IUSSTF
Indo-US Science and Technology Forum

Indo-US Science and Technology Forum

Annual Report
2014-2015

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

INDO-US SCIENCE AND TECHNOLOGY FORUM

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

Annual Report
2014-2015

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 U.S. Department of State are the respective nodal departments.

IUSSTF
Indo-US Science and Technology Forum

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> Programmatic activities such as workshop/ symposia and network center have led to the interaction of over 800 US and Indian scientists and technologists creating several new opportunities and paving the way to sustained collaborations in diverse areas of science, technology and innovation.

IUSSTF has a dynamic program portfolio that has been developed keeping in mind the requirements of Indian and US scientific and technological communities as well as the common priorities of both the countries. The IUSSTF program portfolio covers activities catering to a large section of scientific communities. These include support for **bilateral symposia and workshops** on thematic and applied areas including areas of strategic interest; **visitation and fellowship programs** for researchers; student exchanges through **internships**; **advanced training schools** for human resource development and collaborative R&D through **joint networked centers**. As a part of **academia-industry connect programs**, IUSSTF actively reaches out to industries to generate events on technology opportunities for business development that fosters **innovation and enterprise**. IUSSTF nurtures inter-disciplinary contacts between leaders of the next generation of scientists and technologists by convening the flagship **Frontiers of Science** and **Frontiers of Engineering Symposium** in partnership with the U.S. National Academies.

Lately IUSSTF has also been focusing on sectors in line with national priorities such as Renewable Energy, Women Scientists and Entrepreneurs, High School Student innovators, etc. This report includes these and many other programmatic activities carried out during the Indian fiscal year 2014-15. The following are the Salient Outcome and Achievements during the report period.

Recognizing the importance of networking of scientists and professions for exchange of ideas, 16 **Workshops/ Symposia** were supported in the areas of Nano Engineering and Science, Healthcare, Cancer Prevention, Proteomics, Algorithms, Big Data, Forest & Land Conservation. Participation of over 300 Indian scientists and 150 US scientists was directly supported by IUSSTF.

In an effort to promote long-term interactions between scientific groups/ institutions on common areas of interest, IUSSTF supports **Virtual R&D Network Centers** for a duration of 2-3 years. Under this mechanism 4 new joint centers were initiated and activities continued under 15 on-going Joint centers. Altogether, more than 70 Indian and US scientific groups/ institutions and similar number of young scientists/ students are at present jointly working in the areas of nano technology, energy, materials science, health sciences, physical sciences, chemical sciences, atmospheric sciences, astronomy and astrophysics, etc under this mechanism of collaboration. 24 joint research publications in international journals emanated from these collaborations and about 150 reciprocal student and faculty exchanges took place.

IUSSTF's programmatic activities such as workshops/symposia and network centers have led to the interaction of over 800 US and Indian scientists and technologists creating several new opportunities and paving the way to sustained collaborations in diverse areas of science, technology and innovation.

Fellowships for young scientists and internships for undergraduate/ postgraduate students provide opportunities for scientific as well as cultural exposure to each others countries and help in developing long term linkages between young and budding scientists. During the reporting year over 150 Indian and US student exchanges took place through various internships namely **S N Bose Scholar Program, Khorana Scholar Program, Viterbi-India Program, Research Internship in Science and Engineering, Bhaskara Advance Solar Energy Research Fellowships and Graduate Research Opportunities World Wide (GROW).** The Indian Science and Engineering Research Board (SERB), Department of Science and Technology (DST) and Department of Biotechnology (DBT) and the National Science Foundation (NSF) of US supported these fellowships/ internships.

IUSSTF also has arrangements with the **American Physical Society (APS) and American Society for Microbiology (ASM)** to support exchange visits of scientists and students. During the reporting period IUSSTF supported visits of 13 Indian and US faculty and students under these programs.

To foster linkages between the outstanding next generation of scientists and technologists from India and the US, the 5th **Indo-American Frontiers of Engineering Symposium** was organized in Mysore. Over 80 young researchers from India and US participated and shared the research trends in various emerging areas of engineering.

Women in Science and Innovation- IUSSTF in partnership with the Department of Science and Technology, Govt. of India, the Embassy of the United States of America and COACh USA convened two workshops and training programs in September 2014 at New Delhi and Bangalore respectively, on topics such as effective negotiation skills, successful leadership methods, science communication, best practices, publishing in respected journals, grant writing, etc. A workshop on Women in STEM was jointly organized with NSF and DST as partners.

In addition to promotion of collaborative activities in basic science and engineering areas of mutual

From the ED's Desk

interest, IUSSTF has been actively promoting culture of innovation and entrepreneurs through two programmatic activities. Under the **DST-Lockheed Martin India Innovation Growth Program (IIGP)** funded by DST and Lockheed Martin Inc, 50 Indian innovators were trained through a boot camp by the faculty of Stanford Graduate School of Business. Of these 30 innovators were shortlisted through a competition and were provided hand holding by our program partners - Federation of Indian Chambers of Commerce and Industry (FICCI) and IC2 Institute of University of Texas Austin. Further, IUSSTF also organised an experiential visit of a team of 20 innovators, incubator managers and innovation/ entrepreneurship promotion agency officials to the Silicon Valley and Washington DC with support of The Indigo Entrepreneurs (TiE) and other program partners. IUSSTF is also proud to be a partner in the **Stanford-India Biodesign** Program for biomedical innovation, under which several entrepreneurs have been trained and a number of affordable biomedical devices and aids have been developed and commercialized.

The US-India Science & Technology Endowment Fund (USISTEF) has now become a well-known program for promotion of Innovation and Entrepreneurship collaboration between Indian and US technology entrepreneurs through grant to joint projects for commercializing science and technology based innovations for societal benefit. In its fourth year, 4 new bilateral Indo-US teams were awarded joint projects and support was continued for 11 ongoing joint projects in the areas of affordable biomedical devices, diagnostics, water, sanitation, clean energy, cold chain, financial inclusion, prosthetics, etc. A few products developed under the initial year of the program have received various required clearances and are now very near to commercialization. Like earlier calls, a large number of proposals (about 120) were received under the Fifth Call for Proposals and 5 new proposals were shortlisted for due diligence process. A total support of up to Rs. 350 million (about US$ 5.5 million) has been committed for these projects so far.

"The year 2014-15 thus has been a very successful year for the IUSSTF in forging new linkages between individuals, institutions and funding agencies. Its activities touched a large section of students, scientists and professionals, ranging from high school students to young scientists to senior scientists in India and the US. It has programs ranging from promotion of basic sciences to technology development to innovation and entrepreneurs. In its endeavor to keep with the time, IUSSTF has developed several programmatic activities for students in STEM, young innovators and entrepreneurs and women scientists and entrepreneurs."

As part of promoting the bilateral teams, USISTEF participated in various innovation events and provided expo space for USISTEF supported teams in these events including TiEcon 2014 Silicon Valley, US, one of the largest conferences focused around entrepreneurship and Indo-US Tech Summit.

The **Indo-U.S. Joint Clean Energy Research and Development Center (JCERDC)** is another strategic program entrusted to IUSTSF for implementation in India. This is a joint initiative of the Government of India and the US Department of Energy to facilitate joint research and development on clean energy technologies and their rapid deployment with the greatest impact. For this program, both governments have pledged $5 million (about Rs. 26 crore) per year for five years, with matching private sector funding. This first-of-its-kind initiative has brought together more than 100 Indian and US institutional and industrial partners to work jointly in the space of clean energy research in the three priority areas: Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings.

Under JCERDC, more than 70 high quality joint publications in eminent peer reviewed journals have emanated and a large number of conference proceedings have been brought out.

India-U.S. Grand Challenge: Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the US is an activity catalyzed by the IUSSTF in its endeavor to bring together Indian and US science funding agencies. Under this program Indian Science & Engineering Research Board (SERB), Department of Science & Technology, Government of India has partnered with the National Institute of Biomedical Imaging and Bioengineering (NIBIB, NIH), USA. In Total 6 projects have been supported under this program in India.

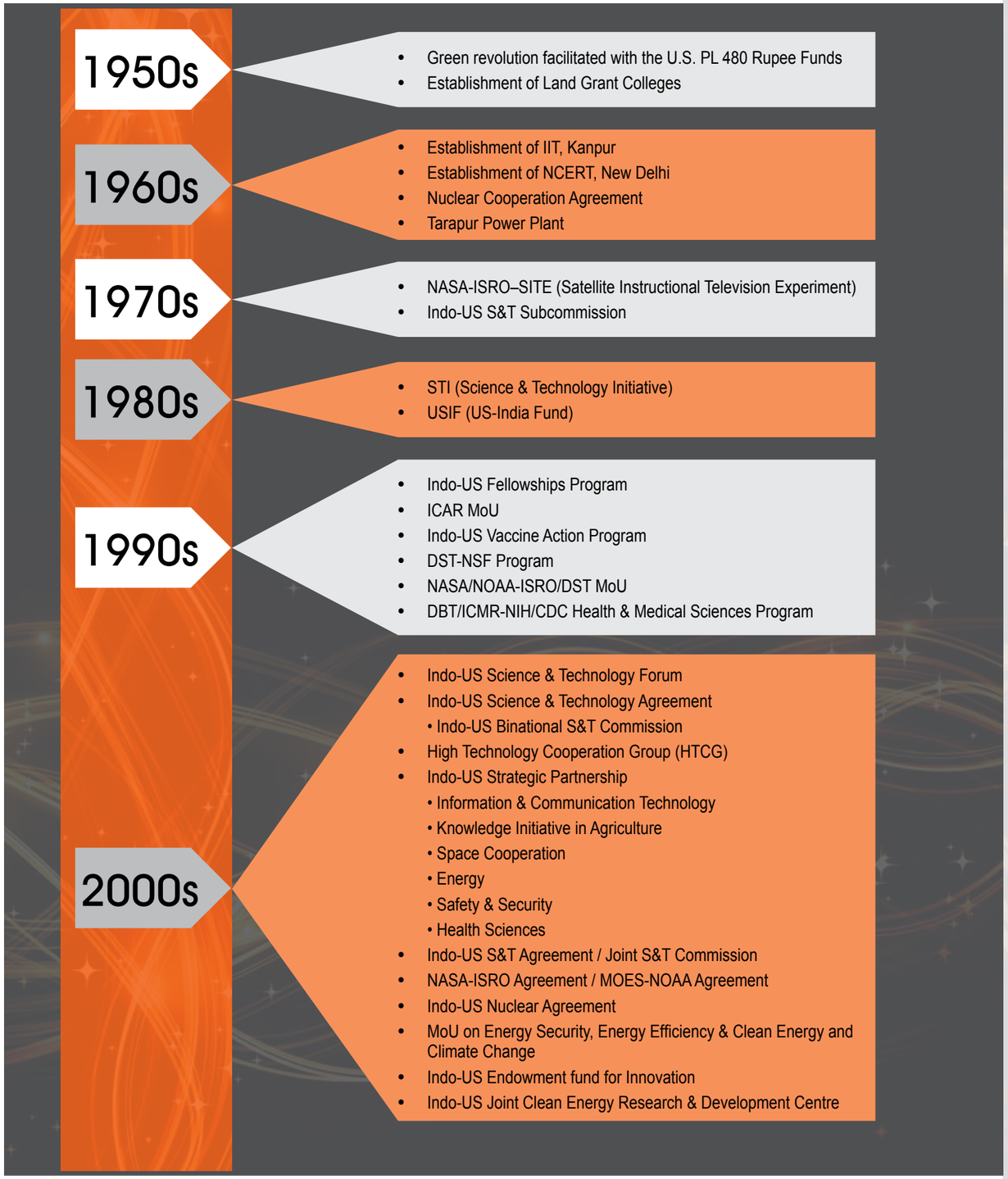
The IUSSTF has played a significant role in developing the concept and planning and organizing the first ever **India-US Technology Summit.** The objectives of the Technology Summit were to provide a platform for industries, institutions, and government agencies from India and the United States to exchange ideas and showcase their expertise; forge new partnerships to increase trade and investment in the knowledge sector; and, bring together leaders from all sectors – government, industry, research, and academia – for high level policy discussions.

The IUSSTF showcased its various programmatic activities in the Tech Summit with its pavilion receiving a large number of dignitaries and other visitors including Indian and US policy makers, students, researchers, industry etc. In addition, the IUSSTF also organized three events under the aegis of the Technology Summit with wide participation of Indian and US experts - Indo- U.S. Tech Women & Women Entrepreneurs Workshop; IUSSTF Round table on Collaborative R&D in Clean Energy and IUSSTF Round table on Water Challenges.

The year 2014-15 thus has been a very successful year for the IUSSTF in forging new linkages between individuals, institutions and funding agencies. Its activities touched a large section of students, scientists and professionals, ranging from high school students to young scientists to senior scientists in India and the US. It has programs ranging from promotion of basic sciences to technology development to innovation and entrepreneurs. In its endeavor to keep with the time, IUSSTF have developed several programmatic activities for students in STEM, young innovators and entrepreneurs and women scientists and entrepreneurs. Details of these activities are provided in the following pages. This has been possible due to a very supportive Governing Board, India and US Government agencies, partnering organizations and the active interest shown by the stakeholders in its activities. We are thankful to them for this great support.

Rajiv Sharma
Executive Director, IUSSTF

History of Indo-US S&T Cooperation



Objectives of IUSSTF

Catalyst to facilitate, seed and promote US-India bilateral collaboration in science, technology, engineering & biomedical research and innovation 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 and declarations.
- Create awareness through exchange and dissemination of information and opportunities toward 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 concern leading to long-term partnership based on shared value.
- Explore new frontiers by nurturing contacts between young and mid-career scientists and technologists to develop mutual trust, leadership and fraternity in research and development.

Management

The IUSSTF functions as

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

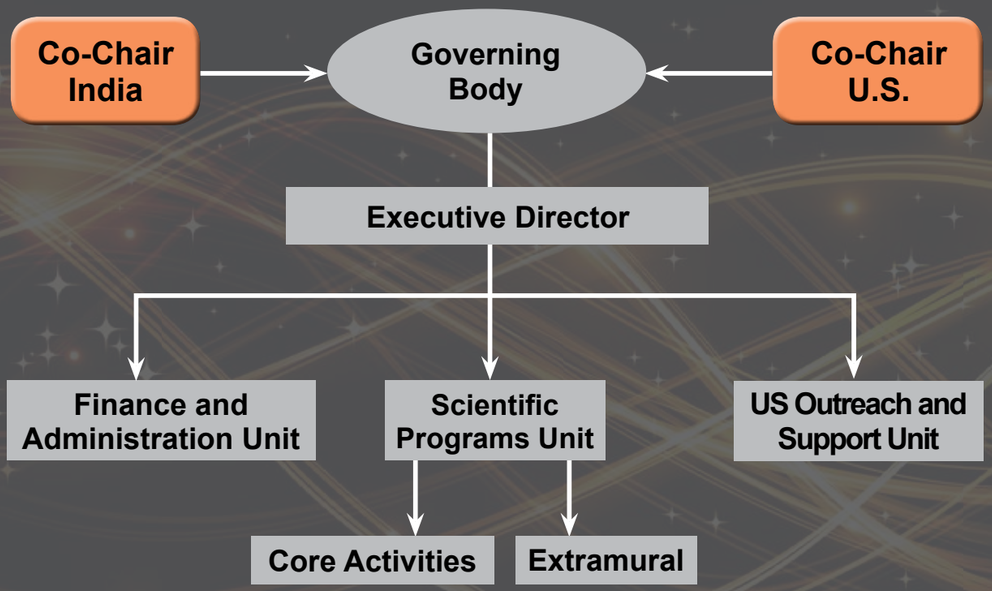
To ensure that the activities undertaken by the IUSSTF conform to the highest standards of excellence, a joint Governing Body consisting of seven Indian and seven American eminent scientists provide leadership to IUSSTF.

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

Funding

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

The 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, the IUSSTF welcomes fund contributions both in India and USA. As a 501(c)(3) entity, INSTP serves to raise funds in USA to complement support for bilateral S&T activities.



Indian Co-Chair

K. VijayRaghavan
Secretary, Department of Biotechnology, Government of India and Additional Charge Secretary Department of Science and Technology, Government of India
(May 2014 - Dec. 2014)

Ashutosh Sharma
Secretary, Department of Science & Technology, Government of India
(Jan. 2015 - Present)

US Co-Chair

Jonathan Margolis
Deputy Assistant Secretary for Science, Space and Health, Bureau of Oceans and International Environmental and Scientific Affairs, U.S. 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

15th Governing Board Meeting

15 November 2014, New Delhi

The Extraordinary Meeting of the Governing Body (GB) of the Indo-U.S. Science and Technology Forum was held at IUSSTF under the Co-Chairmanship of Dr. VijayRaghavan, Secretary, Department of Biotechnology and Secretary, Department of Science & Technology (Additional Charge), Govt. of India (Indian Co-Chair) and Dr. Jonathan Margolis, Deputy Assistant Secretary, Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State (U.S. Co-Chair), on 15 November 2014.

In the GB business meeting, the Executive Director, IUSSTF highlighted the ongoing and several new programs implemented and launched during the year, most of which were in partnership with government agencies, professional societies, industry and academia. The Governing Body expressed its unanimous appreciation of the role that has been played by IUSSTF to forge and catalyze a wide variety of bilateral S&T collaborations since its inception in 2000.

The Governing Body put on record their acknowledgement of the efforts of past Co-Chairs Dr. Norman Neureiter and Dr. T. Ramasami, and thanked them for their guidance and support to IUSSTF.

FLAGSHIP PROGRAMS

5th Indo-American Frontiers of Engineering Symposium

18 - 21 May 2014

Contact Persons

Upadrasta Ramamurty
Indian Institute of Science, Bangalore

Lisa Alvarez-Cohen
University of California, Berkeley

The fifth ***Indo-American Frontiers of Engineering (IAFOE) 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 Engineering (NAE) from May 18th to 21st at the Infosys Campus in Mysore, India. About 60 outstanding engineers under the age of 45 met to discuss cutting-edge developments in four areas: *Biomaterials*, *Water Resource Management in the Face of Climate Change*, *Green Approaches to Communications,* and *Engineering in the Context of Big Data*. The event facilitates international and cross-disciplinary research collaboration, promotes the transfer of new techniques and approaches across disparate engineering fields, and encourages the creation of a transatlantic network of world-class engineers.

The IAFOE began with welcome and opening remarks by *Venkatesh Narayanamurti* (Foreign Secretary, US National Academy of Engineering), *Ray O. Johnson* (Chief Technology Officer, Lockheed Martin Corporation), *Rajiv Sharma* (Executive Director, Indo-US Science and Technology Forum), Indian Co-Chair *Upadrasta Ramamurty* (Indian Institute of Science, Bangalore) and US Co-Chair *Lisa Alvarez-Cohen* (University of California, Berkeley).

Session I

The first session on **Green approaches to communications** was co-chaired by *Kirk W. Cameron* (Virginia Tech) and *Kumar N. Sivarajan* (Tejas Networks Ltd.). They flagged four new approaches in wireless networks: Power-optimized mobile handsets, Energy-efficient cellular architectures, Software power management and Energy harvesting in wireless sensors. The first speaker was *Vijay Janapa Reddi* (University of Texas at Austin) who spoke about Mobile Processor Architectures: Design Implications and Challenges for Energy Efficiency. *Radhakrishna Ganti* (Indian Institute of Technology, Madras) spoke about Energy Efficiency in Cellular Networks. *Joseph Turner* (MiserWare) gave a talk about the Challenges and Opportunities in Mobile Software Power Management. *Neelesh Mehta* (Indian Institute of Science, Bangalore) ended the session with a talk on Energy Harvesting-Based Green Wireless Communication Systems.

Session II

The session on **Water resources management in the face of climate change** was co-chaired by *Sharad Jain* (National Institute of Hydrology, Roorkee) and

Mark Tompkins (NewFields). The co-chairs highlighted the fact that although the earth is a blue planet, accessibility to water is affected due to several reasons such as remoteness, inability to store seasonal flows, socio-political preferences and capacity etc. The lead speaker in the session was *V. V. Srinivas* (Indian Institute of Science, Bangalore) who gave a talk on Climate change causes and hydrologic predictive capabilities. *Balaji Narasimhan* (Indian Institute of Technology, Madras) spoke about the Emerging water resources modeling technologies to understand climate change impacts on various sectors and develop adaptation strategies. *Kristin Gilroy* (US Army Corps of Engineers) presented the interactions and adaptations of natural and constructed elements of water resources systems. Finally, *Peter Wijsman* (Arcadis) spoke about Adapting to rising tides with the power of information technology – San Francisco Bay Area and beyond.

Session III

Jennifer Dy (Northeastern University) and *Sriram Raghavan* (IBM-India) co-chaired the session on **Engineering in the context of big data**. Keeping in mind the facts that manufacturing is a $2 Trillion sector, discrete manufacturing provides products for consumers and the supply chain, there is a high potential for productivity improvement, and manufacturing generates a very large amount of data; *Athulan Vijayaraghavan* (System Insights) spoke about the Internet of Manufacturing Things. *Pankaj Dayama* (IBM Research) gave a talk on Predictive analytics for industrial applications. *Nirmal Keshava* (Astra Zeneca) spoke about the Intersection of healthcare, drug discovery, and big data. *Kiri Wagstaff* (Jet Propulsion Laboratory) spoke about modeling the human, not the data, to facilitate discovery in her talk on Facilitating discovery in big data sets.

Session IV

The session on **Biomaterials** was co-chaired by *Debra Auguste* (City College of New York) and *Ashok Raichur* (Indian Institute of Science, Bangalore). *Dhirendra Katti* (Indian Institute of Technology, Kanpur) began the session with a talk on Glimpses into the exciting world of biomaterials through drug delivery systems. *Rinti Banerjee* (Indian Institute of Technology, Mumbai) spoke about Stimuli responsive lipid and biopolymeric biomaterials for drug delivery and tissue engineering. *Suzie Pun* (University of Washington) gave a presentation on Biomaterials for targeted drug delivery. Taking the learnings from the previous talks and sessions forward – the final talk of the symposium was presented by *John Santini* (ApoGen Biotechnologies) on Transforming biomaterials with novel therapies - from science to entrepreneurial start-ups. He spoke about entrepreneurship and startups; what makes an entrepreneur; and the key ingredients and lessons to keep in mind while starting a company.

In addition to the technical talks given at the symposium, attendees had the opportunity to present their work in an afternoon poster session on May 19th. These posters were displayed throughout the meeting and provided an opportunity for every participant to share information about his/her work. *Baldev Raj* (President, Indian National Academy of Engineering) gave a Pre-Dinner Speech titled *A Perspective on Technological Challenges in India*.

Another unique dimension of the IAFOE Symposium is the **Frontiers of Engineering Awards** that have been instituted by IUSSTF. The award consists of USD 10,000 to be shared between the partnering Indian and American awardees, spread over a period of two years.

Women in Science, Entrepreneurship and Research (WISER)

Contact Person

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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 U.S. Embassy and the Department of Science and Technology (DST), Government of India to organize four annual workshops and several round tables on women in science.

With the objective to study and co-develop programs to promote and facilitate **Women in Science, Entrepreneurship and Research (WISER)**, an Indian delegation comprising of senior government officials, and scientists who have been promoting women in science,

Composition of the Indian Delegation

Paramjit Khurana
University of Delhi, South Campus, Foreign Secretary, National Academy of Sciences of India

Shobhana Narasimhan
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Anita Gupta
Associate Head, National Science and Technology Entrepreneurship Board, Department of Science and Technology, Delhi

Jyoti Sharma
Principal Scientific Officer, In-Charge, DISHA Women Fellowships, Science for Equity empowerment and Development (SEED), Department of Science and Technology, Government of India

Rajiv Sharma
Executive Director
Indo-U.S. Science and Technology Forum (IUSSTF) , New Delhi

Rama Lakshmi Datta
Joint Director
Vivekananda Institute of Biotechnology, Nimpeth

Smriti Trikha
Senior Science Manager
Indo-U.S. Science and Technology Forum (IUSSTF), New Delhi

entrepreneurship and research in India visited USA from 14-18 July 2014. The goal of the visit was to facilitate research and educational partnerships between women scientists and to co-develop joint programs to promote leadership, mentoring, and networking of women scientists and entrepreneur in both countries. Aim of the visit was also to launch some joint programs for Women in Science and Women entrepreneurs for consideration of US - India Joint Commission Meeting (JCM) on S&T Cooperation scheduled in mid-November 2014.

at the National Science Foundation, Arlington VA; U.S. Department of State, Washington DC, Lockheed Martin, Global Vision Center (GVC), Crystal City, Intel, Santa Clara, TiE Silicon Valley, Anita Borg Institute (ABI), Palo Alto and University of California, Berkeley. The members of the delegation will continue to work with key stakeholders to organize and execute joint programs for Women in Science and Women entrepreneurs for consideration of US - India Joint Commission Meeting (JCM) on S&T Cooperation scheduled in mid-November 2014.

