# Indo-US Science and Technology Forum

IUSSTF

## Annual Report

2015-2016

*An autonomous organization jointly established by the Department of Science & Technology, Government of India and the US Department of State.*

# INDO-US SCIENCE AND TECHNOLOGY FORUM

*Catalyzing Indo-US Science, Technology and Innovation Collaborations for over 15 years!*

IUSSTF

# Annual Report

2015-2016

The Indo-US Science and Technology Forum (IUSSTF) established under an agreement between the Governments of India and the United States of America in March 2000, is an autonomous, bilateral organization jointly funded by both the Governments that promotes science, technology, engineering and biomedical research and innovation through substantive interaction among government, academia and industry. The Department of Science & Technology, Government of India and the US Department of State are the respective nodal departments.

IUSSTF
Indo-US Science and Technology Forum

# Contents

It is with great pleasure that I present the Annual Report of bi-national Indo-US Science & Technology Forum (IUSSTF) for the Indian fiscal year 2015-16 to all the stakeholders and partners. Though I formally joined IUSSTF only towards the later part of the year, my association with IUSSTF as an active partner in several of its activities goes back in time. I look forward to my role in shaping up the future of this important institution with a lot of excitement and pride.

Creation of IUSSTF was indeed a landmark occasion wherein the two largest democracies of the world decided to forge a formal alliance to promote S&T cooperation between the scientific communities of both countries. Conceptualized as a single window entity to facilitate the process and channelize all S&T collaborative initiatives between the two sides, IUSSTF's role was envisioned as catalytic in nature to connect the S&T ecosystems in both the countries, leverage intellectual resources and achieve synergies to realize challenging goals within the overall S&T landscape.

IUSSTF recently completed sixteenth year of its existence and it has been a wonderful journey so far. As it has evolved as an institution, IUSSTF has taken on board a large number and a wide variety of stakeholders, partners and beneficiaries. The journey, which started with a very limited number of programs, more in a symbolic manner to reflect the spirit of cooperation, has now fully blossomed into a broad based portfolio of several networking events, visitation programs, strategic initiatives, innovation and entrepreneurial pursuits and public-private partnerships in diverse areas of Science, Technology & Innovation.

The year covered by this report can be seen as another important landmark in the history of IUSSTF. Our flagship programs continue to do exceedingly well and are immensely popular amongst the scientific communities on both sides. The India Innovation Growth Program (IIGP) connects Indian innovators to the US Innovation eco-system. Like in the past, this year also a delegation of such innovators was taken to University of Texas at Austin and Silicon Valley. IUSSTF continues to promote engagements of Women in Science, Innovation and Entrepreneurial space, jointly with its partner institutions.

The first phase of strategic program – the Indo-US Joint Clean Energy R&D Center (JCERDC), is in advanced stages of implementation. The program has been able to achieve its envisioned objectives of creating a research base and capacity building in its core identified areas of Solar Energy, Building Energy Efficiency and Second Generation Biofuels. The outcomes of the first phase will be useful in defining the contours of the follow-up phase, for which the dialogue is on between Indian and US stakeholders.

From the Executive Director's Desk

The Grand Challenge Initiative on Affordable Blood Pressure Measurement Technologies has now reached a stage of consolidation with a good number of projects generated on both sides. The next phase of the program will focus on generating new approaches for overall integration and collaborative projects. We expect to raise the level of engagement as this partnership matures to a higher degree.

Partnership for International Research and Education (PIRE) is a flagship international program of NSF, to which India is formally a partner along with several other countries. The first formal award was made under PIRE, after the successful conclusion of the 2014 call for proposals. The next call is due in May/ June 2016 and we expect to raise the level of Indian participation in this call.

In addition to several ongoing visitation programs under different categories, four new visitation programs were initiated during the year. These are:

- SERB - Indo-US Postdoctoral Fellowship for Indian Researchers in USA.
- Water Advanced Research and Innovation (WARI) Fellowship.
- Bio-energy – Awards for Cutting Edge Research (B-ACER).
- Building Energy Efficiency Higher & Advanced Network (BHAWAN) Fellowships.

The PACEsetter Fund has been established jointly by the Indian and US Governments to accelerate the commercialization of innovative Off-Grid Clean Energy access solutions by providing early stage grant funding. IUSSTF is partnering with the US & Indian Federal agencies to administer the Fund. The awards are likely to be announced shortly against the first call.

For the last few years, IUSSTF is also functioning as the Secretariat for United States-India Science & Technology Endowment Fund (USISTEF) to administer a unique Grant-in-Aid support program for "Start-ups" to facilitate translation of S&T innovation driven ripe ideas into viable market opportunities. A good number of projects have been supported under this program. Outcomes of some of the projects have already hit the market. The very nature of projects supported under the program testify the societal impact and better quality of life for people, in addition to economic value addition and job creation through entrepreneurial pursuits. The entire cycle of due-diligence for "Sixth Call" projects under USISTEF program was concluded with the identification of three awardees this year. Several projects supported in early days of the program are approaching conclusion next year and corresponding products reaching the market space will further enhance the visibility and impact of this program.

As I mentioned earlier, it has been a wonderful journey so far. My predecessors have done a great job in scaling up the level of engagement over the last one and a half decades and taking the Forum to where it stands today. Sixteen years is a reasonably long journey as well for any institution to stand the test of time and relevance. While incremental value addition is a continuous and ongoing process, institutions need to thoroughly reinvent and rediscover themselves periodically and reestablish their relevance and efficacy. This calls for a 360 degree review and corresponding repositioning to align oneself with the dynamic needs of the real life order. IUSSTF is also entering that zone where it ought to raise the levels of aspiration with a renewed sense of purpose and not only explore new things to do, but also new ways of doing things. Our past legacy is a good launching pad to embark upon this bold and adventurous journey and I am sure that together we can make things happen. I am thankful to all our stakeholders and partners for their unstinted support in the past even as I look forward to their continued patronage in realizing our dreams.

**Rajiv Kumar Tayal**
Executive Director, IUSSTF

## History of Indo-US S&T Cooperation

**1950s**

- Green revolution facilitated with the US PL 480 Rupee Funds
- Establishment of Land Grant Colleges

**1960s**

- Establishment of IIT, Kanpur
- Establishment of NCERT, New Delhi
- Nuclear Cooperation Agreement
- Tarapur Power Plant

**1970s**

- NASA-ISRO–SITE (Satellite Instructional Television Experiment)
- Indo-US S&T Subcommission

**1980s**

- STI (Science & Technology Initiative)
- USIF (US-India Fund)

**1990s**

- Indo-US Fellowships Program
- ICAR MoU
- Indo-US Vaccine Action Program
- DST-NSF Program
- NASA/NOAA-ISRO/DST MoU
- DBT/ICMR-NIH/CDC Health & Medical Sciences Program

**2000s**

- Indo-US Science & Technology Forum
- Indo-US Science & Technology Agreement
  - Indo-US Binational S&T Commission
- High Technology Cooperation Group (HTCG)
- Indo-US Strategic Partnership
  - ❖ Information & Communication Technology
  - ❖ Knowledge Initiative in Agriculture
  - ❖ Space Cooperation
  - ❖ Energy
  - ❖ Safety & Security
  - ❖ Health Sciences
- Indo-US S&T Agreement / Joint S&T Commission
- NASA-ISRO Agreement / MOES-NOAA Agreement
- Indo-US Nuclear Agreement
- MoU on Energy Security, Energy Efficiency & Clean Energy and Climate Change
- US-India Science and Technology Endowment Fund
- Indo-US Joint Clean Energy Research & Development Centre
- India-US Grand Challenge: Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the US
- PACEsetter Fund



## Objectives of IUSSTF

*Catalyst to facilitate, seed and promote US-India bilateral collaboration in science, technology, engineering and biomedical research through substantive interaction among academia, R&D laboratories, industry and government.*

- ❖ Support exciting and enabling science and technology program portfolio that paves way for sustainable interactions and potential collaborations through networking.
- ❖ Promote and strengthen strategic partnerships in science and technology under various intergovernmental initiatives.
- ❖ Create awareness through exchange and dissemination of information and opportunities towards promoting bilateral scientific and technological cooperation.
- ❖ Encourage public-private partnership and technopreneurship to foster elements of innovation and enterprise through knowledge networking between academia and industry.
- ❖ Capitalize on the scientific and technological synergy on issues of common interest leading to long-term partnership based on shared values.
- ❖ Explore new frontiers by nurturing contacts between young and mid-career scientists to develop mutual trust, leadership and fraternity in research and development.

# Structure of IUSSTF

## Management

IUSSTF functions as an

- Autonomous,
- Bilateral,
- Nongovernmental,
- Not-for-profit society.

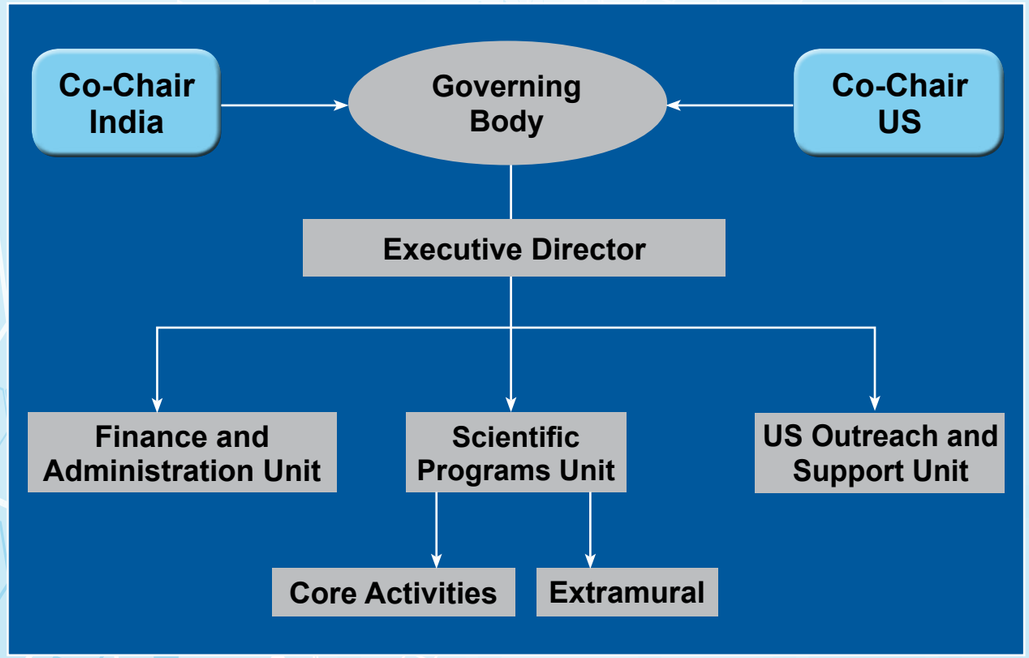
To ensure that the activities undertaken by IUSSTF conform to the highest standards of excellence, a joint Governing Body consisting of seven Indian and seven American eminent scientists provide leadership to IUSSTF.

The Executive Director manages the IUSSTF affairs from its headquarters at Fulbright House in New Delhi.

## Funding

Annual interest earning from the endowment created by the US Government with matching contribution from the Government of India through the Department of Science and Technology provides regular funds to administer the IUSSTF programs.

IUSSTF also has the freedom to receive grants, gifts, donations or other contributions from industries, foundations and private benefactors. Contributions to IUSSTF are tax-exempted under Section 80G of the Indian IT Act. Toward furtherance of its objectives, IUSSTF welcomes fund contributions both in India and USA.






# Composition of the Governing Body

## Indian Co-Chair

**Ashutosh Sharma**
Secretary, Department of Science & Technology,
Government of India

## US Co-Chair

**Jonathan Margolis**
Deputy Assistant Secretary for Science, Space and Health, Bureau of Oceans and International Environmental and Scientific Affairs, US Department of State

## Indian Members

**T.S. Rao**
Sr. Adviser
Department of Biotechnology
Government of India

**J.B. Mohapatra**
Joint Secretary and Financial Advisor
Department of Science and Technology
Government of India

**Amitava Bandopadhyay**
Chief Scientist & Head
International Directorate
Council of Scientific and Industrial Research

**Indranil Manna**
Director, Indian Institute of Technology
Kanpur

**Ambuj D. Sagar**
Professor of Policy Studies
Dean
Alumni Affairs & International Programs
Indian Institute of Technology, Delhi

**Vijay Chandru**
Chairman & CEO
Strand Life Sciences

## US Members

**Roderic Pettigrew**
Director
National Institute of Biomedical Imaging and BioEngineering, NIH

**Phyllis G. Yoshida**
Deputy Assistant Secretary
US Department of Energy

**Mark Coles**
Expert
Division of Physics
National Science Foundation

**Leo M. Chalupa**
Vice President for Research
George Washington University
Washington D.C

**Norman P. Neureiter**
Member and Public Welfare Medalist
National Academy of Sciences

**Ray O. Johnson**
Senior Vice President and
Chief Technology Officer
Lockheed Martin Corporation

# Strategic
# PROGRAMS

*Indo-US Joint Clean Energy*
*Research and Development Center*

# Indo-US Joint Clean Energy Research and Development Center

## Contact Persons

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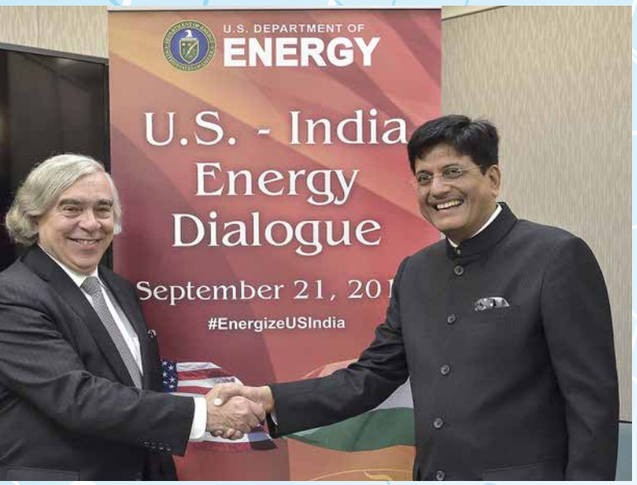
Recognizing the need to address climate change, ensure mutual energy security, and build a clean energy economy that drives investment, job creation, and economic growth; India and the United States launched the US-India Partnership to Advance Clean Energy (PACE) on November 24, 2009 under the US-India Memorandum of Understanding to enhance cooperation on Energy Security, Energy Efficiency, Clean Energy and Climate Change. As a priority initiative under the PACE umbrella, the US Department of Energy (DOE) and the Government of India signed an agreement to establish the **Joint Clean Energy Research and Development Center (JCERDC)** on November 4, 2010. The JCERDC is designed to promote clean energy innovation by teams of scientists and engineers from India and the United States.

The overall aim of the JCERDC is to facilitate joint research and development on clean energy to improve energy access and promote low-carbon growth. To achieve this objective, the Indo-US JCERDC supports multi-institutional network projects using a public-private partnership




model of funding. The priority areas of the JCERDC are Solar Energy, Second-generation Biofuels and Building Energy Efficiency.

According to the Joint Statement issued on January 25th 2015 - ***"Shared Effort; Progress for All"***; Prime Minister Modi and President Obama emphasized the critical importance of expanding clean energy research, development, manufacturing and deployment, which increases energy access and reduces greenhouse gas emissions. The leaders announced actions to advance India's transition to a low carbon economy. India intends to increase the share of use of renewables in electricity generation consistent with its intended goal to increase India's solar target to 100 gigawatts by 2022.

The Joint Statement clearly builds upon the success of the JCERDC by taking its activities and progress to the next level.

The **US - India Energy Dialogue** was held on September 21, 2015 at the US Department of Energy. The Indian delegation was led by Mr. Piyush Goyal, Minister of State (IC) for Power, Coal, New and Renewable Energy and the US side was led by Dr. Ernest Moniz, the US Secretary of Energy. The Dialogue reviewed the progress made by the six Working Groups and identified new areas for cooperation. They also reviewed various energy related issues agreed in the India – US Joint Statement during President Obama's visit to India in January 2015. During the Dialogue, presentations were made by the three JCERDC consortia. Both sides agreed that substantial headway has been made for the development of new technologies for distributed power generation through solar thermal route and for the development of new tools for improved building energy efficiency codes. It was also agreed to enhance cooperation on clean energy and climate change, by launching a new track on smart grid and grid storage as part of the PACE-R program.

The JCERDC is funded by the **Indian Ministry of Science and Technology** and the **US Department of Energy**. The program is being administered in India by the **Indo-US Science and Technology Forum (IUSSTF)**. On the basis of a rigorous binational review and evaluation process, three consortia were selected for award. The awards were announced in April






2012. In February 2016, Project Monitoring Committee (PMC) review meetings were held for all three consortia to monitor their progress in conformity with the outputs, milestones, targets and objectives of the Project. The PMC for each consortium comprises of eminent experts from the relevant field and members of the Government of India and IUSSTF.

### JCERDC in Numbers

- 2 Continents
- 2 Nations
- 3 Research areas
- 65 Research tasks
- ~316 Researchers

A brief summary on the progress thus far of the projects awarded in the space of Solar Energy, Building Energy Efficiency and Second-Generation Biofuels are as follows:

## SOLAR ENERGY

The ***Solar Energy Research Institute for India and the United States (SERIIUS)*** is co-led by the Indian Institute of Science (IISc)-Bangalore and the National Renewable Energy Laboratory (NREL)-Golden.

SERIIUS carries out fundamental and applied research, analysis and assessment, outreach, and workforce development through specific bi-national projects in three Research Thrusts - Sustainable Photovoltaics (PV), Multiscale Concentrated Solar Power (CSP), and Solar Energy Integration (SEI). The vision is to ready these solar electricity technologies toward the long-term success of India's Jawaharlal Nehru National Solar Energy Mission and the US Department of Energy (DOE) SunShot Initiative.

The achievements of the project thus far include:

### Sustainable Photovoltaics (PV)

- An 8.0 % Copper Zinc Tin Sulfide (CZTS) solar cell on flexible Corning Willow® glass has been achieved; Phase pure CZTS was obtained on FTO and Mo coated glass substrates; 8.0% (7% average) Copper Indium Gallium (di) Selenide (CIGS) nanoparticle based solar cell has been fabricated on flexible Corning Willow® Glass.

| Partnering Institutions, India | Partnering Institutions, USA |
|---|---|
| **Lead Institution:**<br>Indian Institute of Science, Bangalore | **Lead Institution:**<br>National Renewable Energy Laboratory |
| **Other Academia Partners**:<br>• Indian Institute of Technology, Bombay<br>• Indian Association for the Cultivation of Science, Kolkata<br>• International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI), Hyderabad<br>• National Institute of Solar Energy (NISE), Gurgaon<br>• Indian Institute of Technology, Madras<br>• Center for Study of Science, Technology and Policy (CSTEP), Bangalore | **Other Academia Partners:**<br>• Lawrence Berkeley National Laboratory<br>• Arizona State University<br>• Binghamton University<br>• Carnegie Mellon University<br>• Colorado School of Mines<br>• Massachusetts Institute of Technology<br>• Purdue University<br>• Stanford University<br>• University of Central Florida<br>• University of South Florida<br>• Washington University<br>• Sandia National Laboratory |
| **Other Industry Partners:**<br>• Thermax Ltd.<br>• Clique Developments Ltd.<br>• Hindustan Petroleum Corporation Ltd.<br>• Moser Baer India Ltd.<br>• Wipro Ltd.<br>• Bharat Heavy Electrical Ltd. | **Other Industry Partners:**<br>• RAND Corporation<br>• Corning Inc.<br>• Semlux Technologies, Inc.<br>• SunEdison, Inc.<br>• Solarmer Energy Inc.<br>• Underwriters Laboratories (UL). |

Good quality single phase CIGS films were achieved by electrodeposition as well as by the ink-based route. In last 7 months, an efficiency of 9.3% has been achieved for selenized CZTS (not on flexible glass), and a study of the science of the cells has shown that band states are enhancing recombination and limiting efficiency.

- Two new Organic Photovoltaic (OPV) materials with absorption > 650 nm have been designed at NREL and synthesized at IISc; a > 4% OPV module has been developed; and OPV cells on flexible Corning Willow® glass have been fabricated with 5.67% efficiency. Work in the last 7 months has resulted in an increase of efficiency of 1.56 $cm^2$ OPV cells on flexible Corning Willow® glass to 7.5%; further new OPV materials (fluorinated and partially fluorinated polymers) have been developed jointly at IISc, NREL, IACS and Solarmer with absorption > 800 nm; an 8.9% cell (1.56 $cm^2$) has been fabricated (not on flexible glass).
- Dye-sensitized solar cells (DSSC) with 8% efficiency have been fabricated; Si nanowire fabrication has been standardized, and fabrication of preliminary Si nanowire based solar cells has been initiated; various $TiO_2$ architectures have been explored. In the last 7 months, DSSC efficiency has been raised to 10%; NiOx/Si solar cells have been fabricated to explore the effectiveness of using carrier selective contacts on Si; ZnO and $TiO_2$ have also been used for carrier selective contacts; Si nanowire fabrication has been further standardized, and fabrication of Si nanowire based HIT cells has started. Furthermore, as recommended in the last PMC meeting, work on perovskite based solar cells has been initiated; cells with $MAPbI_3$ and mixed halide perovskites have yielded efficiencies of 5% to 14% depending on size and material; best stability achieved is 1000 hr for a 10% cell.
- Solar cells have been fabricated with 15.9% efficiency on 6" wafers received from SunEdison; process of recovery of silicon from kerf dust was being optimized.
- Over 1200 samples of Corning's flexible Corning Willow® glass has been shipped to partner organizations; these have been used to fabricate CZTS, CIGS and OPV solar cells; flexural studies have also been done. In the last 7 months, Roll-to-roll (R2R) work has started at CAMM and NREL.
- Modelling work on PV from materials to devices to modules is under way, including: Band structure calculations; modelling and simulation of HIT cells from Moser Baer; modelling improvement in efficiency for perovskite solar cells, end-to-end (process to panel) simulation; and simulation of defects. In the last 7 months, the modelling of process-to-panel level performance estimation of HIT cells has been completed; detailed temperature and illumination dependence of HIT cell performance has been modelled; modelling of perovskite solar cells which predicts the route to near-ideal efficiencies of 28%; modelling of a novel bifacial tandem cell has yielded a possible efficiency of 33%; *ab initio* modelling for mobility in various materials being used in SERIIUS projects has been done.





- In the last 7 months, data collection of reliability and degradation in India and USA has continued (in India, jointly with NCPRE and NISE); analysis of PV power plants in hot-dry and cold-dry climates has been performed; risk priority number (RPN) analysis of failure and visual degradation seen in various climatic zones has continued; diode thermal runaway modeling has been done; and hot spot analysis and modelling has been undertaken. Green Offices and Apartments (GOA) work for deployment of DC solar power has continued; analysis of solar powered submersible pumps has been undertaken. A major workshop on "PV Module Reliability in Hot Climates" was organized by SERIIUS jointly with NCPRE, NISE and NREL.
- Work on encapsulants with improved WVTR has been done; Al doped ZnO films and Cu doped ZnS films have been developed for TCO applications; Artificial soiling apparatus has been developed. During the last 7 months, new COC-MOF nanocomposite encapsulant films with good WVTR and transparency >94% has been achieved; p-type Cu:ZnS TC with s > 150 S/cm has been developed; *ab initio* calculations for mobility have been done; IZO and Mo coating for various applications on large sheets and rolls of Willow® glass has been done; Artificial soiling apparatus has been used to analyze dust samples collected from over 50 sites in India.

## Multiscale Concentrated Solar Power (CSP)

- Optimization of Organic Rankine cycle (ORC) and Supercritical $CO_2$-based cycles, based on thermodynamic analysis; Completed technical design of a research (laboratory scale) supercritical $CO_2$ test loop for closed Brayton cycle; and all components are procured. During the past 7 months, the S-$CO_2$ laboratory has been made ready, and all the critical components for the loop have been fabricated. Design of a tubular serpentine receiver; CFD model predicts efficiency > 90% is ready at Sandia National Labs. A spiral-wound direct S-$CO_2$ hybrid tubular and cavity receiver has been designed, fabricated and tested using the Fresnel lens concentrator at IISc.
- Development of the first 4 $m^2$ heliostat prototype with 2-axis tracking, with high reflectivity AlS glass, linear actuator for elevation, and geared motor for azimuth motion.
- Development of a (Cu-Sn)-based novel hemispherical highly reflective intermetallic mirror material with > 93% reflectivity; Development of High thermally stable absorber coating with high corrosion resistant property is achieved.
- Optimization of scroll geometries for small-scale ORC is complete. A 'burn-in' test rig has been designed to improve tolerances on scroll elements.
- Assessment of thermal performance of dual-media thermocline tanks, with quartzite rock as filler material, and single-media thermocline tanks with only molten salt as high temperature thermal storage options for CSP. Completed design of a laboratory scale molten-salt-loop system to test storage option for high temperature $CO_2$ Brayton cycles. The molten

salt laboratory has been made ready, and all the critical components for the loop have been fabricated. Test loop for the thermal property evaluation of high and medium temperature molten salt based heat transfer fluids has been designed and fabricated.

- Encapsulation of phase change materials for low temperature thermal storage loop has been initiated.
- The core project with BHEL is on the development of a ceramic volumetric receiver for S-$CO_2$. A design concept of a volumetric receiver with SiC ceramic as the absorber material is finalized, geometric modeling completed and a test material is fabricated. A laboratory scale open cycle test S-$CO_2$ loop for testing the receiver module has been designed at BHEL. To understand the heat transfer and thermal storage performance of ceramic honeycomb with air as the heat transfer fluid, a separate test rig is built at BHEL.

## Solar Energy Integration (SEI)

- A detailed report on "Solar Resource Assessment and Technology Roadmap" has been submitted. Land and solar resource assessment studies using NREL's satellite data and limited ground measurement data from Karnataka was completed. Manufacturing process analyses of CIGS modules and polysilicon were conducted in detail. Assessment of indigenous manufacture of polysilicon and CIGS was completed. The capital and operating costs of establishing a polysilicon manufacturing facility in India and the corresponding cost/kg of producing polysilicon was ascertained. An assessment of scope of cost reduction was also conducted. Similar study for CIGS modules is under progress.
- A detailed technical assessment of thin film solar cells based on CIGS, CZTS and perovskite materials was carried out.
- Parabolic Trough technology: CSTEP's Solar Techno-Economic Model (CSTEM) tool, for parabolic trough technology has been upgraded under SERIIUS and now includes various Heat Transfer Fluids (HTF) and absorber and trough types as user input choices.
- Detailed review of Solar Tower technology as well as a subsequent analysis of plant parameters has been performed and submitted as a SERIIUS report tilted – 'Global review of Solar Tower Technology'. Insights from this report were used to perform solar tower modelling using CSTEM tool. Base version of CSTEM PV tool has been completed. This web based tool performs an hourly evaluation of the PV system performance along with financial assessment.
- A detailed report on "Energy Storage for Renewable Energy Deployment in India: Potential, Economics and Technology Options" was prepared. In addition, techno- economic assessments for PV- battery systems were carried out for select locations in India chosen for off-grid solar electrification as per the recent REC plans.
- A theoretical prediction of a novel low temperature electrolyte for Na-S system was completed and published in Journal of Materials Chemistry A.
- Detailed experimental as well as modelling studies on select Li ion battery cathodes (oxides, phosphates, silicates, vanadium oxide, etc.) and anodes of select chemistries were completed.
- Synthesis and characterization of a few benchmark Metal Organic Framework (MOF) compounds were completed.

## Summary of Innovations

- *Optoelectronic Devices having Selective Contacts* from Stanford University.
- *A Novel Method to Prevent Potential Induced Degradation (PID) of Photovoltaic Modules during Manufacturing or after Field Installation* from Arizona State University.
- *A Process for Preparation of Homogenous Mixture for Thermal Storage and Heat Transfer Applications* from HPCL.
- *A Method for Preparation of a Composition containing Nanoparticle for Thermal Storage and Heat Transfer Applications* from HPCL.

