O) on the Pt(110) surface of the PtPb/Pt nanoplates, with purple representing Pt atoms and orange representing Pb atoms.

Fuel cells are a promising technology for clean and efficient electrical power generation, but their cost, activity, and durability are key challenges to commercialization. Today's fuel cells use expensive platinum (Pt)-based nanoparticles as catalysts to accelerate the reactions involved in converting the chemical energy from renewable fuels -- such as hydrogen, methanol, and ethanol -- into electrical energy. Catalysts that incorporate less expensive metals inside the nanoparticles can help reduce cost and improve activity and durability, but further improvements to these catalysts are required before these fuel cells can be used in vehicles, generators, and other applications. Now, scientists from the U.S. Department of Energy's (DOE) Brookhaven National Laboratory, California State University-Northridge, Soochow University, Peking University, and Shanghai Institute of Applied Physics have developed catalysts that can undergo 50,000 voltage cycles with a negligible decay in their catalytic activity and no apparent changes in their structure or elemental composition. The catalysts are "nanoplates" that contain an atomically ordered Pt and lead (Pb) core surrounded by a thick uniform shell of four Pt layers. To date, the most successful catalysts for boosting the activity of the oxygen reduction reaction (ORR) -- a very slow reaction that significantly limits fuel cell efficiency -- have been of the Pt-based core-shell structure. However, these catalysts typically have a thin and incomplete shell (owing to their difficult synthesis), which over time allows the acid from the fuel cell environment to leach into the core and react with the other metals inside, resulting in poor long-term stability and a short catalyst lifetime. Scientists have focused their research on the compressively strained Pt(111) surfaces, in which Pt atoms are squeezed across the surface, because the oxygen binding energy is optimized. In general, scientists thought that tensile strain on the same surface plane would result in overly strong binding of oxygen and thus hinder the ORR reaction. But the researchers showed that introducing a large tensile strain along one direction of a different surface plane, Pt(110), could also improve ORR catalytic activity. They added Pb to the core of the Pt shell, causing the Pt atoms to stretch across the surface. After the research group from Soochow University, synthesized the nanoplates, characterized their structure and elemental composition at the CFN. Using electron diffraction patterns and images from high-resolution scanning transmission electron microscopy (STEM), both of which reveal the relative positions of atoms, he confirmed the core-shell structure and the composition and sequence of the atoms. To verify that the core contained Pt and Pb and that the shell contained Pt, he measured the change in energy of the electrons after they interacted with the nanoplates -- a technique called electron energy-loss spectroscopy. With this information, the team distinguished how the nanoplates formed with the individual Pt and Pb atoms. To their surprise, the surface planes were not Pt(111) but Pt(110), and these Pt(110) planes were under biaxial strain -- compressive strain in one direction and tensile strain in the other -- originating from the PtPb core. In durability tests simulating fuel cell voltage cycling, the collaborators found that after 50,000 cycles there was almost no change in the amount of generated electrical current. In other words, the nanoplates had minimal decay in catalytic activity. After this many cycles, most catalysts exhibit some activity loss, with some losing more than half of their original activity. Microscopy and synchrotron characterization techniques revealed that the structure and elemental composition of the nanoplates did not change following durability testing. Compared to commercial Pt-on-carbon (Pt/C) catalysts, the team's PtPb/Pt nanoplates have one of the highest ORR activities to date, taking the amount of Pt used into account, and excellent durability. The team's nanoplates also showed high electrocatalytic activity and stability in oxidation reactions of methanol and ethanol. Eventually, the laboratory-level electrocatalysts will need to be tested in a larger fuel cell system, where real-world variables -- such as pollutants that could impact surface reactivity -- can be introduced.