The visit of the delegation was supported by the Department of Science and Technology, Government of India. The delegation had very successful engagements and meetings

During the interactions with various stakeholders several areas of possible collaborations were identified such as Round table to catalyze researcher-to-researcher collaborations in STEM

in partnership with National Science Foundation, Faculty fellowships for women in science in partnership with Department of Science and Technology, Executive education program on leadership for women in science in partnership with industry or Department of State to build mentoring networks for women scientists, technologists and entrepreneurs, many programs to promote women entrepreneurs through capacity building programs in partnership with Anita Borg Institute, TiE Silicon Valley and industry and Industry sponsored programs to promote Women in STEM.

Training Program in Leadership and Career Advancement for Indian Women Scientists and Engineers

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As a part of the continued efforts to promote Women in Science, the Indo- US Science and Technology Forum (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 September 1-5, 2014, Delhi and September 8-12, 2014, Bangalore. 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, and publishing in respected journals, grant writing, and the job search.

The training sessions were conducted by Prof. Geraldine Richmond, President Elect, American Association for the Advancement of Science, Founder and Chair of COACh International, Laura Greene, University of Illinois, Professor of Physics, Pushpalatha Murthy, Professor of Chemistry, Michigan Technological University and Program Director in the Division of Graduate Education at the National Science Foundation and Jean Stockard, Professor Emeritus at the University of Oregon.

Dr. Manju Sharma, Former Secretary, Department of Biotechnology, Government of India, Mr. John Beeds India Mission Director, USAID, Ms. Kumud Srinivasan, President, Intel India, Prof. Baldev Raj, National Institute of Advanced Studies, Bangalore, Prof. Vijayalakshmi Ravindranath, Chairperson, Centre For Neuroscience, Indian Institute of Science, Bangalore and Dr. Renu Swarup, Advisor, Department of Biotechnology shared their valuable perspective. Several highly accomplished and eminent Indian women scientists and technologists participated in various panel discussions organized during the 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 a few important components of the session. The session included identifying participants' strengths and interests, common mistakes of graduate students/faculty/researcher 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 Work in Peer Reviewed Journals

This session provided advice and training on publishing scientific and technical results in peer-reviewed English

language journals. Topics included publication and review process for many journals, organizing a paper, determining when and where to publish results, identifying data to include in the publication, organizing the material, working with editors, 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, and assist in developing and maintaining strong leadership networks.

Session VI: Mentoring for Success

This session included an assessment of participants' 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. This session includes an assessment of participants' 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.

For each of these training programs the participants drawn were the mid career Indian women scientists and trainers. Over 100 Indian women scientists across universities, R & D institutions were trained during these two training programs.

Indo-US Workshop on Advancing Women Faculty in STEM

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The workshop was conceptualized during the visit of the WISER delegation in July 2014 and through a series of interactions between the Indo-US Science and Technology Forum (IUSSTF), the Department of Science and Technology (DST), and the National Science Foundation (NSF). It was also organized as a follow up of the earlier Women in Science workshops organized by US Embassy New Delhi, the Department of Science and Technology, and the Indo-U.S. Science and Technology Forum. The Workshop was organized in conjunction with the 3rd Indo-US Joint Commission Meeting on Science and Technology scheduled on 14 and 17 November 2014, New Delhi.

The focus of the Workshop was on leadership, mentoring, and evaluation with special emphasis on using evidence and data-based research to develop, implement and refine research-based programs related to promoting gender equity and STEM. The goal of the workshop was to initiate partnerships with Indian researchers on topics of mutual interest that promote the advancement of women in STEM fields and catalyze new research collaborations between India and the United States. Dr. Jonathan Margolis, Deputy Assistant Secretary for Science Space & Health, Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State, Dr. Renu Swarup, Senior Advisor, Department of Biotechnology, Government of India and Dr. Chandrima Shaha, Director, National Institute of Immunology, Delhi shared their perspectives during the inaugural session.

The workshop was attended by the eminent women scientists and researchers from both US & India. The US participants were university researchers funded by NSF's ADVANCE Program.

The interactions enabled sharing of best practices and exchange of ideas and information on ways to change university structures and cultures to assure that women faculty in STEM enjoy more productive, successful, and satisfying careers.

Various areas of collaboration were identified during the workshop including creating mentoring networks for Women Scientists, Leadership Training Programs and workshops on program/project evaluation.

Silicon Valley Experiential Learning Program for Women Entrepreneurs

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 was 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. The partnership was announced at the Indo-US Joint Commission Meeting, 17 November, New Delhi.

This partnership program envisages providing a unique opportunity to top 6 women entrepreneurs from the WEQ 2014 contest for a week long experimental learning visit to Silicon Valley, USA. During this visit women entrepreneurs will be provided with extensive mentoring, networking opportunities and access to capital, which is one of the biggest obstacles to growth for women entrepreneurs. The effort is to support networking amongst women entrepreneurs, connect them with government agencies and other support organizations.

The finale of WEQ 2014 was organized by the Anita Borg Institute on 21 November, 2014 at Bangalore during the annual Grace Hopper Celebration of Women in Computing India (GHCI), Bangalore. WEQ provided an excellent platform for the women entrepreneurs to showcase their business ideas and receive feedback from an eminent panel of judges, who evaluated the viability of the business plans. The partnership was launched at the Finals of WEQ. Top 6 women entrepreneurs were identified and recognized at the Award Ceremony. Sreepriya Koppula Turnaround Systems Private Limited was announced the winner of WEQ 2014 and received a grand cash prize of Rs. Five lakhs.

Top women entrepreneurs at WEQ

Sreepriya Koppula
Founder and CEO
Turnaround Systems Private Limited
http://goturnaround.com

Sreepriya is a seasoned technologist and has worked at various IT start-ups (YASU - acquired by SAP, Ketera Technologies - acquired by Deem Inc.) as a software engineer before starting her own venture, Turnaround. She founded Turnaround, an Image-tech software product company with solutions for high quality images in e-commerce. It is a platform built using Image Processing technology to solve time consuming problems for online retail. Sreepriya is passionate about building products and their go-to market strategies.

Sreepriya is an alumni from IIT Kharagpur and is a part of the Startup Leadership Program (SLP) - a peer to peer entrepreneurial learning community. In 2014, she graduated from Ignite Program for Innovation & Entrepreneurship by Stanford Business School. She is the winner of the popular Women Entrepreneur Quest 2014 organized by the Anita Borg Institute during the annual Grace Hopper Celebration India conference.

Ashwini Asokan
CEO
Mad Street Den
http://www.madstreetden.com/

Ashwini Asokan is the CEO and co-founder of Mad Street Den, an Artificial Intelligence & Computer Vision start-up in India. Until recently, she was leading the mobile innovation team at Intel's Interaction and Experience Research Lab (IXR) in Silicon Valley driving the development of new products using machine learning, sensing & AI related technologies. Ashwini has always wanted to change the narrative on artificial intelligence from killer robots, cops in flying cars, and machines taking over the world to a more positive, meaningful and fun one. She was inspired to bring AI out of successful labs of the world into the mainstream consumer market and that idea compelled her to move back to Chennai, her hometown in India, to found Mad Street Den. The company is a Computer Vision and Artificial Intelligence start-up enabling businesses with its cloud based platform, MAD Stack.

Lavina Mahbubani
Co-founder, Head of Design
Lumos Design Technology Pvt. Ltd
www.lumos.co.in
www.iwearlumos.com

Lavina heads the Design team at Lumos Design Technology. Her role within Lumos centers is the integration of electronics into apparel and accessories in a seamless manner. She brings in six years of design experience as an apparel designer for the Landmark group and Arvind Lifestyle Brands Ltd. During her stint, she handled various successful brands such as Ginger Ed Hardy and Flying Machine. Lavina is a Gold Medalist from National Institute of Fashion Technology (India's leading college for fashion technology). She was selected by the Fashion Design Council of India to represent India at the prestigious World of Wearable Arts 2009, in New Zealand. She has also recently been nominated by Femina Women Awards 2015 as an achiever in the Science & Innovation category.

Pooja Sharma
Founder and Product Head
White Sepal Services Private Limited
www.feepal.in

Pooja heads the technical team of White Sepals Services (P) Ltd. She completed her Post Graduation in Computer Science from the University of Rajasthan and then did her six months training from the Department of Information Technology and Communication (DOIT&C), Rajasthan. During her college days Pooja had some idea of Feepal, but due to the lack of resources and business experience she was not able to move ahead. In 2011, she came to New Delhi and joined a start-up mainly because of two reasons: firstly, to have some experience in technology and secondly to know how to manage start-ups. In 2013 she got the chance to meet a few educationists who appreciated her idea. They joined together and co-founded White Sepal Services (P) Ltd. in September 2013. Pooja takes care of the product and technology functions of the company White Sepal Services (P) Ltd. As an entrepreneur she has developed technological products for companies like Deloitte, Dabur, Clean and Clear etc. The technology and aggregation model behind Feepal is her brain child.

Vineeta Singh
Founder and CEO
Vellvette Lifestyle Private Limited
http://www.fabbag.com/

Vineeta Singh is the Founder and CEO of Vellvette Lifestyle Private Limited. Her company FAB BAG is a monthly beauty subscription service and e-Commerce platform that leverages internet and social media to disrupt the way beauty and grooming products are purchased and sold in India. Through a unique affordable monthly "beauty bag" model, Fab Bag reaches existing and underserved markets to spread awareness about premium and prestige, global and Indian brands. Fab Bag was launched as Vellvette.com in July 2012 and started selling subscriptions and e-Commerce products in September 2012. After a successful year of scaling up revenues, Vellvette changed the brand and domain name to an easy-to-remember-and-recommend "FabBag.com". In a little over 2 years, the business has scaled from 200 paying subscribers in December 2012 to 10,000+ paying subscribers and more than 100 brands.

Naiyya Saggi
CEO & Co-founder - BabyChakra.com; Director - Infomoko Technology Pvt. Ltd.
www.babychakra.com

Naiyya Saggi is the CEO and co-founder of BabyChakra.com, a platform that helps parents discover and decide on the best local services, right from when they are expecting a baby to when their child is five. As CEO, Naiyya is in charge of fundraising, strategic partnerships, product and team building. Naiyya is a Fulbright and JN Tata Scholar. She has an MBA from the Harvard Business School, Boston. Prior to her MBA she worked at McKinsey & Company as a consultant and at the Public Health Foundation of India on secondment from McKinsey. She did her undergraduate degree in Law from The National Law School of India University (Bangalore), where she was elected University President. Over the last six years, she has worked extensively in healthcare and education. She is the author of multiple national and international articles including an HBS case study on scaling oncological interventions. She has been featured in The Economic Times, India's leading financial publication, as a young leader.

Team India 2014:
Intel® International Science and Engineering Fair (ISEF)

Contact Persons

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The Indo-US Science and Technology Forum partnered with the Department of Science and Technology, Government of India and Intel to support 18 Indian high school students for a two week-long scientific exposure to the United States of America, from 11 – 22 May 2014. TEAM India comprised of high school students who were winners at the **Initiative for Research and Innovation in Science (IRIS)** a research based science fair initiative for school students held in India annually. IRIS is a public – private partnership heralded by the Department of Science & Technology (DST), Confederation of Indian Industry (CII) and Intel Education for empowering the next generation of innovators. The students were selected after a rigorous process of support camps and various elimination rounds across the country.

TEAM India participated and competed at the Intel® International Science and Engineering Fair (ISEF), Los Angeles, USA, the world's largest pre-collegiate high school science research competition; and also participated in a week-long exposure trip to science, research and technology based activities in museums, universities, high schools along with meeting Nobel laureates, eminent scientists and scholars.

The TEAM India was flagged off by Dr. T. Ramasami, Secretary, Department of Science and Technology, Government of India and the United States Ambassador to India, Ms. Nancy J. Powell.

TEAM India got an opportunity to meet and interact with Dr. APJ Abdul Kalam, former President of India on 9 May 2014 at his residence during the pre-departure orientation.

Team India 2014:
Intel® International Science and Engineering Fair (ISEF)

ISEF 2014 was held from 12 - 17 May 2014 at Los Angeles, USA wherein 12 Indian projects participated and after competing with more than 1700 participating science and research projects from 78 countries won 13 Special and Grand Awards for themselves and for the country.

TEAM India visit post ISEF 2014

Team India also got an opportunity to become the first set of ISEF India Finalists to get an additional 5 day exposure visit after ISEF in USA. The visit was an immersive experience of the scientific and the entrepreneurial culture of USA.

WINNERS

Abhishek Verma & Daksh Dua, Maharaja Agrasain Public School, Delhi.
Subject category: Animal Sciences
Project: *Rubusellipticus*an effective solution against Giardiasis
Awards: Intel ISEF Best of Subject Category Award (cash prize 5000US$) Intel ISEF First Grand Award (cash prize 3000US$) Intel Foundation Cultural and Scientific Visit to China Award Minor planet named after each one of them as part of ISEF First Grand Award.

Deeksha P. Hebbar, Vivekananda English Medium School, Puttur, Karnataka
Subject category: Animal Sciences
Project: Effective treatment for Cattle Dermatitis by using Cashew Tree (*Anacardium occidentale*).
Awards: Intel ISEF Fourth Grand Award (Cash prize 500US$) and a Special award from Ashtavadhani Vidwan Ambati Subbaraya Chetty Foundation (Cash prize 500US$)

Shreya Nandy and Kopal Gupta, Amity International School, Mayur Vihar, New Delhi
Subject category: Chemistry
Project: Unique Kit for detection and removal of pesticides and insecticides from the surface of fruits and vegetables.
Awards: Intel ISEF Fourth Grand Award (Cash prize 500US$) Rob and Melani Walton Sustainability Solutions Initiatives award (cash prize US $2500 & trip to Arizona, USA).

Animesh Tripathi, Sanskriti School, New Delhi
Subject Category: Computer Sciences
Project: Optimizing Digital Content for Color-Blind Audiences Enhancement Algorithms by 7.
Awards: Intel ISEF Fourth Grand Award (Cash prize 500US$) Google CS Connect Award (Cash Prize 5000US$).

Amrit Sahu, DAV Public School, Bhubaneswar, Odisha
Subject Category: Engineering - Electrical and Mechanical
Project: VOICE-O-NATOR - An Aid for the Speech Impaired
Award: Intel ISEF Fourth Grand Award (Cash prize 500US$)

Jaya Sagar, Government Senior Secondary School, Manali, Himachal Pradesh
Subject Category: Plant Sciences
Project: *Brassica Juncea* (Mustard) Flowers can be used to Attract Pollinators for Better *Malusdomestica* (Apple) Yield.
Awards: Intel ISEF Fourth Grand Award (Cash prize 500US$) Special award from Ashtavadhani Vidwan Ambati Subbaraya Chetty Foundation (Cash prize 500US$)

Debapratim Jana, South Point High School, Kolkata, West Bengal
Subject Category: Engineering: Materials and Bioengineering
Project: Alternative Materials for Solar Cell Development
Award: Special award from Patent and Trademark Office Society (Cash prize 500US$)

During these 5 days, 'Team India' visited some of the best universities, science museums; interacted with scientists at University of Southern California, school education practitioners and students of same age group at Lynbrook High school; participated in various hands on activities at the Exploratorium, California Academy of Sciences, NASA's Ames Research Center and Maker Faire at San Mateo, California, USA. This visit was jointly organised by the Indo-US Science and Technology Forum (IUSSTF) in partnership with DST and Intel. Such an exposure encouraged students, created excitement of creative pursuits of STEM education, motivated young students to undertake research in the frontier areas of science & technology and also developed a spirit of innovation and entrepreneurship. 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.

Team India visited the **University of Southern California, Los Angeles** and interacted with professors and scientists from various departments - Robotics, Life sciences, Biomedical Microsystems Lab etc. They also got an opportunity to interact with Prof. G. K. Suryaprakash, Professor and George A. and Judith A. Olah Nobel Laureate Chair in Hydrocarbon Chemistry and Director, Loker Hydrocarbon Research Institute, University of Southern California.

TEAM India visits the Maker Faire, San Mateo

Team India attended the **Maker Faire** being held at San Mateo, 18 May. At the faire they were greeted by a giant metallic octopus that spewed fire from its tentacles and smiled grotesquely through metallic teeth! The Maker Fair gave them an opportunity to meet with innovators working with all kinds of mediums to produce gadgets and designs that left one spellbound. Team India also got a chance to try their skills at making small gadgets with LED lights and to observe 3D printers work their magic.

TEAM India visits the Stanford University

Next up was a visit to Stanford and a chance to get a feel of its amazing 8000 acre campus. The students visited the Stanford Chapel and also craned their necks backward to see if they could take in the majestic Stanford tower in one shot and capture it in their memories.

TEAM India interacts with students & teachers at the Lynbrook High school, San Jose

A visit to Lynbrook High School on 19th May, for an interaction with students of their own age saw Team India making new friends and comparing notes on the way their schools matched up. They also took a tour of the school campus and commended the Principal and teachers on the vast space and amenities. Team India joined for a biology class and science club activities. Team India presented an overview about their projects to the Lynbrook students.

TEAM India visits Intel Museum, Santa Clara

Team India visited the Intel Museum at Santa Clara, and got to know how the first Intel Chip was created; what a Silicon nugget looks like and how Intel technology has now evolved to producing Nano chips and microprocessors. While at the Intel Museum, they also got a chance to do a hands-on workshop which focused on design, instruction and collaboration.

Team India visits NASA AMES Research Centre

A short scenic journey brought the group to the NASA AMES Research Centre; where they explored the museum and plied the resource people with questions. The students enjoyed the exhibits and activities that cover NASA-themed science topics, NASA Space Station exhibit, flight simulator,and the real moon rock.

TEAM India visits the Exploratorium, San Francisco

The Exploratorium at Piers 15/17 was a wonder world of fun facts and amazement. Team India split up to try and take in every single exhibit and working model and yet came out wanting more time to devote at this hub of science and discovery.

TEAM India visits the California Academy of Sciences, San Francisco

On 21 May, the Team India visited the California Academy of Sciences, one of the largest museums of natural history in the world that brings the whole universe under one roof- an aquarium, a planetarium, a natural history museum and more! The 412,000 square feet structure is not only physically impressive, but probably the greenest museum on the planet, with a 2 ½ acre living roof, an expansive solar canopy and an extensive water reclamation system and walls insulated with recycled blue jeans.

Team India 2014:
Intel® International Science and Engineering Fair (ISEF)

Consulate General of India hosts an evening for TEAM India

The grand finale of the trip was a reception at the residence of **Mr. N. Parthasarathi**, the Consulate General of India, San Francisco. Team India eagerly shared their experiences and their views on and discussed about opportunities in India and USA.

STRATEGIC PROGRAMS

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 *U.S.-India Partnership to Advance Clean Energy (PACE)* on November 24, 2009 under the U.S.-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 U.S. 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.

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 renewable in electricity generation consistent with its intended goal to increase India's solar target to 100 gigawatts by 2022.

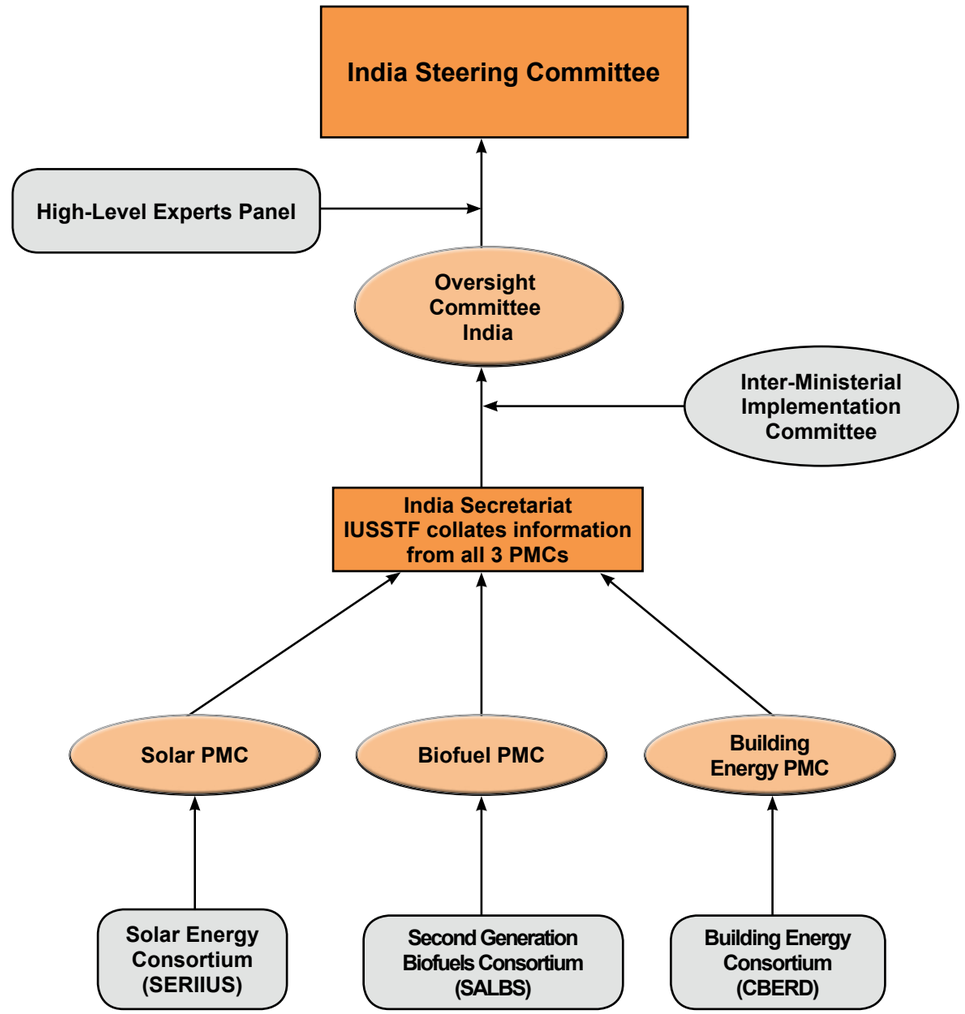
The Joint Statement clearly builds upon the success of the JCERDC by taking its activities and progress to the next level. To quote the Joint Statement – "*The United States intends to support India's goal by enhancing cooperation on clean energy and climate change, to include expanding the Partnership to Advance Clean Energy Research (PACE-R): A renewed commitment to PACE-R, including extending funding for three existing research tracks of solar energy, building energy efficiency, and biofuels for an additional five years and launching a new track on smart grid and grid storage.*"

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 JCERDC is funded by the Indian Ministry of Science and Technology and the U.S. Department of Energy. The program is being administered in India by the Indo-U.S. 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 September-October 2014, 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.

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

CONSORTIUM REVIEW AND MANAGEMENT MECHANISM



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 U.S. Department of Energy (DOE) SunShot Initiative.

The achievements of the project thus far include the following:

- Consortium research projects were initiated following the SERIIUS 10-Point Work Plan, developed through an all-SERIIUS consensus process for the Sustainable PV, Multiscale CSP, and SEI Research Thrusts. Each thrust has several sub tasks, which are closely monitored by the Project Monitoring Committee.
- SERIIUS Web Gateway (www.SERIIUS.org) is in full operation, providing information about the Consortium to the public, establishing a special and secure "Consortium Collaboration Tool" for sharing research information among SERIIUS partners, and social media links (Facebook and Twitter).
- Inter-SERIIUS-partner organization visits have blossomed, and are key to ensuring research interactions, sharing of results, fostering relationships, and maintaining the enthusiasm for SERIIUS among members.
- Two Project Monitoring Committee Meetings have thus far, closely monitored and evaluated the advancement of the project.

SERIIUS Partners

Collaborating Institutions, India	Collaborating Institutions, USA
Lead Institution: Indian Institute of Science, Bangalore	**Lead Institution:** National Renewable Energy Laboratory
Other Academia Partners	**Other Academia Partners**
1. Indian Institute of Technology, Bombay	1. Lawrence Berkeley National Laboratory
2. Indian Association for the Cultivation of Science, Kolkata	2. Arizona State University
3. ARCI, Hyderabad	3. Carnegie Mellon University
4. Solar Energy Center, Gurgaon	4. Colorado School of Mines
5. Indian Institute of Technology, Madras	5. Massachusetts Institute of Technology
6. CSTEP, Bangalore	6. Purdue University
	7. Stanford University
	8. University of Central Florida
	9. University of South Florida
	10. Washington University
	11. RAND Corporation
	12. Sandia National Laboratories
Other Industry Partners	**Other Industry Partners**
1. Thermax Ltd	1. Corning Incorporated
2. Clique Developments Ltd	2. SunEdison. LLC
3. Hindustan Petroleum Corporation Ltd.	3. Solarmer Energy Inc.
4. Moser Baer India Ltd	
5. Wipro Ltd	
6. Bharat Heavy Electrical Ltd.	