## Prototypes Fabricated

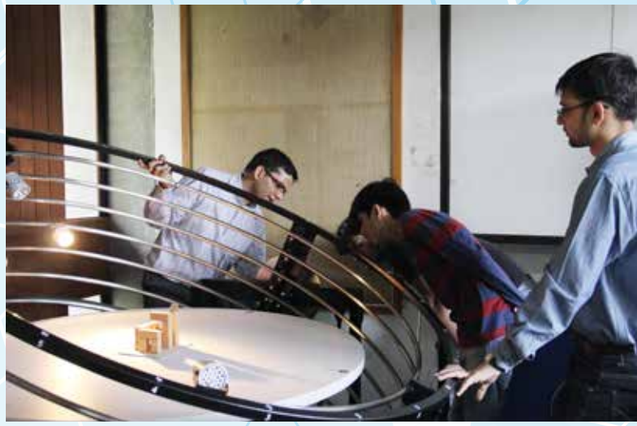
- First S-$CO_2$ test loop for CSP.
- Scroll expander with optimized geometry is being fabricated for testing in an ORC rig.
- 4$m^2$ heliostat prototype with 2 axis tracking with high reflectivity AlS glass, linear actuator for elevation and geared motor for azimuth motion.
- 2 small scale solar receivers for S-$CO_2$ have been designed and fabricated for testing in IISc loop.

## SERIIUS in numbers

- 98 journal accepted or published
- 72 proceedings papers
- 4 Invention Disclosures filed
- Researcher exchanges: 20
- Workshops conducted: 10
- 2 user models namely AMoBT *(ab initio* model for mobility and Seeback coefficient using Boltzmann Transport Equation) and CSTEM (CSTEP Solar Techno-Economic Model) have been made online
- SERIIUS Special Issue in the Applied Thermal Engineering (ATE) Journal which is expected to be published in June 2016 with 28 articles.







# BUILDING ENERGY EFFICIENCY

The **US-India Joint Centre for Building Energy Research and Development (CBERD)** is co-led by the Center for Environmental Planning and Technology (CEPT) University, Ahmedabad and Lawrence Berkeley National Laboratory. The CBERD consortium focuses on the integration of information technology with building physical system technology with an aim to bring energy efficiency in commercial and multi-family residential high-rise buildings. CBERD is dealing with multiple aspects of building energy efficiency in a coherent manner, however for ease of carrying out R&D, it has divided project into six tasks, namely, Building energy model & energy simulation; Monitoring and energy benchmarking; Integrated sensors and controls; Advanced HVAC (Heating, Ventilation and Air Conditioning) system; Building envelopes; and, Climate responsive design. In addition to these tasks, CBERD is working on a crosscutting task with an aim to address cost benefit framework for energy investments adopting triple bottom line approach.

The achievements of the CBERD consortium thus far include:

## Simulation and Modelling

- Development of WinOpt, an early design tool based on EnergyPlus engine. This tool later on was extended with additional capabilities and renamed eDoT.
- Use of 'Open Studio Measures' to implement Energy Conservation Building Code (ECBC) was explored and technical collaboration with NREL was initiated with help from LBNL.
- Fault Diagnostics and Detection lab HVAC equipment has been installed and building management system (BMS) system has been completed.
- An alpha eversion of eDOT was reviewed by HOK Architects. Feedback received from them; will be incorporated in next version of tool.
- Schneider Electric, India is working with IIITH team on Fault Detection and Diagnostic (FDD) laboratory set up.
- Predictive control demonstration, improvement work has been initiated with INFOSYS.
- Establishment of Fault Diagnostics and Detection lab at IIIT Hyderabad.

## Monitoring and Benchmarking

- CEPT and LBNL team developed graduated benchmarking approach for energy benchmarking of buildings.
- Development of technical specifications for tiered, scalable, and cost effective energy information system. Schneider Electric India worked with team on EIS.
- Schneider Electric India and Wipro Eco Energy also provided cost share for benchmarking

| Participating Institutions, India | Participating Institutions, USA |
|---|---|
| **Lead Institution:**<br>Center for Environmental Planning and Technology University, Ahmedabad | **Lead Institution:**<br>Lawrence Berkeley National Laboratory |
| **Other Academia Partners**:<br>• International Institute of Information Technology, Hyderabad<br>• Malaviya National Institute of Technology, Jaipur<br>• Indian Institute of Technology, Bombay<br>• Indian Institute of Management, Ahmedabad<br>• Auroville Center for Scientific Research | **Other Academia Partners:**<br>• Oak Ridge National Laboratory<br>• University of California Berkeley<br>• Carnegie Mellon University<br>• Rensselaer Polytechnic Institute |
| **Industry Partners:**<br>• Asahi India Glass<br>• Biodiversity Conservation India<br>• Infosys Technologies.<br>• Neosilica Technologies<br>• Oorja Energy Engineering Services<br>• Paharpur Business Centre<br>• PLUSS Polymers<br>• Philips Electronics India<br>• Saint Gobain Corp<br>• Schneider Electric India<br>• Sintex Industries Limited<br>• Skyshade Daylights<br>• Wipro EcoEnergy | **Industry Partners:**<br>• Autodesk, Inc.<br>• California Energy Commission<br>• Delphi<br>• enLighted Inc.<br>• Honeywell<br>• Ingersoll-Rand/Trane<br>• Lighting Science Group Corp<br>• Nexant<br>• Saint Gobain Corp<br>• SAGE Electrochromics<br>• SynapSense |
| **Supporting Organizations:**<br>• Indian Green Building Center, CII<br>• Indian Society of Heating Refrigeration and Air Conditioning Engineers<br>• Rajasthan Electronics and Instruments Limited<br>• Indian Society of Lighting Engineers<br>• Glazing Society of India | **Supporting Organizations:**<br>• Bay Area Photovoltaic Consortium<br>• City of San Jose<br>• HOK Architects<br>• Natural Resources Defense Council |

activity. Apart from formal CBERD partner, team worked with FERN and GINGER group of hotels.
- CEPT constructed Net Zero Building under non-CBERD grant and with help from CEPT's internal resources, CBERD team is using this heavily instrumented building to gain insights for end use energy data.

## Integrated Sensors and Controls

- IIIT-H team have developed Smart Power strip.
- IIIT-H have developed low energy wireless motion sensor. Low energy wireless motion sensor: Low power wireless motion sensor is a wireless device which can be used to switch On/Off an air-conditioner or any other gadget which has IR controlling interface such as TV, music system etc. based on the human occupancy in a given space.
- Affordable smart power strip: WiFi communication based Smart power strip monitors the connected devices and provides details such as device IDs, usage time, location, and power consumed. This provides the load profile of the plug loads in a building to help in developing strategies for plug load management. Smart strip also allow user to manage connected device.
- EnLighted, Philips and Synapsense worked with LBNL and IIIT-H team on smart luminaire controller and power strip.
- IIIT-H established lighting / luminaire testing equipment.

## Advanced HVAC Systems

- Development of Dedicated Outdoor Air System (DOAS) with Indirect Evaporative Cooling of fresh ambient air using exhaust from conditioned Spaces. Low energy cooling technology meeting adaptive thermal comfort standards, saves cooling energy considerable.
- Microchannel Heat Exchanger (MCHX) and Indirect evaporative space cooling system: Indirect evaporative space cooling: Diabetic rotating contacting device based evaporative cooling technology for water which can be used in structural cooling. This technology saves operational energy where water is used in close loop for space cooling. This technology has more potential to provide thermal comfort in hot and dry climates.
- MNIT-J team worked on chiller standards for India.
- Calibrated simulation model for radiant cooled HVAC system.
- MNIT-J is working with non – CBERD partner, Desiccant Rotors International (DRI), India for wetting of strategies to handle latent load in radiant cooling systems and creation of MNIT's HVAC facility.
- MNIT-J is working with CBERD industry partner Oorja for discussion of design and installation of experimental setup of radiant cooling system.
- IIT Bombay's heat pump laboratory have been upgraded to work on Micro-Channel heat Exchanger and Dedicated Outdoor air systems.
- Radiant cooling test bed set up at MNIT Jaipur.

## Building Envelopes

- CEPT team with PLUSS developed Phase Change Material (PCM) flakes which can be integrated with masonry unit. CBERD team is exploring possibilities of characterizing thermal mass of PCM encapsulated masonry unit.
- ORNL and CEPT are conducting inter laboratory comparison of PCM.
- CEPT and LBNL developed algorithm to calculate adjusted Solar Heat Gain Coefficient (SHGC) in presence of Non-Co planer shading devices. This was has been tested and presently efforts have been made to develop module to calculate adjusted SHGC which can ultimately be adopted as part of EnergyPlus.
- IIIT-H and SGRI is conducting controlled experiment for estimation of energy saving potential of high albedo surfaces, during this period both have continued working on data collection from field.
- IIIT-H, CEPT and LBNL have finalized natural exposure characterization protocol for cool roofing products in India. IIITH is working with non CBERD industry partners to collect samples for long term testing.
- PLUSS Adv. Technologies is working actively with CEPT team on PCM experiments.
- Saint Gobain is working with IIITH team on cool roof experiments.
- Skyshade Ltd is working with CEPT team on Mirror Box and SPSS along with LCP panel research.
- Saint Gobain and Asahi worked with CEPT on COMFEN India version.
- Hygrothermal property characterization facility at CEPT.
- Establishment of daylight study facility at CEPT will construction of mirror box and single patch sky simulator.
- Cool roof testing facilities at four locations in India.
- Cool roof aging protocol development test apparatus at IIITH and CEPT.
- Phase change material testing facility at CEPT (up gradation of existing test bed).

## Climate Responsive Design, and Cross cutting task on cost optimization of energy efficiency

- Approximately 20 buildings across India were monitored for its year-round environmental performance.
- Approximately 500 building occupants were surveyed for their user satisfaction, thermal comfort, and long term post occupancy evaluation.
- Thermal Comfort Chamber establishment at CEPT University.
- Earth Air Tunnel experimental set up constructed at MNIT-J.

## CBERD in numbers

- 50 papers in peer reviewed journal and conferences
- 2 Filed patents
- 3 tools available in public domain
- 32 research exchanges
- 14 Joint workshops

- 7 Equipment and test bed establishment

## SECOND GENERATION BIOFUELS

The **US-India Consortium for development of Sustainable Advanced Lignocellulosic Biofuel Systems** is co-led by the CSIR-Indian Institute of Chemical Technology, Hyderabad and the University of Florida, Gainesville.

The major goal of this project is to develop and optimize selected non-food biomass (high yielding biomass and brown-mid rib (bmr) varieties of sorghum, sweet sorghum, pearl millet, bamboo and switch grass)-based advanced biofuels systems and bio-based products like biogas and lignin-based by-products for the US and India. The successful completion of the project is expected to benefit both nations by delivering a working model for feedstock production and supply, biochemical conversion approaches and technologies that have been validated on pre-commercial scale systems, and the overall economics and sustainability of biofuel production and supply systems.

The achievements of the project include:

### Work Package 1

***Sorghum***

- Screening of high biomass sorghum genotypes for various agronomic traits led to the identification of some promising varieties. Most promising genotypes including ICSV 25334, ICSV 25332, ICSV 25333, SBr-9 and NP 3 have been identified producing good grain and stover yields of >40 t $ha^{-1}$.
- Sorghum genotypes: CSH 13, Gird 36, Gwalior III, ICSSH 28, MP II, NSS 1015A × DSSV 165 and Sel B-Pop performed better at both 10 $dsm^{-1}$and 15 $dsm^{-1}$ levels of salinity.
- Based on the multi-location testing in on-station trials as well as on-farm testing in farmer's fields, the high biomass and high sugar containing sorghum hybrid RVICSH-28 was released in 2015 for commercial cultivation in Madhya Pradesh.
- Transcriptome studies on drought tolerant sorghum varieties, IS 18542 and IS 23143 for identification of differentially expressed genes and assembling of transcriptome is in progress.
- Two high biomass sorghum genotypes, CSH-13 and ICSSH-28, have been identified for higher nitrogen use efficiency (NUE).


- The brown midrib trait associated with low lignin content is being transferred to high biomass sorghum lines. Nineteen $BC_1F_1$ varieties were generated in the 2013-2014 post rainy season by backcrossing the 19 crosses developed between high biomass lines and low lignin (*bmr* 12) sources with the recurrent parents. Four $BC_3F_1$ were generated. Three $BC_3F_1$ with *bmr* 12 allele were confirmed genotypically and advanced to $BC_3F_2$ and $BC_4F_1$ generations.
- The entry (CSV 15 × IS 21891-1-1-1) × (HC 260 × B 35-2-1-1-1) recorded highest dry biomass yield with brown midrib background.
- Seeds of promising high biomass sorghum entries, ICSV 25333, IS 18542, ICSSH 28, CSH 13 and CSH 22SS have been multiplied in post-rainy season of 2013-14 and supplied to partners and farmers
- Large-scale demonstration trials for identification of farmers preferred cultivars for dry stalk yield resulted in identification of ICSV 93046 and IS 18542 as best performing varieties in Gujarat and ICSSH 28 and ICSV 93046 were best performing varieties in Madhya Pradesh.

***Pearl millet***

- Pearl millet entries, IP 15564, IP 15535 and IP 10077 were selected for high dry stover yield with low lignin percentage.
- In high biomass pearl millet hybrid trials 1 and 2, dry biomass yields of five best performing hybrids were in the range of 14 - 17 t $ha^{-1}$.
- In high biomass pearl millet population trials 1 and 2, dry biomass yields of five best germplasm accessions were in the range of 15 - 21 t $ha^{-1}$.
- High biomass pearl millet germplasm accessions, IP-10437, IP-14294, IP-20409, and IP-14542 recorded dry stover yields of 13 t $ha^{-1}$, IP 22269 recorded about 14 t $ha^{-1}$, whereas IP-10151 and IP-15556 recorded 15 t $ha^{-1}$.
- Seed of potential pearl millet hybrids yielding dry biomass of about 15-22 t $ha^{-1}$ in MLT's have been identified and being multiplied.

***Bamboo***

- Twenty-bamboo germplasms were successfully established as mother plants for further studies at captive land in Modasa, Gujarat.
- *Bambusa balcooa*, *Dendrocalamus strictus*, *Bambusa vulgaris*, *Bambusa ventricosa*, *Phyllostachys nigra, Melocanna baccifera, Sasa fortuneii, Bambusa wamin, Sasa palmata* and *Bambusa multiplex f. variegate* were selected for genetic variation studies using molecular approaches.
- *Bambusa balcooa* was found to be more diverse based on cluster and species relationship analyses.
- Bamboo vegetative propagation protocol was established based on PGR application with NAA

| Participating Institutions, India | Participating Institutions, USA |
|---|---|
| **Lead Institution:**<br>CSIR-Indian Institute of Chemical Technology, Hyderabad | **Lead Institution:**<br>University of Florida, Gainesville, FL |
| **Other R &D Institutions and Academia Partners:**<br>• International Crops Research Institute for the Semi-Arid Tropics, Hyderabad<br>• Indian Institute of Millets Research, Hyderabad<br>• Jawaharlal Nehru Technological University, Hyderabad<br>• Tamil Nadu Agricultural University, Coimbatore<br>• Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior<br>• Centre for Economic and Social Studies, Hyderabad<br>• Indian Institute of Technology-Delhi, New Delhi<br>• Indian Institute of Technology-Madras, Chennai<br>**Industry Partners:**<br>• Abellon Clean Energy Pvt. Ltd., Ahmedabad<br>• Hindustan Petroleum Corporation Limited, Bangalore | **Other R & D Institutions and Academia Partners:**<br>• University of Missouri, Columbia, MO<br>• Virginia Tech, Blacksburg, VA<br>• Montclair State University, Montclair, NJ<br>• Texas A&M University, College Station, TX<br>**Industry Partners:**<br>• Show Me Energy, Missouri<br>• Green Technologies LLC, Gainesville Florida |

and IAA at 200 ppm showing new shoots in vegetative propagation.
- Adaptation study of *Bambusa balcooa* has been initiated at three sites, namely Modasa, Khas and Vithalapara.
- Broad range salinity screening has been performed on all 20 bamboo accessions.
- Data collection and monitoring of growth from large-scale cultivation trial of *B. balcooa* conducted on the marginal lands of Lakshmipura (Khedbramha), Aakru (Botad) and Vadod (Limbdi) on farmer's fields are in progress.
- Good bamboo growth has been observed in Vadod, followed by Lakshmipura.

## Work Package 2

- Comparative pretreatment experiments were conducted on sorghum biomass using steam explosion in combination with acid, alkali and alkaline peroxide with 10% solid loading and various operating conditions.
- Standardization of o-phosphoric acid pretreatment in pearl millet resulted in 72% lignin reduction, increased glucan content to 39%, xylan reduction to 19% and lowered the ash content by 8%.
- Saccharification of pretreated sorghum biomass resulted in cellulose conversion efficiency of 80% with 40 FPU Sacchari SEB enzyme per gram cellulose at 10% solid loading.
- Fermentation studies using an in-house *Pichia kudriavzevii* yeast strain was found to tolerate high temperatures (48°C) and showed tolerance to various inhibitors.
- The productivity of *Pichia stipitis* increased more than 200% and yielded more than 50% in adaptation studies for inhibitor tolerance in CSTR.
- *S. cerevisiae* consumed glucose rapidly and produced 97% ethanol yield, while *P. stipitis* showed rapid consumption of xylose with 90% ethanol yield.
- Mono and mixed culture fermentation studies were yield out on the simulated hydrolysate mimicking sorghum hydrolysate.
- Fermentation studies on alkali peroxide pretreated and saccharified sorghum biomass hydrolysate produced 15 -16 g/L ethanol.
- Co-fermentation of glucose and xylose by mixed culture of S. cerevisiae and *P. stipitis* showed complete glucose utilization at different concentrations.
- Seven potent fungal strains and an in-house xylanase producing bacterial strain showed FPase activity in the range of 19-30 FPU per gds

in submerged and SSF fermentation studies.
- HPA-100 spiral wound nanofiltration module was found to concentrate glucose with minimum losses in permeate.
- Indigenous hydrophobic flat sheet membrane enriched ethanol with complete retention of sugars.
- Hybrid process of MBR + RO provided high reduction in COD with potential for low cost treatment of biomass wastewater treatment on industrial scale.
- Analysis of lignin content separated in the extraction process showed 70% recovery in preliminary lignin valorization studies.

## Work Package 3

- Marginal target ecologies of Madhya Pradesh and Gujarat were surveyed for current crop practices, yields and market potentials to promote biofuel crops.
- Baseline economic data would be used to evaluate economics and yields of the biofuel crops in contrast to current productivity of crops and market potential.
- Baseline survey has been completed for Gujarat and Madhya Pradesh.





- On the basis of agricultural practices and local conditions, socio-economic and environmental indicators were developed and customized by interviewing key stakeholders such as universities, government departments and farmers to evaluate the certification processes.
- Life cycle analysis (LCA) data sheet has been created manually for the Indian scenario. Carbon emission and energy input / output LCA data sheet has been created and integrated for WP-1 and WP-2 work related aspects.
- A supply chain model is being developed based on the available village and taluka wise marginal lands for biofuel feedstock production and supply to optimum locations and process industries for maximum biomass supply.
- Biofuel crop production models are under development considering maximum resource utilization with integration of policies.

## Consortium in numbers

- Patents: 4
- Journal/Book Publications: 36
- Papers presented at conferences: 73
- Workshops conducted: 10

# Strategic PROGRAMS

*US-India Science and Technology Endowment Fund*

# US-India Science and Technology Endowment Fund

## Contact Persons

**Smriti Trikha**
Indo-US S&T Forum
New Delhi
strikha@indousstf.org

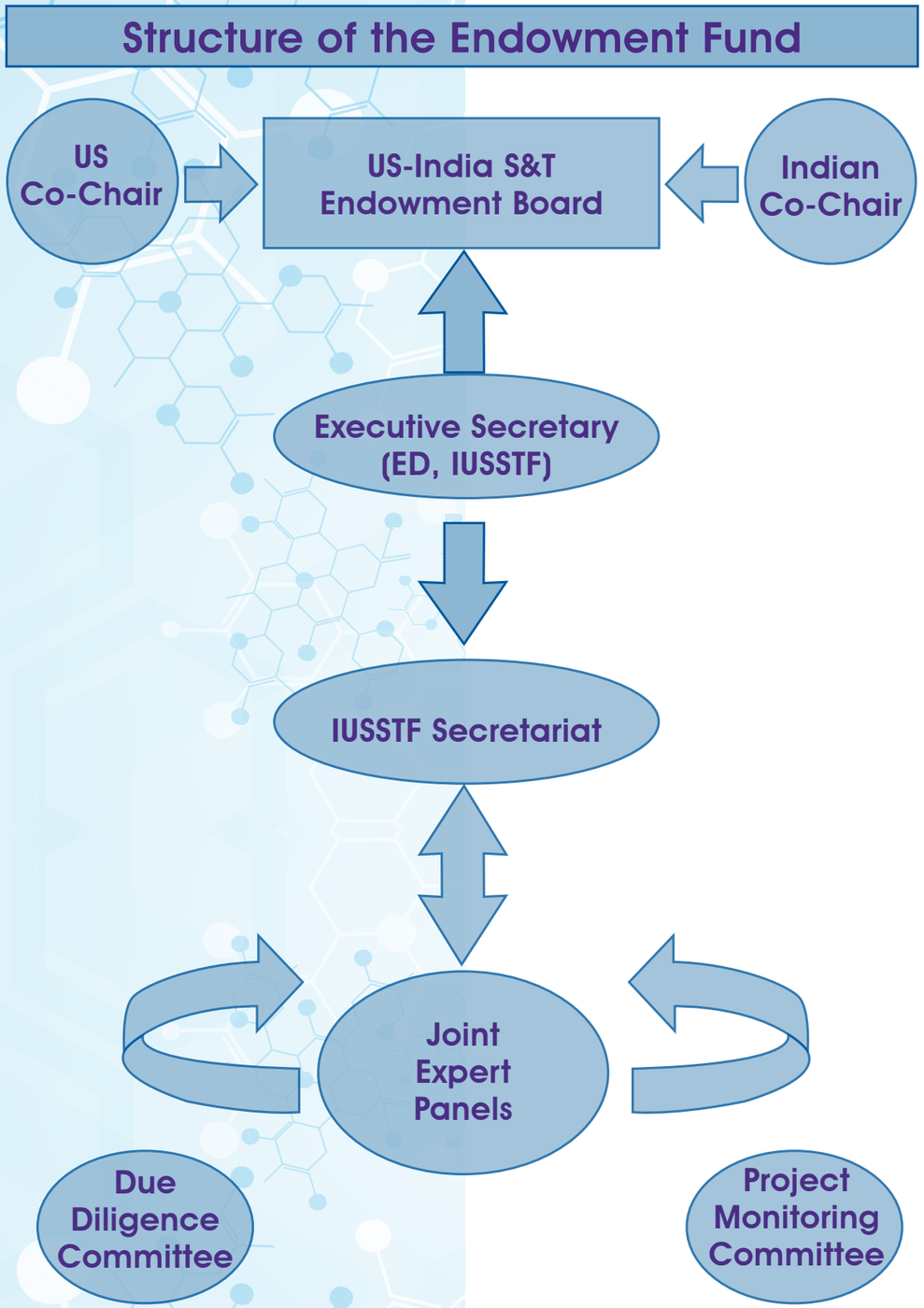
**Tarun Mittal**
Indo-US S&T Forum
New Delhi
tarun.mittal@indousstf.org

The **United States–India Science & Technology Endowment Fund (USISTEF)** was established in 2009 by the Governments of the United States of America (through the Department of State) and India (through the Department of Science & Technology). The fund aims to support and foster joint applied R&D to generate public good through commercialization of technology achieved through sustained partnerships between US and Indian researchers and entrepreneurial initiatives. These initiatives can originate from government, academic, non-governmental or commercial entities, and any combination thereof provided they focus on applied R&D, incorporate a business plan and proof of commercial concept, and have significant sustainable commercial potential. The United States - India Science & Technology Endowment Fund through a competitive grants program, selects and financially supports promising joint US-India entrepreneurial initiatives by providing grants up to Rs. 2.50 crores or approx. USD 400,000 (subject to prevailing exchange rates).

Eighteen promising innovative projects have thus far been funded by the US- India Science and Technology Endowment Fund. A funding of over 35 crores (approx $ 5.5 million) has been committed to support these projects.

The program is coordinated and administered through the bi-national **Indo-US Science and Technology Forum (IUSSTF)**. The areas covered under the program are **(1) Healthy Individual (HI)** with a focus on affordable biomedical devices, diagnostic/ preventive/ curative measures, or food and nutrition products to improve health, and **(2) Empowering Citizens (EC)** with a focus on reducing the digital/technology divide including others, information and communication technologies with societal impact in areas such as Water, Agriculture, Financial Inclusion, Education and IT & Communication.