Source https://www.sciencedaily.com/releases/2016/12/161216115518.htm

10. New Invention to Inspire New Night-Vision Specs

Scientists at The Australian National University (ANU) have designed a nano crystal around 500 times smaller than a human hair that turns darkness into visible light and can be used to create light-weight night-vision glasses. Professor Dragomir Neshev from ANU said the new night-vision glasses could replace the cumbersome and bulky night-vision binoculars currently in use. "The nano crystals are so small they could be fitted as an ultra-thin film to normal eye glasses to enable night vision," said Professor Neshev from the Nonlinear Physics Centre within the ANU Research School of Physics and Engineering. "This tiny device could have other exciting uses including in anti-counterfeit devices in bank notes, imaging cells for medical applications and holograms." Co-researchers said the ANU team's achievement was a big milestone in the field of nanophotonics, which involves the study of behaviour of light and interaction of objects with light at the nano-scale. "These semi-conductor nano-crystals can transfer the highest intensity of light and engineer complex light beams that could be used with a laser to project a holographic image in modern displays," said Dr Rahmani, a recipient of the Australian Research Council (ARC) Discovery Early Career Researcher Award based at the ANU Research School of Physics and Engineering. The team built the device on glass so that light can pass through, which was critical for optical displays. "This is the first time anyone has been able to achieve this feat, because growing a nano semi-conductor on a transparent material is very difficult," said a reseacher from the Nonlinear Physics Centre at ANU.

Source https://www.sciencedaily.com/releases/2016/12/161207093027.htm

Engineering Innovation in India

Dr APJ Abdul Kalam IGNITE 2016 Award

The winners of the Dr APJ Abdul Kalam IGNITE 2016 Competition, received their awards from President, Shri Pranab Mukherjee in New Delhi on Nov 7, 2016. Speaking on the occasion, the Union Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardhan, congratulated all the winners and said he was really amazed by the range of creativity expressed by these young minds. Addressing the young winners, Dr. Harsh Vardhan, said that they have a duty not to adapt to the problems our society is facing but transcend them and to help India become a creative, compassionate and collaborative society. Given the various challenges the country faces and may face in this 21st century, "we will need an army of young people like you who would help the Government and society by identifying and addressing problems faced in day to day life and also likely to be faced in the long term. I am sure you all will live up to our collective expectations".

Dr. APJ Abdul Kalam IGNITE 2016 competition –is a national competition of original technological ideas and innovations by children up to class 12 or those out of school up to the age of 17 years -it is organized by National Innovation Foundation (NIF) every year to promote creativity and originality among children. The awards of IGNITE competition are announced every year on October 15th, Dr APJ Abdul Kalam's birthday, which is celebrated as the Children's Creativity and Innovation Day by NIF. Starting in 2008, in the last eight years, 173 awards have been given to 246 children. This year, a total of 31 students have been awarded for their ideas/innovations. An exhibition showcasing award winning ideas was put up at the venue. NIF will file patents in all applicable cases in the name of the students and will also engage designers/fabricators to develop prototypes of the students' ideas. NIF, an autonomous body of the Department of Science and Technology, Government of India, has been actively engaged in promoting creativity and innovation in our society with active support of Honey Bee Network.

Brief details of two award winning innovations are given below

- **Emergency light in two-wheelers**

The siblings, Pranav and Gayatri, believe that even a small step in the right direction can make a huge difference. They had often heard stories of road accidents, involving two-wheelers. Their mother would worry every time they had to travel by a two-wheeler with their father. In most cases of such mishaps, the two-wheeler rider is knocked down and run over by other passing vehicles. They observed that the major cause for such accidents is the fact that approaching vehicles are unaware of the mishap that has already occurred. This could be due to speed, bad weather or lack of adequate light. Pranav and Gayatri have come up with the idea of installing a system with an emergency light or siren on the two-wheeler. It would get activated upon accident and alert approaching vehicles about the same. The system can be connected to impact sensors which will activate the hazard lights even if the engine shuts down, thus preventing the accident.

- **Real-time data transmission system in electronic voting machines**

Roshan overheard his teachers discussing how voting numbers in many areas are rigged. He thought of a button in the EVMs which can transmit the total number of votes directly to the cloud server as the voting proceeds and also to district Election Commission office if required at regular interval. A software can be developed for this which will prevent any untoward happening during/after voting. The rate of voting will be recorded per minute any undue activity will alert the monitoring agencies.

Source http://pib.nic.in/newsite/PrintRelease.aspx?relid=153357