PROJECT MONITORING COMMITTEE, INDIA
Solar Energy Research Institute for India and the United States (SERIIUS)

Anil Kakodkar
(Chairman), INAE Satish Dhawan Chair of Engineering Eminence, Bhabha Atomic Research Centre, Mumbai

R. Banerjee
Indian Institute of Technology, Bombay

Suresh Chand
National Physical Laboratory, New Delhi

Vikram Kumar
Indian Institute of Technology, Delhi

S. C. Mullick
Indian Institute of Technology, Delhi

K. S. Narayan
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Reji K. Pillai
India Smart Grid Forum, New Delhi

B.V.S.S. Prasad
Indian Institute of Technology, Madras

C. Ranganayakulu
Aeronautical Development Agency, Bangalore

A. K. Raychaudhuri
S.N. Bose National Centre for Basic Sciences, Kolkata

Bhim Singh
Indian Institute of Technology, Delhi

J. Srinivasan
Indian Institute of Science, Bangalore

K. Vijaymohanan
Central Electro Chemical Research Institute, Karaikudi

- A biannual Internal Review Meet of the consortium partners help in synchronizing the advancement of the group and sketching the roadmap for the future.

» Number of Partnering Institutions: 32 (India and the United States)
» Research papers in peer-reviewed journals
  - Published: 74
  - Published conference proceedings: 142
» Patent Disclosure: 1

Sustainable Photovoltaics

- An 8.0 % CZTS solar cell on flexible Willow® glass from Corning has been achieved; Phase pure CZTS is achieved on FTO and Mo coated glass substrates; Single phase CIGS films were achieved by electrodeposition; Phase purity was achieved by optimizing the annealing condition and devices are being made and in process of testing; 8.0% (7% average) CIGS nanoparticle based solar cell has been fabricated on flexible Corning Willow® Glass. This efficiency has been achieved by rapid thermal processing (RTP) of the coated CIGS nanoparticle film in selenium.
- Two new OPV materials with absorption > 650 nm have been designed at NREL and synthesized at IISc; a > 4% OPV module has also been developed.
- DSSCs with 8% efficiency have been fabricated as reported earlier; Si nanowire fabrication has been standardized, and fabrication of preliminary Si nanowire based solar cells has been initiated.
- As reported earlier, solar cells have been fabricated with 15.9% efficiency on 6" wafers received from Sun Edison;

Process of recovery of silicon from kerf dust is being optimized. As reported earlier, a series of co-ordinated measurements and simulations have been made on HIT solar cells obtained from Moser Baer.

- Corning's flexible Willow® glass continues to be shipped. It has been used to fabricate CZTS and CIGS solar cells.
- 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.
- Field data obtained from installations in different climatic zones in India and USA continues to be taken and analysed; solar PV development for rural and commercial application continues.
- Work on improved encapsulants with improved WVTR; Al doped ZnO films developed for TCO applications; Work on dust mitigation.

Multi scale Concentrated Solar Power

- Optimization of 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; procurement of components is in progress; Design of a tubular serpentine receiver; CFD model predicts efficiency > 90% is ready at Sandia National Labs.
- 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. First heliostat prototype gives us insight to the actual cost, weight, and other requirements of a heliostat.
- 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. Completed Machining of scroll elements for first prototype is complete. A 'burn-in' test rig is being 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 CO2 Brayton cycles.
- A new Core project (CSP-Core2) with BHEL has commenced, on the development of a ceramic volumetric receiver for S-CO_2. The financial resources allocated to IISc for CSP-Core 1 is being utilized in CSP-Core 2. In CSP-Core 2, a design concept of a volumetric receiver with SiC ceramic as the absorber material is finalized, geometric modelingcompleted and a test material is fabricated. A laboratory scale open cycle test s-CO_2 loop for testing the receiver module has been designed source.

Solar Energy Integration

- Report on resource assessment and technology roadmap frameworks for PV and CSP in India. A detailed report on ''Solar Resource Assessment and Technology Roadmap'' was submitted. Projections of solar power capacity in India in 2031-32 were made based on three scenarios-Planning Commission's low carbon Growth study, steady Renewable Purchase Obligation growth and ICF International's Green scenario. Further, a detailed policy overview of solar energy in India including central and state policies for grid connected plants, roof top PV, rural electrification schemes and decentralized solar applications was completed along with identification of policy gaps and recommendations to bridge these. A study on innovative financing schemes for solar projects in India was also carried out.

Indo-US Joint Clean Energy Research and Development Center

- SERIIUS Quarterly Newsletters were compiled and uploaded on SERIIUS web site for informing the consortium about SERIIUS activities, government's solar policies and solar news in general.
- A detailed technical assessment of thin film solar cells based on CIGS, CZTS and perovskite materials was carried out. The study reviewed the three solar cell technologies based on these materials, their fabrication processes and final device properties.
- A computational tool, CSTEM (CSTEP's Solar Techno-Economic Model) for estimating the optimized solar multiple for Parabolic Trough plants was made available through the SERIIUS website. A comprehensive review of the Solar Tower technology was conducted with respect to the performance, cost, merits and de-merits of different variants under Indian conditions and report based on this work-'' Global Review of Solar Tower Technology'', was submitted and also published as a journal article. A detailed engineering model for the reflected image from the heliostat was developed.
- A detailed report on ''Energy Storage for RE Deployment in India: Potential, Economics and Technology Options'' was completed. This study included storage requirement estimation and economics for rural microgrid, telecom sector, roof-top PVs and Power grid.
- Assessment of options to enhance the life of sodium-sulfur rechargeable battery.
- Studies of Li-ion, Supercapacitor and Unitized Regenerative Fuel cells (URFC) for grid scale applications. A few experimental as well as modelling studies on Li ion battery cathodes and anodes of select chemistries were completed and published in high quality journals.
- Development of Novel Storage Materials for Solar-Hydrogen Produced by PV Electrolytic System:Metal Organic Framework (MOF) materials to store hydrogen studied. A few benchmark MoF compounds were synthesized and characterized.

BUILDING ENERGY EFFICIENCY

The ***U.S.-India Joint Centre for Building Energy Research and Development (CBERD)*** will conduct collaborative research and promote clean energy innovation in the area of energy efficiency in building with measurable results and significant reduction in energy use in both nations. CBERD is co-led by CEPT University-Ahmedabad and Lawrence Berkeley National Laboratory. CBERD focuses on the integration of information technology with building controls and physical systems for commercial/high-rise residential units.

The highlights of the project includes the following:

- CBERD organized the first joint CBERD forum in India. On 17th November 2014 R&D leaders from both countries met and discussed progress towards milestones defined earlier.
- After this joint meeting, US CBERD R&D leads visited Indian organizations located in various parts of India. (New Delhi, Hyderabad, Ahmedabad, Jaipur, Mumbai, Bangalore) Their visit included meeting with industry partners at CBERD sites, working with team members at labs and joint technical sessions. Their visit took place during 18-21st November 2014.
- All India and US R&D team leads met at CEPT University, Ahmedabad on 22nd November 2014 to share their notes and present their plans for next phase of CBERD. The session included valuable sharing of project insights and lessons learnt from the past 2 years of work; and delineation of next steps at both the program and task levels. The US CMO had an extensive work-session with PACE-D partner Nexant-the key organization that handles the PACE program's deployment work in India.

CBERD Partners	
Collaborating Institutions, India	**Collaborating Institutions, USA**
Lead Institution: Center for Environmental Planning and Technology (CEPT) University, Ahmedabad	**Lead Institution:** Lawrence Berkeley National Laboratory
Other Academia Partners 1. International Institute of Information Technology, Hyderabad 2. Malaviya National Institute of Technology, Jaipur 3. Indian Institute of Technology, Bombay 4. Indian Institute of Management, Ahmedabad 5. Auroville Center for Scientific Research 6. Indian Green Building Center, CII 7. Indian Society of Heating Refrigeration and Air Conditioning Engineers 8. Rajasthan Electronics and Instruments Limited 9. Indian Society of Lighting Engineers	**Other Academia Partners** 1. Oak Ridge National Laboratory 2. University of California Berkeley 3. Carnegie Mellon University 4. Rensselaer Polytechnic Institute
Other Industry Partners 1. Asahi India Glass 2. Biodiversity Conservation India 3. Infosys Technologies. 4. Neosilica Technologies 5. Oorja Energy Engineering Services 6. Paharpur Business Centre/Green Spaces 7. PLUSS Polymers 8. Philips Electronics India 9. Saint Gobain Corp 10. Schneider Electric India 11. Sintex Industries Limited 12. Skyshade Daylights 13. Wipro EcoEnergy 14. Glazing Society of India	**Other Industry Partners** 1. Autodesk, Inc. 2. California Energy Commission 3. Delphi 4. enLighted Inc. 5. Honeywell 6. Infosys Public Services 7. Ingersoll-Rand/Trane 8. Lighting Science Group Corp 9. Nexant 10. Saint Gobain Corp 11. SAGE Electrochromics 12. SynapSense 13. The Weidt Group 14. Bay Area Photovoltaic Consortium 15. City of San Jose 16. HOK Architects 17. Natural Resources Defense Council

- » Number of Partnering Institutions: 41 (India and the United States)
- » Research papers in peer-reviewed journals:
  - Published: 4
  - Published conference proceedings: 22
- » Patent Filed: 1
- » Software generated: 9
- » New process development: 7

Scientific/ Educational Exchanges

❖ Development of a framework of Regional Data Glazing and Shading Aggregator (RDA) concept by LBNL that would enable Indian partner CEPT to become a regional aggregator for the International Glazing database (IGDB) and Complex Glazing Shading Database (CGDB).

❖ The triple bottom line (TBL) methodology has been used as instructional material for a Carnegie Mellon graduate elective course in the MS in Sustainable Design and the MS in Building Performance and Diagnostics with 15-20 students per year. Two faculty, four MS and one PhD student were engaged in developing the framework and in customizing the first set of proof sets to the Indian baseline.

❖ The TBL methodology for evaluating building investments was presented at "Innovation with Impact" - a cross disciplinary exhibition of Carnegie Mellon University on April 9, 2015.

❖ The TBL methodology was presented in a Master Class associated with the Australian Green Building Council's Sustainable Cities Conference in Melbourne on March 19, 2015.

PROJECT MONITORING COMMITTEE, INDIA
Center for Building Energy Research and Development (CBERD)

Nagesh R. Iyer
(Chairman), Distinguished Emeritus Professor, Former Acting Director, (AcSIR), Chennai

N. Sarat Chandra Babu
Centre for Development of Advanced Computing, Bangalore

B.G. Fernandes
Indian Institute of Technology, Bombay

Y. K. Jain
School of Planning and Architecture, New Delhi

Subrata Kar
Indian Institute of Technology, Delhi

Ajay Khare
School of Planning and Architecture, Bhopal

Mahua Mukherjee
Indian Institute of Technology, Roorkee

K.Ramamritham
Indian Institute of Technology, Bombay

B. V. Venkatarama Reddy
Indian Institute of Science, Bangalore

Sanjay Seth
Bureau of Energy Efficiency, New Delhi

S. Srinivasamurthy
Indian Institute of Science, Bangalore

G.N. Tiwari
Indian Institute of Technology, Delhi

Technology Demonstrations/ test beds and data analysis

❖ Launch of demonstration EIS Springboard Program (ESP): Recruitment of two hotel chains- 'Fern' and 'Ginger' for demonstration of Energy Information Systems (EIS) packages in hotels, based on the CBERD defined packages.

❖ Continued operations and collection of performance data from the installed open-API lighting control system from industry partner EnLighted at LBNL.

❖ Continued cool roofs monitoring at Infosys office buildings in Bangalore, and MSEDCL utility building in Nagpur.

❖ Daylighting equipment: Conceptual design of the large-scale outdoor goniophotometer completed.

❖ Web-Based Indoor Environmental Quality and Thermal Comfort Surveys deployed in three new buildings in India and data collection is in progress; will be ramped up to include more buildings.

Industry collaboration progress:

Industry partners continued to provide ongoing engagement and value, as highlighted through the examples below:

❖ Initial work on Project Dasher with Autodesk: LBNL and AutoDesk Research recently started planning collaborative work due to start in FY16, focused on integrating real-time energy performance assessment into the Project Dasher visualization tool for IEQ in larger occupied spaces.

- EIS demonstrations with two industry partners, Schenider Electric and Wipro. These two partners will engage significantly in the EIS package product demonstrations, bringing in relevant expertise in product development and as service provider respectively.
- Cool Roof monitoring experiments and demonstration with partners by Saint Gobain Research India: SGRI and Indian partner IIIT-H are conducting a controlled experiment for estimating the energy saving potential of high albedo surfaces on flat concrete roofs in identical test huts specifically constructed by SGRI in four different climatic zones of India.
- Saint Gobain Glass and ASAHI Glass are actively helping to conduct Thermal Comfort Survey
- Industry partner Delphi's sample components are being used for integration of MCHX evaporator in 1.5TR air-conditioning unit at Indian partner IIT-B's team experimental setup.

SECOND GENERATION BIOFUELS

The ***U.S.-India Consortium for development of Sustainable Advanced Lignocellulosic Biofuel Systems*** emphasizes on sustainable feedstock cultivation and supply, biochemical conversion technologies for production of second generation biofuels with minimal environmental impact, and analysis of overall sustainability and supply chain of feedstock. The consortium is co-led by the Indian Institute of Chemical Technology-Hyderabad and the University of Florida-Gainesville.

The project comprises of three work packages – WP-1 involves the feedstock development and supply, WP-2 focuses on the conversion technologies, and WP-3 addresses sustainability, marketing and policy.

The highlights of project progress thus far are as follows:

- High biomass sorghum genotypes were screened for various agronomic traits (plant height, fresh yield, stover yield, etc.) during the post-rainy season for potential high biomass producing lines. Thirty-six HBM genotypes were identified, out of which 10 showed superior stalk yields.
- Large-scale demonstration trials of farmers preferred cultivars were conducted in Gujarat, MP and Tamil Nadu. Data collection is in progress.
- A total of 40 biomass lines are being screened for salinity tolerance (10 dsm^{-1}).
- A total of 28 advanced breeding progenies in brown midrib background were evaluated for biomass quantity and the entry (CSV 15 × IS 21891-1-1-1) × (HC 260 × B 35)-2-1-1-1 with dry biomass of 29.9 t ha-1 recorded the highest yield in the trial.
- Fifty pearl millet hybrids were evaluated at 8 locations (ICRISAT, 2 locations in Madhya Pradesh, and 5 locations in Gujarat) during rainy season of 2014. Data analysis is under progress.
- Thirty-two trials on farmer's fields (6 identified pearl millet high biomass OPVs/germplasm) were conducted in Madhya Pradesh and Gujarat. Data analysis is under progress.
- Abellon has collected 20 different bamboo germplasm from various parts of India after consulting with National Bamboo Mission (NBM). Six out of 20 germplasm lines have been established at Modasa for further studies, while others are in the process of being established.
- A stress tolerance study of existing *Bambusa balcooa* under *in-vitro* and *in-vivo* conditions is ongoing. Genetic variation studies conducted on 6 varieties of Bamboo using molecular approaches showed *Bambusa balcooa* to be the most diverse variety. Pre-processing and commutation of 5 lignocellulosic biomass samples of sorghum and pearl millet was optimized at HPCL and the commuted biomass was dispatched to the WP-2 partners involved in conversion technology.
- The biomass of promising HBM sorghum and pearl millet lines were supplied to WP2 partners.
- Land survey for the cultivation of coarse cereals as well as sorghum was conducted in various areas of Madhya Pradesh involving ICRISAT, DSR and RVSKVV scientists. Sites for conducting MLT's for sorghum and pearl millet were identified as well. Preliminary interactive survey with local farmers with regards to

SALBS Partners	
Collaborating Institutions, India	**Collaborating Institutions, USA**
Lead Institution: Indian Institute of Chemical Technology, Hyderabad	**Lead Institution:** University of Florida
Other R &D Institutions and Academia Partners 1. International Crops Research Institute for the Semi-Arid Tropics- Hyderabad 2. Directorate of Sorghum Research-Hyderabad 3. Jawaharlal Nehru Technological University-Hyderabad 4. Tamil Nadu Agricultural University 5. Rajamatha Vijayaraje Sindia Krishi Vishwa Vidyalay, Gwalior 6. Centre for Economic and Social Studies 7. Indian Institute of Technology-Delhi 8. Indian Institute of Technology-Chennai	**Other R & D Institutions and Academia Partners** 1. University of Missouri 2. Virginia Tech 3. Montclair State University 4. Texas A&M University
Industry Partners 1. Abellon Clean Energy 2. Hindustan Petroleum Corporation Limited	**Industry Partners** 1. Show Me Energy 2. Green Technologies

PROJECT MONITORING COMMITTEE, INDIA
US-India Consortium for development of Sustainable Advanced Lignocellulosic Biofuel Systems (SALBS)

K. Gurumurthi
(Chairman), Former Director, Institute of Forest Genetics and Tree Breeding-Coimbatore

Jayant Modak
Indian Institute of Science, Bangalore

K. J. Mukherjee
Jawaharlal Nehru University, New Delhi

A.K. Panda
National Institute of Immunology, New Delhi

V. V. Ranade
National Chemical Laboratory, Pune

cultivation of sorghum and pearl millet for biomass production was conducted by CESS group.

- Cellulolytic fungi from various biosphere zones were isolated and 21 fungal cultures were identified at TNAU. Standardization of alcohol fermentation to establish base levels on glucose substrate using in-house Saccharomyces cerevisiae has been initiated at IIT-D. Similarly, standardization of pre-treatment variables of the biomass samples, isolation of microbial strains from various biosphere zones, and screening of biomass degrading-enzymes (xylanase and cellulase) have been initiated at I ICT.
- Commercial cellulotic enzymes have been procured from various sources and analyzed for their efficacy to hydrolyze pretreated biomass.
- An algorithm based on various parameters/benchmarks available in literature has been designed by JNTU team for assessing the suitability of pre-treated biomass for ethanol fermentation.
- Pre-treatment experiments were undertaken with sorghum biomass (1 Kg, <10 mm particle size) with different combination pre-treatment's such as (a) only Steam explosion, (b) Alkali treatment and Steam explosion, (c) Acid treatment and Steam explosion and (d) peroxide with Steam explosion under the operating conditions of pressure (10 Kg/cm^2), temperature (180°C), and residence time (20 min).
- The saccharification results showed that non-specific adsorption of cellulases increased with an increase in lignin content in the material. The highest saccharification yield (94%) was achieved in case of pure cellulose (obtained from caustic-carbonic cooking). The Langmuir adsorption isotherm of high lignin (12%) containing material showed maximum bound enzyme (protein) concentration as 316 mgg^{-1} (Ebm) with an adsorption rate constant of 0.0083 (K_a).
- Abellon has reviewed and compiled globally available documents on certification systems. They have consulted three independent experts working in the fields of social/woman development, extension education, CESS, and an NGO group for their inputs on the design of the baseline survey forms. Second round of Focussed Group Discussions (FGD) with farmers has been conducted at Khas and Modasa.
- Similarly, primary and secondary data with respect to non-food based biofuels has been reviewed and compiled. CESS has independently compiled a questionnaire for the baseline survey after a preliminary visit to the field sites of Indore and Gwalior in Madhya Pradesh.

» Number of Partnering Institutions: 18 (India and the United States)

» Research papers in peer-reviewed journals
  - Published: 9
  - Published conference proceedings: 61

» Intellectual property generated: 2

STRATEGIC PROGRAMS

United States - India Science and Technology Endowment Fund

Contact Person

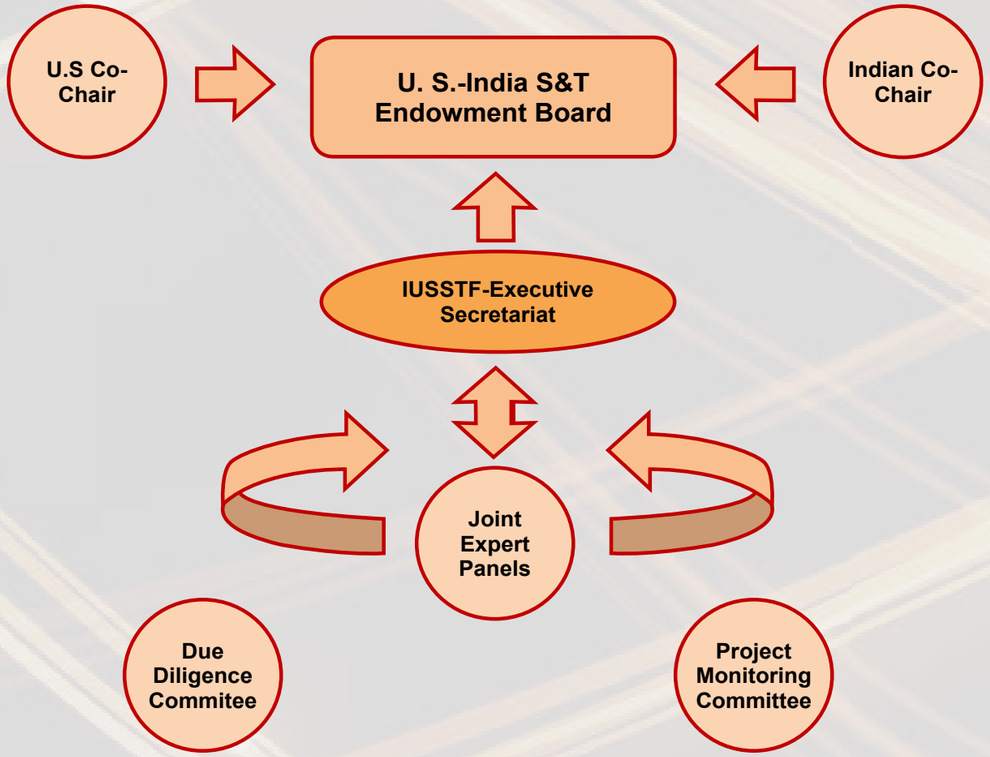
Smriti Trikha
Indo-US S&T Forum, New Delhi
E-mail: endowment@indousstf.org

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 envisages 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 grant program, selects and financially supports promising joint U.S.-India entrepreneurial initiatives by providing grants up to Rs. 2.50 crores or approx. USD 400,000 (subject to prevailing exchange rate)

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

The program is coordinated and administered through the bi-national **Indo-U.S. 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, and education.

STRUCTURE OF THE ENDOWMENT FUND



Given below are the Joint U.S.-India entrepreneurial projects supported by the U.S.-India S&T Endowment Fund:

S. No.	Project Title	Lead US Partner	Lead Indian Partner
1.	A fair price for healthy fruits & vegetables: Helping farmers access cold-storage technology	**Sorin Grama** Promethean Power Systems, Boston	**Rustom Irani** Icelings-Chirag Ice Factory Pvt. Ltd., Navi Mumbai
2.	Mobile phone based HbA1C analyzer	**Stephen Chen** Teco Diagnostics, Anaheim	**Sidhant Jena** Janacare Solutions Pvt. Ltd., New Delhi
3.	A novel way to manage fecal incontinence in non-ambulatory patients	**Matt Durack** Lunar Design, San Francisco	**Nishith Chasmawala** Consure Medical Pvt. Ltd. , Surat
4.	Branchless banking and financial services for the unbanked and under-banked	**Angela Schmuck** IDmission LLC, Mesa AZ	**Abhipriya Gupta** Eko India Financial Services Pvt. Ltd., New Delhi
5.	Commercialization of cultivated sea plants based organic bio-stimulants for applications in the USA	**Ganesh Vishwanath** GloBridge Ventures LLC	**Abhiram Seth** Aquagri Processing Pvt. Ltd., New Delhi
6.	Solar electric tractor- agriculture and power	**Keith Rutledge** Solectrac LLC, CA	**Parimal Shah** Lovson Enterprises Pvt. Ltd, Ahmedabad
7.	Affordable, clean cookstove and electric power sources for rural India	**Aleksandr Kushch** Hi-Z Technology Inc., San Diego	**Neha Juneja** Greenway Grameen Infra Pvt. Ltd., Navi Mumbai
8.	OneBreath: Affordable mechanical ventilation for India	**Matthew Callaghan** OneBreath, Inc., Palo Alto	**Ashwin Naik** Vaatsalya Healthcare, Bangalore
9.	Commercializing a scalable low-cost arsenic remediation technology for societal impact	**Shashi Buluswar** LIGTT Corp., Oakland Ashok Gadgil LBNL, Berkeley, CA	**Joyashree Roy** Jadavpur University, Kolkata and Raja Mohanty LWT Pvt. Ltd., Gurgaon
10.	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
11.	Easy to use, integrated neonatal resuscitation solution	**Dan Harden** Whipsaw, San Jose Anurag Mairal, Stanford Global Biodesign, CA	**Avijit Bansal** Windmill Health Technologies, New Delhi
12.	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 Arup K Sengupta Society for Technology with a Human Face, Kolkata
13.	Development of a low-cost, portable auto-refractor	**Shivang Dave** PlenOptika, Somerville, MA	**Sriram Ravilla** Aurolab, Madhurai
14.	Commercializing a transformational modular roofing solution for low-income urban homes	**Shashi Buluswar** LIGTT Corp., Oakland, CA	**Hasit Ganatra** Re-Materials, Ahmedabad
15.	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

Progress of the Ongoing Projects

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

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

The Solution:
The teams of Promethean Power Systems and Icelings Chirag have co-developed an off-grid refrigerated container, which will be installed on small farms and remote villages throughout India. This will increase the farmer's incomes by eliminating costly 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 gas into the atmosphere. Additionally, it also reduces capital and operating costs.