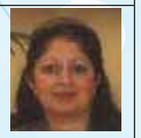
## Structure of the Endowment Fund








## Composition of the USISTEF Board

| India | | United States | |
|---|---|---|---|
| **Arabinda Mitra**<br>(Co-Chair)<br>Advisor & Head<br>International Cooperation (Bilateral),<br>Department of Science and<br>Technology, Government of India |  | **George N. Sibley**<br>(Co-Chair)<br>Minister Counsellor, Economic,<br>Environment, Science & Technology<br>Affairs, US Embassy, New Delhi |  |
| **H.K. Mittal**<br>(EC-Indian panel Co-Chair)<br>Head &Advisor<br>National Science and Technology<br>Entrepreneurship Development<br>Board, Government of India |  | **Greg Cole**<br>Director – GLORIAD Program,<br>Center for International,<br>Networking Initiatives,<br>Oak Ridge National Lab |  |
| **Bindu Dey**<br>Advisor,<br>Department of Biotechnology<br>Government of India |  | **Talat Hasan**<br>(EC-US panel Co-Chair)<br>General Partner,<br>Hitek Venture Partners |  |
| **Deepanwita Chattopadhyay**<br>(HI-Indian panel Co-Chair)<br>MD & CEO,<br>IKP Knowledge Park, Hyderabad |  | **Gunjan Sinha**<br>(HI- US panel Co-Chair)<br>Executive Chairman,<br>Metricstream |  |
| **Balaram Bhargava**<br>Executive Director, School of<br>International Bio design<br>All India Institute of Medical<br>Sciences |  | **Steven Ferguson**<br>Deputy Director, Licensing and<br>Entrepreneurship, National<br>Institutes of Health |  |
| **Anjan Das**<br>Executive Director<br>Confederation of Indian Industries (CII) |  | **Phillip Singerman**<br>Associate Director for Innovation<br>& Industry Services Office of the<br>Director, National Institute for<br>Science & Technology |  |
| **Acquino Vimal**<br>Director (AMS), Ministry of<br>External Affairs,<br>Government of India |  | **Mojdeh Bahar**<br>Assistant Administrator, Research<br>Operations & Management,<br>Office of Technology Transfer,<br>Agricultural Research Service,<br>US Department of Agriculture |  |
| **Deepam Mishra**<br>CEO, i2india, Bangalore |  | **Sheila E. Desai**<br>Senior Science & Technology<br>Advisor, Center for Innovation &<br>Partnerships<br>USAID, New Delhi, India |  |
| | | **Sanjay Joshi**<br>Managing Principal,<br>ZS Associates |  |

**The projects supported by the US-India S&T Endowment Fund (USISTEF) thus far include:**

| S.No. | PROJECT TITLE | LEAD PARTNERS | Expected Date for Project Completion |
|---|---|---|---|
| FIRST CALL PROJECT | | | |
| 1. | *A Fair Price for Healthy Fruits & Vegetables: Helping Farmers Access Cold-Storage Technology* | **Chirag Ice Factory Pvt. Ltd.** Navi Mumbai<br>**Promethean Power Systems, Inc,** New Delhi | **Project Completed** |
| SECOND CALL PROJECTS | | | |
| 1. | *A Novel Way to Manage Fecal Incontinence in Non-Ambulatory Patients* | **Consure Medical Pvt Ltd** New Delhi<br>**Lunar Design** San Francisco, CA | **Apr-16** |
| 2. | *Mobile Phone Based Hba1c Analyzer* | **Janacare Solutions Private Limited** New Delhi<br>**Teco Diagnostics** Anaheim CA | **Apr-16** |
| 3. | *Branchless Banking for the Unbanked and Under-Banked Areas* | **Eko India Financial Services Private Ltd.** Gurgaon<br>**IDmission LLC** Mesa, AZ | **Apr-16** |
| THIRD CALL PROJECTS | | | |
| 1. | *Commercialization of Cultivated Sea Plants Based Organic Bio-Stimulants for Applications in the USA* | **Aquagri Processing Pvt. Ltd.** New Delhi<br>**GloBridge Ventures LLC** CA | **Apr-16** |
| 2. | *Solar Electric Tractor-Agriculture and Power* | **Lovson Enterprises Pvt. Ltd** Ahmedabad<br>**Solectrac LLC** CA | **Aug-16** |
| 3. | *Affordable, Clean Cookstove and Electric Power Sources for Rural India* | **Greenway Grameen Infra Pvt. Ltd.** Navi Mumbai<br>**Hi-Z Technology Inc.** San Diego CA | **May-16** |
| 4. | *Onebreath: Affordable Mechanical Ventilation for India* | **Vaatsalya Healthcare** Bangalore<br>**OneBreath, Inc.,** Palo Alto, CA | **May-16** |
| 5. | *Commercializing a Scalable Low-Cost Arsenic Remediation Technology for Societal Impact* | **Jadavpur University,** Kolkata<br>**Luminous Water Technologies Pvt. Ltd.** Gurgaon<br>**ITT Inc,** Oakland, CA<br>**Lawrence Berkeley National Laboratory** Berkeley, CA | **Jan-16** |
| 6. | *Affordable and User-Centric Knee Joints to Remobilize Above-Knee Amputees in India and Globally* | **Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS)** Jaipur<br>**D-Rev (Design Revolution)** San Francisco, CA | **May-16** |
| 7. | *Easy to Use, Integrated Neonatal Resuscitation Solution* | **Windmill Health Technologies** New Delhi<br>**Whipsaw,** San Jose, CA<br>**Stanford Global Bio-design** Palo Alto, CA | **Aug-16** |
| FOURTH CALL PROJECTS | | | |
| 1. | *Transforming Arsenic and Fluoride Crisis in Drinking Water into an Economic Enterprise* | **Rite Water Private Limited** Nagpur<br>**Society for Technology with a Human Face** Kolkata<br>**WIST Inc** Brighton, MA | **Apr-17** |
| 2. | *Development of a Low-Cost, Portable Auto Refractor* | **Aurolab,** Madurai<br>**PlenOptika** Somerville, MA | **Oct-16** |
| 3. | *Commercializing a Transformational Modular Roofing Solution for Low-Income Urban Homes* | **Re-Materials** Ahmedabad<br>**ITT Inc** Oakland, CA | **Sept-16** |
| 4. | *Developing Novel Biological Seed Treatments to Confer Abiotic Stress Tolerance in Crops* | **SFPL Crop Life Sciences (p) Ltd** Jalna<br>**Adaptive Symbiotic Technologies** Seattle, WA | **Oct-17** |
| FIFTH CALL PROJECTS | | | |
| 1. | *Hand-held Forced Oscillation Device for Improved Detection and Monitoring of Airway Disease* | **CSIR-Institute of Genomics and Integrative Biology** Delhi<br>**Cognita Labs and Rice University** Houston, TX | **May-17** |
| 2. | *Moving Beyond the Pavement: Affordable Mobility for Users around the World* | **Pinnacle Industries Ltd** Pithamour<br>**GRIT** Cambridge, MA | **Dec-17** |
| 3. | *Jaipur Belt (Belt System for Body Support)* | **Newndra Innovations Pvt Ltd** Jaipur<br>**MedSpark** LLC, Obispo, CA | **Jun-18** |



Strategic Programs

# FIRST CALL PROJECT

## A Fair Price for Healthy Fruits & Vegetables: Helping Farmers Access Cold-Storage Technology

**Sorin Grama**
Promethean Power Systems
New Delhi

**Rustom Irani**
Icelings-Chirag Ice Factory Pvt. Ltd.
Navi Mumbai

### Problem

Nearly $10 billion of agricultural produce is lost in India every year due to inadequate cold storage.

### Solution

The teams of Promethean Power Systems and Icelings-Chirag have co-developed an off-grid refrigerated container, which can be installed on small farms and remote villages throughout India. This will increase the farmer's incomes by eliminating spoilage while allowing them to sell the produce at a fair price independent of harvest timing. The system does not use an on-board refrigeration compressor for cooling and therefore will not release harmful refrigerant gases into the atmosphere. Additionally it also reduces capital and operating costs.

### Project Accomplishments

The teams have successfully installed a cold-storage facility with thermal battery backup at an agricultural farm in Pune. Once chilled, the produce can be transported in simple, lightweight insulated trucks to a cold-storage warehouse or distribution facility where it can be further chilled and stored as long as necessary. The heat gained during transportation is minimal and does not affect the quality because the produce is already chilled. Chilling the fresh produce immediately at the source decreases spoilage, increases shelf life of the farm products and increases the profits of the farm. Therefore, within a single peak season, the equipment pays for itself in cost savings from reduced spoilage. The cold-storage facility (1-2 tons) is available at competitive prices.





# SECOND CALL PROJECTS

## Branchless Banking and Financial Services for the Unbanked and Under-Banked

**Angela Schmuck**
IDmission LLC
Mesa, AZ

**Abhishek Sinha**
Eko India Financial Services Pvt. Ltd.
Gurgaon

### Problem

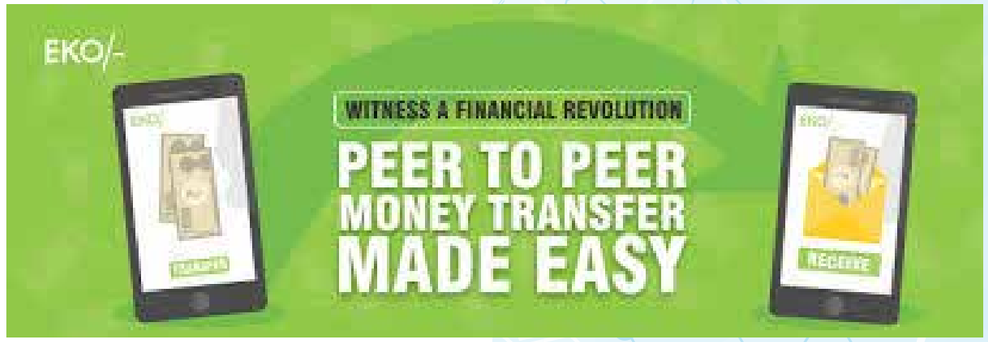
A large section of the Indian population (~500 million) still remains without access to banking services. Traditional financial service delivery models have failed to serve low-income populations.

### Solution

Building a low-cost payment infrastructure for instant small value financial transactions by leveraging existing retail shops, tele-connectivity and banking infrastructure would extend branchless banking services to the common man. The project aims to deliver financial services efficiently and at scale through smartphone-based application mechanism integrating with the Unique Identification (UID).


### Project Accomplishments

The company so far has opened 5000 Customer Service Points (CSPs) in four Indian States viz. Delhi, Maharashtra, Telangana and Uttar Pradesh. The number of Eko Counters opened utilizing the USISTEF Grant is 180 CSPs in these states. At the EKO counters the limit for value of transactions per customer/per month is Rs 10,000 (US$ 146) (without KYC information) and Rs 25,000 (US$ 363) (with KYC). The total volume of transactions is 15,000 per CSP per day. Pre-payment activities like mobile recharges, e-commerce transactions, and mobile wallet transactions comprises only 1% of the total figure. Apart from this, Eko India is providing training to the existing Customer Service Points to perform the financial transactions in the most efficient and professional manner.



## Mobile Phone Based HbA1c Analyzer

**Stephan Chen**
Teco Diagnostics
Anaheim

**Sidhant Jena**
Janacare Solutions Pvt. Ltd.
New Delhi

### Problem

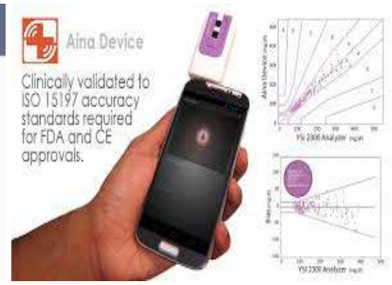
There is an acute need for a low-cost and portable HbA1c monitor top screen to manage diabetes in the developing world. However, most standardized HbA1c monitors are expensive, bulky assay-based systems and thus not suited for mass adoption.

### Solution

The team proposed to co-develop a low-cost mobile phone platform to measure HbA1c. Their novel platform comprises of two components- a colorimetric test strip for HbA1c and a software application that uses the phone's camera to analyze the test strip. Additionally, the software application can provide automated decision support and transmit data to remote specialists, thus enabling millions of field health workers to screen and manage diabetes in even the most remote communities.

### Project Accomplishments

The team has successfully developed a low-cost mobile phone platform to measure HbA1c and has successfully commercialized the product under the brand "AINA" by M/s Janacare Solutions (P) Ltd. AINA comprises of a novel hardware sensor that plugs into any smartphone and an array of proprietary dry-chemistry strips to test seven basic blood parameters. There are two versions of the device (AINA Standard for Primary Clinics and AINA Device for patients) which can measure the test results for HbA1c; Lipid Profile (HDL, LDL, TLC etc.) and Creatinine and Haemoglobin. It can be operated by individuals and health workers. The devices are available at competitive prices in the market. Further the team is developing next-generation test devices to monitor heart failure and chronic kidney diseases.






## A Novel Way to Manage Fecal Incontinence in Non-Ambulatory Patients

**Matt Durack**
Lunar Design
San Francisco

**Nishith Chasmawala**
Consure Medical Pvt. Ltd.
Surat

### Problem

Fecal incontinence, the inability to control the release of stool, is a ubiquitous clinical problem that affects more than 50 million patients globally. The absence of an adequate management solution for fecal incontinence leads to increased utilization of hospital resources and adversely impacts the mortality by 7%.

### Solution

The team has developed a self-expanding device with a unique placement, deployment and withdrawal mechanism. The device requires minimal training and can be administered without the need for imaging and works on all patients, irrespective of their stool type or sphincter tone. The product offers a hygienic insertion mechanism and is very sanitary and patient friendly.

### Project Accomplishments

Consure Medical has successfully launched the US FDA 510(k) cleared, QoraTM Stool Management

Kit (SMK). The QoraTM suite of products are commercially available in the US and in India in three variants - Qora AridaTM for hygienic acute episode management, Qora AIMTM for complex patient management requiring frequent MRI scans, and QoraAeonTM for critical, long-term care patients in acute care as well as long-term care settings. The QoraTM SMK portfolio is indicated for use for up to 29 days.

Aiming to become the new standard of care in bowel management, QoraTM is now the most advanced closed system fecal containment device, specially designed to:

- Prevents moisture-associated skin breakdown and pressure ulcers.
- Prevent cross-infection through effective fecal containment.
- Manage severe and frequent diarrhoea episodes.
- Reduce material use and optimize nursing time and effort.

# THIRD CALL PROJECTS

## Commercialization of Cultivated Sea Plants based Organic Bio-Stimulants for Applications in the USA

**Ganesh Vishwanath**
GloBridge Ventures LLC
CA

**Abhiram Seth**
Aquagri Processing Pvt. Ltd.
New Delhi

### Problem

There are two fundamental issues being targeted here: the endemic poverty in India, and the rising consumer demand for organic products in the US.

### Solution

Aquagri has pioneered seaweed cultivation in India with a prime focus on creation of livelihood opportunities for the coastal communities and to enhance its sustainability by developing a wide range of value added products.

Aquagri through sea plant cultivation would help in expanding the cultivation base itself. GloBridge Ventures LLC plans to work in collaboration with Aquagri to market and distribute the products/solutions with a focus on organic segments that improves efficiency, lowers cost and improves the health of livestock and crop productivity.

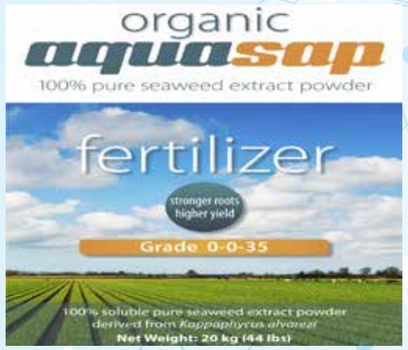
### Project Accomplishments

The team has developed bio-stimulant products and has registered their product with United States Department of Agriculture (USDA) under their National Organic Program (NOP) and California Department of Agriculture (CDFA).

SeaNutri (US Partner) began commercialization in 2015 and has received positive feedback on product solubility, uptake of nutrients, and soil conditioning. In 2015, the product was tried on almonds, tomato, strawberry, avocado, grapes, potato and green vegetables and received good feedback/results.

AquaSap (derived from Red Algae is a 100% Seaweed Powder/Liquid (AquaSap – Carrageenan) that increases photosynthesis resulting in healthier foliage. It increases flowering and decreases fruit drop and provides the highest organic Potassium application without using Potassium hydroxide.

The product can reduce regular dose of fertilizer by 25%.









## Solar Electric Tractor - Agriculture and Power

**Keith Rutledge**
Solectrac LLC
CA

**Parimal Shah**
Lovson Enterprises Pvt. Ltd
Ahmedabad

### Problem

Rising diesel prices makes it very difficult for subsistence farmers in less developed countries to afford tractors to increase agricultural production.

### Solution

The Solar Electric Tractor (Solectrac) is a fully functional agricultural tractor that operates with upto 5 times the efficiency of a diesel tractor performing the same farming tasks. The solar electric tractor with a battery-inverter system provides electric power anywhere, anytime. Solectrac can also be used for portable power, water pumping and mechanical functions as well as hauling and transportation needs. Because the Solectrac is electric, its batteries can be charged directly by clean renewable energy or it can be charged at low cost from the electric utility grid at off-peak rates. Solectrac uses patented "quick change" battery packs to extend operational periods.

### Project Accomplishments

The team has developed one fully functional agricultural tractor of higher efficiency than a diesel tractor performing the same farming tasks. The solar electric tractor utilizes solar energy replacing fossil fuel and implements manufacturing to produce a cost-effective farm tractor for both US and Indian farmers. The development of a second prototype of a fully functional tractor is under process.

## Affordable, Clean Cook Stove and Electric Power Sources for Rural India

**Aleksandr Kushch**
Hi-Z Technology Inc.
San Diego CA

**Neha Juneja**
Greenway Grameen Infra Pvt. Ltd.
Navi Mumbai

### Problem

Over 160 million households constituting 70% of India's population are cooking on polluting cookstoves/indoor open fires. Over 50 million households do not have access to reliable electricity.

### Solution

The project aims to provide a complete household energy solution that combines clean cooking and reliable, on-demand power generation. The project aims to develop a stove called "*The Greenway Power Stove*" which will employ a novel clean combustion technology and a low cost thermoelectric module to generate electricity from the stove during cooking for charging mobile phones.

### Project Accomplishments

The team has developed the "*Greenway Power Stove*" with low cost thermoelectric modules and generators that can also generate electricity from the cook stove. The product has entered the market and is commercially available for sale by Greenway Appliances. These thermoelectric generators have been integrated into two distinct products - Greenway SmartStove™ and Greenway JumboStove™ which are available in the market at competitive and affordable prices.





## Affordable and User-Centric Knee Joints to Remobilize Above-Knee Amputees in India and Globally

**Krista Donaldson**
D-Rev (Design Revolution)
San Francisco

**Pooja Mukul**
Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS), Jaipur

### Problem

Over 1.9 million people in India are above-the-knee amputees and unable to live productive lives. With 77% of India's population living under $2 a day, amputees rarely receive rehabilitation and have no access to quality prostheses.

### Solution

The team is co-developing *Re-motion knee* i.e. a high-performance, low-cost prosthetic knee joint for above-knee amputees that addresses problems seen with prosthetic clinics: successful fitting, follow-up and reporting of amputees. The goal for the ReMotion Pilot Program is to become a global model of the delivery of high performance affordable medical products targeting low-income patients. This partnership will place India and the US at the forefront of affordable quality medical products design and implementation, and is the first step in global scaling and commercialization of the ReMotion Knee.

### Project Accomplishments

The ReMotion Knee is the first high performance affordable polycentric prosthetic Knee joint that will be available to transformal amputees at the bottom of the pyramid in India and across the developing world. The ReMotion knee is designed and optimized to meet the occupational, environmental and socio-cultural needs of low resource users. The ReMotion knee is ISO 10328 certified and launched in the US for global sale on December 8, 2015 and in India on February 13, 2016. The team has successfully fitted 120 ReMotion Knee Joints across India from the commencement of the project. The project has established mobility, dignity and autonomy of amputees across the world.

## Easy to Use, Integrated Neonatal Resuscitation Solution

**Dan Harden**
Whipsaw, San Jose
CA

**Avijit Bansal**
Windmill Health Technologies
New Delhi

**Anurag Mairal**
Stanford Global Biodesign
Palo Alto, CA

### Problem

Five out of every hundred babies born (6 million worldwide, 1.3 M in India every year) have birth asphyxia-largely preventable by basic resuscitation. Current devices are difficult to use, ineffective especially in developing world.

### Solution

The innovation (NeoBreathe™) is an integrated neonatal resuscitation solution that's much easier to use and suitable for field conditions. It will therefore empower front-line health workers such as medical professionals, community health workers, midwives and other skilled birth attendants to perform basic neonatal resuscitation effectively – with minimal training.

### Project Accomplishments

The innovative device NeoBreathe™ is a human-safe unit which was fabricated and deployed at 12 healthcare centers spanning 5 Indian states, including 2 government

hospitals in Delhi and Madhya Pradesh.

The device has been showcased at one regional conference and at the largest All India Conferences of Pediatricians viz. NEOCON and PEDICON. The device was received with tremendous enthusiasm by pediatricians as well as potential distributors. Several advance orders were also booked in the Conference itself. The full commercial launch is planned for Aug. 2016 and full scale manufacturing design is being currently set-up.

**Rendered Model**

**Actual Product Photograph**





## OneBreath : Affordable Mechanical Ventilation for India

**Matthew Callaghan**
OneBreath, Inc., Palo Alto

**Vijay Simha**
Vaatsalya Healthcare
Bangalore

### Problem

Respiratory illness is a leading cause of hospitalization and death in developing nations. Each year thousands of patients die because of lack of early access to mechanical ventilation.

### Solution

In this project, the team of Vaatsalya and OneBreath will develop and commercialize a novel ventilator specifically addressing the need for high quality pre-hospital and emergency care in India's lower income population. The designed ventilator will specifically target rural and semi-rural hospitals treating a range of respiratory patients. The cost, durability and ease-of-use are critical factors that are considered.

### Project Accomplishments

OneBreath is a ventilator intended for use in ICUs, emergency rooms, and ambulances. The OneBreath ventilator has designed to provide continuous respiratory support for patients. The cost of OneBreath's ventilators is 12% less than that of regular ventilators in India.

The team has developed low cost OneBreath Ventilators with the following features:

- Advanced ventilation variants including Assist Control (AC), Synchronized Intermittent Mandatory Ventilation (SIMV), Pressure Support Ventilation (PSV), Plus Pressure Support (+PS).
- New condition-based ventilation.
- Intuitive touchscreen interface with real-time waveforms.
- Bluetooth wireless connectivity.
- Operates on internal compressor or external oxygen and compressed air.
- Long-lasting rechargeable batteries.


## Commercializing a Scalable Low-Cost Arsenic Remediation Technology for Societal Impact

**Shashi Buluswar**
ITT Inc
Oakland, CA

**Joyashree Roy**
Jadavpur University
Kolkata

**Ashok Gadgil**
Lawrence Berkeley National Laboratory, Berkeley, CA

### Problem

About 60 million individuals in West Bengal and Bangladesh, along with millions more in China, Nepal, and Cambodia, are exposed to high levels of naturally occurring arsenic every time they drink from their local well.

### Solution

The team have developed and patented Electro Chemical Arsenic Remediation (ECAR) which enables low cost affordable arsenic-remediation of water, within a sustainable service delivery model. Under this model, safe water would be provided to school children while excess may be sold at a low cost affordable price. This public-private partnership would ensure that the plant is not abandoned due to failed maintenance that has plagued other implementations.

### Project Accomplishments

The team has taken Electro-Chemical Arsenic Remediation (ECAR) technology invented and patented by the Gadgil Lab (Berkeley). ECAR can provide affordable access to arsenic-safe water to rural communities with a "Make in India" technology and a financially sustainable service delivery model. It aims at protecting school children from arsenic-caused diseases, and also offering the water to close-by families at an affordable price. The social embedding model would ensure that the plant is maintained with proper reinvestments and repairs – lack of which has led to abandonments and failures of arsenic treatment plants for the past three decades.





# FOURTH CALL PROJECTS

## Transforming Arsenic and Fluoride Crisis in Drinking Water into an Economic Enterprise

**Mike German**
WIST, Inc, Brighton
MA

**Abhijeet Gaan**
Rite Water Solutions (I) Pvt. Ltd.
Nagpur

### Problem

Over 100 million people across 18 of 29 states in India experience arsenic and fluoride poisoning by drinking contaminated groundwater. This results in hundreds of thousands of people suffering from cancer, bone deformities and early death.

### Solution

The economic opportunity by blending a novel, locally-sourced Donnan Principle-based arsenic and fluoride adsorbent (Donna-AFSorb) with a micro-franchise business model providing appropriate community-based or domestic water filters to villagers. A second-generation, multi-contaminant adsorbent has been developed that can be locally produced. The synthesis of Donna-AFSorb has been optimized at the lab-scale for treatment of arsenic, fluoride, phosphate, nitrate, selenite and uranium.

### Project Accomplishments

Field validation of Hybrid Ion Exchange (HIX)-Nano media by modification in existing installation has been completed and field trials for modified system has been done in Kolkata. The teams established a protocol for Public Health Engineering Departments (PHEDs) to validate HIX-Nano systems. The brand name of the treated water is "Drink Well".

The project creates 3 Jobs for every 500 households in the region where the project is undergoing.

## Development of a Low-Cost, Portable Auto-Refractor

**Shivang R. Dave**
PlenOptika,
Somerville, MA

**Sriram Ravilla**
Aurolab,
Madurai

### Problem

There are more than 1 billion people worldwide who are suffering from poor vision because they do not have the prescription eyeglasses they need - in India, this number is more than 130 million people. With the right pair of low priced eyeglasses, quality of life and productivity can be greatly improved. A major barrier to obtaining eyeglasses in low-resource settings is getting an accurate prescription. There is an acute shortage of trained optometrists to prescribe eyeglasses and current technologies for measuring a prescription require intensive training or are too expensive for widespread use.

### Solution

The team aims to improve eye care through the QuickSee™ - an innovative, inexpensive, hand-held device that quickly prescribes corrective eyeglasses with the click of a button. While maintaining the current standard of care, this device will enable a ten-fold reduction in the time needed to measure an eye for corrective eyeglasses and can be used by technicians with minimal training.

### Project Accomplishments

'Quick See™' is based on wave front aberrometry—an extremely accurate technique that is currently used to guide LASIK surgery. Unlike *conventional auto refractors, which measure only the lower order aberrations* of the eye, Quick See™ measures the full aberration fingerprint of the eye, enabling an accurate eye check-up. The main feature of Quick See™ is that it is hand-held. Additionally, it is smaller than a laptop, rugged, and battery-operated. The device is priced competitively at a lower cost. This is an easy-to-operate device which can be held to one's eye where he/she can find the red spot, and push a button. The Quick See™ measures the eyesights in just a few seconds.

20 prototypes are under assembly line. The team is expecting the commercial version for sales around June – July 2016.





## Developing Novel Biological Seed Treatments to Confer Abiotic Stress Tolerance in Crops

**Rusty Rodriguez**
Adaptive Symbiotic Technologies,
Seattle, WA

**Anup Karwa**
SFPL Crop Life Sciences Pvt. Ltd.
Krishidhan Seeds, Jalna, Maharashtra

### Problem

Only 9% of the earth's landmass is conducive for crop production, while 91% is under abiotic (drought, salinity, temperature) and biotic stress (pathogens, insects) due to land degradation, urbanization and climate change.

### Solution

The project partners have developed a novel seed treatment, BioEnsure™, which contains a mixture of beneficial fungal endophytes designed to enhance the tolerance of crop plants to abiotic stresses such as drought, salinity and temperature. BioEnsure™ was developed by harnessing the natural power of symbiosis which enables a broad-spectrum of agricultural crops to flourish under areas of drought, extreme temperatures and saline soils.

### Project Accomplishments

The project partners developed BioEnsure™ as microbial seed treatment. Over the last few years it has been demonstrated that plants treated with BioEnsure™ produce up to 85% more yield than the untreated plants under severe drought stress. Even in normal, low stress years, BioEnsure™ gives an average of 7% more yield.

BioEnsure™, a variant of gluconates is registered as an organic item by the Organic Materials Review Institute.

Key features of BioEnsure™ are that it is natural nutrient (metal) chelate, 100% water soluble, and stable over a wide pH range. It is compatible with most common agrochemicals (in-house validated) and the product is biodegradable and organic leaving no chemical residue (ECOCERT Certified).

The main benefit of BioEnsure™ is that it provides more yield than untreated plants under severe drought stress. It is highly nutrient efficient, economical and affordable. BioEnsure™ has a stable shelf life period of over 3 years.

The Indian PI is selling the product in India under the brand "Krishi Mitra", Krishi Dhan", GlucoZinc, GlucoPotash, GlucoMag, GlucoFe, GlucoMn, GlucoCal, GlucoCalbor, GlucoMix, Power-B, TriO, Relief, etc.

Marketing and sales network in India is managed by 50 Agri Business Managers.

## Commercializing a Transformational Modular Roofing Solution for Low-Income Urban Homes

**Shashi Buluswar**
LIGTT Corporation
Oakland, CA

**Hasit Ganatra**
Re-Materials
Ahmedabad

### Problem

Over 100 million Indians live in slums. The majority of these houses have inadequate roofs made of corrugated metal, asbestos cement sheets, or clay tiles. Families suffer from unbearably hot living spaces, high maintenance costs, frequent leaks, difficult installation, and a high risk of injury if the house collapses.

### Solution

The start-up team is committed to provide high quality shelter to families in slums and villages around the world. To achieve this, the team has developed a modular roofing product made from recycled materials. This solution is superior to widely used cement and metal sheets that cause poor living conditions. Currently, the team has several ongoing pilots with families in slums in Ahmedabad.

### Project Accomplishments

The teams have installed 12 ModRoof™ to twelve low-income urban homes in Ahmedabad, India and adjoining areas. The target is to install 15 units in the defined territory.

The ModRoof™ panels are made to be strong, waterproof, fireproof, and long-lasting, which improves safety and decreases maintenance. ModRoof™ has a life-time of 15 – 20 years, if a certain maintenance program is followed. The coating has a life-time of 20 years+ if well maintained. It has to be recoated after 7-10 years and then every 5 years. ModRoof™ installed homes are cooler in the summer, dry and quiet in monsoon season, and overall provide higher-quality living spaces all year round. ModRoof™ is a low-cost and easy-to-install system with attractive payment plans available through top micro-finance companies.





# FIFTH CALL PROJECTS

## Moving Beyond the Pavement : Affordable Mobility for Users Around the World

**Sudhir Mehta**
Pinnacle Industries Ltd
Pithamour, MP

**Tish Scolnik**
GRIT, Cambridge
MA

### Problem

People with disabilities face challenges as regular wheelchairs don't meet most of their needs.