Accomplishments:
The team have successfully developed, deployed a fully operational 20 feet solar- hybrid cold room at Green Tokri, a farm outside Pune. The team has also developed an 8 feet container which is fully operational with four compartments, capable of each being maintained at a different temperature.

The final tranche will be released to the project team on the basis of recommendations received from the Project Monitoring Committee and site inspection meetings.

Mobile phone based HbA1c analyzer

Stephan Chen
Teco Diagnostics, Anaheim

Sidhant Jena
Janacare Solutions Pvt. Ltd., New Delhi

The Problem:
There is an acute need for a low-cost and portable Hb1Ac monitor top screen and manage diabetes in the developing world. However, most standardized HbA1c monitors are expensive, bulky and assay based systems and thus not suited for mass adoption.

The Solution:
The team is co-developing 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.

Accomplishments:
The team has successfully developed a low-cost mobile phone platform to measure HbA1c which has been fully integrated with a software application DX-Phone device with very encouraging clinical data. The project is undergoing with the third milestone activities.

A novel way to manage fecal incontinence in non-ambulatory patients

Matt Durack
Lunar Design, San Francisco

Nishith Chasmawala
Consure Medical Pvt. Ltd., Surat

The 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%.

The 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 overall very sanitary and patient friendly.

Accomplishments:
The team has received the following:

- FDA 510 (k) clearance for first product received.
- Core patent granted (with all original claims) in USPTO, EPO, Japan and Singapore.
- Consure Medical will be commencing a pilot launch of the product at a reputed hospital in Bangalore.
- Company has obtained requisite approvals for piloting the product at two hospitals in USA as part of Tranche II deliverable
- Scalable manufacturing process established and COGS targets will be achieved by end of this year.
- The project is undergoing with the third milestone activities.

Affordable and user-centric knee joints to remobilize above-knee amputees in India and globally

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

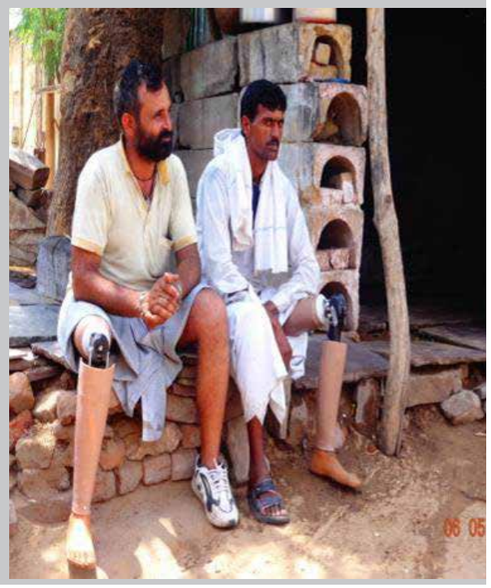
Pooja Mukul
Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS), Jaipur

The 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.

The Solution:
The team is co-developing Re-motion knee version 3 i.e. a high-performance, low-cost prosthetic knee joints for above-knee amputees that address problems seen with prosthetics clinics: successful fitting, follow-up and reporting of amputees. The goal for 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.

Accomplishments:
The team has co-developed a radically affordable Re-motion knee version 3 which is designed and optimized to meet the occupational, environmental and socio-cultural needs of low resource users. Re-motion knee v3 aims to restore mobility, dignity and autonomy of amputees across the world. It will retail at less than $80, yet designed to perform on par or better than expensive polycentric knees, which usually start at $1,400.

The team has successfully fitted 70 patients with the v3 ReMotion Knee at BMVSS in Jaipur. Currently, the team is analysing the data along with data from other clinics around the world to improve their data collection methods before they start the India Pilot Program. The third tranche will be released to the team in which 430 patients will be fitted as a part of the final milestone activities.



Affordable, clean cookstove 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

The 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.

The 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 mobile phone charging.

Accomplishments:
The team is co-developing low cost thermoelectric modules, generators; in-design and distribution of products for cookstoves that can generate electricity from the stove during cooking. These generators have been integrated into two distinct products providing on demand clean energy. HI-Z Technology has the experience in developing low cost thermoelectric modules and generators and Greenway owes expertise in design and distribution of products for rural markets. A first run of biomass cook stoves has been successfully completed in December 2014. While this project does focus on manufacturing the thermoelectrics for the stove, after six months of 24/7 living at the facility, Greenway has manufactured its own regular stove.

Commercialization of cultivated sea plants based organic bio-stimulants for applications in the USA

Ganesh Vishwanath
GloBridge Ventures LLC, CA

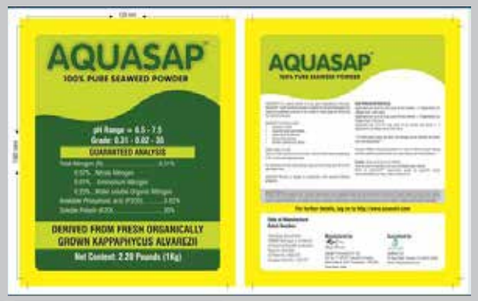
Abhiram Seth
Aquagri Processing Pvt. Ltd., New Delhi

The Problem:
There are two fundamental problems that are attempted the endemic poverty in India and the rising consumer demand for organic products in the US Market.

The 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.

Current Status:
The team have developed bio-stimulants products and have registered their product with United States Department of Agriculture (USDA) under their National Organic Program (NOP) and California Department of Agriculture (CDFA). They have successfully shipped the product to the US market. Second milestone activities are ongoing.



Solar electric tractor- agriculture and power

Keith Rutledge
Solectrac LLC, CA

Parimal Shah
Lovson Enterprises Pvt. Ltd, Ahmedabad

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

The Solution:
The Solar Electric Tractor (Solectrac) is a full function agricultural tractor that operates with up to 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. Solectracs can also be used for portable power, water pumping and mechanical functions as well as hauling and transportation needs. Since 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. Solectracs use patented "quick change" battery packs to extend operational periods.

Current status:
The team has co-developed the improved Pre-Production Prototype (PPP) tractor and next generation of electric tractor which are currently being tested in the US. The solar electric tractor utilizes solar energy replacing fossil fuel; reduces food cost and empowers farm communities by combining Solectrac's expertise in electric vehicle design with Lovson's tractor and implement manufacturing to produce a cost-effective farm tractor for both US and Indian markets. The team has shipped tractor component to the US.

OneBreath: Affordable mechanical ventilation for India

Matthew Callaghan
OneBreath, Inc., Palo Alto

Ashwin Naik
Vaatsalya Healthcare, Bangalore

The 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.

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

Current status:
Based on the feedback from doctors, the team has finalized product specifications and industrial and interface designs of mechanical ventilator for emerging markets including India that will meet safety and regulatory requirements. Second milestone work is ongoing.

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

The Problem:
Five out of every hundred babies born (6 million worldwide, 1.3 M in India every year) have birth asphyxia. In fact, 904,000 children (210,000 in India) will die and an equal number will be disabled for life every year. 811, 000 die annually from Birth Asphyxia, largely preventable by basic resuscitation. Current devices are difficult to use, ineffective especially in developing world.

The Solution:
The innovation NeoBreathe™ is a first-of-its-kind, easy to use, integrated neonatal resuscitation solution (combining functions of multiple devices) suitable for field conditions. It will 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. Thus, impacting birth asphyxia the third largest cause of newborn deaths.

Current status:
Based on the interaction with the Clinicians, the team has developed a final product specification, conducting bench testing to create prototypes. Second milestone work is ongoing.

Commercializing a scalable low-cost arsenic remediation technology for societal impact

Shashi Buluswar
LIGTT Corporation, Oakland, CA

Joyashree Roy
Jadavpur University, Kolkata

Ashok Gadgil
Lawrence Berkeley National Laboratory , Berkeley, CA

Raja Mohanty
Luminous Water Technologies Pvt. Ltd., New Delhi

The 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.

The 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.

Current status:
The team has identified the site for installation of 10,000 LPD ECAR prototypes. They have designed and integrated a tube-settler in the ECAR to promote rapid settling and removal of ECAR particles, increasing throughput significantly. The team has conducted additional tests of reactor components as needed to facilitate ECAR reactor design. Second milestone activities would start by April 2015.

Branchless banking and financial services for the unbanked and under-banked

Angela Schmuck
IDmission LLC, Mesa AZ

Abhipriya Gupta
Eko India Financial Services Pvt. Ltd., New Delhi

The 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.

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

Current status:
The team has launched a front-end Android application that would enable E-KYC of customers through a web-based portal application, transfer money into any bank account for walk-in or registered customers through NEFT or instantly through IMPS (Immediate Payment Service).

This has been recently in the market. The team has also developed a faster, more intuitive and more engaging mode of transaction on the smart phone leading to smoother transactions for Bank agents. The team had also tied up with CKS (Center for Knowledge Studies) to design a mobile phone accessory that would enable any smart phone to act as a quality scanner in order to enable E-KYC for all CSPs with any type of smart phone. This has been launched in the market. The team has completed the production of some prototypes, which were tested by 10 CSPs (Customer Service Points) for two months in the market. The response of the proto-type by the CSPs was satisfactory. They are planning to launch the stand across more CSPs in the near future.

Fourth Call for Proposals

In the Fourth Call for proposals, over 192 executive summaries (83 in Empowering Citizens and 109 Healthy Individual categories) were received from the U.S./Indian binational teams.

On the basis of the Joint Expert Panels reviews and further approval received from the US-India S&T Endowment Board following 4 entrepreneurial teams (2 in Empowering Citizens and 2 in Healthy Individual categories) were awarded under the call.

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

Arup K Sengupta
Society for Technology with a Human Face, Kolkata

The Problem:
Over 100 million people across 18 of India's 23 states experience arsenic and fluoride poisoning by drinking contaminated groundwater, resulting in hundreds of thousands of people suffering from cancers, bone deformities, and early death. The World Health Organization calls the crisis the "*largest mass poisoning in human history.*"

The Solution:
Drinkwell is a for-profit social enterprise poised to transform the water crisis into 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.

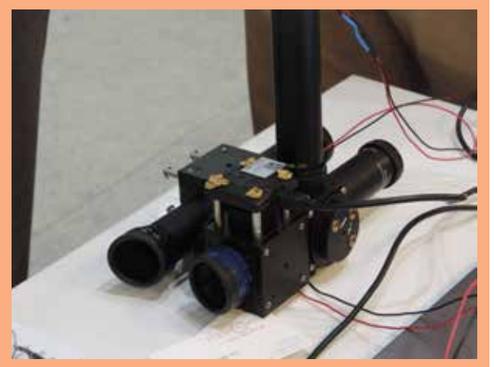
Development of a low-cost, portable auto-refractor

Shivang R. Dave
PlenOptika, Somerville, MA

Sriram Ravilla
Aurolab, Madurai

The Problem:
There is an acute shortage of trained optometrists to prescribe eyeglasses and current technologies for measuring a prescription requires intensive training to use or are too expensive for widespread use.

The Solution:
Through the project partnership, PlenOptika-Aurolab aims to reduce the barriers to obtaining eyeglasses by commercializing the QuickSee which is an innovative, inexpensive, hand held device developed by PlenOptika that helps eye care professionals to quickly prescribe eyeglasses. This disruptive technology breaks the trade-off between price and training requirements that prohibits current devices from improving the prescription process in low-resource settings.



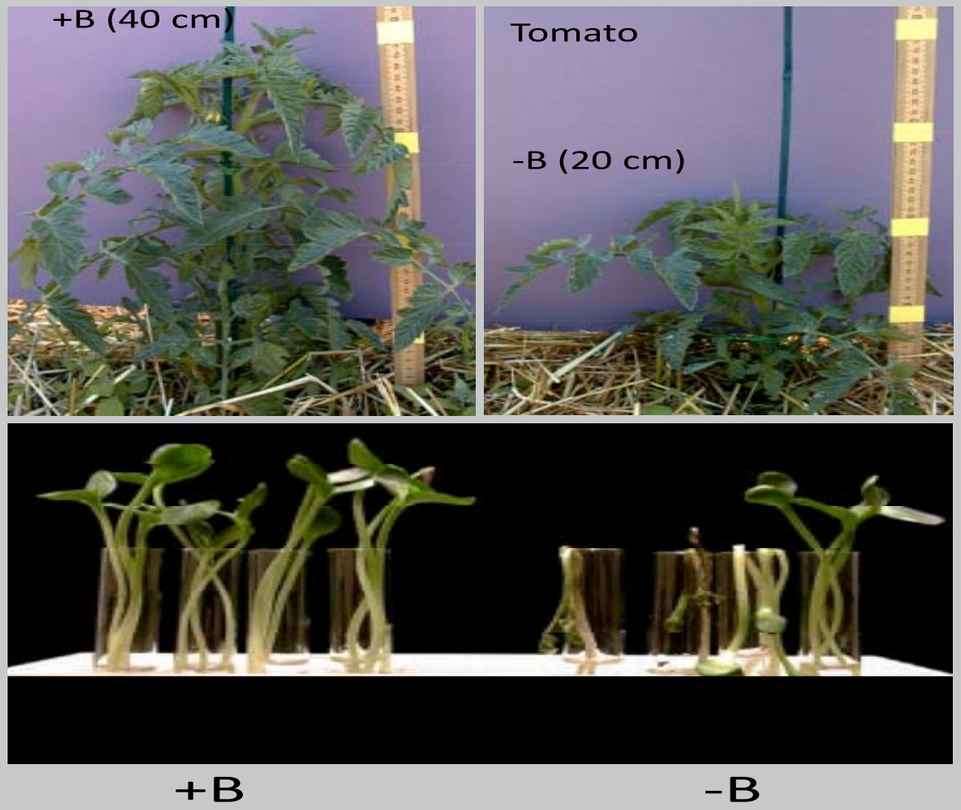
Developing novel biological seed treatments to confer abiotic stress tolerance in crops

Rusty Rodriguez
Adaptive Symbiotic Technologies, Seattle, WA

Anup Karwa
SFPL Crop Life Sciences Private Limited
Krishidhan Seeds, Jalna, Maharashtra

The Problem: Only 9% of the planet landmass is conducive for crop production, while 91% is under abiotic and biotic stresses (drought, salinity, temperature) which are further likely to increase due to land degradation, urbanization and climate change.

The Solution: Through a proprietary novel seed treatment called *BioEnsure* developed by the project team by harnessing natural symbiotic microorganisms designed to improve the tolerance of plants to abiotic stresses such as drought, salinity and temperature is envisaged for commercialization. *BioEnsure* enables a broad-spectrum of agricultural crops to flourish under areas of drought, extreme temperatures and saline soils. The team intends to deploy BioEnsure in India and the U.S. The team will develop products for unique soils and climates occurring in India.



Commercializing a transformational modular roofing solution for low-income urban homes

Shashi Buluswar
LIGTT Corporation, Oakland, CA

Hasit Ganatra
Re-Materials, Ahmedabad

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

The 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.

United States - India Science and Technology Endowment Fund

Fifth Call for Proposals

The United States-India Science and Technology Endowment Fund (USISTEF) have announced Fifth Call for Proposals in June 2014. Over 141 executive summaries were received in the two broader categories of Healthy Individual and Empowering Citizens. The number of executive summaries received in the Empowering Citizens category was 53 and 88 in the Healthy Individual category from the U.S./ India bi-national teams. Four expert panels were formed in U.S. and India, one in each category and each country respectively, comprised of technical experts, entrepreneurs, venture funding agencies and Board members. These expert panels independently evaluated the executive summaries. Subsequent to the Joint Indian and U.S. panel co-chairs meeting, 17 executive summaries (9 in the Healthy Individual and 7 in the Empowering Citizens categories) were shortlisted for the Stage II: detailed Business Plan and Presentation. The five bi-national teams shortlisted for Stage III (Due Dilligence and Budget Discussion) are given below:

On 11-12 February 2015, the Joint Expert Panel meeting were held to review the detailed business plan and presentation by the shortlisted teams at Sunnyvale, Silicon Valley, CA. After the detailed business plan, presentation and interaction with the bi-national project teams, five promising proposals (3 in Healthy Individual and 2 in Empowering Citizens categories) were identified for the next round of Stage III: Due Diligence and Budget Discussion meeting. The project teams were asked to submit the financial budget and related documents. The IUSSTF would conduct the Budget Discussion meeting for these finalist project teams.

S. No.	Proposal Title	Lead U.S. Partner	Lead Indian Partner
Healthy Individual (HI) Category			
1	Handheld forced oscillation device for improved detection and monitoring of airway disease	**Ashutosh Sabharwal** Cognita Labs and Rice University, Houston, TX	**Anurag Agrawal** CSIR-Institute of Genomics and Integrative Biology, Delhi
2	Jaipur belt (Belt system for body support)	**Paul Scott** MedSpark, LLC, Obispo, CA	**Ganesh Ram Jangir Newndra** Innovations Pvt Ltd, Jaipur
3	Moving beyond the pavement: Affordable mobility for users around the world	**Tish Scolnik** GRIT, Cambridge, MA	**Sudhir Mehta** Pinnacle Industries Ltd, Pithampur
Empowering Citizens (EC) Category			
4	Agriculture technology access	**Mukul Varshney** John Deere	**Rohtash Mal** EM3 AgriServices Private Limited, Noida
5	Low cost device for point of use sensing and mitigation of pathogens in drinking water	**Swomitra Mohanty** University of Utah, Salt Lake City UT	**Himanshu Sant** Espira (India) Inc., Goregaon West Mumbai

Other Programmatic Activities

TiECon 2014-Fostering Entreprenuership May 16 & 17, Silicon Valley, Santa Clara, CA

The U.S.-India Science and Technology Endowment Fund team participated in two days full-track conference "TiECon 2014-Fostering Entreprenuership" organised at the Santa Clara Convention Center, Silicon Valley on May 16-17, 2014. TiEcon is one of the largest & longest ongoing conferences focused around entrepreneurship and tech innovation. The objective of participating in TiEcon 2014 was to provide larger visibility and outreach to the USISTEF activities on an international level and to spark discussion and innovative

ideas around the latest industry trends. On the sidelines of the conference, a Tech Exposition was also running where the Endowment Project Awardees showcased their product and technologies that have been supported under the fund. The Tech Expo offered unique opportunity to network with industry luminaries, VCs, successful entrepreneurs and seasoned executives at the TiEcon. On May 17, the USISTEF also had a great panel session on "Cross-Border Innovation spurs Entrepreneurship", with the panellist Mr. H K Mittal, Head & Advisor, National S&T Entrepreneurship Development Board, Mr. Nilesh Shah, S&T Officer, US Embassy, New Delhi and Dr. Pooja Mukul, Technical Coordinator, BMVSS,

Jaipur for the session. The session included different aspects of the funding in areas of Healthcare, Empowering Citizens and Technology. The session also briefed about vision and mission of the Endowment program and how it focuses on commercialization and how in future the product and the technology would benefit the society. One of the Endowment Fund grantee; OneBreath Inc. for their work in the field of Life Sciences was also awarded in the Tie50.

IIT Kanpur- TechKriti 2015, March 19-22 Kanpur

The U.S.-India Science and Technology Endowment Fund through the IUSSTF also participated as a "Title Sponsor" in the TechKriti 2015 between March 19 to 22 - the annual festival of the IIT Kanpur focussed on the technological and entrepreneurial. On the sidelines of the festival, a tech expo was also organised where various programmatic activities of the IUSSTF were placed that provided awareness and great opportunity to the undergraduate and postgraduate students of engineering to know about the visitation programs. The Expo also encouraged the interested student to apply in the future calls of Viterbi, S N Bose scholars and Khorana programs. The USIST-Endowment Fund was able to showcase their innovative technologies and products. It also encouraged the start-ups to know more about the program and related call announcements.

3rd Indo-U.S. Joint Commission Meeting, 17 November 2014, New Delhi

Six binational entrepreneurial teams supported by the United States-India Science and Technology Endowment Fund were felicitated at the 3rd Indo-US Joint Commission Meeting (JCM) held on 17 November 2014, New Delhi by Dr. John P. Holdren, Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST); Prof. K Vijay Raghavan, Secretary, Department of Science and Technology and Secretary, Department of Biotechnology, Government of India, Dr. Jonathan Margolis, Deputy Assistant Secretary for Science, Space, and Health; Bureau of Oceans and International Environmental and Scientific Affairs; Dr. George N. Sibley, Minister Counselor, Economic, Environment, Science & Technology Affairs, U.S. Embassy, New Delhi and U.S. Co-Chair, USISTEB and Dr. Arabinda Mitra, Advisor & Head International Cooperation (Bilateral), Department of Science and Technology, Government of India and Indian Co-Chair, USISTEB. Some of the salient accomplishments of the Endowment Fund Awardees were highlighted in the presentation made by the Co-Chairs of the US-India Science & Technology Endowment Fund during the JCM.

United States - India Science and Technology Endowment Fund

The following six US-India Science and Technology Endowment Fund Awardees were felicitated during the 3rd India-U.S. Joint Commission Meeting on Science & Technology Cooperation.

S. No.	Title of Proposal	Lead Partners
1.	**Commercializing a scalable low-cost arsenic remediation technology using patented Electro-Chemical Arsenic Remediation (ECAR)** that enables locally affordable arsenic remediation of water, within a sustainable service delivery model.	**Joyashree Roy**, Jadavpur University, Kolkata **Shashi Buluswar**, LIGTT Corporation, Oakland, CA **Ashok Gadgil**, Lawrence Berkeley National Laboratory, Berkeley, CA **Raja Mohanty**, Luminous Water Technologies Pvt. Ltd., Gurgaon
2.	**One-Breath: Affordable mechanical ventilator** Develop and commercialize a novel ventilator specifically addressing the need for high quality pre-hospital and emergency situations.	**Ashwin Naik**, Vaatsalya Healthcare, Bangalore **Matthew Callaghan**, OneBreath, Inc., Palo Alto.
3.	**Transforming arsenic and fluoride crisis in drinking water** using novel arsenic and fluoride adsorbent (Donna-AFSorb) and by adopting a micro-franchise business model.	**Abhijeet Gan**, Rite Water Solutions (I) Pvt. Ltd., Nagpur **Mike German**, WIST Inc., Brighton, MA **Arup K SenGupta**, Society for Technology with a Human Face, Kolkata
4.	**Development of a low-cost, portable auto-refractor** providing improved eye care through an innovative, inexpensive, hand held device that quickly prescribes corrective eyeglasses with the click of a button.	**Sriram Ravilla**, Aurolab, Madhurai **Shivang Dave**, PlenOptika, Somerville, MA.
5.	**Modular roofing solution for low-income urban homes compressed recycled cardboard.**	**Hasit Ganatra**, Re-Materials, Ahmedabad **Shashi Buluswar**, LIGTT Corporation, Oakland, CA.
6.	**Novel biological seed treatments to confer abiotic stress tolerance in crops.** The team intends to commercialize a propriety novel seed treatment called BioEnsure which contains a mixture of beneficial fungal endophytes designed to improve the tolerance of plants to abiotic stresses such as drought, salinity and temperature.	**Anup Karwa**, SFPL Crop Life Sciences Pvt. Ltd., Krishidhan Seeds, Jalna **Rusty Rodriguez**, Adaptive Symbiotic Technologies, Seattle.

Indo-U.S. S&T Partnerships

Tackling 21st century challenges together!

The robust partnership between India and the United States in science, technology, and innovation has benefited both countries immensely. Our collaboration has been vital in achieving shared goals, including creating economic growth and jobs, helping people live longer and healthier lives, finding solutions to challenges affecting both societies and with global benefits. In November 2014, the Confederation of Indian Industry and the Indian Department of Science & Technology partnered with the United States for the 20th Technology Summit and Technology Platform. The event was held from 18-19 November, 2014 in India.

The objectives of India-U.S. Technology Summit were to provide a platform for industries, institutions, and government agencies from India and the United States to exchange ideas and showcase their expertise; forge new partnerships to increase trade and investment in the knowledge sector; and, bring together leaders from all sectors – government, industry, research, and academia – for high level policy discussions.

The Summit was inaugurated by **Dr. Harsh Vardhan**, Minister for Science & Technology & Earth Sciences, Govt. of India; **Dr. John P. Holdren**, Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy and Co-Chair of the President's Council of Advisors on Science and Technology; **Ambassador Kathleen Stephens**, Charge d'affaires, Embassy of the United States of America; and, **Prof. K. VijayRaghavan**, Secretary, Department of Biotechnology and Department of Science & Technology (Additional Change), Govt. of India.

The focus areas of the Summit included Manufacturing, Pharmaceuticals, Biotechnology, Healthcare, Clean & Renewable Energy, Sustainable Cities, Earth Sciences, IT Hardware & Software, Embedded Systems, Internal Security, Cyber Security, Agriculture, Water & Sanitation, Robotics & Automation, Science & Technology, Research and Development, Higher Education, Intellectual Property Rights, Design, Innovation & Entrepreneurship. A large number of stakeholders from industry, government, and research participated at this event as exhibitors, speakers, and delegates. Events included policy dialogues, business presentations, round table discussions, networking opportunities, and exhibitions of technology products and services.

IUSSTF organized the following three events under the aegis of the Technology Summit:

The **Indo- U.S. Tech Women & Women Entrepreneurs Workshop** was organized by Indo-U.S. Science and Technology Forum (IUSSTF) as a part of the Indo-U.S. Technology Summit 2014 at Greater Noida, Delhi NCR on 18 November. Leading Indian and U.S. women tech entrepreneurs and leaders came together on one common platform to address aspiring women professionals on building careers in science & technology and reaching to the top.

Ambassador Kathleen Stephens, Chargé d'affaires, a.i., US Embassy, Dr. Jonathan Margolis, Deputy Assistant Secretary for Science, Space, and Health; Bureau of Oceans and International Environmental and Scientific Affairs, Mr. H.K. Mittal, Head, National Science and Technology Entrepreneurship Board, Department of Science and Technology, Government of India and Dr. Renu Swarup, Senior Advisor, Department of Biotechnology, Government of India participated in the opening session of the Workshop. The workshop had an excellent line up of speakers from the industry. There was a tremendous amount of interest from the industry to partner on Women in Science initiatives. There were focused panel sessions on sharing of success stories, and creating mentoring and networking opportunities for women in science & technology and also develop plans for future collaborations. Three Panel sessions were organized.

Session I: Panel discussion on ***"Nothing really can stop women from being successful tech leaders"*** with moderator Dr. Anju Jain, India Country HR Manager, Caterpillar, and Founder, Chai Pe and Panellists as Ms. Shweta Khurana, Head, K12 Education, Corporate Affairs Group, Intel South Asia; Ms. Diane Farrell, President, U.S.-India Business Council (USIBC); Ms. Elizabeth Hernandez, Vice President, Corporate Affairs, Asia Pacific and Japan, HP; Ms. Kalpana Margabandhu, Director - India CIO Lab and BT/IT Location Executive, IBM India; Ms. Eve Psalti, Global Director, Education Audience Strategy, Microsoft Corporation.

Session II: Panel discussion on ***"Tech women leaders as mentors – how to get there?"*** with Ms. Meera Kaul, Chairperson, Meera Kaul Foundation as the moderator and Ms. Deepanwita Chattopadhyay, MD & CEO, ICICI Knowledge Park; Dr. Telle Whitney, CEO and President, Anita Borg Institute for Women and Technology; Dr. Ellen Stofan, NASA Chief Scientist and Dr. Amy DuBois, Health Attache and Regional Representative for South Asia, US Embassy, New Delhi as the members of the panelist.

Session III: Panel discussion on ***"Networking women tech professionals and women entrepreneurs"*** with moderator as Ms. Padmaja Ruparel, President, Indian Angel Network and panelist Ms. Nidhi Saxena, Founder, Chairman & CEO, Karmic Lifesciences; Dr. Shikha Sharma, Managing Director, Nutri Health Systems Pvt. Ltd.; Dr.

Nandini Tandon, Vice Chairman of the Board of El Camino Hospital, Silicon Valley, California and Ms. Priya Tandon, Founding Partner, Tenacity Group Inc.

The workshop also provided a platform to several women entrepreneurs awarded under the U.S.-India Science and Technology Endowment Fund to present their innovative technologies. Presentation were given by women innovators and entrepreneurs - Dr. Jaya Singh, Director, BKC Weather Sys Pvt. Ltd. on "Knowledge-based agro advisories: Going beyond rainfall prediction" and project awardees of the US-India Science and Technology Endowment Fund- Dr. Pooja Mukul, Technical Consultant, Bhagwan Mahaveer Viklang Sahayata Samiti on her awarded project "Affordable and user-centric knee joints to remobilize above-knee amputees in India and globally"; Dr. Ayesha Chaudhary, Co-Founder, Windmill Health Technologies for her project title "Easy to use, integrated neonatal resuscitation solution" and Dr. Susan Amrose, Project Scientist and Lecturer, UC Berkeley for her project title *"Commercializing a scalable low-cost arsenic remediation technology for societal impact".*

IUSSTF Round table on Collaborative R&D in Clean Energy: Keeping in mind the fact that science and technology have since long been an important cornerstone of cooperation between India and the United States; both nations recognize the fact that further collaboration can and would enhance our shared understanding of the planet's climate by expanding efforts to develop new programs to meet environmental and climate challenges. The Round table discussion on ***Collaborative R&D in Clean Energy*** was built on the successful Indo-U.S. Joint Clean Energy Research and Development Center (JCERDC) as a starting point. The activities of the JCERDC would contribute greatly to the sustainability and prosperity of not only our two countries but the world at large by helping diversify energy supply and accelerate the transition to a low-carbon economy.

The session began with invited speakers from India and the United States sharing their views on the importance of collaboration and identifying key areas of mutual benefit. This was followed by the principal investigators of the three JCERDC Projects – Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings – sharing their experiences about the program and their respective projects.

The Lead Principal Investigators of the ***Solar Energy Research Institute for India and the United States (SERIIUS)*** project – Prof. Kamanio Chattopadhyay (Indian Institute of Science, Bangalore) and Dr. David Ginley (National Renewable Energy Laboratory, Golden) – described the work carried out by SERIIUS. This includes fundamental and applied research, analysis and assessment, outreach, and workforce development through specific bi-national projects in three Research Thrusts: Sustainable Photovoltaics (developing next-generation materials, devices, and manufacturing processes tailored to both countries' needs, environment, and resource availability); Multiscale Concentrated Solar Power (overcoming critical science and engineering challenges for reliable, multiscale CSP systems);

and, Solar Energy Integration (identifying and assessing key technical, economic, environmental, and policy barriers to enable a research agenda for technical readiness in India and to benefit the United States). The vision they described is to ready these solar electricity technologies toward the long-term success of India's Jawaharlal Nehru National Solar Energy Mission and the U.S. Department of Energy (DOE) Sun Shot Initiative.

Prof. Ashok Gadgil (Lawrence Berkeley National Laboratory) and Prof. Rajan Rawal (CEPT University-Ahmedabad) presented the progress of the ***U.S.-India Joint Centre for Building Energy Research and Development (CBERD)*** project. The consortium conducts collaborative research and promotes clean energy innovation in the area of energy efficiency in building with measurable results and significant reduction in energy use in both nations. CBERD focuses on the integration of information technology with building controls and physical systems for commercial/ high-rise residential units. The R&D tasks are intended for technology acceleration and include building energy modelingand simulation; monitoring and benchmarking of buildings; communication and controls integration; building envelope and passive design; advanced HVAC (heating, ventilation, and air conditioning) and lighting technologies;

thermal comfort; grid responsive buildings; renewable energy source integration in buildings; and, scientific collaboration between U.S. and India.

The ***U.S.-India Consortium for development of Sustainable Advanced Lignocellulosic Biofuel Systems*** works on sustainable feedstock cultivation and supply, biochemical conversion technologies for production of second generation biofuels with minimal environmental impact, and analysis of overall sustainability and supply chain of feedstock. The progress of this consortium was presented by the Principal Investigators Prof. Ahmed Kamal (Indian Institute of Chemical Technology-Hyderabad) and Prof. Pratap Pullammanappallil (University of Florida-Gainesville).

After this the session moderator, Dr. Satish Kumar (Energy Efficiency Ambassador - Vice President, Schneider Electric, Global Operations, and, Chairman, Alliance for Energy Efficient Economy) opened the floor for a discussion. The round table participants deliberated upon several issues that included the vision to continue research collaboration under the current JCERDC beyond its tenure; additional priority areas in clean energy for bilateral engagement; mechanisms to strengthen engagement with various stakeholders including industry; success of JCERDC model (multi-institutional network projects using a public-private partnership model of funding); ways to economically incentivize technology transfer; means to improve technology leapfrog capability; financing options; and, policies and programs for faster deployment of technologies.

IUSSTF Round table on Water Challenges: 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; cooperation between our countries is critical in tackling water-related issues. This discussion was aimed to deliberate on various issues related to water quality and water management as well as explore new avenues for India-U.S. Collaboration in these critical areas.

The round table began with a brief introduction by Dr. Kshipra Misra (Additional Director, Defense Institute of Physiology and Allied Sciences, New Delhi), Coordinator of the round table. Dr. Sanjay Bajpai (Director/ Scientist 'F', Technology Mission Cell Water & Solar Energy, Department of Science and Technology, Govt. of India) delivered the special address. He highlighted DST's association with research in the area of Water which had begun from the year 2007. He also highlighted the need for both the countries to collaborate and develop solutions with respect to common problems regarding water issues. Dr. Pushpito Ghosh (Former Director, CSIR-Central Salt & Marine Chemicals Research Institute), Moderator of the session gave a brief on the usability of water in the Indian context, the Challenges faced and how there is a need to broaden our perspective and take these issues to the next level and develop solutions which could help the population of both the countries. The discussion was then directed to the panelists for the session.

Taking into account that the purification systems we have are centralised, the accessibility of this to remote and rural populations remains a major hurdle; 30% of our population still has access only to contaminated water resources. Hence there is a pressing need for affordable and newer technologies to come through social marketing systems and the need for decentralised/small scale water purification systems for the rural population. The panelists noted that an integrated approach should be to bring in the state departments as a task force. Any step taken to solve these issues should try to customise solutions demographically. Another step would be to position the existing technologies to accommodate the needs of the rural population. A critical analysis of various available technology options was important and needs to be taken up. A basket of technology options needs to be evolved to enable users identify and select the most appropriate one suited to their requirements. Water salinity and hardness remains a major issue with regard to water quality and in this context it was discussed that as India has a long coastline, it could be used to our advantage through Desalination of Sea water.

The 1993 Outbreak of Cholera in Bengal was brought up as an example of water borne epidemics and the importance of clean water sources. Any solution that is to be developed would have to be effective, robust, affordable and profitable to the end users. During the discussion, the need to identify the scope and opportunity of a development partner in this scenario was brought up.

The participants felt that in the current Indian context, the need for low-cost technologies is critical. Most of the technologies that are funded and developed do not percolate to low-resource settings. Hence the focus of any collaborative development in this area should be to reach out to the rural populations. It was agreed by the panel and the round table members that there is a requirement for capacity building initiatives in the water resources technology area. In order to achieve this, it was suggested that DST and agencies like IUSSTF attempt to develop a dynamic visitation program in the priority area of Water. It was envisaged that such an interaction would enable the creation of sustainable and vibrant linkages between the two nations, as well as build long term Indo-American science and technology relationships. Prof. Thomas E. Clemente from the University of Nebraska-Lincoln expressed his willingness to partner with Indian agencies to develop such an initiative. This collaboration would develop capabilities to address both static challenges as well as evolving challenges particularly in the area of water-energy-agriculture nexus. The Round-table concluded that collaboration should focus on doing things hitherto not done and promote research endeavours for pursuing novel ideas and innovations.

The **Indo-U.S. Science and Technology Forum** also showcased its wide program manifesto that helps create linkages between India and the United States through the exchange and dissemination of information and opportunities in promoting bilateral scientific and technological cooperation. The IUSSTF booth was well appreciated by both delegates and dignitaries. Visitors to the booth included Dr. Harsh Vardhan, Minister for Science & Technology & Earth Sciences, Govt. of India; Dr. John P. Holdren, Assistant to the President for Science and Technology, Director of the White House Office of Science and Technology Policy and Co-Chair of the President's Council of Advisors on Science and Technology; Ambassador Kathleen Stephens, Charge d'affaires, Embassy of the United States of America; Prof. K. VijayRaghavan, Secretary, Department of Biotechnology and Department of Science & Technology, Govt. of India; Mr. Charles H. Rivkin, Assistant Secretary of State for Economic and Business Affairs; Dr. Ray O. Johnson, Chief Technology Officer, Lockheed Martin Corporation; and, Dr. Jonathan Margolis, Deputy Assistant Secretary, Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State.

Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in the U.S. and India

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Hypertension diagnosis and management is a critical healthcare issue. But, 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-U.S. Grand Challenge Initiative on Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the U.S.*** 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 U.S. 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 of the **first call** for Expressions of Intent (EOI) on the Indian side, IUSSTF received 57 project EOIs and the Expert Committee shortlisted 14 EOIs for detailed proposal submissions. After an in-depth review and evaluation process, the following 3 proposals were selected for support.

Development of a low cost arterial tonometry based blood pressure monitoring device

Santosh Noronha
(Principal Investigator)
Indian Institute of Technology-Bombay
Mumbai

C. S. Pramesh
(Co-Investigator)
Tata Memorial Centre
Mumbai

Hypertension is a leading risk factor for cardiovascular disease and a significant cause of morbidity and mortality in both India and US. A rural healthcare camp in India gets close to a 1000 patients on an average. A clinician spends 3-5 minutes for taking a blood pressure measurement of an individual patient using a sphygmomanometer. This leads to clinicians spending more time diagnosing patients and seeing less number of patients. Blood pressure is currently measured using a sphygmomanometer. Sphygmomanometers need routine calibration checks and regular preventive maintenance which makes them less user friendly. There is also a risk of these devices losing their calibration in case they are dropped or bumped during usage. The team is attempting to build a next generation blood pressure monitoring device which can help ease difficulties faced by clinicians as well as personal users. The best way to measure 'absolute' peripheral BP is by using an invasive probe. Alternately, a cuff can be used to occlude the brachial artery (or radial artery) for oscillometric measurement. Arterial tonometry is another competing technique for BP measurement. Arterial tonometry is best suited for beat to beat measurement of BP. On the other hand, tonometry provides a 'relative BP'measurement with some amplification factor that depends on the specific sensor and appliedpressure distribution.The objective is to build a low cost arterial tonometry based bloodpressure monitoring device.

Arterial compliance probe for cuff-less blood pressure measurement

Mohanasankar Sivaprakasam
(Principal Investigator)
Healthcare Technology Innovation Centre, Indian Institute of Technology Madras, Chennai

Boby George
(Co-Investigator)
Indian Institute of Technology-Madras, Chennai

Jayaraj Joseph
(Co-Investigator)
Healthcare Technology Innovation Centre, Indian Institute of Technology Madras, Chennai

V. Jagadeesh Kumar
(Co-Investigator)
Indian Institute of Technology-Madras, Chennai

The team is developing a novel method and device for blood pressure evaluation, based on real time measurements of vessel wall properties using a vascular compliance probe that can be used to quickly obtain accurate readings in minimally obtrusive manner. The technique utilizes ultrasound transducers and plethysmograph sensors to quickly perform cuff-less, non-invasive blood pressure measurement. The technique is based on fundamental principles of arterial pressure-flow thereby creating a method that is independent of patient or population specific calibration constants. The project aims to deliver a field validated technology for calibration free, cuff-less evaluation of blood pressure amenable for use in resource constrained settings.

Rapid real time blood pressure measurement and hypertensive predisposition diagnostics using pulse transit time and blood pressure variability

Bala Pesala
(Principal Investigator)
CSIR-Central Electronics Engineering Research Institute (CSIR-CEERI), Chennai

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

Tavpritesh Sethi
(Co-Investigator)
CSIR-4PI (Fourth Paradigm Institute)
New Delhi

The proposed wearable device would consist of electro-active polymer wrist band for automatic recalibration of BP and corrections using accelerometers/sensors to compensate for errors due to the motion; and, improved error-correction algorithms and models that utilize the large amount of gathered BP data and blood pressure variability studies to minimize the need for frequent recalibration.

SECOND CALL

IUSSTF received 35 Expressions of Intent (EOI)'s in response to the second call for EOIs announced in February 2014. The Expert Committee shortlisted 8 Expressions of Intent for further submission of detailed proposals. After an in-depth review and evaluation process, 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
(Principal Investigator)
Indraprastha Institute of Information Technology (IIIT), 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 project proposes to measure PTT using multiple photoplethysmograph (PPG) and PPG-ECG combination recorded at two different sites along the same artery and argue that this approach will eliminate a number of assumptions like constant PEP, involved in the most common method of measuring PTT using QRS complex as timing reference. 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
(Principal Investigator)
Indian Institute of Technology-Bombay, Mumbai

In recent years, there has been significant advancements where continuous, non-invasive and cuff less monitoring of blood pressure is done by devices that can be worn like a watch, band or finger- ring. Along this perspective, flexible and stretchable light weight pressure sensors using organic thin film transistors (OTFT) have high potential to become mainstream technologies. These devices have advantages of using biocompatible organic semiconductor materials, flexibility, stretch ability, combined electronic and ionic transport, higher sensitivity, multi-parametric sensing and simultaneous switching and sensing (amplification) functioning. The aim of this project is to develop simple, low cost, and easy to use OTFT based sensors for non-invasive, cuff-less and continuous monitoring of blood pressure. The approach will be to improvise the Gate electrode and the insulating layer in such a way that it measures even a small pressure fluctuation and reflects it in significant signal amplification. This will involve using conducting flexible/stretchable substrate and patterned dielectric layers along with different kinds of organic semiconducting materials as active layers. The project will also investigate device designs so that it allows monolithic fabrication on the flexible/stretchable substrate and also better pressure sensitivity. The developed sensor will be used to measure human pulses from several areas, including carotid, brachial, finger, ankle, radial artery, and the apical region. The efforts will also be put on to develop low voltage operating devices so as to reduce power consumption.

Cuffless Noninvasive Blood Pressure Measurement using Radial Arterial Pressure Patch

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A. L. Vyas
(Co-Investigator)
Indian Institute of Technology, Delhi
New Delhi

Anamika Prasad
(Co-Investigator)
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New Delhi

K.K. Deepak
(Co-Investigator)
All India Institute of Medical Sciences
New Delhi

Suneet Tuli
(Co-Investigator)
Indian Institute of Technology, Delhi
New Delhi

With cardiovascular disease incidence and related mortality in rise in India, early hypertension monitoring of large population via a robust and maintenance free device has large implication in early detection and treatment of cardiovascular diseases (CVD) and is the driving force behind the team's work. Here, BP is measured via recording and calibrating radial artery pressure waveform via cuff less method. The device electronics is being developed using open-source Aurdino platform. Data is stored locally on removable SD card, which can be read at a doctor's office post the monitoring period. The project team from IIT Delhi collaborates closely with AIIMS-New Delhi for the development, and later for calibration and testing.

Innovation **Programs**

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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 2014.

The following innovations were announced as the winners of the 2014 competition:

Innovation	Organization Name	Innovators
Non-invasive oral cancer detection device	Innobreeze Communication Technologies Pvt. Ltd.	**K R Suresh Nair**
ECG using an android smartphone	Kallows Engineering India Pvt. Ltd.	**Gajanan Nagarsekar**
Technology platform for producing proteins and viral therapies	Seagull Biosolutions Pvt. Ltd.	**Vishwas D Joshi**
Low cost automated web security solution	Ironwasp Information Security Solutions Pvt Ltd	**Lavakumar Kuppan**
Hurdle technology for processing of shelf stable meat products	ICAR	**R. Thomas**
Low cost solar parabolic dish concentrator	Solwedish Solar Pvt. Ltd.	**G Madan Mohan Reddy**
Advanced PCM heat exchanger for cold storage	Thermal Energy Service Solutions Pvt. Ltd.	**Rajat Gupta**
Low cost, no consumable waterless urinal technology	Ekam Eco Solutions Pvt. Ltd.	**Uttam Banerjee**
Visually challenged ergonomic footwear	Gitam University	**Krishna Sai Inkoolu**
Solar boiler using linear fresnel technology for process heat	Promethean Energy Pvt. Ltd.	**K.P.Ashwin Krishna**
Converting shuttle loom to rapier loom	Shreenidhi Green Services	**Ravinder Vannam**
Bhungroo- both waterlogging & irrigation solution	Naireeta Services	**Biplab Ketan Paul**
Broad spectrum root canal filling composition for endodontic usage	Goa Dental College and Hospital	**Rajdeep Pavaskar**
Multifunctional finishing of textiles using eco-friendly	The Bombay Textile Research Association	**Shital S Palaskar**
Medical diagnostic test kit	Thrombochek Labs Private Limited	**Vikrant Vaidya**
Nutrient sequestration from waste water and reuse	West Bengal University of Technology	**Shaon Roy Chaudhri**
Swajal smart water station	Saurya EneerTech	**Vibha Tripathi**
Geothermal cooling technology	GIBSS	**Arun Shenoy**
Bio-adhesive	CSIR-Central Leather Research Institute	**A. Gnanamani**
Pest-repellent food protecting sheets	Leela Holdings	**Sudhir Reddy**
Smart coatings for corrosion protection	CSIR-National Physical Laboratory	**S.K. Dhawan**
Assisted respiration	OneBreath India Pvt. Ltd.	**Cyja Jose**
CardioTrack - Remote ECG diagnostics	Uber Diagnostics Private Limited	**Avin Agarwal**
Emergency labour cot	RITE Products	**Gayathree Mohan**
Ultra-light-weight electric-assist bike	Individual	**Jaspreet Singh**
ICT intervention to empower maternal healthcare	IIT Guwahati	**Saurabh Srivastava Keyur Sorathia**
Companian diagnostics for diabetes	Affigenix Biosloutions Pvt Ltd.	**Arumugam Muruganandam**
E-waste recycling and metal separation plant	Respose Waste Management and Research Pvt. Ltd.	**Rupal Fadia**
Mosquito breeding disruptive device-TAKE IT EAZZY	Individual	**E C Thomas**
Redox engineering for 3-Hydroxypropionic acid	SVBIOTECH	**Sathyavrathan Pathanjali**

DST-Lockheed Martin India Innovation Growth Program

A record total of 1346 applications were received from sectors as diverse as healthcare, textiles, agriculture, defence and food processing. Each application was thoroughly examined by a team of experts from FICCI and external subject matter experts to select the best 100 innovations. These applications and technologies were shared with all partners for further short-listing.

A ***Technology Commercialization & Entrepreneurship Workshop*** was held from April 20-25, 2014 wherein the selected 44 innovators were provided training in basic principles of product commercialization, readiness for market, business models, IP rights, competitive positioning, and mechanisms for revenue by experienced faculty members from the Stanford Graduate School of Business. The ***Innovators' Competition and Awards function*** was held from May 20-23, 2014. The top 44 innovators presented their innovations to a panel of technologists and commercialization experts from India and the United States. At the end of the competition, 30 best innovations were awarded.

The awards ceremony was presided over by Prof. K. VijayRaghavan, Secretary, Department of Science and Technology, Government of India.

The top 10 Innovators selected from the IIGP- 2014 were taken to Silicon Valley and Stanford Graduate School of Business for learning the best practices of Innovation/ startups and successful commercialization. 20 Innovators were also presented with a cash prize of Rs. One Lakh each.

Two technology expositions were organized in 2014 (in Goa on 25 September 2014 and in Jaipur on 4 December 2014) to showcase the commercialization deals signed by the Indian innovators with leading industry partners. The innovators also got a platform to exhibit their technologies at these expositions to potential industry partners, investors and other start- ups.

Stanford India Biodesign Fellowships

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The **Stanford-India Biodesign (SIB) Fellowship** is a leadership training program in biomedical technology innovation initiated by the Indian Department of Biotechnology (DBT), Govt. of India, and Stanford University in partnership with IUSSTF. The goal of this program is to train the next generation of biomedical technology innovators in India through a fellowship to be held jointly at Stanford University, the Indian Institute of Technology (IIT)-Delhi, and, All India Institute of Medical Sciences (AIIMS), New Delhi. This program is directed to candidates with advanced degrees in engineering, medicine or business who could be potential innovators in early-stage development of new biomedical technologies for emerging healthcare needs.

Over the course of the one-year program, approximately half of the Fellows' time will be spent in India and the other half at Stanford University. The core objective of the program is a multidisciplinary team-based fellowship where SIB fellows will work with other young innovators with a combination of engineering, medical and industry backgrounds. The team will examine clinical needs within the Indian setting, identify opportunities for biomedical technology innovation with the goal to potentially invent, prototype, develop and patent one or more new technologies. Fellows will also be mentored by "real-world" experts from the biomedical technology, legal and venture capital industries both in the United States and India. The program would also include exchange of faculty between the academic institutions.

In May 2014, the Jaipur Knee, a project funded through Biodesign to provide a low-cost prosthetic knee for India, was deployed in 6000 patients. In September 2014, a case study of SIB 2011 fellows' biopsy device was covered by Ernst & Young in their "Innovation in Healthcare" report.

Individuals selected for the 2015 SIB Fellowship:

Name	Background	
Debayan Saha	Manufacturing engineering and industrial management.	
Harsh R. Sheth	Plastic and reconstructive surgery, minimally invasive surgery and robotic surgery.	
Shashi Ranjan	Microfluidics, microfabrication and nanotechnology.	

Visitation
Programs

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

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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)

The following microbiologists were awarded in 2014-15:

Avery August from Cornell University, Ithaca, NY was awarded the Research Professorship to implement the research project titled *Anti-Inflammatory agents in Mastitis* at the University of Hyderabad with Dr. Pallu Reddanna.	
Gurdeep Rastogi from Chilika Development Authority, Dept. of Forest and Environment, Bhubaneswar was awarded the Research Professorship to implement the research project titled *Spatiotemporal analysis of picophytoplankton communities in a brackish water estuary* at the Monterey Bay Aquarium Research Institute (MBARI) with Dr. Alexandra Worden.	
Jayanthi Shastri from T N Medical College & Nair Hospital, Mumbai was awarded Teaching Professorship to deliver a short course on *Vector borne Diseases: Diagnosis, Prevention & Control* at the University of South Florida, hosted by Dr. Cathy Pettii.	
Peter Uetz from Virginia Commonwealth University, Richmond, VA was awarded Teaching Professorship to deliver a short course on *The Two-Hybrid System: from interactome to metabolome* at the DBT-ICT-Centre for Energy Biosciences, hosted by Dr. Rupali Walia.	
Ralph Keil from Pennsylvania State University, Hershey, PA was awarded Teaching Professorship to implement the short course on *Molecular Genetic Analysis of Signaling Pathways* at Bose Institute, hosted by Dr. Srimonti Sarkar.	