### Solution

The Leveraged Freedom Chair (LFC) is an all-terrain wheelchair designed to meet the needs of people with disabilities around the world. Version one (LFC1) is currently in production in India. It is rugged and ultra-low-cost, but does not fold, making shipping and transportation difficult. Version two (LFC2) is currently in production in the United States. It folds and uses efficient manufacturing techniques to produce, but is too expensive to be viable in emerging markets.

The team proposes a third version-LFC3 manufactured at scale in India and designed to be both low-cost and foldable. Combining the mobility offered by the LFC1 with the folding and manufacturing improvements of the LFC2, it will help to achieve a global scale and provide life-changing mobility.

The Indian PI will be manufacturing the wheelchairs under its CSR activity.

# Hand-held Forced Oscillation Device for Improved Detection and Monitoring of Airway Disease

**Anurag Agrawal**
CSIR-Institute of Genomics and Integrative Biology, New Delhi

**Ashutosh Sabharwal**
Cognita Labs and Rice University, Houston, TX

## Problem

Lack of simple and accurate diagnostic tests makes lung diseases among the top three threats to public health. Currently available method i.e. Spirometry requires expert supervision and is not sensitive enough for detection of lung diseases. The most promising alternative to Spirometry i.e. Forced Oscillation Technique (FOT) devices are however poorly penetrated in the market due to cost, bulkiness etc.

## Solution

The team proposes to field test and commercialize a hand-held, portable, battery-operated FOT device named SmartCMOT that uses novel design and analysis elements to improve diagnosis in the field, while lowering prices by 90% and reducing the risk of infection transmission between patients. This would permit early, accurate and cost effective assessments.

## Project Accomplishments

In this joint project, PIs are developing the world's first hand-held, portable and battery-powered FOT device, called PulmoScan, for measurement of lung function. The new device will significantly expand the usage scenarios for medical professionals to conduct lung function testing. Early and accurate diagnosis could lead to lifestyle modification and therapeutic interventions that improve the quality of life and reverse or arrest the decline in lung function.

The portable proprietary hardware is being developed by Cognita Labs, based in Houston, Texas, and includes innovations to significantly reduce the device size and battery consumption. The proprietary algorithms to automate diagnostic data analysis are being developed by IGIB, New Delhi, and includes novel innovations at the intersection of clinical and statistical sciences.

The first full hardware prototype was functional in May 2015, and the second prototype has cleared first-stage accuracy testing in December 2015. The algorithms have successfully cleared testing on an existing marketed FOT platform (Viasys Master PFT IOS module), achieving accuracy of greater than 90% in classifying normal from airway disease and showing potential to distinguish Chronic Obstructive Pulmonary Disease from asthma. These will be adapted to PulmoScan hardware, once human testing starts.





# Development of Low Cost Belt System for Human Body

**Ganesh Ram Jangir**
Newndra Innovations Pvt Ltd
Jaipur

**Paul Scott**
MedSpark, LLC
Obispo, CA

## Problem

A common problem for wide range of professions is back and waist pain. Possible remedies include intake of high doses of painkillers or usage of constrictive elastic belts which usually restrict body movements. Surgery of the spine is complex and can have severe side-effects in addition to a lengthy recuperation period.

## Solution

JaipurBelt™ is a cost effective solution that can minimize a patient's pain and drudgery. It is useful for many applications, including manual lifting, frequent bending up and down, or other situations where high levels of stress are applied to the spine and waist without restricting body movements.

JaipurBelt™ is human powered, lightweight and economical exoskeleton for wide range of workers and professionals who have to work in back-bent position , have to bend up /down frequently, have waist and back pain or have problems like Kyposis, Spondylitis, Slip-Disk, due to workload, age or lifestyle.

It supports the spine and waist by sharing physical work load up to a predefined, variable limit without restricting body movements.

## Project Accomplishments

The Indian PI has developed a prototype which is suitable for farmers, laborers and other people who are engaged in physical labour work. JaipurBelt™ was selected as one of the top five finalists at the Indian Merchants Inclusive Innovation Awards-2014.

## Sixth Call for Proposals

The United States-India Science and Technology Endowment Fund (USISTEF) announced the Sixth Call for Proposals in May 2015. Over 136 executive summaries were received in the two broad categories of Healthy Individual and Empowering Citizens. Four expert panels were formed in the US and India, one in each category and each country respectively, and comprised of technical experts, entrepreneurs, venture funding agencies and Board members. These expert panels independently evaluated the executive summaries. Subsequently, after the Joint Indian and US Panel Co-Chairs meeting, 16 executive summaries (9 in the Healthy Individual and 7 in the Empowering Citizens categories) were shortlisted for Stage II (Detailed Business Plan and Presentation).

On 18-20 November 2015, a Joint Expert Panel meeting was held at Sunnyvale, Silicon Valley, to review the detailed business plans and presentations by the shortlisted teams. After this, the following five promising proposals (4 in Healthy Individual and 1 in Empowering Citizens categories) were identified for Stage III (Due Diligence and Budget Discussion).

| S. No. | Project Title | Partners | |
|---|---|---|---|
| | | Indian | US |
| 1. | Development and certification of super affordable, rugged, reliable, connected and easy to use Defibrillators with a built-in power source (Hand Cranked) for low resource settings | **Jeevtronics (P) Ltd**, Pune | **Dhurjaty Electronics LLC** Rochester, NY |
| 2. | Modular diagnosis of cervical cancer utilizing smartphone diagnostics and artificial intelligence | **Aindra Systems (P) Ltd**, Bangalore | **Alexapath LLC** Brooklyn, NY |
| 3. | Development of Non–Stress fetal monitoring tool that captures the fetal heart rate and its variability over the course of a 20 minute ante-natal check-up | **Brun Health (P) Ltd** New Delhi | **Ivan Tzvetanov** Berkeley, CA |
| 4. | Heart disease management system consisting of affordable wearable sensors, break-through materials, wireless communication and health monitoring centre allows physicians to better manage their cardiac patients cost-effectively | **Monitra Healthcare Private Limited** Hyderabad | **DuPont Performance Polymers** Sunnyvale, CA |
| 5. | The Rhino Digester: An onsite waste to fuel appliance - Organic Waste Disposal Digester for Industrial and Domestic use | **Flycatcher Technologies** Vadodara | **Datawrx LLC** Plano, TX |





# US-India Science and Technology Endowment Fund : Other Programmatic Activities

## TiECon 2015: Disruptive Entrepreneurship

15-16 May, Santa Clara Convention Centre, Silicon Valley

The United States-India Science and Technology Endowment Fund (USISTEF) team led by George Sibley, Minister Counsellor, Economic, Environment, Science & Technology Affairs, US Embassy, New Delhi & the US Co-Chair of the USISTEF Board, participated at the TiECon 2015 conference at Silicon Valley on May 15-16, 2015. TiECon is the largest global gathering of entrepreneurship bringing together Silicon Valley's diverse, dynamic, and expert ecosystem to ignite and display disruptive technology innovation. This year, 4800 delegates from 22 countries attended TiECon. The objective of USISTEF`s participation was to provide greater visibility and outreach for the Endowment Fund activities, and to engage in an extensive promotional exercise for the newly announced Sixth call of the Endowment Fund in the United States. As part of the partnership between USISTEF and the organizers of the event, USISTEF received a booth at the TiECon-Tech Exposition to display the Endowment's activities and funding opportunities. A number of USISTEF's project teams also showcased their innovative products and technologies from their Endowment-supported projects. The participation of USISTEF's project teams at TiECon-2015 & Tech Expo provided the teams a unique opportunity for networking and partnering. Mr. Sibley was a keynote speaker for the "Global Entrepreneurship" track on May 16, 2015. In his remarks Mr. Sibley spoke about various binational funding programs and elaborated the objectives, timeline and processes of the Endowment Fund.

## INNOFEST

22 August, Indian Institute of Science, Bangalore

InnoFest is a festival of innovations, where more than 1,000 innovators received hands-on-experiences at maker space by MIT Media Labs, design thinking workshops by Frog Design, TED-type personal talks by young founders of InMobi, Ola Cabs, RedBus, PayTM, etc. The event witnessed a number of start-ups and the young entrepreneurs showcasing their innovative ideas transformed into the best of technology driven prototypes. The US – India Science & Technology Endowment Fund sponsored the event under the 'Silver Sponsor' category and set-up a booth for USISTEF at the festival as part of its outreach activities.

## Indo-US Start-Up Konnect Conclave

27 September, Silicon Valley

The Indo-US Start-Up Konnect Conclave was organized by TiE Silicon Valley in partnership with NASSCOM and the Indian Institute of Management Ahmedabad (CIIE) on 27 September, 2015 during the visit of the Indian Prime Minister Mr. Narendra Modi to San Jose. A special Expo was organized to showcase select start -up ventures from India and the US that are making an impact on society with their products and technology. IUSSTF facilitated the participation of a few awardees of the bilateral US-India Science and Technology Endowment Fund (USISTEF) for the expo to showcase their innovations and products developed with the support of USISTEF. Prime Minister Modi viewed all the innovations and had discussions with many of the awardees. Additionally, the USISTEF awardees also had an opportunity to interact and network with various start-up enterprises and with more than 200 investors and business community members at the event.





## IKMC2015: Spreading the Innovation Spirit

2-3 November, Hyderabad International Convention Centre, Hyderabad

International Knowledge Millennium Conference, IKMC, is a get-together of innovators, start-ups, industry experts and policy makers to brainstorm on the path of unshackling and spreading the spirit of innovation. The 2-day conference began with the Inaugural Session on "*Envisioning India 2025: Innovators as Change Agents*". This was followed by three sessions discussing how innovators and startups can equip themselves as they go ahead with their entrepreneurial journey and take their innovations global. Interactive features of the Conference included a Policy Roundtable on mapping innovation ecosystems, Posters from over 100 innovators, Brainstorming with Mentors and a Lightning Pitch Round.The Second Day session was chaired by Dr. Rajiv Sharma, former Executive Director, IUSSTF, and the theme of the session was "*Indian Innovations for Global Development*".

## US-India Startup Assist Workshop

16 November, Noida

With an objective to promote the exchange of ideas among entrepreneurs who are on the path to commercialization, connect them with experts, and help entrepreneurs learn from each other, IUSSTF in partnership with the Embassy of the United States of America and the Federation of Indian Chambers of Commerce & Industry (FICCI) organised the *US-India Startup Assist Workshop* at the FICCI-Lead Incubation Centre in Noida. About 30 award-winning entrepreneurs of the several US-India programs including the US-India Science & Technology Endowment Fund, Millennium Alliance, DST-Lockheed Martin India Innovation Growth Program, Stanford India Bio-design Program, and the DST-IUSSTF-Anita Borg Institute Women Entrepreneurship Quest were invited from across the country. Through the workshop, the entrepreneurs identified common challenges faced by start-ups and suggested solutions. The broad discussion areas included product commercialization, team building, branding, product promotion, government support, scaling up of a venture, regulatory compliance, and fundraising. There was special focus on "promoting women entrepreneurs in science and technology," which remains a priority for bilateral engagement between the governments of the United States of America and India. The workshop was intended to further the engagement between the United

States and India on science and technology entrepreneurship issues, as well as commemorate the Global Entrepreneurship Week - a joint initiative of the US Department of State and the Ewing Marion Kauffman Foundation, to promote and celebrate entrepreneurship worldwide.

## US-India Entrepreneurs Roundtable

8 December, Gurgaon

The "*US-India Entrepreneurs Roundtable*" was organized by the Embassy of the United States of America and IUSSTF on December 8, 2015 at 91 springboard, Gurgaon, Haryana. The event was attended by Deputy Secretary of State, Antony J. Blinken, and Deputy Chief of Mission, US Embassy Michael P. Pelletier. Mr. Blinken interacted with the following six award-winning Indian entrepreneurs of the US-India Science & Technology Endowment Fund:

- Pooja Mukul, Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS), Jaipur- *Affordable and user-centric knee joints Affordable and user-centric knee joints to remobilize above-knee amputees in India and globally*
- Anup Karwa, SFPL Crop Life Sciences Private Limited, Jalna- *Developing novel biological seed treatments to confer abiotic stress tolerance in crops*
- Amit Sharma, Consure Medical Private Limited, New Delhi- *A novel device to manage fecal incontinence in non-ambulatory patients*
- Avijit Bansal, Windmill Health Technologies, New Delhi-*Easy to use, integrated neonatal resuscitation solution*
- Tanmaye Seth, Aquagri Processing Pvt. Ltd., New Delhi- *Commercialization of cultivated sea plants based organic bio-stimulants for applications in the USA*
- Abhinav Sinha, EKO India Financial Services Private Limited, New Delhi-*Branchless banking and financial services for the unbanked and under-banked*

Each entrepreneur briefed Deputy Secretary Blinken about their innovative product and technologies, its impact on society, and how the US-India Science & Technology Endowment Fund has supported them in their entrepreneurial ventures. Mr. Blinken took a deep interest in engaging with each entrepreneur and learning about their inspiration, success, challenges and fundraising. He also discussed about regulatory compliances and government policies. The broad discussion included the value of collaboration with the US, and other possible bilateral engagements to enhance the entrepreneurial ecosystem.

# Indo-US S&T
# PARTNERSHIPS

# Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in the US and India

## Contact Persons

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Hypertension diagnosis and management is a critical healthcare issue. However, the approach for measuring Blood Pressure has remained the same for the past several decades and therefore this area is now ready for disruptive innovation. The **Science & Engineering Research Board (SERB)**, Government of India has partnered with the **National Institute of Biomedical Imaging and Bioengineering (NIBIB, NIH)**, USA to announce the ***Indo-US Grand Challenge Initiative on Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the US.*** The purpose of the initiative is to encourage collaborative research within and between both the countries to propose new approaches to the measurement of Blood Pressure that are unobtrusive or passive, low cost and which can automatically provide frequent data recording and reporting to healthcare workers as well as feedback to the patients.

SERB and NIBIB have launched *two separate and parallel*, but fully coordinated, funding opportunity announcements in India and the US respectively to promote research in this area and generate alternate scientific approaches and technological options. It is expected that this partnership between the two countries will leverage knowledge and material resources to develop new technologies which are relevant for low resource settings not only in their respective political domain but other similar settings all over the world.

## FIRST CALL

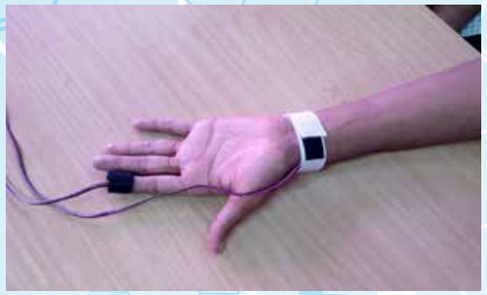
Against the announcement for the **first call** for Expressions of Intent (EOI) on the Indian side, the following 3 proposals were selected for support:

### Development of a Low Cost Arterial Tonometry Based Blood Pressure Monitoring Device

**Santosh Noronha**
IIT Bombay

**C. S. Pramesh**
Tata Memorial Centre
Mumbai

The project aims at building a low cost arterial tonometry based blood pressure monitoring device. The team has envisioned the end product to be used as a cost effective and precise alternative to the existing solutions. The solution is expected



Demonstrating the developed prototype

to be used primarily in the rural areas and public health centers for ambulatory blood pressure monitoring as well as for clinical blood pressure measurement in hospitals. They are exploring an option of building a wearable version of the device. The major constraints to be addressed include accuracy, cost, simplicity and robustness, time for measurement, as also the size and complexity of the instrument.

The team has been working on development of a high throughput mechanism for estimation of blood pressure. The blood pressure is estimated using various parameters like photoplethysmogram(PPG), electrocardiogram(ECG) and temperature. The sensor technology being developed is small in size, light weight, cost effective, has immunity to external factors like temperature, electromagnetic interference and most of all it has a scope for mass production.

The team has also collaborated with contacts via the Healthcare Research Consortium at IIT Bombay for helping them to clinically validate the device. They also plan to work towards getting CE marking for the product so that the device meets international standards. Once the clinical trials are successfully completed they plan to launch the device for clinicians, after which it would be launched as a personalized diagnostic device.

## Arterial Compliance Probe for Cuff-Less Blood Pressure Measurement

**M. Sivaprakasam**
HITC, IIT Madras

**Jayaraj Joseph**
HITC, IIT Madras

**Boby George**
IIT Madras

**V. Jagadeesh Kumar**
IIT Madras

Non Invasive measurement of Blood Pressure (NIBP) has well established utility in screening, clinical diagnosis and patient follow-up for a variety of critical disease conditions. Traditional methods of NIBP, such as auscultation and oscillometry, use a cuff and require expert medical personnel and hence are not readily amenable in field or home settings. Majority of cuff-less blood pressure (BP) monitoring technologies are based on tonometry, Pulse Contour Analysis (PCA) and Pulse Transit Time (PTT) principles. Reliable tonometry measurements require expertise, whereas PTT based techniques suffer from both subject specific and population specific calibration issues and are hence limited to home or well-being applications and are yet to attain wide spread acceptance. Wide spread use of pulse contour analysis based techniques for BP estimation is also limited by the requirement of population specific calibration. Hence, there is a strong need for the development of easy to use, reliable, cuff-less techniques for measurement of blood pressure, that do not require patient specific or population specific calibration, which can potentially be used in clinical, field and even in home care scenarios.

Healthcare Technology Innovation Centre (HTIC) of IIT Madras has developed and tested a novel method for calibration free, cuff-less BP in controlled laboratory settings. The work was done as part of the project titled "Arterial compliance probe for cuff-less BP measurement" under the Indo-US Grand Challenge Initiative – Affordable Blood Pressure Measurement Technologies for Low Resource Settings. This method eliminates the need for any calibration coefficients. Following the development of a set of mathematical models for blood pressure computation, design of custom probes that measure local PTT, and development of essential electronics experimental hardware, a proof of principle of the proposed method has been demonstrated in laboratory settings. The method and technology has been filed for national and international patent protection and the work has been presented in a leading biomedical engineering conference upon invitation.

Building on the successful 'proof-of-principle' results of phase-1 of the project, the team has proposed a detailed plan for phase-2 to deliver a full-fledged technology and pre-commercial device for calibration-free, cuff-less BP measurement that is verified as per technical standards and validated in various healthcare settings. The proposal is currently under evaluation at the Department of Science and Technology.

## Rapid Real Time Blood Pressure Measurement and Hypertensive Predisposition Diagnostics Using Pulse Transit Time and Blood Pressure Variability

**Bala Pesala**
CSIR-Central Electronics Engineering Research Institute Chennai

**Anurag Agrawal**
CSIR-Institute of Genomics and Integrative Biology, New Delhi

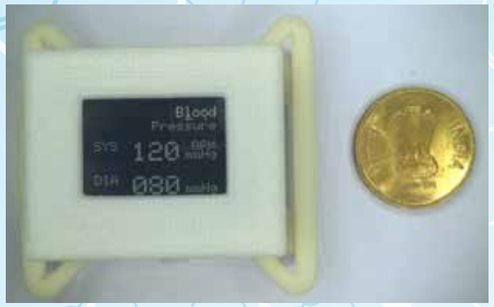
**Tavpritesh Sethi**
CSIR-4PI, New Delhi

**Suriya Prakash**
CSIR-Institute of Genomics and Integrative Biology, New Delhi

**Gautam Morey**
Sofomo Embedded Solutions Pvt. Ltd., Pune

**Debashish Das**
CSIR-Institute of Genomics and Integrative Biology, New Delhi

This project is aimed at the development of a wearable, mass deployable device capable of real time continuous monitoring of hypertension based on pulse transit time. The project is divided into three main categories: Hardware development, software



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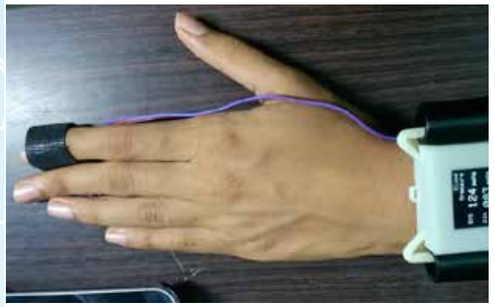

The Prototype


Demonstration of the prototype

development, algorithm development, testing and validation. As a part of hardware development, the team has realized three wearable prototypes based on high performance Advanced RISC Machines (ARM) processors. An algorithm to obtain the systolic and diastolic blood pressure from Pulse Transit Time has been developed and in addition the team has also come up with an android application capable of communication with the wearable device. The algorithm was tested on various subjects by employing Dynamic exertion and Static exertion. The models developed show that both Systolic and Diastolic Blood Pressures can be predicted accurately. The team is now working towards proving that the results achieved are suitable for mass deployment in low resource settings.

## SECOND CALL

As part of the **Second Call** the following 3 proposals were selected for support:

### A Low Cost and Easy to Use Cuff-Less Blood Pressure Measuring Device Using Pulse Transit Time and Pre-Ejection Period

**Sujay Deb**
Indraprastha Institute of Information Technology
New Delhi

Non-invasive and cuff-less measurement of arterial blood pressure (BP) is desirable for continuous patient monitoring. Among the various possible techniques, Pulse Transit Time (PTT) based approach for estimation of BP is the most promising one. But change in BP is reflected both in PTT and Pre-ejection Period (PEP). The goals of the project are the designing and development of portable equipment which can monitor single lead ECG and multiple PPG signals simultaneously in a cost effective manner.

The complete system will be designed from the principle along with transducers and signal acquisition unit so that optimal






Preliminary hardware prototype for cuff less BP monitoring

design decisions can be implemented at every step.

The device will be capable of storing and communicating vital information along with sufficient computation capability to implement BP and other diagnostic information extraction algorithms.

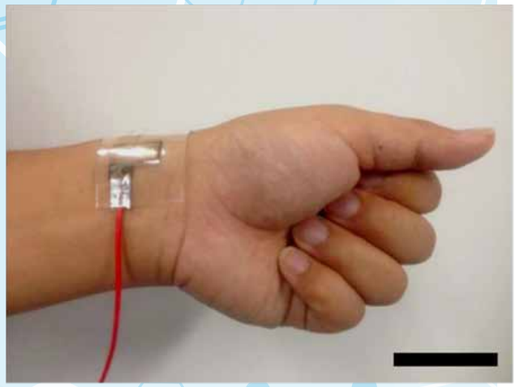
The team would investigate and study the techniques to measure PTT from simultaneously recorded PPG and ECG signals and propose, implement and validate automatic BP measurement technique.

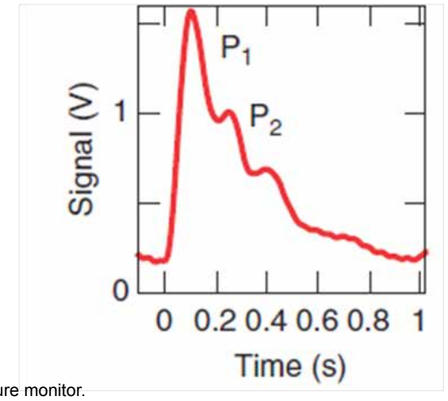
This approach can help in finding an appropriate BP calibration methodology since true PTT can be measured by this technique. The proposed BP monitoring device will be low cost, wearable and easy to use for both regular monitoring at home environment and small health-care centers.

### Blood Pressure Measurement Device based on Flexible Organic thin film transistors

**Dipti Gupta**
IIT-Bombay

The project aims to demonstrate a proof of concept for using organic thin film transistors (OTFT) as pressure sensor useful for measuring blood pressure. Towards these goals, the project is approaching the problem in a way that it measures even a small pressure fluctuation and reflects it in significant signal amplification. At present, the team has worked upon three such problems. The first and foremost problem is developing highly stretchable substrate onto which OTFT devices can be placed upon. This part is important as the stretchable substrate can firmly attach to the skin surface and is able to sustain higher level of strains. The team is working






Wearable blood pressure monitor.

towards embedding stiffer islands into these substrates so that they do not detach.

The second problem being addressed is developing low voltage OTFTs to reduce power consumption. In this part, the team identified a new dielectric material, and fabricated OTFTs. The devices exhibit excellent performance characterized by a low threshold voltage. These results are promising as it will enable using these OTFTs into an array of sensors. This work has been accepted for publication in "Applied Physics Letters".

Next, the project aims to microstructure the dielectric layer so that upon application of pressure, it produces a significant variation in capacitance. For this purpose, the team is optimizing photolithography methods to develop spike patterns. They have obtained preliminary results in which it was found that the MIM structure with microstructured dielectric layer shows change in capacitance values with applied pressure. However, this needs to be further studied in detail.

## Cuffless Noninvasive Blood Pressure Measurement Using Radial Arterial Pressure Patch


**Sitikanta Roy**
IIT-Delhi

**Anamika Prasad**
IIT, Delhi

**Rajnish Juneja**
AIIMS Delhi

**Suneet Tuli**
IIT-Delhi

**KK Deepak**
AIIMS Delhi



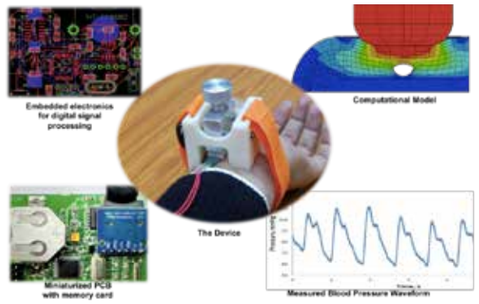



To measure the fluid pressure from tissue embedded blood vessels the team uses tactile sensing or touch sensing mechanism, which works on a "arterial tonometry" based principle. Sensor selection, calibration, reading electronics development, and system integration are the major parts of the project. During the first phase of the project, they have successfully identified the right tactile sensors in the market that are sensitive enough in the expected blood pressure range. They have also designed, optimized the reading electronics, and printed the optimized PCB. The first working prototype has been fabricated from a 3D printed housing casing. Device and its components are shown in the Figure below.

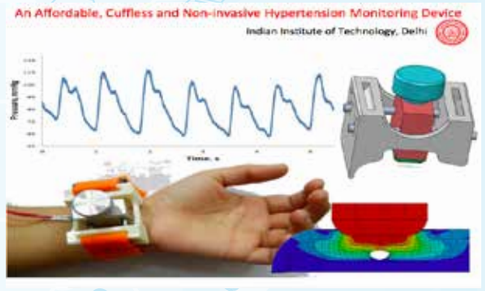
The immediate next steps in the projects are the following:

- Refine sensor calibration for tactile sensor, as well as develop a Digital Signal Processing algorithm for noise cancellation of the blood pressure readings.
- Perform fluid-structure simulation study to identify best placement location, and hold down pressure for the device.

**Device Patient calibration:** The efforts in this direction will focus on calibrating and optimizing the device and housing to make it applicable for different patient groups. A simple transfer function for calibrating against gold standard brachial measurement will be needed at this step and will involve clinical trial and validation. In addition, they aim to focus on an experimental step-up (the details to be worked on), which will be used in testing the device with different pressure inputs.




Showing the device and its underlying components




Alternative depicting the Radial Blood Pressure Device

# PACEsetter Fund

## Contact Persons

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Energy access is crucial for improving the quality of life for India's citizens and their economic conditions, and 24/7 energy availability remains a priority for the Indian government. Off-grid, clean energy technologies, combined with innovative financing models, market-based solutions, and policy alignment, have tremendous potential to become a transformative agent of economic opportunity and rural development.

In 2013, the Governments of the Republic of India and the United States of America launched *Promoting Energy Access through Clean Energy (PEACE)* as a new track under the *US-India Partnership to Advance Clean Energy (PACE)*, alongside the existing research (PACE-R) and deployment (PACE-D) tracks. PEACE aims to harness commercial enterprise to bring clean energy to individuals and communities un-served and underserved by the electricity grid. In June 2015, these governments established the **PACEsetter Fund**, a new joint fund to support the PEACE initiative by providing early-stage grant funding to accelerate the commercialization of innovative off-grid clean energy products, systems, and business models.

The mission of the PACEsetter Fund is to accelerate the commercialization of innovative off-grid clean energy access solutions by providing early-stage grant funding that would allow businesses to develop and test innovative products, business models and systems. The Fund's main purpose is to improve the viability of off-grid renewable energy businesses that sell small scale (under 1 megawatt) clean energy systems to individuals and communities without access to grid connected power or with limited/intermittent access. (Less than 8 hours per day).

The PACEsetter Fund is an INR 50 crore (USD 7.9 million) fund jointly capitalized by the Governments of the Republic of India and the United States of America. The Fund will award grants for direct support of innovative technology, business models, and programs including but not limited to: rural energy services companies (full scale integrated operators); rural distribution companies/ franchisees; operations / maintenance companies; technology implementers/system integrators; and enterprises. The Fund will also consider awarding grants for product development, studies, research, capacity building and technical assistance, as long as this will provide significant support to the companies and organizations that provide small scale (under 1 MW) clean energy access solutions to individuals and communities with no or limited access to grid connected power.

The bi-national **Indo-US Science and Technology Forum (IUSSTF), New Delhi**, India is the Administrator of the Fund.

139 Expressions of Interest (EoI) were received in response to the First Call for Proposals. Of these, the following 13 have been shortlisted for further consideration:

| S. No. | Title of EoI | Lead Implementing Organization |
|---|---|---|
| 1 | Remote Performance Monitoring & Outsourced Service Management of Solar Pumps & Off-grid Solar PV Plants through an online portal with pilot demonstration projects in Rajasthan & Andhra Pradesh States | Shri Shakti Alternative Energy Limited, Hyderabad, India |
| 2 | Solar PV Micro Grids for Remote Hamlet Electrification | Mera Gao Micro Grid Power Pvt Ltd, Lucknow, India |
| 3 | Waste to Energy Innovation at Small-scale | Grassroots Energy Inc., Belmont, MA, USA |
| 4 | Lakshadweep Floating Wind Turbine | Glosten Inc., Seattle, Washington, USA |
| 5 | Entrepreneur-led user-owned model for Solar-powered DC Microgrids in Remote Hamlets | Vayam Renewable Limited, New Delhi, India |
| 6 | Microgrid Remote Monitoring & Control | Customized Energy Solutions India Private Limited, Pune, India |
| 7 | Roof top solar for anchor load with charging stations in rural Bihar | Saija Sahyog, Bihar, India |
| 8 | Unlocking Clean Home Energy for the Base of the Pyramid: Developing and Piloting the PAYG Integrated Home Energy System in India | BioLite Inc., Brooklyn, NY, USA |
| 9 | Powering Agriculture: Community Based Solar Pumps | Environment Conservation Society (Switch ON), Kolkata, India |

| | | |
|---|---|---|
| 10 | Efficient, Rugged, Electricity supply through Solar energy with storage | R K Solar Power Systems (P) Ltd., Bangalore, India |
| 11 | Energy Development Finance Company: Initial support for launching a Market maker Debt Fund to catalyze growth of market players in Decentralized Renewable Energy (DRE) based Energy Access Projects | Centre for Innovation, Incubation and Environment (IIM Ahmedabad) and cKinetics (New Delhi), India |
| 12 | Development of user friendly gasifier and engine system for irrigation | Optima Heat Technologies, Tamil Nadu, India |
| 13 | High rate biomethanation of organic waste for generation of power for off-grid applications. | Ahuja Engineering Services Pvt. Ltd, Secunderabad, India |

# Partnerships for International Research and Education

**Contact Person**

**Nishritha Bopana**
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**Partnerships for International Research and Education** (PIRE) is a program supported by the National Science Foundation (NSF), USA, and promotes international activities across all NSF-supported disciplines. PIRE seeks to catalyze a higher level of international engagement in the US science and engineering community which is essential to addressing critical science and engineering problems. With this background, in 2014, the Science and Engineering Research Board (SERB), a Statutory Body under the administrative control of Department of Science & Technology (DST), Govt. of India, entered into a formal understanding with NSF to partner for the PIRE program. The primary goal of PIRE is to support high quality projects in which advances in research and education could not occur without international collaboration. In the global context, US researchers and educators must be able to operate effectively in teams with partners from different nations and cultural backgrounds. PIRE promotes excellence in science and engineering through international collaboration and facilitates development of a diverse, globally-engaged science and engineering workforce.

Subsequent to the NSF-SERB joint review of the proposals received under the 2014 call; "***GROWTH - Global Relay of Observatories Watching Transients Happen***", an international collaborative network of astronomers and telescopes dedicated to the study of short lived cosmic transients was selected for award. The Lead PI of this project on India side is Dr. G.C. Anupama, Professor, Indian Institute of Astrophysics (IIA), Bangalore, Karnataka, and Dr. A.N. Ramaprakash, Professor, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune is the Co-PI. The Lead institute on the US side is the California Institute of Technology. GROWTH is poised to discover many fast transients with the advent of the next generation of wide-field synoptic imaging with the Zwicky Transient Facility (2017) and Large Synoptic Survey Telescope (2022). The timely characterization provided by GROWTH will be vital to realising the scientific value provided by these discoveries. The GROWTH network will provide students and postdocs with an excellent environment for collaboration with international partners as well as for acquiring valuable skills in observational astronomy and data science.

# 6th Indo-American Frontiers of Science Symposium

10-12 August 2015, Irvine, USA

## Organizing Co-Chairs

**Jeffrey Basara**
University of Oklahoma
Norman

**Anurag Agrawal**
CSIR Institute of Genomics & Integrative Biology, New Delhi

The sixth ***Indo-American Frontiers of Science (IAFOS) Symposium*** was convened by the Indo-US Science and Technology Forum (IUSSTF) as its annual flagship event in partnership with the US National Academy of Sciences (NAS) from 10-12 August at Irvine, California. The symposium brought together 62 brilliant young scientists and technologists from Indian and US academia, laboratories and industry. At the symposium, attendees presented their talks as part of eight interdisciplinary sessions on contemporary research topics to colleagues outside their field with a view to both conveying and deriving cross-disciplinary information and insights through a format, which allows informed one-to-one discussions amongst the participants.

**Session I:** The session on ***Exoplanets and cosmic habitability*** was organized by *Sujan Sengupta* (Indian Institute of Astrophysics) and *Alyssa Rhoden* (Arizona State University). The introductory speaker in the session was *Jonathan Fortney* (University of California Santa Cruz) who spoke about exoplanets and cosmic habitability. He discussed the numerous methods that astronomers have developed to find exoplanets and what kinds of planets can and cannot be found by these methods. Planets move - This is the paradigm shift that has developed over the last 20 years and changed the way the planet formation is understood. With this background, *Kevin Walsh* (Southwest Research Institute) spoke about giant planet migration and volatile transport in the early solar system. *Kuljeet Marhas* (Physical Research Laboratory) in her presentation compared the isotopic data of volatiles and organics from primitive early solar system objects and discussed their importance in understanding the possibility of life.

**Session II:** Newly-discovered microbes represent deep evolutionary branches and comprise the majority populations in many environments. Yet we know little about how these microbes survive and contribute to Earth's ecosystems. We are gaining the first insights into the genetic content of these communities using single cell genomics and metagenomics. The session on ***Origin and extent of life*** was organized by *Mrinalini Puranik* (Indian Institute for Science Education and Research, Pune) and *Daniel Bond* (University of Minnesota). *Karen Lloyd* (University of Tennessee) covered the hypotheses about the original steps that led to life's development as well as the wide range of microbial life that exists today. *Sudha Rajamani* (Indian Institute of Science and Education and Research, Pune) in her talk discussed scenarios and mechanisms pertaining to the origin and replication of molecules of an RNA world. *Kelly Wrighton* (Ohio State University) spoke about identifying factors that constrain life 2500 meters below the surface.

**Session III:** The session on ***Biomechanical basis of animal behavior*** began with a talk by the introductory speaker *Sanjay Sane* (National Center for Biological Sciences, Bangalore) on the biomechanics of behavior. His talk put in perspective the importance of mechanics in animal behavior. *Mary Caswell Stoddard* (Harvard University) spoke about mimicry, recognition and evolutionary biomechanics and the insights from avian eggs. *Joby Joseph* (University of Hyderabad)

made a presentation on noise or spontaneous activity in neuronal systems, and its causes and strategies. The organizers of this session were *Namrata Gundiah* (Indian Institute of Science, Bangalore) and *Alison Pischedda* (University of California-Santa Barbara).

**Session IV:** The session titled ***From molecules to public health – impact of big data on medicine*** was organized by *Anurag Agrawal* (CSIR Institute of Genomics & Integrative Biology, New Delhi) and *Labib Rouhana* (Wright State University, Dayton). The contributions of DNA, exotic RNAs that do not encode proteins, and others to health or disease in individuals and cohorts of people is being defined though molecular epidemiology and population health studies that link so-called 'omics data to large medical imaging files, data from national health and death registry systems, electronic medical records, social networks and other systems. *Lauren Becnel's* (Baylor College of Medicine) talk provided an overview to these concepts and leading biomedical big data initiatives. *Chirag J. Patel* (Harvard University) described concepts of exposome science and discussed implications of environmental exposures in the coming era of "precision medicine". *Tavpritesh Sethi* (All India Institute of Medical Sciences) spoke about medicine and the matrix - coming around a full circle in next generation healthcare.

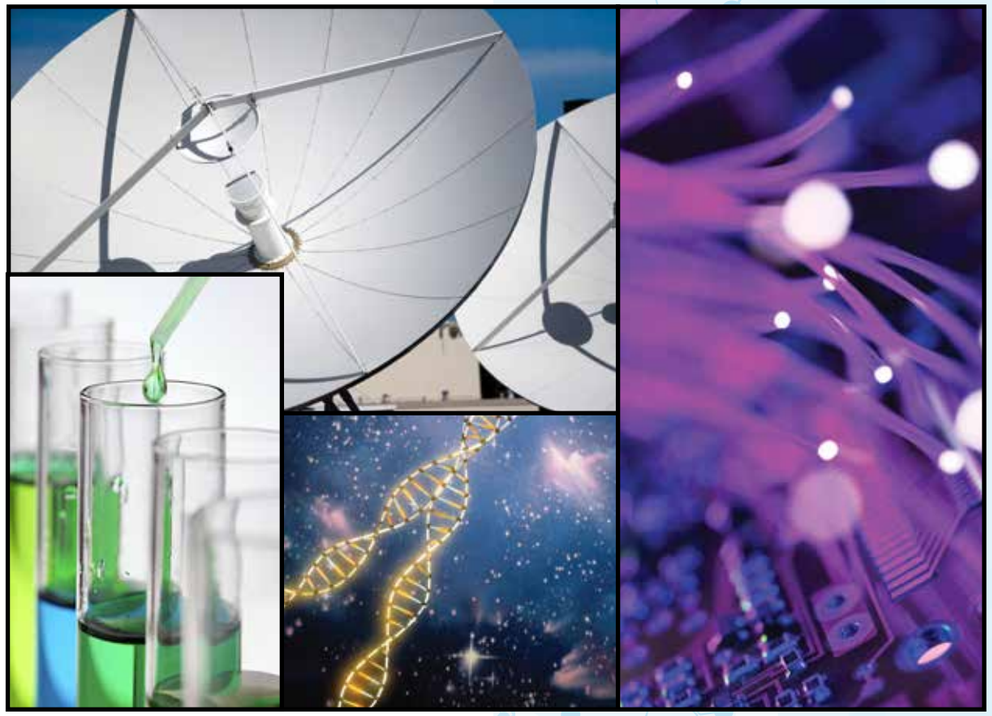
**Session V:** In the session on ***Machines that can hear, see and act***, the lead speaker *René Vidal* (Johns Hopkins University) spoke about visualizing, analyzing and learning from large-scale data. If an agent can sense, think, and act in an unknown environment, how *must* it act? *Shivaram Kalyanakrishnan* (Indian Institute of Technology Bombay) gave an overview about Reinforcement Learning (RL) and described its key algorithmic elements. He then presented some exciting new results to illustrate the role RL can play in designing increasingly autonomous and general-purpose systems. *Gert Lanckriet* (University of California, San Diego) discussed some aspects of automated music analysis for music search and recommendation: i) automated music tagging (e.g., identify ``funky jazz with male vocals'' based on music audio), and ii) (audio) content-based music recommendation, to provide a list of relevant or similar song recommendations given one or more seed songs (e.g., playlist generation for online radio). The session was organized by *Shivani Agrawal* (Indian Institute of Science, Bangalore) and *Randal Burns* (Johns Hopkins University, Baltimore).

**Session VI:** The south asian monsoon is one of the strongest phenomenon in the tropical climate system, and affects the lives of over two billion people via its effects on food security, water resources and power generation. The session on ***Monsoon / precipitation variability and predictability*** was organized by *Anoop Mahajan* (Indian Institute of Tropical Meteorology, Pune) and *Jeffrey Basara* (University of Oklahoma, Norman). The introductory speaker *Roxy Mathew Koll*'s (Indian Institute of Tropical Meteorology, Pune) talk was titled "Whither the Monsoon" and he gave a background on the South Asian monsoon and spoke about the fate of the population and biodiversity in view of a monsoon climate which is changing. *Vimal Mishra* (Indian Institute of Technology, Gandhinagar) highlighted the importance of the Indian summer monsoon for water availability in India. *Deepti Singh* (Stanford University) examined historical trends of the monsoon that are critical for agricultural planning and development.

**Session VII:** The session on ***Cognition at the edge of awareness*** was organized by *Jonaki Sen* (Indian Institute of Technology, Kanpur) and *Evelina Fedorenko* (Massachusetts General Hospital, Charlestown). The introductory talk was delivered by *Martin Monti* (University of California Los Angeles) on introducing the main questions surrounding the study of the neuroscience of human consciousness. *Narayan Srinivasan* (University of Allahabad) spoke about the effects of meditation on cognition and awareness and pointed out that meditation not only leads to better perceptual performance, but also changes in visual awareness. *Laura Lewis* (Harvard University) gave a talk on the shifting structure of brain networks at the transition into unconsciousness.

**Session VIII:** Particle physics aims to understand the fundamental character of nature at the tiniest distance scales accessible. The final session on ***Particle physics at the energy and intensity frontiers*** was organized by *Rukmani Mohanta* (University of Hyderabad) and *Rafael Lang* (Purdue University, West Lafayette). The introductory talk of the session was given by *Shrihari Gopalakrishna* (Institute of Mathematical Sciences, Chennai). *Basudeb Dasgupta* (Tata Institute of Fundamental Research, Mumbai) spoke about the potential for cross-talk of particle physics with other areas of science and technology. *Sadia Khalil* (Kansas State University) spoke about the search being done at the Large Hadron Collider that is predicted by beyond standard model of particle physics theories.

Poster sessions are a standard event at most conferences. At the FOS Symposium however, it is a little different. This is because unlike a limited-attention side-show in most other conferences, poster presentations here are as integral part of the deliberations as full scale presentations. This was achieved by giving each poster presenter a minute to speak about the work from the main podium.



# Women in Science

## Contact Persons

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**Women in Science** is one of the priority areas for engagement between the United States and India. Both countries share a common goal of promoting, enabling and retaining women in science, and increasing access to science and technology for women. The Governments of India and USA are committed to collaborate on issues of leadership, mentoring, and networking of women scientists in both countries.

Over the years, the Indo-US Science and Technology Forum (IUSSTF) has been actively engaged in promoting Women in Science. Since 2009, IUSSTF partnered with the US Embassy and the Department of Science and Technology (DST), Government of India to organize four annual workshops and several roundtables on women in science.

As a part of the continued efforts to promote Women in Science, IUSSTF in partnership with the Department of Science and Technology, Government of India and COACh International organized the **Training Program in Leadership and Career Advancement for Indian Women Scientists and Engineers**. Two Training Programs were successfully organized on August 29-31, 2015 in Pune and September 2-4, 2015 in Guwahati.

Prof. Geraldine Richmond, Founder and Chair of COACh International, President, American Association for the Advancement of Science, Presidential Chair and Professor, Department of Chemistry and Biochemistry, University of Oregon, USA; and her team organized these training programs. The program was hosted by the Indian Institute of Science Education and Research (IISER), Pune and the Indian Institute of Entrepreneurship (IIE), Guwahati.

For each of these training programs, the participants were drawn from the mid career Indian women scientists and trainers. Last year, similar training programs were organized in New Delhi and Bangalore in September 2014. Over 200 Indian women scientists across universities and R & D institutions were trained during these four training programs.

The women scientists were trained on topics such as effective negotiation skills, successful leadership methods, communicating science effectively, working in a team environment, consensus building, establishing a strong in-person and internet presence, publishing in respected journals, grant writing, and job search. Special sessions on various funding opportunities, intellectual property rights, innovation and entrepreneurship and sexual harassment were conducted. The training program provided the participants an opportunity for interacting with successful women scientists, engineers and entrepreneurs. Such an exposure motivated the participants to draw inspiration and aspire to undertake challenging assignments towards a professionally enriching experience and attaining leadership roles.

**Dr. Soumya Swaminathan,** Director General, Indian Council of Medical Research (ICMR), Secretary, Department of Health Research, Government of India and **Prof. K.N. Ganesh**, Director, IISER Pune shared their perspectives at the Inaugural Session held on 29 September at IISER Pune. **Mr. George N. Sibley**, Minister-Counselor for Economic, Environment, Science & Technology Affairs, US Embassy, New Delhi interacted with the participating women scientists and shared his views at the Concluding Session.

**Ambassador Richard Rahul Verma**, US Ambassador to India, **Dr. Asha Kishore**,

Director, Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram and **Mr. Vinod K. Pipersenia**, Chief Secretary, Government of Assam, shared their valuable perspectives at the Inaugural session held on 2 September at Indian Institute of Entrepreneurship, Guwahati. Several highly accomplished and eminent Indian women scientists and technologist participated in the various panel discussions organized during these training programs.

### Session I: Career Launch and Acceleration

This session provided techniques necessary for an effective career launch in STEM fields. Discussion, role-playing and group problem solving were important components of the session. The session included identifying participants' strengths and interests, common mistakes of graduate students/faculty/researchers and ways to avoid them, effective in-person and cyber interviews, effective communication methods for research and teaching presentations, building a strong CV and developing a strong internet presence.

### Session II: The Art of Effective Negotiation

This session taught the fundamentals of negotiation relevant to a variety of one-on-one conversations and group settings. Topics included the importance of negotiation to advance research and career objectives, identification of negotiables including start-up packages, space, authorship, supplies, etc., necessary elements of a successful negotiation, the importance of developing alternatives to an agreement, techniques for handling difficult people and conversations, the importance of listening and appreciating different viewpoints and identification of short and long-term negotiation goals.

### Session III: Publishing Research in Peer Reviewed Journals

This session provided advice and training on publishing scientific and technical results in peer-reviewed English language journals. Topics include publication and review process for many journals, organizing a paper, determining when and where to publish results, identifying data to include in the publication and organizing the material, and working with editors and on-line submissions and responding to reviews.

### Session IV: Persuasive Scientific Presentations

This session provided training on how to present research results in a manner that maximizes the ability of the audience to understand why the work was conducted, the methods used, the results obtained and impact of the research on the field. The content of the session was based on research that has examined factors that maximize audience retention of information by






making a clear, concise and compelling oral/visual presentation.

### Session V: Leadership and Networking Skills for Women in Science and Technology

The session included presentations by the facilitator, small group discussion and experiential learning. This session was designed to give participants the basic concepts of leadership, describe recent research on leadership qualities that lead to success and failure, discuss effective leadership styles for women in different cultures, conduct a self-assessment to identify areas for skills enhancement, provide techniques and strategies for career advancement into leadership roles, assist in developing and maintaining strong leadership networks.

### Session VI: Mentoring for Success

This session included an assessment of participant's interest in mentoring activities, an assessment of previous mentors, responsibilities of the mentor and mentees, and skills identification for increasing the quality of interactions between mentor and mentee including effective listening and communication methods.

### Session VII: Proposal Writing and Grantsmanship

This session module provided training in effective techniques for writing proposals to gain research support for a scientific or engineering project. Topics included identifying the priorities of the agency or program solicitation, determining criteria for assessment and writing to the criteria, developing a format for the proposal following known guidelines, identifying the objectives of the research project, developing a budget and cost assessment, interacting with program officers and agencies, and developing research partnerships.

# Women Entrepreneurs Silicon Valley Experiential Learning Visitation Program

## Contact Persons

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The Indo-US Science and Technology Forum (IUSSTF) partnered with the National Science & Technology Entrepreneurship Development Board (NSTEDB), Department of Science and Technology (DST), Government of India and the Anita Borg Institute (ABI), a non-profit organization focused on the advancement of women in computer science and engineering to enhance the entrepreneurial ecosystem for women entrepreneurs in India. The joint partnership is established in synergy with the Women Entrepreneurship Quest (WEQ).

WEQ is a unique business plan competition for women entrepreneurs in technology. It is designed to reach out and identify talented women in technology in the founding or leadership team of early stage startups, who have applied technology in innovative ways to solve meaningful business problems.

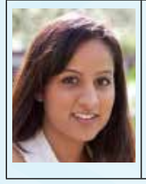
As per the partnership, the top six women entrepreneurs of the WEQ 2014 contest along with four ecosystem partners were being sponsored for an all-expense-paid experiential learning visit to Silicon Valley, USA from 13 to 17 April, 2015. This partnership was announced at the Indo-US Joint Commission Meeting, November 2014.

The Silicon Valley experiential learning visit was organized with the objective to provide a great opportunity to the selected Indian women entrepreneurs to interact with highly accomplished domain experts, successful entrepreneurs, mentors, VCs from the Valley and learn more about their experience in adeptly tackling business challenges and scaling up their ventures. The effort was to provide extensive mentoring, networking opportunities to these selected women entrepreneur. The program envisaged to help the women entrepreneur navigate the

exciting entrepreneurial journey by sharing best practices and building long term networks.

The women entrepreneurs had an enriching experience pitching their business to the VCs - Artiman Ventures, Storm Ventures, Charles River Ventures and Mayfield Ventures. The delegation had meetings at the Stanford Graduate School of Business and interacted with UC Berkeley startups at the Skydeck, University of California, Berkeley. The group also visited a women led start up D-rev in San Francisco. The delegation had the great opportunity to interact with Meera Kaul, Chairperson of Meera Kaul Foundation, Ari Horie, CEO and Founder of Women Startup Lab, and President and CEO, Telle Whitney, Anita Borg Institute. The delegation visited Ebay and Google and also met with the **Venkatesan Ashok,** Indian Consulate General San Francisco, Rajiv Sharma, Executive Director, IUSSTF and Telle Whitney, President and CEO of ABI.

## Profiles of the women entrepreneurs

| | |
|---|---|
|  | **Sreepriya Koppula**<br>Founder and CEO<br>Turnaround Systems Private Limited<br>http://goturnaround.com |
|  | **Ashwini Asokan**<br>CEO<br>Mad Street Den<br>http://www.madstreetden.com/ |
|  | **Lavina Mahbubani**<br>Co-founder, Head of Design<br>Lumos Design Technology Private Limited<br>www.lumos.co.in, www.iwearlumos.com |
|  | **Pooja Sharma**<br>Founder and Product Head<br>White Sepal Services Private Limited<br>www.feepal.in |
|  | **Kalaivani Chittaranjan**<br>MD and CEO<br>K-Nomics Techno Solutions Private Limited<br>www.mintbook.com |
|  | **Naiyya Saggi**<br>CEO & Co-founder<br>InfomokoTechonology Pvt. Ltd<br>www.babychakra.com |





## Profiles of the Ecosystem partners

| | |
|---|---|
|  | **Dr. Anita Gupta**<br>Director/Scientist–F & Associate Head<br>National Science and Technology Entrepreneurship Development Board,<br>Department of Science and Technology, Government of India |
|  | **Dr. Smriti Trikha**<br>Senior Science Manager<br>Indo-US Science and Technology Forum<br>New Delhi |
|  | **Dr. Hiranmayee Vedam**<br>Advisor (IPR & E)<br>Indian Institute of Technology<br>Gandhinagar |
|  | **Mrs. Dakshayini Suryaprakash**<br>Senior Manager<br>Global Incubation Services (GINSERV)<br>Bangalore |

# Student Symposium

22 August 2015, New Delhi, INDIA

**Contact Person**

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The preparation of the next generation of scientists, engineers and innovators is one of the most crucial tasks in nation building. An important aspect of education in the 21st century is to provide the experience of international research to young scholars. Such initiatives would offer them an array of experiences, both academic and social, that would help them gain a global perspective and prove invaluable in their professional careers.

With an aim to address the need for human resource development and capacity building in frontier areas of science and technology, the ***Department of Biotechnology*** (DBT), Govt. of India, the ***Department of Science and Technology*** (DST), Govt. of India and the ***Science & Engineering Research Board*** (SERB) in partnership with the ***Indo-US Science and Technology Forum*** (IUSSTF), ***WINStep Forward*** (WSF) and the ***University of Southern California*** (USC) support three prestigious student internship programs namely the **Khorana Program for Scholars**, the **S.N. Bose Scholars Program** and the **Viterbi-India Program**.

These three internship opportunities are designed as leadership programs that are intended to spark the imagination and broaden intellectual horizons by introducing top Indian and American students to scientific and innovation ecosystems of leading US and Indian institutions. The goal is to nurture and inspire future thought leaders across a broad spectrum of sciences, industry and society. The program also aims to seamlessly bridge the academic and entrepreneurial communities in US and India.

Experiencing scientific research at top-tier laboratories has consistently motivated scholars to pursue higher education and careers in science. An external evaluation of all three programs by Ernst & Young in 2014 indicated that almost 85% of the scholars have opted for doctoral programs at prestigious institutions across the globe. An overwhelming 99% of students felt that these internship programs were 'Important' and/or 'Critical' in their admissions for higher studies. More importantly, the programs remind the students and their hosts of India's rich scientific tradition. It is also an exceptional investment in developing India's future scientific and technological leadership.

In 2015, as many as 126 young scholars had been placed at leading institutions across the United States. These include California Institute of Technology (Caltech), Carnegie Mellon University, Case Western Reserve University, Cornell University, Harvard University, Louisiana State University, Massachusetts Institute of Technology (MIT), Michigan State University, Missouri University of Science & Technology-Rolla, National Center for Atmospheric Research, Ohio State University, Pennsylvania State University, Purdue University, Stanford University, University of California-Berkeley, UC-Los Angeles (UCLA), UC-San Francisco (UCSF), University of Illinois-Urbana Champaign (UIUC), University of Iowa, University of Michigan, University of Minnesota, University

of Notre Dame, University of Oklahoma, University of Pennsylvania, University of Southern California (USC), University of Washington, University of Wisconsin-Madison, Virginia Polytechnic Institute and State University, and, The University of Texas at Austin. Similarly, American students at a similar stage of their careers, including MD-PhD scholars, were selected as S. N. Bose scholars for 8-12 week internships at leading Indian institutions, such as National Center for Biological Sciences (NCBS), Indian Institute of Science (IISc), IITs, IISERs, Tata Institute for Fundamental Research (TIFR), and Medical schools.

After the completion of their internship at different partner Universities across the US, in order to bring all the scholars together on a common platform to enable them to share their research work and experiences not only with one another but also with mentors, faculty, program administrators and former scholars; a **Student Symposium** was organized in New Delhi on 22nd August 2015. The idea behind the symposium was to create cohesiveness by creating an opportunity for scholars to meet each other and look beyond just one summer and their own immediate goals and aspirations. Another objective was to enable the science leadership of the country to view first-hand the work that the students have accomplished as part of the program.

The symposium attracted a robust response from young scholars and also a galaxy of noted scientists and science administrators from various scientific institutions and agencies in India.