IUSSTF-American Physical Society (APS) Fellowships

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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 will be awarded to faculties and scientists from India and USA every year to teach 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. Upto 4 recipients are selected by a joint APS-IUSSTF review committee, with a call for proposals twice 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 mostly support upto 4 graduate student travel to India by US citizens, while still enabling some students of Indian citizenship to travel to the United States. These studentship programs will help to build early career relationship between the next generation of physicists from 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.

Recipients of Indo-US Professorship Awards-2014:

Name	University	Host	Subject area	
B. Muralidharan	Indian Institute of Technology-Bombay	Michigan State University	Lecture series on "Nano and Spin Caloritronics"	
Dan Liu	University of New Haven	Parvatibai Chowgule College, Margao	Lecture series on "Statistical Mechanics"	
Mark M. Wilde	Louisiana State University	Naresh Sharma, Tata Institute of Fundamental Research, Mumbai	Lecture series on "Quantum Information Theory"	

Recipients of Indo-US Physics Students Visitation program-2014:

Name	University	Host	Research area	
Amit Kumar	Indian Institute of Science Education and Research, Kolkata	Samarendra Mohanty, University of Texas, Arlington	Optogenetic Manipulation of Cells	
Ananya Ghatak	Banaras Hindu University, Varanasi	Carl M Bender, Washington University, St. Louis	Non-linear PT-symmetric differential equations	
D. Vigil-Fowler	University of California, Berkeley	Manish Jain, Indian Institute of Science, Bangalore	Open-shell optical absorption using the Bethe-Salpeter equation (BSE) methodology	
G. Ozturkler	University of New Haven	Chowgule College, Margao	Tour and discussions at Physics and Biotechnology Department along with attending seminar on theory and practice of statistical and condensed matter physics	

Research Internships in Science and Engineering (RISE)

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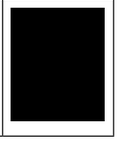
The Indo-US Science and Technology Forum supported ***Research Internships in Science and Engineering (RISE) program*** provides unique opportunities for science, technology, engineering and medical students from the United States to undertake internships in national laboratories, federal research centers, 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.

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 following 5 students interned in India under the RISE Program in 2014-2015:

Name	University	Mentor	Subject area	
Gareth G. Westler	University of Minnesota	Sumathy Krishnan, Technology Informatics Design Endeavour (TIDE) India, Bangalore	Civil Engineering/ International Development	
Garima Singh	North Carolina State University	S.N. Singh, Indian Institute of Technology, Kanpur	Controller Design and Stability Analysis of VSC-HVSC Power System	
Lalita Priyamvada	Emory University	Anmol Chandele, ICGEB, Delhi	Microbiology and Molecular Genetics	
Rohit Singh	University of Massachusetts, Lowell	GV Ramana, Indian Institute of Technology, Delhi	Geotechnical Engineering Program	
Jack Andrew McCracken Pringle	Cornell University	Suhas P Wani, International Crops Research Institute for the Semi-Arid Tropics, Telangana	Modeling Farming Systems in the Semi-arid Tropics of India	

Bhaskara Advanced Solar Energy (BASE) Fellowship Program

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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-U.S. 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.

Student Internships 2015:

Name	Parent Institute	U.S. Mentor	Subject Area	
Abhishek Swarnkar	Indian Institute of Science Education and Research, Pune	**Joseph M. Luther** National Renewable Energy Laboratory	Solution processed all-inorganic colloidal quantum dots for solar cell	
Devika Choudhury	Indian Institute of Technology Bombay	**Jeffrey W. Elam** Argonne National Laboratory, Argonne	Synthesis and characterization of transparent conducting films for photovoltaics using atomic layer deposition	
Kinjalben K. Patel	S. V. National Institute of Technology, Surat	**Neelkanth G. Dhere** Florida Solar Energy Center, University of Central Florida	Optimization of processes for fabrication of CZTS thin film soar cells	
T. Logu	Madurai Kamaraj University, Madurai	**Pratim Biswas** Washington University Missouri	Preparation and characterization of I-III-VI2 ternary semiconductor nano structure thin films for photovoltaic applications	
Neha Chaturvedi	Indian Institute of Technology Delhi	**Alex K-Y.Jen** University of Washington, Seattle	Development of innovative devices for energy applications	

Name	Parent Institute	U.S. Mentor	Subject Area	
Pradeep K. Sundaraj	Shiv Nadar University, Noida	**David Ginley** National Renewable Energy Laboratory, Golden	Development of a novel standalone solar vapor absorption thermoelectric generator	
Rahul Singh	Sharda University, Noida	**Muhamad Ashraful Alam** Purdue University, West Lafayette	Modeling, simulation, design and preparation of dye sensitized solar cell	
Samir K. Sarkar	Indian Institute of Science, Bengaluru	**Christine K. Luscombe** University of Washington, Seattle	Donor-acceptor based organic molecules for dye sensitized	
Sonali Das	Indian Institute of Engineering Science and Technology, Shibpur	**Debashis Chanda** University of Central Florida, Orlando	Design and fabrication of ultra-thin, high efficient monocrystalline silicon solar cells based on plasmonic light trapping effects	
Vishal Bharti	National Physical Laboratory, Delhi	**Yang Yang** University of California, Los Angeles	Polymer & perovskite solar cell	
Venkata Subrahmanya Raghavendra Vara Prasad Oruganti	National Institute of Technology,Warangal	**Marcelo Godoy Simões** Colorado School of Mines, Golden	Development of control strategies for multifunctional grid connected photovoltaic inverter systems	
R. Venkatkarthick	CSIR-Central Electrochemical Research Institute Karaikudi	**Shannon W. Boettcher** University of Oregon, Eugene	Design and synthesis of photo anodes for solar hydrogen production by water splitting	

Fellowships 2015:

Name	Parent Institute	U.S. Mentor	Subject Area	
Balachander Krishnan	PSG Institute of Advanced Studies, Coimbatore, Tamil Nadu	**Pradeep Haldar** SUNY Polytechnic Institute, Albany	Flexible CIGS solar cells using roll-to-roll fabrication technique	
Bharat S. Rajpurohit	Indian Institute of Technology, Mandi	**Lingfeng Wang** University of Wisconsin-Milwaukee	Smart energy management system for DC micro-grid	
Milind S. Dangate	Amrita School of Arts & Sciences, Kerala	**W.S. Sampath** Colorado State University, Fort Collins	Conductive polymer binders for CdS/CdTe devices	
Mukesh Kumar	Indian Institute of Technology Ropar	**Qiquan Qiao** South Dakota State University, Brookings	Nanoscale charge transport studies on Cu-Zn-Sn-S/Se (CZTS) thin film solar cell	
Prabodh Bajpai	Indian Institute of Technology, Kharagpur	**Anurag K. Srivastava** Washington State University, Pullman	An approach to resilient power system with multiple microgrids	
Shaibal K Sarkar	Indian Institute of Technology, Bombay	**Maikel Van Hest** National Renewable Energy Laboratory	Novel hole scavenging layers for higher stability in perovskite solar cells	
Sanjay Agrawal	Indira Gandhi National Open University, New Delhi	**Rajit Gadh** University of California, Los Angeles	Grid connected hybrid solar photovoltaic thermal/wind systems	
Sanjoy Kumar Parida	Indian Institute of Technology Patna	**Joseph Ojo** Tennessee Tech University, Cookeville	Development of control strategies to improve the dynamic performance of a solar pv microgrid system	
Surya Prakash Singh	CSIR-Indian Institute of Chemical Technology, Hyderabad	**Guillermo C. Bazan** University of California, Santa Barbara	Design & development of novel donor and acceptor materials for organic photovoltaic solar cell	
Vari Sivaji Reddy	National Institute of Technology Calicut	**Antonio Facchetti** Nothwestern University, Evanston	Plasmonic effects of metal nanostructures for high performance polymer solar cells	

Khorana Program for Scholars

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The Khorana Program for Scholars is a tripartite arrangement between the Department of Biotechnology, Govt. of India, the University of Wisconsin-Madison [representing partner US Universities], 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 while a member of the UW faculty.

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 UW and partner U.S. Universities for a period of 10-12 weeks. Out of a pool of more than 500 applicants each year, 12 students interned under the Khorana program in 2009 and 15 students were selected in 2010 and 2011 respectively.

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
- 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, we have expanded the Khorana Program to several premier US Universities (University of Iowa, University of Illinois, University of Michigan, University of Minnesota, Michigan State University, Indiana University, Georgetown University, MIT and University of Wisconsin-Madison) to enable a larger number of students to gain a transformative international experience. In 2014, the following **30 students** were selected under this program:

Name	Parent Institute	Advisor and Host University	Subject Area	
Aayushi Jain	Indian Institute of Technology, Delhi	**Ernest S. Burgie** University of Wisconsin-Madison	Phytochrome structure and function.	
Ameya P. Jalihal	SASTRA University, Thanjavur	**Oleg Igoshin** Rice University	Computational systems biology/bioengineering	
Amrita S. Gokhale	University of Pune, Institute of Bioinformatics and Biotechnology	**Sheba M. J. MohanKumar** Michigan State University	Understanding the mechanisms of adipose tissue expansion in Diet-induced obesity after prenatal stress	

Name	Parent Institute	Advisor and Host University	Subject Area	
Amrita Singh	IIT Kanpur	**Xin Huang** University of Wisconsin-Madison	Neurosciences	
Anjani S. Chakrala	IIT Madras	**Eric V. Shusta** University of Wisconsin-Madison	Tissue engineering/blood-brain barrier research	
Ankita Gupta	BITS Pilani	**Rohit Bhargava** University of Illinois, Urbana-Champaign	Computational structural biology	
Ann David	Christian Medical College, Vellore	**Yih-Kuen** University of Illinois, Urbana-Champaign	Characterization of upper limb muscle activation pattern during joystick control for power wheelchair driving	
Anu Thomas	Indian Institute of Science Education and Research, Thiruvananthapuram	**K.V. Prasanth** University of Illinois, Urbana-Champaign	Cancer biology	
Archana P. V.	Amrita School of Biotechnology, Amrita Vishwa Vidyapeetham, Kollam	**Susan Conrad** Michigan State University	Breast cancer research	
Ashna Alladin	VIT University	**Matthew L. Bochman** Indiana University	DNA helicases	
Charu Jain	IISER Pune	**William C. Pomerantz** University of Minnesota	Molecular mechanisms of epigenetics	
Deepshikha Dogra	IIT Delhi	**Jeroen Saeij** Massachusetts Institute of Technology	Characterization of the sub-cellular location of Toxoplasma proteins using CRISPR	
Eeshit D. Vaishnav	IIT Kanpur	**Adam C. Martin** Massachusetts Institute of Technology	Computational modeling of mechanical forces responsible for gastrulation during embryogenesis using confocal Imaging data	

Name	Parent Institute	Advisor and Host University	Subject Area	
Gagan Sharma	Indian Institute of Technology, (BHU) Varanasi	**Michael J. Schnieders** University of Iowa	Protein structure predictions using ensemble rotamer optimization with the use of AMOEBA force field	
Garima	BITS Pilani	**Chi Zhang** University of Nebraska-Lincoln	Bioinformatics and computational biology	
Himani A. Galagali	Indian Institute of Science, Bangalore	**Supriya G. Prasanth** University of Illinois Urbana-Champaign	Study the dynamics of Orc1 phosphorylation during the cell cycle in human cells	
Indrashis Datta	Indian Institute of Science, Bangalore	**Heedeok Hong** Michigan State University	Folding of β-barrel outer membrane proteins from E. coli	
Meghana Cyanam	University of Hyderabad	**Sushmitha Roy** University of Wisconsin-Madison	miRNA networks and their role in Cancer	
Prateek Garg	UM DAE - Centre for Excellence in Basic Sciences	**Danny Ducat** Michigan State University	Studying evolution via artificial life and digital organisms	
Preeti Sahu	National Institute of Science Education and Research, Bhubaneswar	**Jared Cochran** Indiana University	Molecular dynamic simulations	
Prerna Priyadarshani	Amity University Rajasthan	**Greg M. Swain** Michigan State University	Electrochemical studies of glassy carbon, diamond and diamond microelectrode arrays	
Sakshi Gupta	Delhi Technological University, Delhi	**Jeffrey P. Mower** University of Nebraska-Lincoln	Comparative genomics and molecular evolution of vascular plant plastids	
Sanika Hakim	University of Pune, Fergusson College	**Julia van Kessel** Indiana University	Molecular genetics, biochemistry	

Name	Parent Institute	Advisor and Host University	Subject Area	
Sanjan Thallam Prasad Gupta	IIT Madras	**Jennifer L. Reed** University of Wisconsin-Madison	Biotechnology	
Shivani V. Malepati	NIT Warangal	**Stephen D Bell** Indiana University	Analysis of mutations and gene expression in cancer	
Shruti Mohan	SASTRA University	**Cheng Kao** Indiana University	Immunology, cell signaling	
Shubham K. Jaiswal	IISER Bhopal	**George Phillips** Rice University	Structural biology	
Shubham Tripathi	IIT Kanpur	**Michael W. Deem** Rice University	Plant biology	
Vaisakh N. Joy	IIT Kharagpur	**Thomas R. Mackie** University of Wisconsin-Madison	Medical biotechnology	
Viswarup Misra	IIT Kharagpur	**Federica Brandizzi** Michigan State University	Plant biology	

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 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 between Indian institutions and the Viterbi School of Engineering 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 a research internship at the Viterbi School of Engineering for a period of 8 weeks. The Indian students who came to USC were typically toppers from high-ranking Institutions in India and were able to conduct outstanding research in a short amount of time.

Students selected for the program year 2014:

Name	Institution	Mentor	Subject	
Aditya Kamath	Indian Institute of Technology, Hyderabad	**Minlan Yu**	Implementation of Open Sketch in Open VS witch	
Ajay Singhvi	Birla Institute of Technologys & Science, Pilani	**Peter A. Beerel**	Design and analysis of delay elements for 2-phase bundled data asynchronous circuits	
Apratim Mukhopadhyay	Jamia Milia Islamia, Delhi	**Urbashi Mitra**	Thread count analysis of paintings using 2-D discrete wavelets	
Ashwini Pokle	Birla Institute of Technology & Science, Pilani	**Yan Liu**	Robust stochastic optimization	

Name	Institution	Mentor	Subject	
Asim Anand	Indian Institute of Technology, Kharagpur	**Richard Leahy**	Cortical changes in autism	
Dheeraj M N	Indian Institute of Technology, Madras	**Todd A Brun**	Quantum walks over graphs	
Dhruva Kartik Mokhasunavisu	Indian Institute of Technology, Guwahati	**Urbashi Mitra**	Sampling and navigation cost for target localization using mobile agents	
Goutham Ezhilarasu	College of Engineering Guindy, Anna University, Chennai	**Stephen Cronin**	Analyzing the behavior (optical and electrical) of 2D nanocrystals of MoS_2 when placed on different substrates and also fabricating opto-electronic devices based on these characteristics	
Radhika Natesh	National Institute of Technology, Surathkal	**Paul Bogdan**	SPH modelling; Analysis of social interaction of Shewanella bacteria using image processing	
Raktim Pal	National Institute of Technology, Trichy	**Bhaskar Krishnamachari**	SINR optimization with mobile robotic nodes	
Ramnandan S. Krishnamurthy	Indian Institute of Technology, Madras	**Craig Knoblock**	Assigning semantic labels to data sources	
Ranjan Anantharaman	Birla Institute of Technology & Science, Hyderabad	**Murali Annavaram**	Speeding up massive graph applications on GPGPU	
Sanjana Singireddy	Birla Institute of Technology & Science, Hyderabad	**Mike Chen**	Linearization techniques in voltage controlled oscillator based analog-to-digital converters	
Shrihari Amarendra Bhatt	Indian Institute of Technology, Kharagpur	**Gerard Medioni**	Structured sampling for 3D face recognition	

Name	Institution	Mentor	Subject	
Sidharth Gupta	Indian Institute of Technology, Kanpur	**Kristina Lerman**	The friendship paradox in egonets	
Soham Rajesh Phade	Indian Institute of Technology, Bombay	**Rahul Jain**	Freeway traffic modelling using queue-ing theory	
Sudipta Biswas	Indian Institute of Technology, Kharagpur	**Hossein Hashemi**	Improving isolation in wireless transceivers capable of simultaneous transmit and receive	
Sukanya V. Patil	Indian Institute of Technology, Bombay	**Alice Parker**	Circuit implementation of neural network responsible for locomotion in C. elegans	
Vaibhav Gandhi	Indian Institute of Technology, Gandhinagar	**Viktor K Prasanna**	High-performance online traffic classification using FPGA	
Vaishnavh Nagarajan	Indian Institute of Technology, Madras	**Milind Tambe**	Multi-agent team playing for computer go domain	

Graduate Research Opportunities Worldwide (GROW) 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. National Science Foundation (NSF) Acting Director Cora B. Marrett signed this new research partnership with T. K. Chandrashekar, Secretary of the Science and Engineering Research Board (SERB). 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 enquiry in India.

In his statement Dr. Chandrashekar said "*The GROW Initiative provides an excellent opportunity to introduce talented American students to the S&T landscape and the long-standing tradition of scientific inquiry in India. We also hope that the program helps foster long-term interactions between the next generation of innovators and thought leaders from India and the United States and contributes to the prosperity of not only our respective countries but the world at large*." Dr. Cora Marrett remarked, "*GROW fosters increased collaboration between Graduate Research Fellows and their peers around the world. Connecting them to leading scientists and research infrastructure outside of the U.S. will help them engage successfully in the global research enterprise*."

The recipient of the first GROW award in 2014 was **Joanna Yang** from Mayo Clinic. Joanna completed her 3-month internship at CSIR - Institute of Genomics and Integrative Biology (IGIB) under the mentorship of **Sridhar Sivasubbu** and **Adita Joshi**. The aim of her study was to test the hypotheses that a modern science curriculum will improve student science and increase knowledge, improve preventative health attitudes, and facilitate intents of increased health-conscious behaviours. The project was aimed toward revamping the science curriculum through a strong foundation in the Nature of Science and student-directed learning. Another aim of her work was to partner with graduate school programming to facilitate research alignment with broader societal value(s).

S. N. Bose Scholars Program

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To address the need for human resource development and capacity building in science and technology, the **Science & Engineering Board** (SERB), Department of Science and Technology (DST), Govt. of India, the **Indo-U.S. Science and Technology Forum** (IUSSTF) and **WINStep Forward** have developed 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. The Program honors an Indian scientist's fundamental contribution to the completion of the Standard Model of the Universe.

The S.N. Bose Scholars Program provides an opportunity to Indian and U.S. 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 U.S. 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 enquiry in India.

In 2015, the following 56 Indian students were selected:

	Name	Parent Institution	U.S Mentor	Subject Area
1	**Aashiq Muhamed**	Indian Institute of Technology Roorkee	**Sanjiva Lele** Stanford University	Mechanical Engineering
2	**Aashish Bhardwaj**	Indian Institute of Technology Ropar	**Dennis M. Kochmann** California Institute of Technology (Caltech)	Mechanical Engineering
3	**Abhishek Kumar**	National Institute of Technology Jamshedpur	**J Hong** University of Minnesotta	Industrial Engineering
4	**Aditi Chatterjee**	Indian Institute of Technology Kharagpur	**John M. Eiler** California Institute of Technology (Caltech)	Geology
5	**Aditi Raghunathan**	Indian Institute of Technology Madras	**Percy Liang** Stanford University	Computer Science
6	**Aishwarya Mahant Kumar Rath**	Sardar Vallabhbhai National Institute of Technology, Surat	**Mitul Luhar** Univeristy of Southern California, Los Angeles	Mathematics
7	**Akshat Jain**	Panjab University	**Pattie Maes** Massachusetts Institute of Technology	Electronics and Communication Engineering
8	**Alok Sharma**	Faculty Of Mathematical Sciences, Delhi University	**Julie C. Mitchell** University of Wisconsin-Madison	Mathematics
9	**Apala Chaudhuri**	Indian Institute of Technology Kanpur	**Taekjip Ha** University of Illinois-Urbana Champaign	Chemistry
10	**Apoorva Joshi**	Vellore Institute of Technology	**Milan Sonka** University of Iowa	Electronics and Communication Engineering
11	**Aprameya Ganesh Prasad**	National Institutes of Technology Surathkal	**Yoon Yeo** Purdue University	Chemical Engineering
12	**Arjun Vijeta**	Indian Institute of Science Education and Research Pune	**Marisa C. Kozlowski** University of Pennsylvania	Chemistry
13	**Ashish Daga**	Indian Institute of Technology Kharagpur	**Suresh V. Garimella** Purdue University	Mechanical Engineering
14	**Ayush Tomar**	Delhi Technological University	**Juergen Pfeffer** Carnegie Mellon University	Computer Science and Engineering
15	**Bhagyashree Chandrakant Prabhune**	College of Engineering Pune	**Krishnan Suresh** University of Wisconsin-Madison	Mechanical Engineering
16	**Brinda Kuthanazhi,**	Indian Institute of Science Education and Research, Thiruvananthapuram	**Timothy S. Fisher** Purdue University	Physics
17	**Chandrachur Bhattacharya**	Jadavpur University	**Asok Ray** Pennsylvania State University	Mechanical Engineering
18	**Ishan Manjani**	Indraprastha Institute of Information Technology,Delhi	**Kevin W. Bowyer** University of Notre Dame	Computer Science and Engineering
19	**Jatindeep Singh,**	Indian Institute of Technology Gandhinagar	**Sreeram Kannan** University of Washington	Electrical Engineering
20	**Kalind Baraya**	Indian Institute of Technology Guwahati	**John M. Pfotenhauer** University of Wisconsin-Madison	Mechanical Engineering

	Name	Parent Institution	U.S Mentor	Subject Area
21	**Kartikeya Singh Sangwan**	University of Delhi	**W. Berry Lyons** Ohio State University	Earth Science
22	**Kazi Ranjibul Islam**	Indian Institute of Science Education and Research, Kolkata	**Mikhail Lukin** Havard University	Physical Sciences
23	**Khyathi Raghavi Chandu**	International Institute of Information Technology Hyderabad	**Ani Nenkova** University of Pennsylvania	Computer Science
24	**Koushik Chatterjee**	Indian Institute of Technology Kharagpur	**Philip Kaaret** University of Iowa	Physics
25	**Lois Thomas**	Savitribai Phule Pune University.	**Wojciech W. Grabowski** National Center for Atmospheric Research (NCAR)	Atmospheric Science
26	**Partha Pratim Dutta**	Indian Institute of Engineering Science and Technology, Shibpur	**Yogesh B. Gianchandani** University of Michigan	Electrical Engineering
27	**Phalguni Shishir Shah**	University of Mumbai- Department of Atomic Energy, Centre for Excellence in Basic Sciences	**Lionel Levine** Cornell University	Physics
28	**Poulami Chakraborty**	Indian Institute of Technology Guwahati	**John M. Carrol** Pennsylvania State University	Design
29	**Pranav Gupta**	Birla Institute of Technology and Science Pilani	**Craig Knoblock** Univeristy of Southern California, Los Angeles	Computer Science
30	**Priyanga Ganesan**	National Institute of Science Education and Research Bhubaneswar	**Jeffrey Schenker** Michigan State University	Mathematics
31	**Rajath Kantharaj**	Birla Institute of Technology and Science Pilani	**Timothy S. Fisher** Purdue University	Mechnanical Engineering
32	**Ramudu Kolisetty**	Birla Institute of Technology and Science Hyderabad	**Paul Bogdan** Univeristy of Southern California, Los Angeles	Electronics & Communications
33	**Ravi Srivastava**	Indian Institute of Technology Gandhinaghar	**Uttam K. Tambar** UT Southwestern Medical Center	Chemistry
34	**Rishav Choudhary**	Indian Institute of Technology Kanpur	**Ahmed Ghoniem** Massachusetts Institute of Technology	Aerospace Engineering
35	**Rishav Roy**	Indian Institute of Technology Kharagpur	**Dino Di Carlo** University of California, Los Angeles	Mechanical Engineering
36	**Robin Singh**	National Intitute of Technology Surathkal	**Raj Kothapalli** Stanford University	Mechanical Engineering
37	**Samprit Ghosh**	Indian Institute of Technology Bombay	**Jerome William Hoffman** Lousiana State University	Mathematics
38	**Shalini Gupta**	Indian Institute of Technology Kanpur	**William DeGrado** and **Michael Grabe** University of California, San Francisco	Chemistry
39	**Shashwat Kumar Singh**	Indian Institutes of Science Education and Research Kolkata	**Max Bezada** University of Minnesota	Earth Science
40	**Shaurya Garg**	Punjab Engineering College University of Technology, Chandigarh	**Rakesh K. Kapania** Virginia Polytechnic Institute and State University	Aerospace Engineering