The formal inaugural function saw the





participation of **Dr. Rajiv Sharma**, Former Executive Director, IUSSTF; **Prof. Raghu Raghavendra**, Vice Dean for Global Academic Initiatives for the Viterbi School of Engineering, University of Southern California, Los Angeles; **Prof. T.K. Chandrashekar**, Former Secretary, Science and Engineering Research Board, Govt. of India; **Dr. K. VijayRaghavan**, Secretary, Department of Biotechnology, Govt. of India; **Dr. Chandrima Saha**, Director, National Institute of Immunology; **Mr. George N. Sibley**, Minister Counselor for Economic Affairs and Environment, Science and Technology, Embassy of the United States, New Delhi and **Prof. Aseem Ansari**, Co-Founder of The Khorana and Bose Programs, University of Wisconsin-Madison. The speakers congratulated the scholars for their remarkable achievements in the short span of their summer internships. They encouraged the students to keep the connections they have created alive as in times to come, increasingly complex problems will require combined inputs of scientists from across geographies and disciplines. The speakers highlighted that the India of today is very different from what it was a couple of decades ago. India now has the required institutional frameworks, infrastructure and ecosystem for talented young scientists to productively pursue their scientific goals with ease. In a globalised setting, India is now a major economy and offers immense opportunities

## Indo-US S&T Partnerships

not only in terms of the problems that need to be solved but also in terms of the entire world eager to join hands with Indian scientists and scientific institutions to pursue common goals.

**Dr. T. Ramasami**, Former Secretary, Department of Science & Technology, Govt of India delivered the Keynote Address. Dr. Ramasami underlined that inspiration is an elevated state of mind. When thoughts are elevated, the mind is able to receive signals and positive energies from everywhere. When the mind is inspired, it expresses a rare level of beauty and excellence. It extracts extraordinary values for the human effort and genius. An inspired mind is uninhibited and knows no limitations and constraints. Creativity prevails over everything moving and stationary, when the mind is truly inspired. He remembered Dr. Homi Jehangir Bhabha who said that *"It is one's duty to stay in one's own country and build up schools comparable with those in other lands"*. He exhorted the young scholars present at the occasion to work hard and contribute to growing Indian science.

Ultimately these programs are about the Scholars - India's brightest students who would forge new partnerships and help create sustainable, long-term networks in the mutual interest of both India and the United States. Six scholars - **Anukriti Mathur** from BITS Pilani, **Avisek Lahiri** from IIT-Kharagpur, **Jayashree Mohan** from NIT- Surathkal, **Ayush Tomar** from Delhi Technological University, **Shalini Gupta** from IIT-Kanpur and **Kalki Kukreja** from IIT-Delhi - shared their experiences with the audience.

The dignitaries also presented certificates to all the scholars in recognition of their achievement. The inaugural function was followed by a very successful poster session where the young scholars presented the work they accomplished during their internship.



# Bilateral WORKSHOPS

# Realizing the Potential of Rare Disorders: Awareness, Research and Drug Development in India

07-09 September 2015, New Delhi, INDIA

**Principal Investigators**

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Rare disorders are defined as those having a frequency of less than 1 in 5000 people. Although individually rare, collectively they affect about 70-80 million people in India. Currently these disorders are ignored by both the health as well as the Pharma sector, making the patients helpless and vulnerable, without any proper facilities for diagnosis and management in India. The United States on the other hand has a well-organized Office of Rare Disorders under the National Institutes of Health, Bethesda. This coordinates and provides a number of facilities for the people. These consist of, among others, creating awareness, diagnosis of those whose disease remained undiagnosed by conventional testing, registries, bio-repositories, clinical care networks as well as translational research program. An orphan drug act exists that encourages and provides incentives to Pharma companies to develop new therapies. This workshop on ***Realizing the potential of rare disorders: awareness, research and drug development in India*** organized by **I.C. Verma** (Sir Ganga Ram Hospital, New Delhi), **Ratna Dua Puri** (Sir Ganga Ram Hospital, New Delhi), **Rashmi Gopal-Srivastava** (National Institutes of Health, Bethesda) and **Stephen Groft** (National Center for Advancing Translational Sciences, Bethesda) brought together US scientists and administrators with their counterparts in India so that a program for rare disorders can be developed in India, that will create awareness, improve infrastructure for diagnosis and research, reduce prohibitive costs for diagnostic tests and therapies, improve regulations to encourage research and drug development.

# Emerging Trends in Health Care: Lessons from Clinical and Translational Research

14-15 September 2015, Mysuru, INDIA

**Principal Investigators**

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Healthcare revolves around the objective of providing the highest quality of care at the lowest cost to the maximum number of people. Employing advanced, sophisticated, and cutting-edge tools developed through detailed research enables clinicians to achieve this goal. To realize this goal, interested minds are exploring collaborative opportunities beyond borders and cultures. Healthcare delivery currently, in general, is beyond the traditional clinician run show. With the advent of new diseases, the healthcare demands are soaring higher. Without integrating technological and sound business principles into healthcare delivery, providing optimal affordable healthcare services will only be a distant dream. This workshop on ***Emerging Trends in Healthcare: Lessons from Translational Research***, organized by **Suresh Bhojraj** (JSS University, Mysuru) and **Richard Weinshilboum** (Mayo Clinic, Rochester) engaged clinicians, biomedical researchers, engineers and business professionals to focus on advancing trends in current cutting edge topics. These included (a) Pharmacogenomics in realizing precision medicine (right drug, right dose at the right time and to the right individual), (b) Role and importance of Electronic Health Records, biomedical informatics and health care delivery in integrating basic research toward clinical care and (c) Special interest topics in drug discovery and development, such as gene transfer technology and current state of G protein coupled receptors in drug discovery.






# Advances in the Seismology of the Sun and Stars

07-11 December 2015, Mumbai, INDIA

**Principal Investigators**

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**Michael Thompson**
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The seismology of the Sun and stars provides very important constraints on their structure and dynamics. Sun's magnetic cycle modulates our climate and affects the functioning of space instrumentation, and on unusual occasions, can even affect electrical systems on Earth. It is therefore very important to appreciate the governing mechanisms of solar magnetism. Studying the stars in our galaxy provides fundamental insights into the position of the Sun and solar system. Do we live in a privileged environment or is the Sun a typical (Sun-like) star? How many stars have planetary systems? Kepler has revolutionized our understanding in this regard, with the discovery of planetary systems around a number of stars. Thus the appreciation and accurate interpretation of these observations will have important practical and scientific consequences. The Indo-US workshop titled ***Advances in the seismology of the sun and stars*** organized by **Shravan Hanasoge** (Tata Institute of Fundamental Research, Mumbai) and **Michael Thompson** (National Center for Atmospheric Research, Boulder) was aimed at discussing advances in the seismology of the Sun and stars. The extraordinary observations of the Sun and stars being taken by the Kepler and Solar-Dynamics-Observatory space missions make this an exciting time for this field. This workshop explored methods to substantially improve the understanding of this data and scientific output.

# Ceramic Coatings and Multilayers

25-29 February 2016, Coorg, INDIA

**Principal Investigators**

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**Carlos G. Levi**
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The Indo-US workshop on ***Ceramic coatings and multilayers*** was organized by **Shrikant Joshi** (International Advanced Research Centre for Powder Metallurgy & New Materials, Hyderabad), **Vikram Jayaram** (Indian Institute of Science, Bengaluru), **Ashutosh S. Gandhi** (Indian Institute of Technology Madras) and **Carlos G. Levi** (University of California, Santa Barbara) and **Sanjay Sampath** (Stony Brook University, State University of New York). The workshop was convened to bring together scientists and practitioners in the field of thermo-structural and functional ceramic coatings and multilayers. These advanced engineered surfaces find widespread applications in energy and propulsion systems, especially in gas turbine engines and emerging areas of solid oxide fuel cell as well as battery technologies. Coatings have now become crucial to an economic and safe operation of advanced engine systems. This has motivated extensive research and development in the field. These systems experience a multitude of degradation mechanisms, from oxidation induced delamination to erosion and chemical attack. A multidisciplinary research strategy is required, not only to elucidate the operational mechanisms, but also to develop a framework for selection of new materials and multilayer architectures. Of further importance are the synthesis and processing of these layered assemblages whose parameterization is critical to coating design, and reliable manufacturing. Finally, advanced characterization and performance evaluation of these layered anisotropic materials remains a critical challenge from both academic and industrial perspectives. The nature of the field necessitates interdisciplinary thinking and activity in topics like thermo-mechanical behavior, kinetics, chemistry, phase equilibria, mechanics and materials sciences. The objectives of the workshop were to develop a summary assessment of the current understanding of processing, structure and properties of ceramic coatings and multilayers for energy systems; achieve a common understanding of the expertise available in India as well as in the USA; identify the salient challenges for further research in these areas; identify new opportunities for collaborative research on fundamental scientific issues; and bring together young researchers to showcase the exciting opportunities in the area of ceramic coatings and multilayers.





# A Road Map Towards Effective Management of Plant-parasitic Nematodes by 2025

7-9 March 2016, New Delhi, INDIA

**Principal Investigators**

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Plant Parasitic Nematodes (PPN) negatively impact all facets of global agriculture. There is hence a compelling need to translate basic research on nematode biology into strategies to achieve effective control. The Indo-US workshop titled ***A road map towards effective management of plant-parasitic nematodes by 2025*** was organized by **Umarao** (ICAR-Indian Agricultural Research Institute, New Delhi) and **David Bird** (North Carolina State University, Raleigh). The goal of the workshop was to develop tools to alleviate at least one half of the yield loss attributable to nematodes by 2025. The workshop brought together a panel of renowned PPN researchers from India and USA to define the challenges that must be overcome to meet this goal. The workshop focused on evaluating the literature (current and old) to distinguish dogma from data; identifying the best PPN species to exploit, and how realistically one can extrapolate from one species to another; assessing the technologies in hand, and those that are needed; identifying gaps in our basic understanding of PPN biology, and suggesting how we plug those gaps; developing assays to get quickly to the field, ideally using farmer-acceptable crops and cultivars; and, identifying appropriate funding source(s).

# Cell Factories

18-20 March 2016, Mumbai, INDIA

## Principal Investigators

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**Jay D. Keasling**
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There is an immense interest in the use of living cells of microbial, mammalian or plant origin as factories to produce small molecule chemicals and protein based products. Each product category has its own set of challenges that need to be overcome before commercial deployment. Bulk chemicals and fuels require high product yields and volumetric productivities to optimize the cost of production and separation. Likewise, for industrial enzymes, the cost of production is a key parameter. For therapeutics, in addition to cost, product quality and consistency are important factors.

One of the major challenges faced in implementing cell based processes includes identification of a suitable host strain followed by application of perhaps several orthogonal engineering strategies that may be required with a single host to achieve the desired goal. There have been significant advances reported in the engineering of host cells, predominantly with the use of model organisms. Though a large number of commercial products are already being produced using living cells, an even larger number has been demonstrated at proof-of-concept stage but are waiting for development of commercially viable processes.

An Indo-US workshop on ***Cell factories*** was organized by **Pramod P. Wangikar (**Indian Institute of Technology Bombay, Powai), **Jay D. Keasling (**University of California Berkeley), **Aindrila Mukhopadhyay** (Lawrence Berkeley National Laboratory) and **Mugdha Gadgil** (National Chemical Laboratory, Pune) to augment the mutual know-how in the field, and enhance bilateral intellectual collaborations.



Joint
CENTERS

# Protein Interactor Discovery and Structure

## Principal Investigators

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**David Eisenberg**
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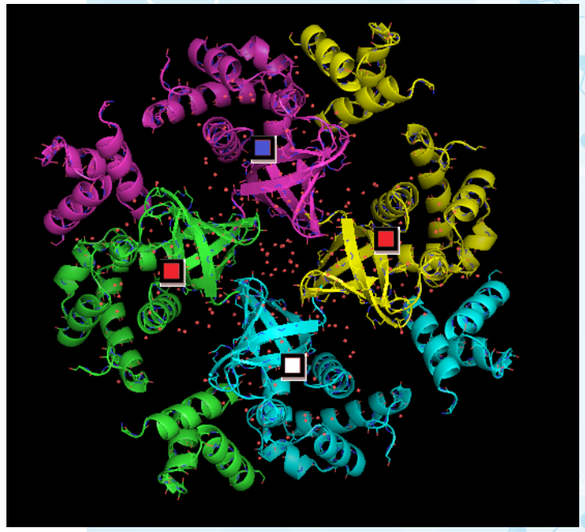
## Introduction

The objective of the center is to enhance the methodology of identification of natural/cognate binding partners of proteins in a genomic scale. An already published ProLinks database of genomic-context derived functional linkage information is being used to get initial set of physically interacting candidates at 95% expected coverage. The joint center has synergized the effort of the US collaborators on structural genomics, and Indian collaborators on protein-protein interaction algorithms, bringing together pioneers and experts in a targeted problem solving setup. The center is expected to bring forth new ideas and lay groundwork for long term collaborations. Specific research goals to be met by the center are:



(a) Establish an effective computational Methodology to predict protein interactors with high confidence.
(b) Leverage computational predictions as in the above objective to design experiments to confirm protein

## Partnering Institutions

| India | USA |
|---|---|
| Indian Institute of Science, Bangalore | University of California, Los Angeles |
| Indian Institute of Technology, Kharagpur | Los Alamos National Laboratory, New Mexico |

interacting partners and enhance protein co-crystallization pipeline.

## Work Plan/Methodology

Briefly, 6811 protein sequences for *E. coli* substrain MG 1655 was obtained from Genbank gi 48994873/U00096.2 accession number. The team identified a total of 21512 functional linkages from the Prolinks database (http://prolinks.mbi.ucla.edu) corresponding to the *E. coli* organism. Of these, 134 pairs were identified which have archived information for protein-protein interaction in the Database of Interacting Proteins (DIP) (http://dip.mbi.ucla.edu). The remaining 21378 were not evidenced by any experimental data. The team obtained a total of 6036 Multiple Sequence Alignments (MSA) from PFAM database (http://pfam.xfam.org), which was used to build the merged MSA for protein pairs corresponding to predictions given by Prolinks. When the PFAM alignments were mapped to Prolinks predicted pairs, 8614 pairs were obtained of merged PFAM alignments which had entries in DIP and 68277 merged PFAM alignments not evidenced in DIP. The increase in the number of merged MSA was due to more than one number of PFAM domains for a given protein. The *E. coli* structural proteome collated from PDB consists of 4615 files representing various proteins in redundant manner. The models from MODBASE further covered 425 proteins and the remaining 1174 proteins were covered by I-TASSER models. About 274 proteins were extremely novel for the team built *ab initio* models using the Quark program (http://zhanglab.ccmb.med.umich.edu/QUARK/). The team would be working with I-TASSER and QUARK derived models at a later stage once the efficacy of the pipeline is established. The team currently has 6851 MSA from PFAM mapped to a PDB or MODBASE structure. Excluding small proteins less than 40 residues, docking poses for 9863 protein pairs from ZDOCK software have been obtained. These are being analyzed to select a subset of most confident predictions to be taken up for co-crystallization experiments.

In parallel, the team have been working on improving the automated quaternary structure detection of proteins in crystal lattice structures. This will allow to better assess protein-protein interfaces and enhance the screening of the true positives. All protein structures in the Protein Data Bank were evaluated with up to dihedral point group symmetry. The algorithm, evaluation and website are under preparation for manuscript submission.

## Exchange visits

The Indo-US center has undertaken two Indian faculty visits to US, one US faculty and one US student visit to India. These exchange visits of graduate students and PIs across the partnering institutes in the last one year has been very fruitful in terms of newer ideas and exposure.

## Achievements

Software generated: A pipeline for generating protein-protein cognate binding partners; and, Point Group Symmetry detection of proteins in crystal lattice structure implementing a new algorithm.





# Climate Change and Health Adaptation

**Principal Investigators**

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## Introduction

In response to excess mortality due to heat wave in May 2010, a network of scientists, researchers and policymakers have been working to plan, develop, implement an actionable heat health early warning system and heat preparedness plan for the municipal corporation of Ahmedabad. For this purpose, the team has conducted international workshops, researcher visits and is

**Partnering Institutions**

| India | USA |
|---|---|
| Indian Institute of Public Health, Gandhinagar<br>Indian Institute of Public Health, Delhi<br>Public Health Foundation of India, Haryana | Icahn School of Medicine at Mount Sinai, New York<br>Natural Resources Defense Council, New York |

undertaking primary research including vulnerability assessment surveys. To enhance knowledge exchange, the NRDC, the IIPHG and the Icahn School of Medicine at Mount Sinai with support from the Indo-US Science & Technology Forum (IUSSTF) held the *India-US Climate Resilience Partnership: High-Level Knowledge Leadership Exchange Forum on Heat-Health and Climate preparedness.* This Exchange brought together key leaders from four growing regions (Gujarat, Maharashtra, New Delhi, and Odisha) in India with leaders in New York City.

The objective of the center is to reconvene scientific experts working on health adaptation research in India and the US to discuss the state of existing scientific research and identify next steps in the efforts of development of a heat health early warning system in India. The progress of activities currently being undertaken will be reviewed. These activities include vulnerability assessment surveys, focus group discussions, fact sheets, posters and training & sensitization workshops.

## Work Plan/Methodology

Potential range of activities include:

- **Capacity building:** Develop a Heat Health Early Warning System for site temperature gauges; create action plan on heat warnings, including opening communication channels between local government, meteorological and health officials to better prepare for heat waves. Develop guidelines, protocols and public health policies to treat heat stress, heat stroke, and heat exhaustion to reduce mortality in hospital wards and public workplaces.
- **Partnerships:** Further develop network of multidisciplinary professionals, including public health professionals, clinical medical specialists, urban planners, environmental experts, occupational health experts and administrators, to discuss and develop recommendations for actionable heat-health-related programs. Form partnerships with other cities and states in India.
- **Policy:** Develop programs to help local populations adapt to increasing heat. Assist in developing heat mitigation policies, such as, cool building recommendations and urban planning for communal cold drinking water facilities and park space.
- **Advocacy:** Create a "Heatline" to provide public support during heat waves. Protect communities by training voluntary community "buddies" to help the elderly and children during heat waves. Train first responders like health workers and doctors on appropriate diagnosis and treatment of heat morbidities.
- **Completed activities:** Identified climate-related health concerns in India and created a practical and creative proposal to address these concerns. The team has completed the innovation process in identifying and developing concepts for a vulnerability assessment on extreme heat events. PHFI-IIPH and NRDC have entered into Memoranda of Understanding (MOUs) with the state of Gujarat and the city of Ahmedabad to formalize collaboration for joint research. As part of the MOU, PHFI-IIPH and NRDC hosted a Kick-off Workshop in Ahmedabad to convene and mobilize relevant scientists, stakeholders, and partners in March 2011. The workshop resulted in a rich discussion of ideas and strategies that form the basis of this proposal and further stages of the research activities.

## Achievements

**Capacity building**

- Circulate warnings in bulk to the public via centralized email databases during a **heat alert**. Develop an SMS alert system to send direct messages to private practitioners in addition to the medical professionals at public hospitals and UHCs. Utilize local radio FM broadcasts to disseminate heat protection tips and high temperature warnings to the city's at-risk populations during a **heat alert**. Explore other means of communications, such as broader use of social media, for example, Facebook, Twitter and the WhatsApp mobile application.
- Increase the number of installed LED screens with rolling updated temperature forecasts available to the public.
- Have health officer visit Urban Health Centers (UHCs) to confirm proper preparation has been made for heat-related illness and conduct case audits during heat season.
- Ensure adequate supply of ice packs and IV fluids.
- Pilot project to provide emergency ice packs and heat-illness prevention materials to traffic police, BRTS transit staff and construction workers.
- Lead child-friendly educational preventative trainings and distribute heat protection materials at local schools.

**Partnerships**

- NRDC and IIPH are also working with the Indian government to mainstream heat wave planning at the state and national levels.
- The team has organized scaling up workshop in partnership with Gujarat Climate Change Department and IUSSTF for potential cities and states and as an outcome of this now assisting Maharashtra and Odisha in developing their Heat Action Plan (HAP).

**Policy**

- Increase efforts to distribute fresh drinking water to the public.
- Expand access to shaded areas for outdoor workers, slum communities, and other vulnerable populations.

**Advocacy**

- Enhance targeted training programs, capacity building efforts and communication on heat illness for medical staff at local hospitals and Urban Health Centres (UHCs), based on the Framework of AMC Medical Professionals and Health Workers.
- Train hospitals to improve expedience of recording of cause of death certificates. Explore creation of simple, user-friendly means to track daily heat-related data and behavioral change impacts. The training could also include recording information education & communication (IEC) efforts.

**Completed activities**

- Created a list of the high-risk areas of the city vulnerable to heat waves for more focused activities on heat prevention.
- Conducted training workshops and outreach sessions with community groups and mobilizers such as Mahila Arogya Samiti, Self-Employed Women's Association (SEWA), ASHA workers, *aanganwadis*, and municipal councils to help inform and get vulnerable communities more actively involved, including women. Incorporate other sectors such as higher education, non-profits, and community leaders to increase reach to communities.
- Developed Ahmedabad HAP 2015 after evaluating previous HAP and with consultation of Health Departments, key stakeholders and policy leaders like Commissioners, Mayor etc.
- PHFI-IIPH and NRDC have entered into Memoranda of Understanding (MOUs) with the Maharashtra Public Health Department, GVK EMRI 108 and Indian Met Department to formalize collaboration for joint research.
- Organized India-US High-Level Knowledge Leadership Exchange Forum on Heat Health and Climate Preparedness in New York supported by CDKN and IUSSTF.

## Exchange visits

The Indo-US center has undertaken eight Indian faculty visits to US. The researchers visited New York City Department of Health, New York City Emergency Response Command Center in Brooklyn, Icahn School of Medicine at Mount Sinai, Columbia University's Mailman School of Public Health and Historic Bellevue Hospital.

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# Excellence in Design of Sustainable Products, Service and Manufacturing Systems

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## Introduction

Sustainable manufacturing aims to minimize resources, optimize outputs, eliminate toxic substances, produce zero waste, and reduce greenhouse gases across the entire life cycle of products. Sustainable manufacturing involves designing, manufacturing, distributing, maintaining, retiring, and reclaiming products in a sustainable way. The products life cycle starts with raw material extraction and processing; continues with the design and fabrication of components; includes design, manufacturing and assembly of the final product as well as its transportation, use and maintenance; and concludes with end-of-life operations.

Currently, the task of ensuring that

**Partnering Institutions**

| India | USA |
|---|---|
| Indian Institute of Science, Bangalore | Washington State University, Washington |
| Center for Study of Science, Bangalore | Syracuse University, New York |
| National Innovation Foundation-India, Ahmedabad | University of California, California |

manufacturing is sustainable is severely hampered by the inadequacy of availability of traceable, trusted, comprehensive, open, transparent and publicly available life cycle inventory (LCI) data to enable science-based decisions for sustainability based on lifecycle assessment (LCA) and, more importantly, by the lack of a science of sustainability and the measurement and standards infrastructure needed to support sustainable manufacturing.

Design can have a major influence to development of sustainable systems. Flexible manufacturing processes need to respond to variability in materials and energy resources while still accounting for sustainability. In order to achieve this goal, design alternatives which address material and energy use, need to be available to manufacturing systems to carry out trade-off analyses of various design choices. Providing such design alternatives relies on capabilities to measure and assess the sustainability of various designs.

Ensuring sustainable manufacturing requires an integrated system of systems approach and spans technical, economic, ecological, and societal issues. Interactions within and across





these levels are critical to the fundamental understanding of sustainable design and manufacturing, because tackling any single issue could result in a suboptimal solution and unintended consequences. Industry recognizes that manufacturing and multi-disciplinary approach and significant global economic benefits will arise in embracing sustainability in general and sustainable manufacturing in particular.

In the current networked and complex manufacturing environment, an integrated systems approach for sustainability requires the development of robust and cost-effective lifecycle analysis and synthesis methodologies, standards and tools so that designers and engineers can track and aggregate the overall sustainability of a product throughout its life and across the networked and distributed production system. To achieve this, the objective of the joint center is to create data sets on processes and their impacts and develop data standards.

## Way forward

**1. Cutting edge Research:** Compile, analyze and collate suitable measures for design of sustainable systems. Develop a repository of methods, guidelines, tools for supporting design of sustainable systems, analyze their efficacy and complementarily, and annotate these using the context of their use.

**2. Training and evaluation:** Prepare training material for educating students to be 'sustainable designers'. Identify a series of real design problems in India and the USA, and take up joint projects involving students from both India and the USA to solve these problems using a selected set of methods and

tools; use these as case studies on design of sustainable systems.

**3. Dissemination:** Develop a website containing the above repositories, people, and case studies based on the problem solving exercises. Publish a series of articles, in peer reviewed journals and conference, on the measures, methods and evaluation of specific methods. Publish a series of books providing a collection of recommendations, findings, and outcomes from the workshops. Apart from the workshop outcomes, the books can be a resource for application-specific issues: sustainable design, sustainable services, sustainable manufacturing etc., or on specific parameters, e.g. economy, society, and environment.

## Achievements

- A 'process template' has been developed for carrying out a systematic design process for redesigning products, services and manufacturing systems that are more sustainable.
- A repository of sustainability measures and methods for assessing and developing sustainable systems has been developed, and are linked with case studies from literature that demonstrate use of these measures and methods. The outcome is a computer-searchable 'database'.
- Together, the template and the database, which are meant to be used together in designing, act both as training material and as resource for carrying out sustainable design.
- In combined-teams, the researchers have undertaken joint exercise for redesigning existing solutions in real-life in India and redesigned these to make these more sustainable. Three problems have been used: redesign of manufacturing of a micro-hydel turbine from rural Karnataka (manufacturing system), redesign of a natural water cooler from Delhi (product system), and redesign of a community workshop for grass-root innovation (service system). The outcomes are to test and demonstrate the efficacy of the research results and the training material (i.e. template and database). The designs will be given to the organizations who own the original designs so that they can use these designs for improving their solutions. The case studies are included as cases in the database as demonstration of how some methods were used and worked.
- A website has been developed to disseminate the outcomes to a wider body of people. The website will eventually contain all the results from the project, archival articles produced from the project, the template, the database, and the case studies that involved their use.

## Exchange visits

The Indo-US center has undertaken one Indian faculty, two Indian Co-PIs, and three Indian student visits to the US; three US faculty and three US student visits to India. These exchange visits of graduate students and PIs across the partnering institutes in the last one year has been very fruitful in terms of newer ideas and exposure.

## Outcome

- Software generated: An integrated template-database of design process-methods for supporting practice and training of sustainable design
- Any other outcome emanated: A website for dissemination of results from the project has been developed that is accessible to a wider audience.



Joint Centers

# Astronomical Object and Feature Characterization and Classification

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## Introduction

The objective of the Joint Center is to characterize and classify astronomical objects. This is done using features based on non-sparse and sparse light curves and other non-temporal data. The complimentary expertise available at the participating institutes on individual aspects of the problem is brought together through this Joint Center which facilities data re-use and sharing and stimulates further development of layered and modular tools and it goes a long way in benefitting the astronomical community at large in this era of large synoptic sky surveys.

## Exchange visits and accomplishments

The Indo-US center undertook various visits from both the Indian side and the US side. The visits have been very fruitful and have led to newer ideas and products. One of the main datasets being used is the Catalina Real-time Transient Survey data. So far the team have been using the individual images and catalogs thereof for the decade long survey. The plan for stacking – or co-adding – the images was formulated during a visit to the US (Varun Bhalerao) and the procedure implemented at IUCAA's High Performance Computing Center during a visit by the US PI (Ashish Mahabal). The coadditions have been carried out (by an undergraduate, Akshat Singhal) for the entire area for one of the three image subsets viz. Catalina Sky Survey (CSS), and are being tested before they will be released. The stacked image goes as much as three magnitude (a factor of ~15) times deeper than individual images in much of the area covered by CSS. The team (Sumit Kulkarni working with Varun Bhalerao and Ashish Mahabal) are also in the process of deriving deep catalogs from these images which can be used as reference for confirming and/or ruling out transients from other surveys, including Gravitational Wave candidates that may have ElectroMagnetic counterparts (for instance those involving Neutron Stars).