	Name	Parent Institution	U.S Mentor	Subject Area
41	**Shelly Aggarwal**	Indian Institute of Technology Madras	**Amit Lal** Cornell University	Electronics and Communication Engineering
42	**Shilpa Vijay**	College of Engineering Pune,	**Mitul Luhar** Univeristy of Southern California, Los Angeles	Civil Engineering
43	**Shristi Singh**	National Institute of Technology Warangal	**Gerald Fuller** Stanford University	Chemical Engineering
44	**Shruthi Tiruchirapalli Kumarraj**	CSIR – Central Electrochemical Research Institute, Chennai	**Nicholas Leventis** Missouri University of Science & Technology, Rolla	Chemical & Electrochemical Engineering.
45	**Sidhyansh Saxena**	Indian Institute of Technology Madras	**Ashutosh Sabharwal** Rice University	Biological Engineering
46	**Sooraj Ben K.R.**	Indian Institutes of Science Education and Research Thiruvananthapuram	**Prashant V. Kamat** University of Notre Dame, Indiana	Chemistry
47	**Soumya Kamal Kanungo**	National Institute of Science Education and Research Bhubaneswar	**James P. Shaffer** The University of Oklahoma	Physics
48	**Soumya Ranjan Sahoo**	National Institute of Technology Rourkela	**Dominik Schillinger** University of Minnesotta	Chemical Engineering
49	**Soumya Wadhwa**	Indian Institute of Technology Guwahati	**Srinivasan Parthasarathy** Ohio State University	Mathematics and Computing
50	**Srishti Bhutani**	National Institute of Technology Kurukshetra	**Arturo E.Schultz** University of Minnesotta	Civil Engineering
51	**Subrata Singha**	Indian School of Mines, Dhanbad	**Mrinal K Sen** Jackson School of Geosciences, The University of Texas at Austin	Geophysics
52	**Suman Ghosh**	Jadavpur University	**Jeffrey Bigham** Carnegie Mellon University	Electronics and Telecommunication Engineering
53	**Ujash Dipak Kumar Shah**	Birla Institute of Technology and Sciences Goa	**Arezoo Ardekani** Purdue University	Mechanical Engineering
54	**Venkatachalam Avadiappan**	Indian Institute of Technology Madras	**Christos T. Maravelias** University of Wisconsin-Madison	Chemical Engineering
55	**Vivek Pandey**	Indian Institute of Technology Roorkee	**Hatsuo Ishida** Case Western Reserve University	Polymer Science and Technology
56	**Vusirikala Venkata Satyanarayana**	Indian Institute of Technology Guwahati	**Lixia Zhang** University of California, Los Angeles	Computer Science and Engineering

The following U.S. Students were selected:

	Name	Parent Institution	Indian Mentor	Host Institution
1	**Anna Barker**	University of Wisconsin-Madison	**Pooja Sharma**	Medanta Medicity, Gurgaon
2	**Christopher B Johnson**	University of Wisconsin-Madison	**Sunita Grover**	National Dairy Research Institute, Karnal
3	**Daniel Patrick Howard**	University of Wisconsin-Madison	**Praveen C**	Tata Institute of Fundamental Research, Bangalore
4	**Debayon Dutta**	State University of New York	**Suddhasatwa Basu**	Indian Institute of Technology Delhi
5	**Hannah M Lider**	University of Wisconsin-Madison	**Vatsala Thirumalai**	National Center for Biological Sciences, Bangalore
6	**James Olson**	University of Wisconsin-Madison	**Ashitava Ghosal**	Indian Institute of Science, Bangalore
7	**Jared Paul Landsman**	University of California, Berkeley	**Rajan Rawal**	CEPT University, Ahmedabad
8	**Kelli E Verhoeven**	University of Wisconsin-Madison	**Pooja Sharma**	Medanta Medicity, Gurgaon
9	**Lucas L Holiday**	University of Wisconsin-Madison	**Suhita Nadkarni**	Indian Institute of Science, Education and Research, Pune
10	**Tenzin N Paljor**	University of Wisconsin-Madison	**Avadhesha Surolia**	Indian Institute of Science, Bangalore

In 2015, IUSSTF, WINStep Forward and the Consulate General of India, Chicago, co-hosted the **2015 S.N. Bose Scholars Orientation** event at the Indian Consulate in Chicago. The Consul General of India, **Dr. Ausaf Sayeed**, welcomed the scholars to the United States and with great warmth asked them to consider themselves as part of his own family. Speaking to the Bose Scholars at the Orientation were the leaders of the major Indian scientific agencies: **Prof. T.K. Chandrashekar**, Secretary of the Science and Engineering Research Board (SERB), **Dr. Rajiv Sharma**, Executive Director of the Indo-US Science and Technology Forum (IUSSTF), and via the internet **Dr. VijayRaghavan**, Secretary of The Department of Biotechnology (DBT). **Dr. Aseem Ansari**, Director Khorana and Bose Programs and Professor, Synthetic Biology and Genomics, University of Wisconsin Madison, encouraged the scholars to make the most of

this unique opportunity and challenged them to become the next transformative thought leader such as Khorana, Bose or Swaminathan. “All of us have great expectations of you and look forward to seeing your careers blossom and the transformative changes you bring about in the future,” Dr. Ansari told the scholars.

Prof. Bassam Shakhashiri, a world-renowned US educator who has promoted strong science education policies during his tenure as director of the American Chemical Society and earlier at the National Science Foundation also addressed the students. He spoke to the Scholars about using their love of science to promote development of society as well as sparking a strong appreciation of science in the general non-scientist population. **Dr. Nevan Hanumara** also had a similar message of using science to benefit society. Dr. Hanumara manages MIT’s Tata Center in Cambridge, MA. He and his students are currently trying to solve societal problems in India using their expertise in design improvement through mechanical engineering. He encouraged the young Scholars to place emphasis on utilizing their future research to solve tackle societal issues. Representatives of major Midwestern universities as well as other universities interested in hosting Bose scholars also participated in the event.

Bilateral Workshops

Recent advances on modeling rare events: Methods and applications

29 May-01 June 2014 ■ Kumarakom, India

Principal Investigators

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Development of molecular simulation algorithms to model rare events is an active field of research. Many of the interesting processes such as chemical reactions, phase transitions, nucleation, protein folding and conformational changes in molecules are examples of rare events in computer simulations. Modeling of such processes continues to be challenging and novel methods have to be designed to overcome the problems related to limited sampling. In order to bring experts from the United States and India to discuss the latest progress in this field, **Nisanth N. Nair** (Indian Institute of Technology-Kanpur) and **Mark E. Tuckerman** (New York University) organized an Indo-US workshop titled **Recent advances in modeling rare events: methods and applications.** The symposium was focused on the recent advances in modeling chemical reactions, structural transformations, protein folding, nucleation etc. Detailed discussions were made on the novel techniques and the current challenges.

Conservation and restoration of ecosystem services in a time of climate change

28-29 June 2014 ■ Dehradun, India

Principal Investigators

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The Himalayas are among the most important eco-regions of the world, sustaining a large part of humanity through the ecosystem services that they provide through climatic and hydrological modulation, nutrient cycling and provisioning biodiversity, thus supporting millions of agricultural and forest-dependent livelihoods. The ecosystem services hinge upon the varied and extensive forest cover across this region, that is under increasing threat of degradation from over-exploitation, infrastructure development and climate change.

In order to create a scientific understanding of the causes of forest degradation, its conservation and restoration, with a special reference to the Western Himalayas, **Ghazala Shahabuddin** (Centre for Ecology, Development and Research, Dehradun) and **Timothy Gregoire** (Yale University, New Haven) organized an Indo-US workshop titled **Forests of the Western Himalaya: conservation and restoration of ecosystem services in a time of climate change**.

The workshop aimed at building multi-disciplinary and multi-institutional research collaborations on Himalayan ecology issues, increasing opportunities for training and learning through institutional collaborations and strengthening ties between scholars and conservation practitioners.

Epidemiology and prevention of cancer

07-09 October 2014 ■ Chennai, India

Principal Investigators

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Systematic cancer registration has long been practiced in India through the National Cancer Registry Program. Over the last 20-30 years, there has been a progressive increase in the incidence of cancer within India although rates are generally lesser than in the US. Geographical variation in the incidence of cancer is well known. India and the US have people of diverse genetic backgrounds and large populations. Such large and genetically diverse populations are an important asset for epidemiological studies aimed at identifying the etiological factors of a complex, multi-factorial disease like cancer.

The Indo-US workshop on **Epidemiology and prevention of cancer** organized by **T.S. Ganesan** (Cancer Institute, Chennai) and **Ernest Hawk** (The University of Texas MD Anderson Cancer Center, Houston), facilitated a useful exchange of valuable information in these areas of research, examining the feasibility of implementing them and allowing the framing of questions and outlining potential future research in these areas for the mutual benefit of both countries. The expertise that US investigators brought to the workshop would enhance and support the level of research that is possible in a diverse country like India. Similarly, the expertise of Indian investigators working to advance public education, cancer screening, and cancer prevention in India (i.e., a lower-resource setting) would assist and inform American efforts to tailor effective programs which might better meet the needs of poor and underserved sectors of the American population. Thus, the conference helped facilitate bi-directional learning to benefit all participants, and more importantly, the health of the populations they serve.

Recent advances in structure biology and drug discovery

09-11 October 2014 ■ Roorkee, India

Principal Investigators

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Structural biology has witnessed rapid advancements in the past few decades. X-rays have played crucial roles in some of the most important scientific breakthroughs since their discovery by Roentgen in 1895. Modern advancements in the three major structure determination techniques - X-ray crystallography, nuclear magnetic resonance (NMR) spectroscopy and cryo-electron microscopy have made it possible to obtain three-dimensional structural information on various biological processes and systems with much less effort than in the past. Lately, the field of drug discovery has seen a paradigm shift with structure-based drug design making a comeback while traditional high-throughput screening methods have persistently produced disappointing results. An Indo-US workshop on **Recent advances in structure biology and drug discovery** was organized by **Pravindra Kumar** (Indian Institute of Technology-Roorkee), **Richard J. Kuhn** (Purdue Discovery Park), **Shailly Tomar** (Indian Institute of Technology-Roorkee), **Carol B. Post** (Purdue University) and **Jeffrey T. Bolin** (Purdue University) to provide a common platform for interaction between scientific and technical representatives from both nations in the context of projects that focus on problems of mutual interest in the area of structure based drug designing, virus crystallography and bioremediation.

Best practices and eco-restoration technologies for enhancing functional quality of urban landscapes

03-05 November 2014 ■ Bengaluru, India

Principal Investigators

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The rapid growth of cities in India and the United States has focused attention on the role of ecological services, the ways that natural resources and habitats in cities help improve environmental and human health. New science-based solutions for improving urban conditions can help augment air and water quality, liveability, and sustainable biodiversity for our burgeoning urban populations. **S. Natesh** (National Institute of Immunology, New Delhi) and **Steven N. Handel** (Rutgers University, New Brunswick) organized an Indo-US Workshop on ***Ecorestoration technologies and best practices for enhancing functional quality of urban landscapes*** at Bangalore. This workshop was an integral part of the International Congress on Green Urban Futures which was organised by Center for Urban Green Spaces, New Delhi and co-hosted by Government of Karnataka and Ministry of Urban Development, Govt. of India.

The objective of the workshop was to join research and results from case studies in both countries' urban centers into a new framework for improving cities' ecological conditions, and identify specific research areas needing more attention and focus. Key issues discussed included urban waterways, urban agricultural zones, the value of small urban habitat parcels, biotechnological approaches in urban restoration, and the increased understanding of urban forestry for improving human conditions in our cities.

More than 180 participants attended the workshop including scientists, foresters, officials of urban local bodies from across the country, pollution control professionals, senior officers from various departments associated with urban sanitation & water supply and civil society professionals.

The deliberations during the workshop pointed at the need for a multi-agency framework to identify and restore landscapes with clear outcomes at the initiation stage itself. Several case studies of eco-restoration projects in India, US and other countries were presented during the meeting and prompted focused discussions. It was decided to develop a few pilot projects in India in collaboration with state pollution control boards, R&D organisations and civil society groups. Center for Urban Green Spaces, New Delhi and Rutgers University agreed to collaborate to develop a long term program on eco-restoration demonstration projects in various parts of India.

Molecular modeling and informatics in drug design

03-06 November 2014 ■ Mohali, India

Principal Investigators

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The discovery of new medicines is a cumbersome process – hugely expensive in terms of time, money, efforts and human resources. With the advent of cutting-edge science and technologies for solving the problems related to biology and chemistry, the process of discovery has been hastened manifold, and now allows scientists to rationally design drugs by understanding their targets at an atomistic level and tailored them to specific diseases. This facilitates the development of drug molecule with better efficacy and less side effects/ toxicity as their properties and possible interactions are better understood at the earlier stages. The use of computational techniques and validated software in drug discovery are gaining popularity, and are routinely being implemented to complement experimental studies. Hence, the future of drug discovery shall strongly depend on the integration of informatics and pharmaceutical sciences. An Indo-US workshop on **Molecular modeling and informatics in drug design** was organized by **Prasad V. Bharatam** (National Institute of Pharmaceutical Education and Research, Mohali) and **Alexander Tropsha** (University of North Carolina at Chapel Hill) with an aim to provide a platform for group-to-group coordination, with a focus on strengthening graduate education in the interdisciplinary area of informatics and drug discovery in India and the United States.

Genomic insights into human morphogenesis: Prenatal, postnatal and molecular dysmorphology

07-09 November 2014 ■ Hyderabad, India

Principal Investigators

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The relative contribution of congenital malformations to neonatal mortality and morbidity is being increasingly recognized in India following improvements in immunization programs and perinatal care. Hence, the need for the care of malformed children and genetic counselling for such families is gaining attention. Further, the recent availability of advanced molecular techniques like microarray and next-generation sequencing have made it possible to identify the causative gene/mutation in a number of malformation syndromes. However, we still do not have information regarding genetic etiology of a number of malformation syndromes and a lot of research interest is being diverted to this aspect. Proper clinical delineation, genetic counselling, prenatal diagnosis and research aimed towards identification of genes will go a long way to decrease disease burden in society due to these conditions. Towards this end, the Indo-US workshop on **Genomic insights into human morphogenesis: prenatal, postnatal and molecular dysmorphology** organized by **Ashwin Dalal** (Centre for DNA Fingerprinting and Diagnostics, Hyderabad), **John C. Carey** (University of Utah, Salt Lake City), **Shubha R. Phadke** (Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow) and **Prajnya Ranganath** (Nizam's Institute of Medical Genetics, Punjagutta, Hyderabad), brought together eminent clinicians and scientists from India and the US to deliberate on various aspects of normal and abnormal human morphogenesis: developmental genetics, clinical evaluation and prenatal imaging for malformations/ malformation syndromes, diagnostic testing, pathophysiology, treatment, supportive care, genetic counselling, prevention and prenatal diagnosis, use of advanced techniques like microarray, next generation sequencing for elucidation of genetic etiology etc.

Proteomics for translational research

06 December 2014 ■ Mumbai, India

Principal Investigators

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Due to the rapid advancement in state-of-the art proteomics technologies, continuous expansion of our scientific understanding, and challenges associated with translational research, it has become necessary to keep up with current trends and advances in proteomics research. In spite of versatile global proteomics research endeavors, there is a serious bottleneck between promising laboratory findings and their successful translation into real clinical applications. Additionally, analysis and management of large datasets obtained from the high-throughput proteomics research is also a formidable challenge. An Indo-US workshop on **Proteomics for translational research** was organized by **Sanjeeva Srivastava** (Indian Institute of Technology-Bombay) and **Philip Andrews** (University of Michigan, Ann Arbor) to bring together the top proteomics researchers of the US and India to discuss many of the existing technological limitations for translational proteomics research and make recommendations for future collaborative research projects to overcome such limitations. This event witnessed participation of the most prominent scientists form US involved in path breaking research in Proteomics and pioneers from the Human Proteome Organization (HUPO) including Prof. Gilbert Omenn (Ex-US HUPO President), Prof. Samir Hanash (Ex-HUPO President), Prof. Catherine Fenselau (Ex-President US-HUPO and American Society for Mass Spectrometry (ASMS)), Prof. John Yates, Dr. Philip Andrew, Dr. Andrew Link, Dr. Robert L. Moritz and many others. In addition, the valuable presence of Dr. Sudhir Srivastava, the Chief, Cancer Biomarkers Research Group, National Cancer Institute, NIH and Dr. Michael Boyne, from the US Food and Drug Administration (FDA) provided imperative guidelines regarding biomarker and drug discovery research. Specifically, the objectives were to build long-term bilateral collaborative research work and provide recommendations for joint proteomics projects for translational research. Most of the participants felt that this Indo-US bilateral workshop had exceeded expectations, and successfully accelerated an alleyway for enduring collaborative research projects, joint educational course development and student exchange programs among the scientists/institutes from these two countries.

Nano-engineering in medicine

17-19 December 2014 ■ New Delhi, India

Principal Investigators

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An Indo-US workshop on **Nano-engineering in medicine** was organized by **Amit Kumar Dinda** (All India Institute of Medical Sciences, New Delhi), **Rupak Banerjee** (University of Cincinnati), **Ashok Kumar Ganguli** (Institute of Nano Science & Technology, Mohali) and **Kunal Mitra** (Florida Institute of Technology) at All India Institute of Medical Sciences, New Delhi 17 – 19 December, 2014, with the objective of bringing medical and nonmedical experts from the leading institutions of the two countries on a common forum to facilitate discussions on successful application of nano-engineering in medicine. The workshop was planned considering the need of translational focus for nanotechnology research in medicine such that new and innovative technology can be transferred from bench to bedside. The hypothesis was that such workshop would be an effective platform for efficient exchange of research ideas between diverse institutions involving complex topics of Nanoengineering modulating specific functions and safety of the nanomaterials for in-vivo diagnostic or therapeutic applications. This would help in determining the unmet needs and central challenges while identifying synergies between the two nations in this field which can transform medical practice worldwide.

Recent trends in thermoelectric materials: Fundamentals to applications

13-15 December 2014 ■ New Delhi, India

Principal Investigators

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Thermoelectricity involves the conversion of a thermal gradient into electricity and vice versa. Although it is of great interest to develop conventional renewable and carbon neutral energy sources, such as, wind, solar, and biomass; there is a potentially large source of energy in the form of heat, which can also similarly be used to generate electricity. Owing to its green technology, there has been a renewed interest in thermoelectric-based waste heat recovery systems for energy generation; however, currently the main impediment in this direction is their limited thermoelectric efficiency. An Indo-US workshop on **Recent trends in thermoelectric materials: fundamentals to applications** was organized by **Ramesh C. Budhani** (Indian Institute of Technology, Kanpur; previously affiliated with CSIR-National Physical Laboratory, New Delhi) and **Donald T. Morelli** (Michigan State University, East Lansing) to focus on fundamentals and applied research in the area of thermoelectric materials and devices thereof. Effective solutions to the major challenges, currently inhibiting the use of thermoelectric devices for energy generation, which includes enhancement of the thermoelectric conversion efficiency (figure of merit) and the use of cost-effective and non-toxic materials was deliberated upon at the workshop.

Learning, algorithms and complexity

05-09 January 2015 ■ Bangalore, India

Principal Investigators

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Algorithms and computational complexity theory form the theoretical foundations and backbone of all of computer science. Increasingly, computational problems for which algorithms must be developed involve analyzing and learning from massive amounts of data. Consequently, it is critical both for machine learning scientists to be aware of recent developments in algorithms and computational complexity theory, so that they can incorporate rigorous theoretical and algorithmic thinking into the design of machine learning algorithms -- and conversely, for theoretical computer scientists to be aware of developments in machine learning and learning theory, so that they can help build the theoretical foundations for learning algorithms that will be used to analyze vast amounts of data in the future. The Indo-U.S. symposium on **Learning, algorithms and complexity** organized by **Arnab Bhattacharyya** (Indian Institute of Science, Bangalore), **Shivani Agarwal** (Indian Institute of Science, Bangalore), **Ronitt Rubinfeld** (Massachusetts Institute of Technology, Cambridge) and **Sanjeev Arora** (Princeton University), brought together leading researchers in the areas of learning, algorithms and complexity to present and discuss the latest developments in these critical areas, with a goal of catalyzing interactions and collaborations, brainstorming on new research directions, and exciting the next generation of computer scientists in India to think across boundaries. Such strong collaborations and cross-boundary thinking will be necessary for facilitating the development of powerful, scalable, and theoretically well-founded computational methods that can address the challenges arising from the need to learn from large-scale data in domains ranging from medicine to finance and from environmental modeling to defense.

Big data analysis and translation in disease biology

18-22 January 2015 ■ New Delhi, India

Principal Investigators

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Due to recent technological developments in DNA sequencing, the medical research sector is producing huge volumes of complex data which can be labeled as Big Data. Together with the technology, bioinformatics tools continue to advance our ability to analyze the massive amount of the sequence data that is generated by sequencing machines. The whole-genome sequencing and its analysis is a window to unveil medical information embedded in the individual genomes to be incorporated for personalized, predictive, diagnostic and therapeutic gain. Over the past few decades, research has shifted from producing data to making sense of data, hence the importance of data-driven research. The symposium on **Big data analysis and translation in disease biology** organized by **Indira Ghosh** (Jawaharlal Nehru University, New Delhi), **Punit Kaur** (All India Institute of Medical Sciences, New Delhi) and **Marylyn D. Ritchie** (Pennsylvania State University) aimed to bring together clinicians and researchers from both the US and India to discuss the advances and challenges in the analysis of the huge amount of biomedical data presently available. The symposium focussed on technologies generating medical data, big data storage and maintenance, data integration, analysis and visualization and big data sharing tools and policies and provided hands on training on the basic practical knowledge on management, interpretation and application of big data. The focal point of the symposium was the genetic and genomic analysis of diseases with specific reference to cancer, genetic disorders and infectious diseases.

More information available at http://ccbb.jnu.ac.in/IUBDDJan2015/

Modeling and managing flood risk in mountain areas

17-19 February 2015 ■ Folsom, USA

Principal Investigators

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Despite efforts to reduce flood risk and losses over a century, floods remain among the most widespread and damaging natural disasters, particularly in mountains. Floods generated in mountainous areas are different from those that accumulate in plains in ways that hinder forecasting, response, and recovery. Mountains are areas of various complexities that lead to a broad range of poorly-understood flood generation processes associated with localized, extreme events, such as cloudbursts, landslides, and glacial lake outbursts. In addition, remoteness, poor communication networks, and inadequate governance make it difficult to establish effective forecasting and response systems in mountain areas.

To identify the science and management challenges and solutions for reducing flood losses in mountain areas, an international group of hydrologists, engineers, and managers participated in an IUSSTF supported workshop in Folsom, USA, to share ideas, techniques, and experiences on **Modeling and managing flood risk in mountain areas.**

From a science perspective, we need better understanding of atmospheric processes and their interactions with the mountain landscape. We also need to develop affordable instruments and wider monitoring in mountain areas. Flood forecasting and early warning systems need to be set up and operationalized. Resources must be dedicated to map high hazard areas, implement monitoring, develop disaster response plans, and engage local communities. Scientists and managers need to acquire and communicate reliable information. Basin-scale hazard assessment and disaster response planning should be conducted in mountainous areas. Mitigation measures, including infrastructure, land planning, and regulation should be implemented by involving local people and officials.

The workshop principle investigators are **Desirée Tullos** (Oregon State University) and **Sharad Jain** (National Institute of Hydrology, Roorkee).

More information can be found at the working group website:http://rivers.bee.oregonstate.edu/research/ModelingandManagingFloods

Frontiers of structural materials research

22-26 February 2015 ■ Coorg, India

Principal Investigators

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Structural materials such as advanced steels, Ti, Zr, Mg, Al alloys, composites, structural ceramics, shape memory alloys, metallic glasses, metallic foams, etc. form an important class of engineering materials. Scientific progress towards understanding these materials is invariably linked to technological progress in various sectors, especially strategic sectors like energy and aerospace. While the era of 1950 to about 1990 saw a great deal of emphasis in understanding and developing advanced structural materials, emphasis in the last two decades has somewhat moved to other areas such as nano- and bio-materials, especially in the USA, which has been a leader in structural materials research. There has been a renaissance of sorts in this area for the past five years or so worldwide. In the Indian context, progress in this area is absolutely critical for technological advances, especially, since ours is a developing economy. In keeping with this, an Indo-US workshop on Frontiers of structural materials research was organized by U. Ramamurty (Indian Institute of Science, Bangalore) and Jan Schroers (Yale University, New Haven) wherein the current status of each of material class was reviewed and future prospects were identified.