## Partnering Institutions

| India | USA |
|---|---|
| IUCAA, Pune<br>St. Thomas College, Kerala | California Institute of Technology, California<br>Harvard –Smithsonian Center for Astrophysics, Cambridge |





Features for characterization have also been derived for 40 million (out of 500 million) Catalina Real-time Transient Survey (CRTS) light-curves and the remaining are in the pipeline. The features are being used for various projects during the forthcoming summer when undergraduate students will be carrying out research at Caltech ("Search for Unusual Variable Objects on the Sky" offered by Ashish Mahabal). Undergraduate projects were also carried out during the summer of 2015 when a student each from IIT Gandhinagar (Samarth Vaijanapurkar) and one from Bryn Mawr (Jingling Li) worked with Ashish Mahabal on a project on Domain Adaptation using CRTS data and two other datasets. Two other undergraduate students (Alison Dugas and Catalina Miritescu) worked with Matthew Graham, and Joon Lee and Sunwoo Oh worked with Ciro Donalek on Virtual Reality projects on CRTS and other datasets. Work on latent structure in solar images was also carried out under the auspices of the center, and has now led to that collaboration flowering further on its own.

## Publications


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- In addition to this, several Astronomer's Telegrams (A Tel) have resulted from the pipeline.


# From Fundamentals to Applications of Nanoparticle Assemblies


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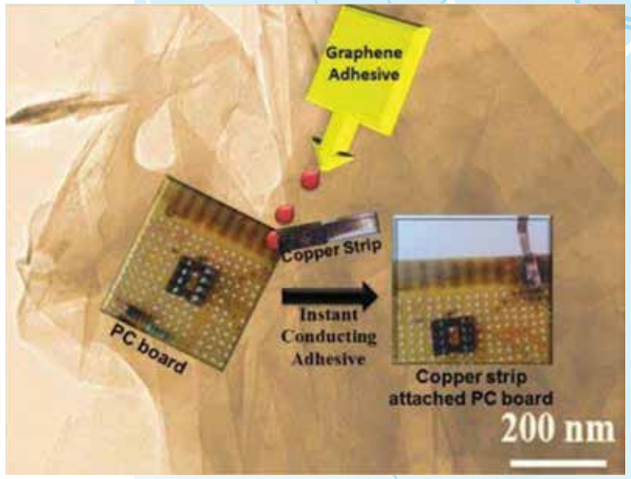
## Executive Summary

"Bottom-up" approaches to nanoparticle synthesis have now matured to an extent that "designer" nanoparticles with desired size, shape and surface/bulk composition can be reproducibly prepared on demand, using wet chemical techniques. A key barrier in converting these synthetic capabilities into products and applications, is the relatively poor state of knowledge of how such nanoparticles may be assembled in a controlled manner. For example, one route to the preparation of metamaterials in visible wavelengths is by the assembly of nanometer-scale split ring resonators, a challenge that is currently unmet by the research community. To address the challenging problem of assembling nanoparticles into precise hierarchical structures at will, it is necessary to investigate the fundamental processes that govern particle-particle and particle-matrix interactions, and to understand how these processes depend on the structure of the constituent nanoparticles and matrices in which they assemble. The development of such understanding necessitates close collaborations between synthetic chemists with the ability to tailor-make well-defined nanoparticles with desired characteristics, researchers who investigate strategies to assemble such nanoparticles using experiments and theory. The virtual center has brought together researchers from the US and India, that have complementary research programs investigating nanoparticle synthesis, their assembly, characterization of the structure of nanoparticles and their assemblies, dynamics in such systems, and that use experiments, theory and simulations. The team focused on the theme of nanoparticle assembly, catalyzed the development of novel, globally relevant technologies in areas such as energy, environment and sustainable industries.

The main themes that the Joint Center explored are (a) the development of predictive linkages between nanoparticle attributes, nanoparticle-matrix interactions, and the assembly of these nanoparticles, and (b) the exploitation of this knowledge to design assemblies and composites with well-defined structure and function, relevant for applications. Thus, the activities of the proposed Center were to connect fundamental understanding with eventual applications, as well as connect synthesis and advanced characterization with theory and modeling.


### Partnering Institutions

| India | USA |
|---|---|
| IUCAA, Pune<br>St. Thomas College, Kerala | California Institute of Technology, California<br>Harvard –Smithsonian Center for Astrophysics, Cambridge |




Instant conducting adhesive from graphene

## Work Plan/Methodology

- The team carried out synthesis of nanoparticles with precise control on their size, shape and their surface and bulk chemistry. Preparation methods used were based on inverse micelles and digestive ripening. The specific nanoparticles prepared include iron oxide and gold nanoparticles. The team also carried out work on understanding the effect of polydispersity in grafting density of polymer chains on nanoparticle surface that influences the shape of nanoparticle-aggregates. The team have used advanced characterization tools, such as optical, confocal and electron microscopies, combined with X-ray diffraction and small angle X-ray and neutron scattering, and spectroscopy to elucidate structure and properties of the individual nanoparticles and their assemblies.
- Chemical modification of graphene was carried out to introduce functional groups in a site specific manner. These were then coupled with silane monomers and novel nanocomposites were prepared.
- The team has resulted in the development of a synthetic pathway to tether unprecedentedly high molecular weight polymer, poly (□ -caprolactone) (PCL), to highly anisotropic graphitic nanoplatelets using a "grafting to" technique.
- The partnership has focused on probing the fluctuation driven anisotropy in effective pair interactions between gold nanocrystals that are densely passivated with short ligands.

## Acheivements

- The effect of time and temperature on the digestive ripening procedure has been explained. Further experiments that can through light on the effects of concentration and the van der Waal interactions on the alkyl chain on digestive ripening are underway.
- The influence of polydispersity in grafting density of polymer chains present on nanoparticle surface on the shape of nanoparticle-aggregates has been elucidated.
- The team also prepared elastic monoliths comprised primarily of colloidal particles.
- The nanocomposites of functionalized graphene and silane monomers exhibited instant conducting adhesive behavior. Furthermore, by introducing bulky pendant groups at the edge sites that exert stress on the basal plane of graphene, its band gap could be engineered. The modified material demonstrated a semi-conducting behavior over the semi-metallic behavior of the pristine material.
- The PCL-graphene nanocomposite demonstrated excellent dispersibility in organic solvent for several months. The confinement effects, imposed by the well-dispersed graphitic nanoplatelets and the polymer chain tethering, resulted in remarkably enhanced thermal properties of the composite, manifested in a significant delay in the thermal degradation temperature of the composite and a noticeable increase in the crystal nucleation rate in comparison with neat PCL.
- The collaborative work on fluctuation driven anisotropy clearly suggested that for dense


Bandgap engineering by chemical modification of graphene

grafting regime, inclusion of anisotropic effects as well as many-body interactions is necessary to adequately describe the thermodynamics and assembly behavior of nanoparticles.

## Exchange visits

The Indo-US center has undertaken one Indian faculty and two Indian student visits to US; five US faculty and two US student visits to India. These exchange visits of graduate students and PIs across the partnering institutes in the last one year have been very fruitful in terms of newer ideas and exposure.

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Group photo of the participants taken during the Faraday Discussions Meeting



# Public-Private PARTNERSHIP PROGRAMS

# DST-Lockheed Martin India Innovation Growth Program

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**The DST-Lockheed Martin India Innovation Growth Program (IIGP)** was launched in 2008 to enhance the growth and development of entrepreneurial economy in India by adopting the prevalent best practices both in US and India. IIGP is designed as an accelerated technology assessment and commercialization initiative through a business plan competition involving commercial assessment of technology; business development; and finally technology commercialization through structured mentoring. The program is a joint initiative of the Department of Science and Technology, Govt. of India; Lockheed Martin Corporation; Indo-US Science and Technology Forum, Federation of Indian Chambers of Commerce and Industry; Stanford Graduate School of Business and the IC$^2$ Institute at the University of Texas. The Program is open to technologies in areas such as aeronautics, agriculture, biotechnology, chemistry, communications, computing, defence, electronics, environment, IT, manufacturing, marine, materials, medical/ life sciences, nanotechnology, etc. Underlining the program commitment to enhance the growth and development of India's entrepreneurial economy, The DST-Lockheed Martin India Innovation Growth Program organized pan-India roadshows conducted in 20 cities including Jaipur, Goa, Ahmedabad, Guwahati, Indore, Patna, Ranchi, Chennai, Bangalore, Chandigarh, Mumbai, Pune, Vadodara, Delhi, Kolkata, Bhubaneshwar, Hyderabad, Nagpur, Srinagar and Cochin with an aim to scout the best innovations from the country. The IIGP received an overwhelming response from the innovators in 2015.

The following innovations were announced as the winners of the 2015 Competition:

| S. No. | Innovation Title | Innovator |
|---|---|---|
| 1 | XrayTo3D - Tabplan3D | Vikas Karade |
| 2 | A novel preventive technique to help patients manage kidney disease | Vincent Lloyd |
| 3 | Dance Aid for Deaf | Janhavi Joshi |
| 4 | MiraCradle - Neonate Cooler | Ankit Jhanwar |
| 5 | Off-grid renewable energy based cold storages for "First Mile" of our food supply chain | Aakash Agarwal |
| 6 | Smartphone integrated noninvasive fetal ECG monitor to detect fetal distress | Saurabh Kulkarni |

| S. No. | Innovation Title | Innovator |
|---|---|---|
| 7 | Complete Indigenous technology to spin hemodialysis grade hollow fiber membranes | Anirban Roy |
| 8 | Guardian | Manik Mehta |
| 9 | Rice Husk Ash to highly dispersible silica | Tanmay Pandya |
| 10 | A serum-based kit for the diagnosis of visceral leishmaniasis (Kala-Azar) and PKDL | Sarfaraz Ahmad Ejazi |
| 11 | DosaMatic- Table top dosa machine | Eshwar K Vikas |
| 12 | Biomimetic smart aerosols for lung cancer, tuberculosis & other pulmonary diseases | Shahdeep Kaur |
| 13 | A continuous non-invasive blood glucose monitoring system based on photoacoustic spectroscopy | Praful P. Pai |
| 14 | Futuristic eco-friendly safe rechargeable magnesium-ion battery | J.Vatsala rani |
| 15 | Energy saving device for producing uniform charcoal heat through LPG | Sanghi Sri Hari Rao |
| 16 | Production of carbon nano-material from industrial gas emissions | Amit Kumar |
| 17 | Genetic diagnostics and personalized medicine for maximum healthcare | Sooraj Ratnakumar |
| 18 | Mobility solution for patients with neurological disorder / spinal cord injury | Mihir Apte |
| 19 | Low cost portable and safe digital X-Ray for the use in orthopedics and pediatrics clinics | Karthik Somasundaram |
| 20 | Home based devices for speech and language problems | Prashant Kumar Goyal |
| 21 | Smart sand - ZaaKSand™ | Abbas Khan |
| 22 | Low cost and green manufacturing using smart enzymes libraries | R. Rajkumar |
| 23 | NetPlug : Give the power of internet to your products | Pranav Pai Vernekar |
| 24 | Development of X-ray visible polymers for non-invasive imaging applications | Paulomi Ghosh |
| 25 | Bone grafts designed via bio-mimetic approach from natural origin materials | Prabhash Dadhich |
| 26 | Foot mounted pedestrian navigation made easy | Amit Kumar Gupta |
| 27 | Efficient cost effective detection kits for banana viruses | Ramasamy Selvarajan |
| 28 | Low-cost point-of-care diagnostic device for blood cell counting | Prakhar Jain |
| 29 | Myco-tablets for decolorization of dye waste water | Prachi Kaushik |
| 30 | Fabric based heating elements for warmth/ fomentation in medical applications | Smita Chandrakant Deogaonkar |





As a part of IIGP-2015 program, IUSSTF in partnership with the Federation of Indian Chambers of Commerce and Industry (FICCI) took a delegation of 10 innovators and 6 incubation managers / Govt. of India Officials to Austin and Silicon Valley from 25 September to 3 October, 2015. The visit coincided with Hon'ble PM, Shri Narendra Modi's visit to Silicon Valley and gave the IIGP innovators an opportunity to showcase their innovative solutions at the India-U.S. Startup Konnect which was presided by PM Modi. The start-up enterprises also networked and interacted with more than 200 investors and business community members at the India-US Start-up Konnect showcase.

# Visitation
# PROGRAMS

# Water Advanced Research and Innovation Fellowship Program

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Recognizing that Water is of fundamental importance for human development, the environment and the economy, and therefore needs to feature prominently in the development agenda of both India and the United States; the Department of Science and Technology, Govt. of India, the University of Nebraska-Lincoln (UNL), the Daugherty Water for Food Institute (DWFI) and the Indo-US Science and Technology Forum (IUSSTF) have partnered to nurture cooperation between students and scientists from both countries. The **Water Advanced Research and Innovation (WARI) Fellowship Program** - a dynamic and transformative program has thus been developed to foster long term Indo-American science and technology partnerships.

The program is envisaged to provide an opportunity to the best and brightest Indian students and scientists to gain exposure and access to world class research facilities at the University of Nebraska-Lincoln and the Daugherty Water for Food Institute; promote research and capacity building in the area of water; encourage and motivate outstanding students to take up research as a career path; and pave way for the next generation scientists and technologists from India to interact with American peers, thus helping to build long-term R&D linkages and collaborations.

For the first call, the following **five student interns** were selected

| | Name/Institution | US Mentor | Subject Area |
|---|---|---|---|
|  | **Ambika Selvaraj**<br>Indian Institute of Technology, Chennai | Yusong Li | Fate and transport of hybrid nano zerovalent iron during emerging contaminant remediation |
|  | **Arindam Malakar**<br>Indian Association for the Cultivation of Science, Kolkata | Dan Snow | To study the formation of prenucleation clusters (PNC) and subsequent mineralization of contaminants (arsenic) in groundwater using specialized nanostructures |
|  | **Himanshu Kumar Khuntia**<br>Indian Institute of Science, Bangalore | Xu Li | Waste water treatment and anaerobic digestion |
|  | **Khalid Muzamil Gani**<br>Indian Institute of Technology, Roorkee | Shannon Bartelt-Hunt | Contamination of ground water with emerging contaminants from soil |
|  | **Sanjeeb Mohapatra**<br>Indian Institute of Technology Bombay, Mumbai | Dan Snow | Role of POM and singlet oxygen in photo degradation of pharmaceuticals |

For the first call, the following **five fellows** were selected

| | Name/Institution | US Mentor | Subject Area |
|---|---|---|---|
| | | | |
|  | **Manish Kumar**<br>Tezpur University, Assam | Yusong Li | Understanding the fate and transport of black carbon in aquatic environment |
|  | **Manish Kumar Goyal**<br>Indian Institute of Technology, Guwahati | Francisco Munoz-Arriola | Assessment of water quantity and quality in the Teesta river basin using remote sensing data and hydrological modelling |





| | | | |
|---|---|---|---|
|  | **Rajeev Pratap Singh**<br>Banaras Hindu University, Varanasi | Shannon Bartelt-Hunt | Fate and bioavailability of agrichemicals |
|  | **Rajesh Singh**<br>National Institute of Hydrology, Roorkee | Karrie Weber | Water quality and pollution abatement studies |
|  | **Vimal Mishra**<br>Indian Institute of Technology, Gandhinagar | Brian Wardlow | Enhancing agricultural water management through high resolution remotely sensed drought monitoring |

# Bhaskara Advanced Solar Energy Fellowship Program

## Contact Person

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Recognizing that climate change, clean and efficient energy and environmental protection are among the biggest challenges facing India and the United States; the Department of Science and Technology, Govt. of India through its Solar Energy Research Initiative, and the Indo-US Science and Technology Forum (IUSSTF) are committed to tackling these issues by building capacity in these frontier areas. To nurture future innovators and thought leaders in Solar Energy, the **Bhaskara Advanced Solar Energy (BASE) Fellowship Program** - a dynamic and transformative program has been developed to foster contacts between students and scientists from India and the United States.

The following student interns have been selected in 2016:

| | Name/Institution | Subject Area | US Mentor |
|---|---|---|---|
|  | **Aniket Rana**<br>National Physical Laboratory, Delhi | Organic solar cells: Material and devices | **Sean Shaheen**<br>University of Colorado Boulder |
|  | **Ameen E.**<br>CSIR-Structural Engineering Reserach Centre, Chennai | Smart power window based on high contrast grating structures | **Volker J. Sorger**<br>George Washington University, Washington |
|  | **Dogga Raveendhra**<br>Indian Institute of Technology, Roorkee | High power quality converters for solar PV power generation and grid integration | **Douglas C. Hopkins**<br>North Carolina State University, Raleigh |

| | Name/Institution | Subject Area | US Mentor |
|---|---|---|---|
|  | **Jagruti Ramsingh Thakur**<br>Indian Institute of Technology, Kharagpur | Research on net metering and solar programs in tracking the solar project | **Naim Darghouth**<br>Lawrence Berkeley National Laboratory, Berkeley |
|  | **Madhu Sudan**<br>Indian Institute of Technology, Delhi | Climate-based daylight predictive method of sky illuminance ratio for atrium building | **Richard G. Mistrick**<br>The Pennsylvania State University State College |
|  | **Manjunath Matam**<br>National Institute of Technology, Goa | Performance improvement of partially shaded solar Photovoltaics array by dynamic reconfiguration | **Brad Lehman**<br>Northeastern University, Boston |
|  | **Mohua Chakraborty**<br>Indian School of Mines, Dhanbad | Design and development of extremely thin absorber based solar cells | **Arunava Gupta**<br>University of Alabama, Tuscaloosa |
|  | **Praneetha S.**<br>Pondicherry University, Pondicherry | Development of Ag-nanowire/metal oxide composite transparent contacts and their performance & reliability assessment in CIGS and HOIP- solar PV cells | **David S. Ginley**<br>National Renewable Energy Laboratory, Golden |
|  | **Sashi Debnath**<br>Indian Institute of Science Education & Research, Kolkata | Fabrication of flexible solar cells from water dispersions | **D. Venkataraman**<br>University of Massachusetts Amherst |
|  | **Soundarrajan P.**<br>Madurai Kamaraj University, Madurai | Transition metal ions (V, Mn, Co, Cu and Nb) incorporated one-dimensional (1D) $TiO_2$ and ZnO nanostructures photoelectrodes for dye sensitized solar cells: increasing specific surface area and photovoltaic parameters by tuning interface energy and fermi-level alignment | **Arun Gupta**<br>The University of Alabama, Tuscaloosa |

| | Name/Institution | Subject Area | US Mentor |
|---|---|---|---|
|  | **Siva Chandrasekhar**<br>Indian Institute of Technology, Delhi | Fabrication of dye-sensitized and perovskite solar cell devices for energy applications | **Qiquan Qiao**<br>South Dakota State University, Brookings |
|  | **Subhash Chander**<br>Mohanlal Sukhadia University, Udaipur | Fabrication of high efficiency perovskite solar cell devices | **Vikram L. Dalal**<br>Iowa State University Ames |
|  | **Yoosuf Ameen M.**<br>National Institute of Technology, Calicut | Effect of interfacial layers on the performance of organic solar cells | **Aditya D. Mohite**<br>Los Alamos National Laboratory New Mexico |

The following fellows were selected in 2016:

| | Name/Institution | Subject Area | US Mentor |
|---|---|---|---|
| | **Chaggan Lal**<br>University of Rajasthan, Jaipur | Photovoltaic performance and synthesis of lead free perovskite solar cells for environment friendly | **Joseph Shinar**<br>Iowa State University, Ames |
|  | **Kallol Mohanta**<br>PSG Institute of Advanced Studies, Coimbatore | Graphene Oxide as acceptor material for organic photovoltaic(s) | **Sudipta Seal**<br>University of Central Florida, Orlando |
|  | **Sandip Kumar Saha**<br>Indian Institute of Technology, Bombay | Characterization and development of phase change material for medium temperature thermal storage for solar thermal plant | **Ganesh Balasubramanian**<br>Iowa State University Ames |
|  | **Somnath Chanda Roy**<br>Indian Institute of Technology, Madras | Growth and crystallization of $TiO_2$ nanotube arrays on plastic substrates for flexible solar cell applications | **Oomman K Varghese**<br>University of Houston |





| | Name/Institution | Subject Area | US Mentor |
|---|---|---|---|
|  | **Soumitra Satapathi**<br>Indian Institute of Technology, Roorkee | Fabrication of highly efficient lead free organic-inorganic perovskite solar cells on dynamic kirigami structures | **Max Shtein**<br>University of Michigan Ann Arbor |
|  | **Subrata Kundu**<br>CSIR-Central Electrochemical Research Institute, Karaikudi | Synthesis of nanomaterials for the fabrication of high performance photovoltaic–thermoelectric hybrid devices | **Choongho Yu**<br>Texas A&M University College Station |

# SERB–Indo-US Postdoctoral Fellowships for Indian Researchers

## Contact Persons

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The Science and Engineering Research Board (SERB), a Statutory body under the Department of Science and Technology, Government of India, in partnership with the Indo-US Science and Technology Forum (IUSSTF) announced the **SERB–Indo-US Postdoctoral Fellowships for Indian Researchers in USA** as an initiative under the SERB Overseas Postdoctoral fellowship Scheme (SERB-OPDF) with the objective to build national capacity in frontier areas of Science and Engineering, which are of interest to India.

The aim of the SERB Indo-US Postdoctoral Fellowships for Indian Researchers is to introduce scientists and engineers in the early stages of their careers to international collaborative research opportunities, thereby furthering their research capacity and global perspective and forging long-term relationships with scientists, technologists and engineers in USA.

The Fellowship will enable young Indian researchers to carry out a clearly defined research project at a place of their choice in US for a period of twelve months. The focus areas of the fellowship include Advanced Manufacturing, Big Data, Bio-energy, Cognitive Science, Complex systems, Cyber security, Encryption and decryption, Energy, Genetic to Physiology, High Performance Computation in Physics, Chemistry, Biology and Mathematics, Humanoid Robotics, Materials, Mechanobiology/Physical Biology, Mechnotronics, Mental Health, Modeling, Imaging, Algorithms and Combinatorial Optimizations, Petroleum and Petro-Chemical Engineering, Quantum Computing and Spintronics, Science of Climate Change, Glaciology, Sustainable Chemistry, and, Theoretical Mathematical Science.





# Bioenergy-Awards for Cutting Edge Research

## Contact Persons

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Recognizing that clean and efficient energy, environmental protection and energy security are among the biggest challenges facing India and the United States; the Department of Biotechnology, Government of India and the Indo-US Science and Technology Forum are committed to tackling these issues by building capacity in these frontier areas. To nurture future innovators and thought leaders in Biofuel and Bioenergy, the **Bioenergy-Awards for Cutting Edge Research (B-ACER)** has been announced a dynamic and transformative program developed to nurture contacts between students and scientists from India and the United States.

The priority areas of the program include Systems & Synthetic Biology (to produce biofuel molecules); Feed stock improvement (microalgae, macro algae, cellulosic biomass, tree born oil); and, Production Technology (cost-effective technology for bio-ethanol, algal biofuel, bio-butanol, bio-hydrogen, fuel cells, bio-refinery).

The first component the program would include internships for five Ph.D. students at Universities in the US for a period of upto six months. The second component of the program would include post-doctoral fellowships for five Fellows to work at Universities in the US for a period of upto twelve months.

The first call for the B-ACER program has been announced recentlyand the short-listing of applications is currently underway.

# Building Energy Efficiency Higher & Advanced Network Fellowships

## Contact Persons

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India is expected to add about 700-900 million $m^2$ of built floor space each year. The US is one of the largest energy consumers in the world and buildings account for over 70% of total electricity consumed in the United States. The potential for building energy savings in both nations is enormous. Keeping in mind the fact that climate change, clean and efficient energy and environmental protection are the key challenges facing India and the United States and to address the need for human resource development and capacity building in the frontier area of Building Energy Efficiency; the Department of Science and Technology, Govt. of India and the Indo-US Science and Technology Forum (IUSSTF) have developed a dynamic visitation program between Indian and US institutions and premier US Universities.

The **Building Energy Efficiency Higher & Advanced Network (BHAVAN) Fellowships** are envisaged to create a sustainable and vibrant linkage between the two nations, as well as build long term Indo-American science and technology relationships.

The first component the program would include internships for seven Ph.D. students at Universities in the US for a period, upto six months. The second component of the program would include post-doctoral fellowships for seven Fellows to work at Universities in the US for a period of upto twelve months.

The first call for the BHAVAN Fellowship Program has been announced and the short-listing of applications is currently underway.






# American Society for Microbiology (ASM) - IUSSTF Professorship in Microbiology

## Contact Persons

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Under an arrangement between IUSSTF and American Society for Microbiology (ASM), the **Indo-US Professorship Awards in Microbiology** were instituted in 2003 with the aim to foster scientific cooperation, education, training and capacity building at individual and institutional levels through exchange visitation. The ASM-IUSSTF Visiting Professorships award is administered parallel with the ASM International Professorship Program.

**The program enables:**

- Microbiologists in India and the United States to visit institutions in the two countries to teach an interactive short course on a topic in any of the microbiological disciplines (Teaching Professor)
- Microbiologists in India to participate in an interactive short course on a topic in any of the microbiological disciplines, or conduct a research project in partnership with colleague in a research facility in the US (Research Professor)

### Visiting Teaching Professorships

Provides microbiologists in India and the United States with an opportunity to visit institutions in the other country to teach an interactive short course on a topic in any of the microbiological disciplines.

**Eligibility**

- Researchers and faculty members scientifically recognized in the area of microbiology.
- Actively engaged in teaching at post-secondary level.

**Duration:** 1-2 weeks.

### Visiting Research Professorships

Provides support to microbiologists in India and the United States to conduct a novel research project in partnership with colleague at a research facility in the other country.

**Eligibility**

- Researchers actively involved in microbiological sciences.
- Preference given to early career scientists who have obtained a PhD, or other equivalent academic degree, within the past 10 years.

**Duration:** Minimum 6 weeks.

# IUSSTF-American Physical Society Fellowships

## Contact Persons

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IUSSTF and the American Physical Society (APS) have partnered to support a bilateral exchange program that includes the **Indo-US Professorship Awards in Physics** which are awarded to scientists from India and USA every year to conduct short courses or provide physics lecture series and, the **Indo-US Physics Student Visitation Program** for student exchange every year. The program was launched in 2008.

'Professorships and Lectureships' consist of 1-2 week courses or a lecture series delivered at an Indian or US institution. Recipients are selected by a joint APS-IUSSTF review committee, with a call for proposals once each year. Awards are typically used for travel, materials and expenses associated with course delivery. The objective of the Visiting Professorship is to enable physicists to build strong collaborative linkages in physics education and research between the scientific communities of US and India.

The Physics Student Visitation Program aims to support graduate student travel to India by US citizens, and for students of Indian citizenship to travel to the United States. These studentship programs will help to build early career relationships between the next generation of physicists from the US and India. The students can apply for this visitation program to attend a short-course, or summer training; to visit with a professor in his/her field of study; to work temporarily in a lab; or for any other opportunity that the student/professor feels is worthy of support.

The recipients of the ***2015 Indo-US Professorship Awards in Physics*** are:

| | Name | Host | Research Area |
|---|---|---|---|
|  | **Jayanta Kr. Bhattacharjee**<br>Harish-Chandra Research Institute, Allahabad | University of Maryland, College Park | Casmir Forces |
|  | **Pritam Deb**<br>Tezpur University | Rice University, Houseton | Physics of Nanostructures; Nanomagnetism |





| | | | |
|---|---|---|---|
|  | **Sanjib Mishra**<br>University of South Carolina, Columbia | Harish-Chandra Research Institute, Allahabad | Neutrino physics, Dark Matter |
|  | **Clifford M. Will**<br>University of Florida, Gainesville | International Center for Theoretical Sciences, Hubli | Gravitational-wave science |

The recipients of the ***2015 Indo-US Physics Students Visitation*** program are:

| | Name/Institution | Host | Research area |
|---|---|---|---|
|  | **Sumit Kumar Birwa**<br>TIFR Centre for Interdisciplinary Sciences, Hyderabad | University of Massachusetts, Amherst | Structure of jammed configurations and avalanches in granular flow |
|  | **Drummond Fielding**<br>University of California, Berkeley | Indian Institute of Science, Bangalore | Physics of the circumgalactic medium and how cooling and instabilities can affects galaxy growth |
|  | **Richard C. Remsing**<br>Temple University, Philadelphia | Jawaharlal Nehru Centre for Advanced Scientific Research | Statistical and quantum mechanics of condensed phase systems |
|  | **Talia Weiss**<br>Virginia Polytechnic Institute and State University, Blacksburg | Tata Institute of Fundamental Research, Mumbai | Biophysics |

# Research Internships in Science and Engineering

## Contact Person

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The Indo-US Science and Technology Forum supported **Research Internships in Science and Engineering (RISE) program** provides unique opportunities for science, technology, engineering and medical students from the United States to undertake internships in national laboratories, federal research centers, academic research institutes, and private R & D laboratories in India. Objectives of the internships are to provide students exposure to Indian S&T milieu, gain practical skills and develop collaborative networks. Internships are envisaged as a source of mutual cultural and professional enrichment for both the interns and their host institutions. The result will be the development of joint efforts that builds long-term collaboration and mutually beneficial professional relationships.

Indian and American citizens currently enrolled at a recognized institution of higher education pursuing Doctoral programs in science, engineering, technology and medical disciplines are eligible to apply for the internship. The internships provide for monthly stipend, accommodation and airfare.

The following 3 students interned in India under the RISE Program in 2015-2016:

| Name/Institution | Mentor | Subject Area |
|---|---|---|
| **Daipayan Sarkar**<br>The University of Texas | **Vinod Srinivasan**<br>Indian Institute of Science, Bangalore | Thermal Science, Fluid Mechanics, Applied Mathematics |
| **Harshad Vijay Kulkarni**<br>Kansas State University | **Debashis Chatterjee**<br>University of Kalyani, Kalyani | Arsenic contamination of groundwater |
| **Jacob John Herman**<br>University of Texas, Austin | **Axel Brockmann**<br>National Center for Biological Sciences, Bangalore | Evolution, Ecology, and Behavior Program |





# Graduate Research Opportunities Worldwide Program

## Contact Person

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The **Graduate Research Opportunities Worldwide (GROW) program** is a partnership between the Science and Engineering Research Board (SERB), Department of Science and Technology (DST), Govt. of India and the National Science Foundation (NSF) to provide NSF Graduate Research Fellows with opportunities to enhance their professional development through research collaborations at top-caliber science and engineering research sites in India.

The objectives of the program are to promote research and capacity building in frontline areas of science and technology; to pave way for the next generation scientists and technologists from the United States to interact with their Indian peers, thus helping to build long-term R&D linkages and collaborations; and, to bring talented American students to research laboratories and academic institutions in India to build a deeper appreciation of the culture of innovation and long-standing tradition of scientific inquiry in India.

# Khorana Program for Scholars

## Contact Person

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The **Khorana Program for Scholars** is a tripartite arrangement between the Department of Biotechnology, Govt. of India, WINStep Forward, and the Indo-US Science and Technology Forum in order to nurture contacts between students in the field of biotechnology and biomedical sciences from India and the US. The program is named in honor of Dr. Har Gobind Khorana who won the Nobel Prize for his work at the interface of chemistry and biology in 1968.

The Khorana Program is a summer internship program for Indian students (currently enrolled in B.Tech., M.Tech. and M.Sc. programs in Biotechnology and allied areas) to undertake a research internship at premier US Universities for a period of 10-12 weeks.

The Khorana Program is envisaged to:

- provide encouragement to young scholars to undertake R&D;
- enable students to carry out research at a premier University in the United States;
- transform research into societal benefits; and,
- build a seamless scientific community between India and the United States.

Keeping in mind the success of the program so far and the large pool of quality applicants available, DBT approved the extension and expansion of the Khorana Program to several premier US Universities (Brandeis University, Carnegie Mellon University, Cornell University, Harvard University, Indiana University-Bloomington, Iowa State University, Johns Hopkins University, Massachusetts Institute of Technology, Medical College of Wisconsin, Michigan State University, Rice University, Rutgers University, Syracuse University, University of California San Diego, University of Illinois at Urbana-Champaign, University of Michigan, University of Nebraska-Lincoln, University of Pennsylvania, University of Southern California, University of Texas-Austin, University of Utah, University of Wisconsin-Madison, Virginia Tech, and, Washington University St. Louis) to enable a larger number of students to gain a transformative international experience.





In 2015, the following **49 students** were selected under this program:

| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Aarathi Menon Sankar**<br>Birla Institute of Technology and Science, Pilani | University of Wisconsin-Madison | Pradyut Paul | Proliferative effect of Lgr5 on ca-Nfatc2 transduced mouse islet cells |
|  | **Abhisarika Patnaik**<br>Indian Institute of Technology, Bombay | University of Utah | Alex Shcheglovitov | SHANK3 and Phelan McDermid Syndrome |
|  | **Amrutha V**<br>Indian Institutes of Science Education and Research, Bhopal | University of Wisconsin-Madison | Barry Ganetzky | Spreading of pathogenic α-Synuclein across the nervous system in *Drosophila* model of Parkinsons Disease |
|  | **Anil Kiran Chokkalla**<br>Indian Institute of Technology, Madras | University of Wisconsin-Madison | Aseem Z Ansari | A novel polyamide based artificial transcription factor to alleviate transcriptional inhibition of frataxin in Friedreich's ataxia |
|  | **Anjali Priya**<br>Cochin University of Science and Technology, Cochin | Indiana University School of Medicine Bloomington | Sumegha Mitra | Study the effect of ubiquitin carboxyl terminal hydrolase 1 (UCHL1) over-expression in ovarian cancer |
|  | **Anukriti Mathur**<br>Birla Institute of Technology and Science, Pilani | Harvard Medical School | Tanya N. Mayadas | Role of human Fcγ receptors in SLE pathogenesis |
|  | **Anupallavi Srinivasamani**<br>Savitribai Phule Pune University, Institute of Bioinformatics and Biotechnology | Blood Centre of Wisconsin Medical College of Wisconsin Milwaukee | Subramaniam Malarkannan | miR23a cluster: a potential regulator of NK cell biology |

| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Apurva Naresh Gajwani** Indian Institute of Technology, Kharagpur | Cornell University | Ashim. K. Datta | Vitamin C degeneration in microwave heating of broccoli |
|  | **Bhanu Priya Somashekar** Birla Institute of Technology and Science, Pilani | University of Illinois at Urbana - Champaign | Prasanth K V | Identification of LincRNAs involved in triple-negative breast cancer |
|  | **Charul Agarwal** Indian Institute of Technology, Delhi | Bloomberg School of Public Health, Johns' Hopkins University | Anthony Leung | Database of identified poly and mono ADP-ribosylated proteins |
|  | **Chiti Arvind** Mount Carmel College, Bangalore | Harvard University & Smithsonian Tropical Research Institute | Christina Riehl | Cooperative nesting behavior of the Greater Ani: An insight into incubation patterns |
|  | **Debalina Datta** University of Hyderabad | Rutgers University New Jersey | Vikas Nanda | Computational design of chlorophyll bound to water soluble chlorophyll-binding protein (WSCP) with ProtCAD |
|  | **Debayan De Bakshi** VIT University, Vellore | University of Wisconsin-Madison | Vincent Cryns | Effect of mammalian-target-of-rapamycin (mTOR) on triple-negative breast cancer |
|  | **Dileep Kishore** Indian Institute of Technology, Madras | University of Wisconsin-Madison | Jennifer Reed | Wildtype flux prediction from RB-Tnseq data |





| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Harsha Gurnani** Indian Institute of Science, Bangalore | Brandeis University | Eve Marder | Homeostatic regulation of channel conductance can help maintain activity patterns throughout neuronal growth |
|  | **Jaydeep Paul** National Institute of Science Education and Research, Bhubaneswar | Syracuse University, New York | Ivan V Korendovych | Synthesis and structural characterization of *de novo* designed peptide and protein |
|  | **Jyotsna Misra** Gautam Buddha University, Greater Noida | University of Wisconsin-Madison | Mark Seeger | Structural studies of the yeast spindle pole body |
|  | **Kaivalya Molugu** Indian Institute of Science, Bangalore | University of Wisconsin-Madison | Yongna Xing | Structural understanding of Aryl Hydrocarbon Receptor (AHR), a potential drug target for cancer |
|  | **Kalki Kukreja** Indian Institute of Technology, Delhi | Massachusetts Institute of Technology | Yinuo Julia Wang | Characterizing the ribosome association of yeast protein Stf2 during acute stress |
|  | **Kanmani Chandra Rajan** A.C. College of Technology, Anna University | Michigan State University | Heedeok Hong | Cloning different fusion proteins with Degrons in pBAD/HisA vector, expression and study of their degradation by FtsH |
|  | **Karen Thulasi Devendrakumar** Tamil Nadu Agricultural University, Coimbatore | Michigan State University | Mariam Sticklen | Transgenic corn expressing Oleosin and Wrinkled1 transcription factor- A system for increased oil production in corn leaves |

| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Kaustav Bera**<br>Indian Institute of Technology, Kharagpur | Case Western Reserve University, Cleveland | Umut Gurkan | Micro pillar embedded channels for probing adhesion and deformability of red blood cells |
|  | **Kshitij Agarwal**<br>Indian Institute of Technology, Kanpur | Johns Hopkins University, Baltimore | Nitish V. Thakor | Identification and differentiation in human hand gripping patterns using EMG and tactile sensing |
|  | **Mona Manoj Katariya**<br>Indian Institutes of Science Education and Research, Pune | University of Wisconsin-Madison | Samuel H Gellman | Synthesis and H-Bonding Studies In b/g- Foldamer Helix |
|  | **Nandhitha Thiruvannamalai Venkatesh**<br>SASTRA University, Thanjavur | Washington University in St. Louis | Himadri B. Pakrasi | Nutrient deprivation in a fast growing Cyanobacterium |
|  | **Natashia Sydney**<br>KIIT University, Bhubaneswar | Virginia Tech, Blacksburg | Elankumaran Subbiah | Effect of autophagy mediated cell death during Influenza Virus Infection |
|  | **Naveen G**<br>Christian Medical College, Vellore | University of Wisconsin-Madison | John G. Webster | Multi Modal Mechanical Ventilator |
|  | **Navneet Singh**<br>University School of Biotechnology GGS Indraprastha University, New Delhi | University of Wisconsin-Madison | Richard L. Gourse | Structure/Function Analysis of TraR, An RNA Polymerase Regulator |





| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Priya Kalyani Chittur**<br>Anna University, A.C. College of Technology | University of Wisconsin-Madison | M. Thomas Record, Jr | Nonspecific Binding of RNAP to Single Stranded Ends of Cy3/Cy5 –Labeled λPR Promoter DNA |
|  | **Rajasri Purama**<br>NIT Warangal | University of Nebraska-Lincoln | Jeffrey Mower | Population genetic analysis of Soybean |
|  | **Ranjan Mukherjee**<br>Indian Institute of Technology, Kharagpur | University of Wisconsin–Madison | Aseem Z. Ansari | Selection of high affinity nucleic acids to counter influenza virus |
|  | **Reshma Jamal**<br>BITS Pilani, Hyderabad Campus | University of Illinois at Urbana Champaign | Sayeepriyadharshini Anakk | Identification of liver specific roles for FXR and SHP |
|  | **Ritu Roy Chowdhury**<br>Indian Institutes of Science Education and Research, Mohali | Massachusetts Institute of Technology | Mriganka Sur | Investigating the role of inhibitory interneurons in information processing in the mouse visual cortex (V1) |
|  | **Saakshi Parolia**<br>Jadavpur University, West Bengal | Iowa State University | Kurt Rosentrater | Partial replacement of wheat with ancient gluten-free grains for naan formulation (traditional Indian bread) |
|  | **Sahana Dinesh Rao**<br>Indian Institute of Science, Bangalore | University of California-San Diego | Timothy S. Baker | Structural changes in adeno associated virus type 2 at acidic pH |

| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Sanjana Ravindran** VIT University, Vellore | Indiana University, Bloomington | Matthew Bochman | Recombineering of *E. coli* phage FV3 genome and production of bacterial Pif1 helicase recombinant proteins |
|  | **Saranya G.** R.V. College of Engineering, Karnataka | Rice University | George N Bennett | Engineering *E. coli* for production of succinate by soybean wastes |
|  | **Shobhit Rahul Patoria** VIT University, Vellore | Rice University | Jeffrey J. Tabor | Figuring out rules for rewiring – two component systems |
|  | **Shravanti Krishna** S Rajalakshmi Engineering College, Chennai | Virginia Tech | Kaja Abbas | Spatial evolution of antigenic sites in human influenza viruses - H3N2 |
|  | **Shreya Gupta**, Indian Institute of Technology (BHU), Varanasi | University of Texas, Austin | Aaron Baker | *In vitro* Blood Brain Barrier to study cancer invasion mechanism and characterization of penetration properties of anti-cancer drugs |
|  | **Shreya Nahata**, Indian Institute of Technology, Roorkee | University of Pennsylvania | Narayan G. Avadhani | Investigating the role of mitochondrial DNA reduction in the induction of cancer stem-like cells in esophageal squamous cell carcinoma |
|  | **Sneha Gupta**, National Institute of Technology, Raipur | University of Nebraska, Lincoln | Linxia Gu | To study the mechanical properties of human ureters |





| | Name/Institution | Host University | Advisor | Subject Area |
|---|---|---|---|---|
|  | **Sruti Devendran** National Institutes of Technology, Calicut | University of Illinois at Urbana Champaign | Surangi Punyasena | Paleoecological analyses of the forest composition and diversity |
|  | **Swaathi Ratna Suresh** Anna University, Alagappa College of Technology | University of Wisconsin–Madison | John Markley, Hesamaddin Dashti | Semi Automated Backbone Assignment – SPARKY |
|  | **Urvi Nikhil Shroff**, Savitribai Phule Pune University, Institute of Bioinformatics and Biotechnology | University of Southern California | Janos Peti-Peterdi | Role of macula densa cells in nephron remodelling and repair |
|  | **Vaibhav Dnyandev Phad**, Indian Institute of Technology, Hyderabad | University of Wisconsin-Madison | Kevin Eliceiri | Light delivery modeling and simulations in a 3D Monte Carlo simulation platform in Optogenetics |
|  | **Vaishali Balachandran**, SASTRA University, Thanjavur | University of Wisconsin-Madison | William Bement | Role of Human AnnexinA1 protein in wound healing |
|  | **Vaishali Yadav**, Indian Institute of Technology, Bombay | Harvard University | Sam Kunes | Study the pattern of CamKII protein synthesis |
|  | **Vikramjit Lahiri**, University of Calcutta, St. Xavier's College | University of Michigan, Ann Arbor | Laura Buttitta | An *in vivo* methylcap sequencing method in *Drosophila* |

# Viterbi – India Program

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An important aspect of engineering education in the 21st century is to provide the experience of international research to young scholars and a practical way to achieve this would be to foster their participation in international research programs. Such initiatives would offer them an array of experiences both academic and social that would help them gain a global perspective and prove invaluable in their professional careers through a cross-cultural exposure. To address this need for human resource development and capacity building in the field of computer sciences and electrical engineering, IUSSTF and the Viterbi School of Engineering at the University of Southern California have partnered to support the **Viterbi-India Program** between Indian institutions and the Viterbi School of Engineering.

The Viterbi-India Program is a dynamic student internship program that would create long-term, sustainable and vibrant linkages between the two nations. The program provides an opportunity for Indian students pursuing a Bachelors or Master's degree in Electrical Engineering, Computer Sciences and Computational Sciences at a recognized institution of higher education and learning in India to undertake research internship at the Viterbi School of Engineering for a period of 8 weeks.

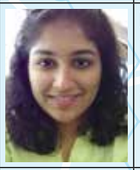
The following 20 students were selected for the program year 2015:

| | Name/Institution | Subject Area | Mentor |
|---|---|---|---|
|  | **Aakanksha Roshan Naik**<br>Birla Institute of Technology and Science, Pilani | Exploring the effectiveness of query expansion techniques in improving language understanding for virtual humans | Anton Leuski |
|  | **Adarsh Amarendra Tadimari**<br>Indian Institute of Technology, Madras | Do trailers affect a movie's success | Shri Narayanan |





| | Name/Institution | Subject Area | Mentor |
|---|---|---|---|
|  | **Aditi Vijaykumar Gupta**<br>Birla Institute of Technology & Science, Pilani | Semantic Typing | Craig Knoblock |
|  | **Aditya Chandrasekar**<br>Birla Institute of Technology and Science, Hyderabad | Modelingtopics in scientific literature using HMM and LDA | Prem Natarajan |
|  | **Ankit Goyal**<br>Indian Institute of Technology, Kanpur | A multimodal approach to dynamic emotion prediction in movies | Shri Narayanan |
|  | **Aravind Srinivas Lakshminarayanan**<br>Indian Institute of Technology, Madras | Computational game theory for security, multi agent teams | Milind Tambe |
|  | **Atharva Girish Wazurkar**<br>Indian Institute of Information Technology, Hyderabad | Low power digital to analog converter in 28nm technology for programmable delay element | Peter Beerel |
|  | **Avisek Lahiri**<br>Indian Institute of Technology, Kharagpur | Large scale video event classification | Ram Nevatia |
|  | **Biswajit Paria**<br>Indian Institute of Technology, Kharagpur | Feature learning in clinical time series using deep learning | Yan Liu |
|  | **Jayashree Mohan**<br>National Institute Technology, Surathkal | Analysis of MERLIN protocol for single-phase downloads over random duration links in mobile networks | Bhaskar Krishnamachari |

| | Name/Institution | Subject Area | Mentor |
|---|---|---|---|
|  | **Kushal Dilipkumar Salecha**, Indian Institute of Technology, Gandhinagar | Smart Grids | Viktor Prasanna |
|  | **Megha Arora** Indraprastha Institute of Information Technology, Delhi | Understanding the impact of demographics on sociability | Kristina Lerman |
|  | **Mehak Gupta** Indian Institute of Technology, Roorkee | Evidence of non-linear manifold in fMRI data | Richard Leahy |
|  | **Prakhar Kumar** Birla Institute of Technology, Pilani | Neural network simulation of neuromorphic circuits | Mike Shuo-Wei Chen |
|  | **Rucha Sanjay Vaidya** College of Engineering, Pune | Usage of DTN for Ebola monitoring and response | John Wroclawski |
|  | **Sagar Kashinath Honnungar** Indian Institute of Technology, Madras | Target detection via low-rank tensor completion | UrbashiMitra |
|  | **Saurav Prakash** Indian Institute of Technology, Kanpur | Reducing complexity for signal processing on graphs | Salman Avestimehr |





| | Name/Institution | Subject Area | Mentor |
|---|---|---|---|
|  | **Tathagata Srimani** Indian Institute of Technology, Kharagpur | Electronics and optoelectronics of a novel transition metal dichalcogenide | Chongwu Zhou |
|  | **Vikranth Reddy Dwaracherla** Indian Institute of Technology, Bombay | Developing an algorithm for stereo vision | Jay Kuo |

# S.N. Bose Scholars Program

## Contact Person

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To nurture future innovators and thought leaders, the Science & Engineering Research Board (SERB), Department of Science and Technology (DST), Govt. of India, the Indo-US Science and Technology Forum (IUSSTF) and WINStep Forward have partnered to support a dynamic and transformative student exchange program between premier institutions in India and the United States. This program is named the **S.N. Bose Scholars Program** after the late Prof. Satyendra Nath Bose, a visionary Indian physicist best known for his work on quantum mechanics in the early 1920s, providing the foundation for Bose–Einstein statistics and the theory of the Bose–Einstein condensate. A Fellow of the Royal Society, he was awarded India's second highest civilian award, the Padma Vibhushan in 1954 by the Government of India. He made important contributions to the field of quantum physics in the 1920s that changed how particle physics has been studied ever since. The class of particles that obey Bose-Einstein statistics, Bosons, was named after him. This program honors an Indian scientist's fundamental contribution to the completion of the Standard Model of the Universe.

The S.N. Bose Scholars Program will provide an opportunity to Indian and US students (enrolled in Bachelors and Masters programs in Atmospheric and Earth Sciences; Chemical Sciences; Engineering Sciences; Mathematical and Computational Sciences; and, Physical Sciences) to undertake a research internship each summer for a period of 10-12 weeks in each other's countries.

The broad objectives of the program are to:

- provide an opportunity to best and brightest Indian students to gain exposure and access to world class research facilities in US academia and labs;
- promote research and capacity building in frontline areas of science and technology;
- encourage and motivate outstanding students to take up research as a career path;
- pave the way for the next generation scientists and technologists from India to interact at an equal footing with American peers, thus helping to build long-term R&D linkages and collaborations; and,
- bring talented American students to research laboratories in India to build a deeper appreciation of the culture of innovation and long-standing tradition of scientific inquiry in India.

Shortlisting of the S.N. Bose Scholars for the year 2016 is currently under progress.





# Intel Science & Engineering Fair 2015

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'TEAM India 2015' - 29 young geniuses went on a special science and technology journey from 10 – 22 May 2015 to the United States of America.

During these 2 weeks, TEAM India participated and competed at the Intel® International Science and Engineering Fair (ISEF), Pittsburgh, USA, the world's largest pre-collegiate high school science research competition; and became a part of a week-long exposure trip to science, research and technology based activities in museums, universities, high schools along with meeting officials from State Dept and Indian Embassy at Washington DC.

The TEAM India was flagged off by Hon'ble Minister of State for Science & Technology Mr. Y.S Chowdary, Dr. Ashutosh Sharma, Secretary, Department of Science and Technology, Government of India and the United States Ambassador to India, Mr. Richard R. Verma.

Before leaving for USA, TEAM India got an opportunity to meet and interact with Late Dr. APJ Abdul Kalam, former President of India on 27 April 2015 at his residence. Dr. Kalam shared some wonderful tips with students for their future success and motivated them.

TEAM India is made up of students who are winners at the **Initiative for Research and Innovation in Science (IRIS)** a research based science fair initiative for school students held in India annually. These students come from all across the country and are selected after a rigorous process of support camps and various elimination rounds. Each of the students is a scientist and an innovator and has to their credit a unique idea developed in to science experiment/research/remedy aimed at making our planet a better place for all. Over the years, several of the young geniuses who went to ISEF as part of team India, have won various Grand Awards for their innovative projects. This year ISEF 2015 was held from 10-16 May 2015 at Pittsburgh, USA wherein after competing with more than 1700 participating science and research projects from over 78 countries, Team India won 5 Grand and 4 special Awards for themselves and for the country.

## Award & Recognitions

**Grand Awards for Team India**

In order to foster and promote cross-cultural exchange of ideas among high school children, the Indo - US Science and Technology Forum in partnership with Intel instituted and announced a Grand Award "Intel Indo-US Science and Technology Forum Scientific and Cultural Award to India" at the Intel Science & Engineering Fair (ISEF) 2015, which entails a Scientific and Cultural exchange visit to India for a week, for five ISEF Best of Subject Category student winners from USA. These US Student winners also showcased their projects at the Initiative for Research & Innovation in Science (IRIS) National Fair





**Five US awardees were:**

| Name/Institution | Research Area |
|---|---|
| **Amol Punjabi**<br>Massachusetts Academy of Math and Science, Worcester, Massachusetts | Rethinking Drug Discovery: New Algorithms for Virtual Drug Screening |
| **Michael Retchin**<br>**Matthew Retchin**<br>Mills E. Godwin High School, Richmond, Virginia | Combating Liver Cancer with DeepMine, a Novel Deep Learning Algorithm |
| **Demetri Maxim**<br>Gould Academy, Bethel, Maine | Directed Differentiation of Human Pluripotent Stem Cells into Functional Kidney Cells that Form Nephrons in Kidney Scaffolds |
| **Karan Jerath**<br>Friendswood High School, Friendswood, Texas | International Oil Spill Remediation: The Numerical Simulation of an *in-situ* Subsea Separator |

2015 from *December 3-7, 2015* at *New Delhi*, India.

**TEAM India visit post ISEF 2015**

'Team India' also got an opportunity to get an additional 5 day exposure visit after ISEF in USA. The Team India received an immersive experience of the scientific and the entrepreneurial culture of USA. The site visits, not only showcased the scientific landscape of USA but also provided an opportunity to the students to assimilate a wider perspective for future studies and possibilities of participating in collaborative research programs.

- First stop for Team India after ISEF 2015 was at the **Smithsonian's National Zoo.** It is one of the only four zoos in US which houses information on endangered and extinct species. Also they got an opportunity to look at the on-going research project on Orangutan memory at Think Tank**.**
- Next up was a visit to Steven F. Udvar – Hazy Center, Chantily, VA and a chance to get a feel of its massive structure with open, hanger-like settings that accommodate large aircraft and spacecraft, as well as entire collections of aviation and space artifacts. The students enjoyed the space shuttle Discovery and laid their hands on the Highs simulators.
- A visit to Hilltop Elementary School on 18th May, wherein students interacted with the young children and faculty provided them an understanding of STEM education in US. In addition visit to North County High School and interactions with students of their own age saw Team India making new friends and comparing notes on the way their schools matched up. Team India joined for a computer class and science club activities. Team India presented an overview about their projects to the North County school students.
- Team India visited the USAID Global Development Lab and got an opportunity to interact with Dr. Brit Steiner, Regional Engagement Chief (Asia) and other scientists at the Center for Mission Engagement. The students got to learn about the various initiatives of USAID in different Asian and African regions to improve quality of life.
- Team India got an opportunity to visit White House Office of Science and Technology Policy (OSTP) and interact with Dr. Kumar Garg, Assistant Director for Learning & Innovation. They were apprised about the various avenues available for learning, innovating and growth for researchers and innovators.
- Team India also got an opportunity to interact and share their experiences with the Deputy Chief of Mission **Amb. Taranjeet Singh Sandhu** at Indian Embassy, Washington DC who also shared with them the future learning and research prospects available both in US & India. Team India showcased their work through poster presentations at the Indian Embassy.
- Next, Team India got a chance to have an Exclusive Preview of the Spark! Lab which was then not open to the public. The activities in Spark! Labs which were designed around common themes connecting to National Museum of American History to inculcate sense of invention process from start to finish. The students visit to The Lemelson Center provided them a chance to create, collaborate, explore, test and invent by exploring the invention process and their own inventiveness.

- Team India visited the Natural History Museum wherein they participated in interactive learning programs viz ; Forensic Mysteries – Mystery at Yorktown Creek and Q?rius Collection Challenge. The students enjoyed learning through interactive staff-led programs using forensic tools and techniques of Smithsonian Scientists.
- Team India visited the National Air and Space Museum where they attended the Space Station Sensation Program. A 60 minute guided tour for the students entailed study of spacecraft as the Apollo 11 command module and the Skylab Orbital workshop. Another 30-minutes program included staff-led demonstrations and hands-on activities illustrating how things fly on Earth and in Space. Also students learnt about the challenges faced by astronauts in space.
- For cultural exposure apart from the scientific exploration, Team India toured various National monuments of interest viz. Lincoln Memorial, the Washington Monument, the White House, the US Capitol, Jefferson Memorial etc.
- Post ISEF the Grand Awardees had the honour of meeting Hon'ble Indian Union Minister for Science & Technology Dr. Harsh Vardhan at his office on 10th August 2015 and showcase their projects. The Hon'ble Minister congratulated the team and encouraged them for further progress in their future careers.

**Intel Indo-US Science and Technology Forum Scientific and Cultural Award to India :** Out of the 5 Grand Awards provided by IUSSTF at ISEF 2015, 3 US students travelled to India to avail the award and showcase their projects at IRIS 2015 in December. The students had an enriching experience here as they got an opportunity to not only network with the bright minds at IRIS but also visited some of the research labs. The awardees also visited International Center for Genetic Engineering and Biotechnology (ICGEB) and National Institute of Immunology (NII) wherein they met senior professors and learnt





about the ongoing work in their research labs. Also they visited "Navchara Hall" at Rashtrapati Bhavan, National Museum and Taj Mahal in Agra. These students were also felicitated by Hon'ble Union Minister for S&T and Earth Sciences Dr. Harsh Vardhan along with Minister of State for S&T and Earth Sciences Mr. Y.S Chowdhary at the award ceremony of IRIS 2015.

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