Transforming storm water into a resource: Design, risks and benefits

16-20 March 2015 ■ New Delhi, India

Principal Investigators

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Sustainably managing scarce water resources is a global challenge that will likely become tougher as the population increases, the economy grows, and climatic changes make current water infrastructure obsolete or more vulnerable. Storm water discharges from the built environment are one of the main causes of water quality impairment, yet storm water could be a valuable resource especially in urban environments, such as cities in India and Southern California. The objective of the Indo-US workshop on **Transforming stormwater into a resource: design, risks and benefits** organized by **Ashmita Sengupta** (Southern California Coastal Water Research Project, Costa Mesa) and **M.L Kansal** (Indian Institute of Technology-Roorkee) was to explore the potential value of low impact developments (LIDs) for reclaiming storm water not only from the point of view of the quality of the treated water but also in terms of pathogen risks for public health, ecological and environmental impacts, as well as amenity values. In the workshop, participants explored the role of large-scale biolfilter implementation, as a LID strategy, in three different ways: new assessment tools, integrated assessment framework, and direct partnership with implementing agencies. The workshop brought together experts with backgrounds in engineering, economics, and social sciences to provide a more holistic evaluation of the transformation of these water stressed urban centers to water sensitive cities.

Virtual Collaborations

IUSSTF supports the **Indo-US Virtual Networked Centers** initiative to enable Indian and American scientists from academia and laboratories to carry out a joint research activity by leveraging existing infrastructure and funding available with the partners through a linkage established by a virtual center. These centers aim to encourage joint project implementation on focal areas of mutual interest through networking, thus paving way to sustainable interactions and developing long-term partnerships. Over the years, IUSSTF has supported about 50 Virtual Networked Centers. At present, support continues for 15 on-going Joint Centers involving over 50 Indian and US Institutions in the areas of nano-technology, energy, materials science, health sciences, physical sciences, chemical sciences, atmospheric sciences, astronomy and astrophysics, etc.

In an endeavor to provide a platform to Indian and US scientists for a meaningful exchange of ideas based on the joint project implementation carried out under the aegis of the Joint Centers (JC), and showcasing the outcomes of these linkages; IUSSTF organized an **Indo-US Joint Center Monitoring Workshop** on 19-20 March 2015 at Bangalore. This was the first monitoring workshop organized and PIs of 18 such JCs were invited to make presentations (for about 20 min) to an Expert Panel of Reviewers and peers on updated developments of the Joint Center activities which was followed by a Q&A session.

The inaugural session began with a welcome address by **Dr. Rajiv Sharma**, Executive Director, IUSSTF. Prof. **T. K. Chandrashekar**, Secretary, Science and Engineering Research Board addressed the workshop participants and also released the **Compendium on Joint Centers** highlighting the collaborative work that has been carried out by the Virtual Networked Centers supported by IUSSTF. The two-day event was an attempt to review the accomplishments of the Joint Centers based on indicators such as new capacity developed, new strengths generated, joint publications, reciprocal exchange visits and deliverables achieved vis-à-vis the original objectives.

The workshop consisted of the following five technical sessions where presentations were made by Indian and/or US Principal Investigators:

SESSION I: Physical, Chemical and Materials Sciences

- Nanomaterials for energy: Prof. G.U. Kulkarni (Jawaharlal Nehru Centre for Advance Scientific Research, Bangalore) and Prof. Timothy S. Fisher (Birck Nanotechnology Centre, Purdue University)
- Novel magnetic structures and excitations in multilayers, interfaces, nanoparticles and bulk: Prof. R. C. Budhani (Indian Institute of Technology, Kanpur)
- From fundamentals to applications of nanoparticle assemblies: Prof. Sanat K. Kumar (Columbia University, New York); Dr. Guruswamy Kumaraswamy (National Chemical Laboratory, Pune) ; and, Dr. Charusita Chakravarty (Indian Institute of Technology Delhi)
- Thin films and nanostructured coatings: Dr. Ganpati D. Yadav (Institute of Chemical Technology, Mumbai) and Dr. Sarbajit Banerjee (Texas A&M University)
- Advanced materials research: Prof. Umesh Waghmare (Jawaharlal Nehru Centre for Advance Scientific Research, Bangalore) and Prof. Vinayak P. Dravid (Northwestern University)
- Functional oxides: Dr. D. D. Sarma (Indian Institute of Science, Bangalore)
- Theoretical studies of the correlated electronic structure of graphene and its fragments: Prof. S. Ramasesha (Indian Institute of Science, Bangalore)
- 3D engineered electrodes for electrochemical energy storage: Dr. Vijayamohanan K. Pillai (CSIR-Central Electro Chemical Research Institute, Karaikudi)

SESSION II: Medical/Health Sciences

- Inflammatory bowel diseases: Dr. Vineet Ahuja (All India Institute of Medical Sciences, New Delhi) and Dr. Amit Awasthi (Translational Health Science and Technology Institute, Gurgaon)
- Nanomedicine for head and neck cancer: Dr. Surinder P. Singh (National Physical Laboratory, New Delhi)
- Climate change and health adaptation: Dr. Dileep Mavalankar (Indian Institute of Public Health-Gandhinagar)

- Optometry and ophthalmology: Dr. R. Krishna Kumar (Elite School of Optometry, Chennai) and Dr. P. Sarita Soni (Indiana University, Bloomington)

SESSION III: Mathematical Computational and Atmospheric Sciences

- Advanced research in machine learning, game theory, and optimization: Dr. Shivani Agarwal (Indian Institute of Science, Bangalore)
- Advanced modelling of tropical land-atmosphere-ocean system: Dr. Sundararaman. G. Gopalakrishnan (National Oceanic and Atmospheric Administration, Miami) and Prof. U.C. Mohanty (Centre for Atmospheric Sciences, Indian Institute of Technology- Bhubaneshwar)

SESSION IV: Engineering Sciences

- Elasto-hydrodynamic lubrication studies: Dr. Gananath D. Thakre (Indian Institute of Petroleum, Dehradun)
- Fire center for advancing research and education in structural fire engineering: Prof. S. K. Bhattacharyya (Central Building Research Institute, Roorkee)

SESSION V: Astronomy and Astrophysics

- Astronomical object and feature characterization and classification: Prof. Ajit Kembhavi (Inter-University Centre for Astronomy and Astrophysics, Pune) and Dr. Ashish Mahabal (California Institute of Technology, Pasadena)
- Analysis of variable star data: Dr. H. P. Singh (University of Delhi, New Delhi) and Dr. Shashi M. Kanbur (State University of New York at Oswego)

The Workshop enabled the PIs to share their thoughts, research and experiences with the funding agency, program administrators and fellow Joint Centers PIs and was a successful networking opportunity for all. The participants unanimously commended the dynamic exchange facilitated by the Joint Networked Centers and its ability to nurture collaborative research, value addition and long-term relationships between the scientific community in India and the United States.

Advanced Materials Research

Principal Investigators

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Partnering Institutions

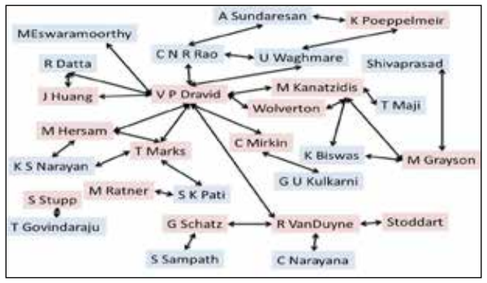
India

- **Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore**
- **Indian Institute of Science, Bangalore**

USA

- **Northwestern University, Evanston**
- **Argonne National Laboratory, Lemont**

The goal of this Joint Centre is to help build a strategic partnership between India and USA in “Advanced Materials Research” under the DST–IUSSTF Program. The short-term objectives of the Joint Centre are to (a) establish grass-root collaborations and cross institutional bridge, (b) identify and focus on the grand challenge problems with out-of-the-box ideas, and (c) develop initiatives for longer-term sustainable interaction involving global education, training and outreach programs. The proposed research areas of collaboration spanned a broad range of emerging materials critical for advances to the next generation Information Technology (IT), Energy and Environment and Biotechnology, which include Nanomaterials, Soft Matter, Molecular Electronics, Materials for Energy Conversion, Structure-Property Relationships and Computational Materials Science. The project period witnessed enhanced joint activities between JNCASR (and IISc) and Northwestern University with Argonne National Laboratory (ANL) representation. These activities have



positioned the Joint Center for tangible output and scholarly initiatives. The Joint Centre supported the exchange of graduate students (PhD), post-doctoral fellows and faculty members between JNCASR and NU and other partnering institutions. Through exchange visits of faculty members and brain-storming discussions during JNCASR-NU workshops, longer visits of students and postdocs were effectively

Key Faculty Participants

Prof. C N R Rao, JNCASR, Bangalore, INDIA	Prof. Matthew Grayson Northwestern University, USA
Prof. Chad Mirkin Northwestern University, USA	Prof. Chandrabhas Narayana JNCASR, Bangalore
Prof. Kenneth Poeppelmeier Northwestern University, USA	Prof. Tobin Marks Northwestern University, USA
Prof. K S Narayan JNCASR, Bangalore	Prof. K Biswas JNCASR, Bangalore
Prof. S. M. Shivaprasad JNCASR, Bangalore	Prof. George Schatz Northwestern University, USA
Prof. Mark Hersam Northwestern University, USA	Prof. C Narayana JNCASR, Bangalore
Prof. Jiaxing Huang Northwestern University, USA	Prof. A Sundaresan JNCASR, Bangalore
Prof. G U Kulkarni JNCASR, Bangalore	Prof. Richard P. Van Duyne Northwestern University, USA
Prof. Mercouri Kanatzidis Northwestern University, USA	

used to accomplish important milestones of research in the following areas:

- **Materials for Energy and Environment**, covering photovoltaics, hydrogen generation thermoelectrics and gas sensing.
- **2-dimensional Nano-materials** with focus on (a) basic science and characterization of graphene and group VI transition metal chalcogenides, and (b) their use in nanoelectronic devices such as field effect transistors.
- **Molecular Electronics**, covering fast, low power flexible devices based on polymers.
- **Nano-lithography**, covering dip-pen nanolithography, polymer pen lithography, development of better tips, nano-particle superlattices and cantilever-free nano-printing and patterning.
- **Interaction of nano-particles and graphene with biomolecules.**
- **Chemistry of Materials**, covering non-centro-symmetric oxyfluorides.

SCOPE OF ACTIVITIES

Theme 1: Materials for Energy and Environment
Faculty Participants: Jiaxing Huang, T. J. Marks, K. S. Narayan, K. Biswas, C. Wolverton, V. P. Dravid, M. G. Kanatzidis, David N. Seidman, U. V. Waghmare, C. N. R. Rao.

Exchange Visits during 2014:

S.No.	Name and Affiliation	Institute visited	Duration
1	**Ramakrishna Matte** *(Postdoc) JNCASR*	Northwestern University	March 10, 2013 – March 9, 2014
2	**K.S.Subrahmanyam** *(Postdoc) JNCASR*	Northwestern University	March 30, 2013 – March 26, 2014

Theme 2: 2-dimensional Nano-materials
Faculty Participants: Jiaxing Huang, C. N. R. Rao, V. P. Dravid, U. V. Waghmare, M. Eswaramoorthy, M. Grayson, M.C. Hersham

Theme 3: Molecular Electronics,
Faculty participants: T. J. Marks, K. S. Narayan, M.C. Hersham

Theme 4: Nano-lithography
Faculty Participants: G. U. Kulkarni, C. A. Mirkin

Theme 5: Interaction of nano-particles and graphene with biomolecules
Faculty Participants: C. A. Mirkin, Mrinmoy De, V. P. Dravid

Theme 6: Chemistry of Materials
Faculty participants: C N R Rao, George C. Schatz, V. P. Dravid, Richard P. Van Duyne, J. Fraser Stoddart, K. R. Poeppelmeier, U. V. Waghmare

Other activities accomplished under the Joint Center over the past years:

(Workshops/Training Programs/Course delivery)

- JNCASR-Northwestern Univesity Workshop in January 21-22, 2013 (Venue: JNCASR).
- A short course and Indo - US Workshop on "Basics of Nanomaterials and Applications in Energy Conversion, Transport and Storage" (20 – 21 August, 2010, Venue: JNCASR)

Other Significant Accomplishments:

- Kanishka Biswas (trained at NU partly through activities of the Joint Centre) joins the faculty of JNCASR, Bangalore (area: thermoelectrics and other semiconductors).
- D Late (trained at NU through activities of the Joint Centre) joins as a Ramanujan Fellow at NCL, Pune (area: nano-electronics based on 2-D materials).
- M Dey (trained at JNCASR & NU through activities of the Joint Centre) joins the faculty of Inorganic and Physical Chemistry Department of IISc, Bangalore (area Nano-bio).
- JC liaised and brokered collaborative program and access to Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL), TN
- Similar efforts are ongoing for access to and collaborations with ANL-APS/CNM.

Significant collaborative efforts have led to a chapter in a book and a good number (~33) of publications in reputed journals in many areas of current relevance. More than 14 faculty members each from JNCASR and NU worked together in teams of three or more research groups at a time. Three of the junior researcher participants have taken up faculty positions in three different institutions (NCL, IISc and JNCASR) in India. In the course of last four years, both the partner institutions have learnt how to work together efficiently. Researchers from NU and JNCASR have a number of joint projects presently continuing through other funding, and they are keen to plan a stronger and more effective Joint Centre to support their research activity that has involved optimal use of complementary skills from both the institutions.

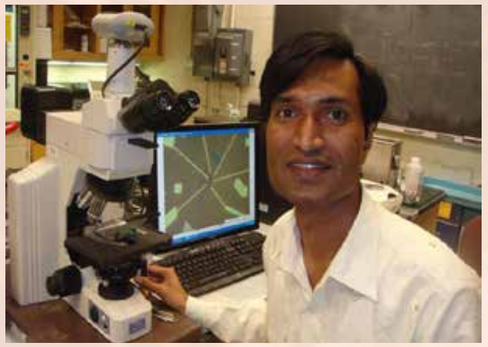
Collaborative Publications

(In total: 33 papers and a chapter in a book have been published so far)

The Publications in the year 2014 are enlisted below:

- Alexander J. Smith, Yung-Huang Chang, Kalyan Raidongia, Tzu-Yin Chen, Jiayan Luo, Lain-Jong Li, and Jiaxing Huang, (2014) *Molybdenum Sulfide Supported on Crumpled Graphene Balls for Electrocatalytic Hydrogen Production.* Advanced Energy Materials, accepted for publication.

- M. Manos, G. S. Papaefstathiou, K. S. Subrahmanyam, C. D. Malliakas, G. S. Armatas and M. Kanatzidis, (2014) *A unique microporous copper-trimesate selenite with high selectivity for CO_2.* CrystEngComm, 16, 3483–3486.
- Deepti Krishnan, Kalyan Raidongia, Jiao-jing Shao, Jiaxing Huang, (2014) *Graphene Oxide Assisted Hydrothermal Carbonization of Carbon Hydrates.* ACS Nano, 8, 449. http://pubs.acs.org/doi/abs/10.1021/nn404805p
- D. J. Late, S. N. Shirodkar, U. V. Waghmare, V. P. Dravid, C. N. R. Rao, (2014) *Thermal Expansion, Anharmonicity and Temperature Dependent Raman Spectra of Single-and Few-layer $MoSe_2$ and WSe_2.* Chem. Phy. Chem. 15: 1592-1598. Website:http://onlinelibrary.wiley.com/doi/10.1002/cphc.201400020/full
- Senanayak, S.P.; Sangwan, V.K.; McMorrow, J.J.; Everaerts, K.; Chen, Z.; Facchetti, A.; Hersham, M.C.; Marks,T.J.; Narayan, K.S. (2014) *Self Assembled Nanodielectrics for Fast-Switching Low-Voltage Polymer Logic Circuits*, (manuscript under review).
- Radha, Boya; Senesi, A.J.; O'Brien, M. N.; Wang, M.; Auyeung, E.; Lee, B.; Mirkin, C. A. (2014) *Reconstitutable Nanoparticle Superlattices*. Nano Letters, 14, 2162-2167, doi: 10.1021/nl500473t.
- O'Brien, M. N.; Boya, Radha; Brown, K. A.; Jones, M. R.; Mirkin, C. A. (2014) *Langmuir Analysis of Nanoparticle Polyvalency in DNA-Mediated Adsorption*. Angew. Chem., submitted.



- Justin P. Wiens, Gilbert M. Nathanson, William A. Alexander, Timothy K. Minton, Lakshmi Sankaran, George C. Schatz. *Collisions of sodium atoms with liquid glycerol: insights into solvation and ionization,* J. Am. Chem. Soc. 136, 3065-74 (2014). DOI:10.1021/ja4106144.
- A K Mishra, M R Marvel, K R Poeppelmeier and UV Waghmare, (2014) *Competing Cation-Anion Interactions and Noncentrosymmetry in Metal Oxide-Fluorides: A First-Principles Theoretical Study.* Crystal Growth & Design 14, 131.

Book Chapter

- Graphene Oxide: New Insight into an Old Material. Kalyan Raidongia, Alvin Tan, Jiaxing Huang in "Carbon Nanotubes and Graphene," 2nd Edition, Elsevier, UK. (Under revision).

Nanomaterials for Energy

Principal Investigators

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Partnering Institutions

India

- **Jawaharlal Nehru Centre for Advance Scientific Research, Bangalore**
- **GE India Technology Centre, Bangalore**

USA

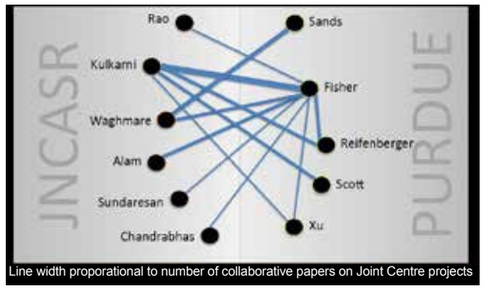
- **Purdue University, West Lafayette**

The objectives of the joint center are:

- Development of a new cohort of globally engaged researchers in nanotechnology and energy with appreciation for diverse professional and international cultures.
- Creation of joint research programs of both academic-academic and industry-academic types leading to new discoveries at the interface between nanotechnology and energy.
- Enhancement of collaborative use of cyber infrastructure research and educational resources such as nanoHUB.org and thermalHUB.org. These resources will support global collaborations through the use of web-based computational tools, online lectures/tutorials, collaborative user/project groups, and material databases.
- Organization and hosting of summer schools and related tutorial materials offered annually to attract strong participation from industrial and academic participants.
- Strengthening of links between academics and global technology companies with R&D centers in the US and India.

Work Plan/Methodology

- Information to be made available on the web and also through personal interactions to all possible applicants from JNC/ICMS, Purdue and GE.
- Based on the discussions among the PIs and the Co-PIs involving colleagues from both sides, the suitability of a prospective visitor is evaluated and the concerned is invited.
- After scrutinizing the work proposal and obtaining



Line width proporational to number of collaborative papers on Joint Centre projects

concurrence from the host, a bilateral or a trilateral exchange visit is formally approved by the PIs.

- The joint Centre members also assist in logistics related to visa, travel and stay. Usually, the exchanges produce publication(s) based on the joint work carried out. This serves as a report of the visit.

Achievements

Topics of collaborative research include:

Metal-semiconductor superlattice thermoelectrics

To understand the microscopic aspects of ScN, ZrN, and HfN relevant to the thermoelectric properties of nitride metal/semiconductor superlattices, the electronic structure was determined, vibrational spectra and thermal properties using first-principles calculations based on density functional theory with a generalized gradient approximation of the exchange correlation energy. There had been found a large energy gap in the phonon dispersions of metallic ZrN and HfN, but a gapless phonon spectrum for ScN spanning the same energy range, this suggests that a reduced thermal conductivity, suitable for thermoelectric applications, should arise in superlattices made with ScN and ZrN or ScN and HfN. To obtain an electronic energy band gap of ScN comparable to experiment, a Hubbard correction with a parameter U (=3.5 eV) was used.

Exfoliated graphite/graphene materials for enhanced interfacial transport

There is a catalyst-free synthesis of cantilevered carbon nanosheet extensions, or petals, from graphite fibers by microwave plasma CVD. Results reveal that the petals grow from the fiber surface layers while preserving graphitic continuity from fiber to the petals. Subtraction of Raman signatures from pristine and decorated fibers reveals a convolution of two underlying peaks at 2687 and 2727 cm^{-1} that are consistent with profiles of multilayer graphene flakes between 5 and 25 layers. Such structures offer the possibility of minimizing interfacial losses in transport applications, improved interactions with surrounding matrix materials in composites, and a route toward substrate independence for device applications.

Liquid nanosolder for electrical contacts and thermal interfaces

An easy and elegant method of CNT nanocircuit fabrication using a metal organic precursor of Pd, namely, Pd hexadecanethiolate, is presented. This precursor directs the self-assembly of individual CNTs spanning a gap between Au electrodes. This is achieved by first, patterning the precursor along the edges or the gap electrodes, as it enables direct patterning by e beam. Further, thermal activation of the precursor at 250 degrees C leads to metallization and the ohmic electrical contact between the CNTs and the electrodes beneath. A resistive fuse action of the soldered CNTs is observed as well.

Integration of carbon nanotubes for solar, thermal and lighting applications

Interaction of single-walled carbon nanotubes with electron-donor and -acceptor molecules causes significant changes in the electronic and Raman spectra. Electron-donating molecules such as tetrathiafulvalene and aniline cause changes opposite to those caused by electron-withdrawing molecules such as nitrobenzene and tetracyanoethylene. Thus, a proportion of the semiconducting SWNTs become metallic on electron donation through molecular charge transfer. Electrical resistivity measurements reveal a systematic variation with electron-donating or -withdrawing power of the interacting molecules.

Solid-state hydrogen storage

Cyclic strain caused by addition and depletion of hydrogen in metal hydride beds results in brittle fracture and subsequent formation of micron-sized, faceted particles which inhibits hydride formation because of poor inter-particle heat conduction that increases the bed's temperature during exothermic hydriding reactions. This work involves the development of a model for generating loose configurations of metal hydride powder and for assessing the commensurate quasi-static loading characteristics. Triaxial strain is applied to simulate evolution of the solid fraction, coordination number, force network connectivity, and internal pressure as consolidation occurs in the absence of interparticle friction. These modeling elements form the mechanical basis of a model that will ultimately predict the thermo-mechanical behavior of metal hydride powders and compacts.

Behavior of Attolitre water droplets

Working with a biased atomic force microscope (AFM) tip in the tapping mode under ambient atmosphere, attoliter (10-18 L) water droplet patterns have been generated on a patterned carbonaceous surface.

Au Nanoparticle-PDMS Composites

A simple, green synthesis technique for preparing Au nanoparticle-PDMS composites is described. The solid solution nature of the PDMS combined with the surface properties of the nanoparticles imparts unique properties to this composite. We demonstrate the utility of this material for water purification and for chemically-triggered storage and release of compounds toward-drug delivery applications.

Other activities accomplished under the Joint Center during 2014-2015:

(Workshops/Training Programs/Course delivery)

- Joint Networked Centre on Nanomaterials for Energy (JNCNE) at Purdue University, West Lafayette, IN USA during 17-18 September 2014.
- JNC-Purdue Workshop during March 2015, JNCASR, India.

Publications

- Smith, KC; Srivastava, I; Fisher, TS; Alam, M. (2014) *Variable-cell method for stress-controlled jamming of athermal, frictionless grains*. Physical Review E, 89, 4: 042203 (DOI: 10.1103/PhysRevE.89.042203)
- Gupta, R; Reifenberger, RG; Kulkarni, GU (2014) *Cell-phone Camera Imaging of a Periodically Patterned Chip as a Potential Method for Point-of-Care Diagnostics*. ACS Applied Materials & Interfaces, 6, 6: 3923-3929 (DOI: 10.1021/am4050426)

Exchange Visits

Sl.No.	Name and Affiliation	Institute Visited	Duration of Stay
Students Visits			
1	**Sridhar Sadasivam** *Purdue University*	JNCASR	Jan 07 – June 09, 2014
2	**Soumik Siddhanta** *JNCASR*	Purdue University	July 15 – Dec 15, 2014
Faculty Visits			
1	**Arvind Raman** *Purdue University*	JNCASR	06-11 January 2014
2	**Peter Bermel** *Purdue University*	JNCASR	07-13 January 2014
3	**Kaushik Roy** *Purdue University*	JNCASR	08-12 January 2014
4	**Graham Cooks** *Purdue University*	JNCASR	08-14 January 2014
5	**G.U. Kulkarni** *JNCASR*	Purdue University	18-22 July 2014

Advanced Research in Machine Learning, Game Theory, and Optimization

Principal Investigators

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Partnering Institutions

India

- **Indian Institute of Science, Bangalore**
- **Microsoft Research India, Bangalore**

USA

- **Harvard University, Cambridge**
- **Carnegie Mellon University, Pittsburgh**
- **Massachusetts Institute of Technology, Boston**

In today's knowledge economy, leadership positions will be occupied by countries that can parse the deluge of data that is being generated in almost every field and can transform this data into meaningful scientific conclusions. Machine learning, game theory, and optimization are three fields that are critical for analyzing and understanding large-scale data and complex systems. While each field has been studied and developed separately over the last several decades, the future lies at the intersection of these three fields, hence creating an urgent need to develop capacity at the interface. To this end, this Indo-US joint center brings together core strengths in the fields of machine learning, game theory and optimization at IISc, Microsoft Research India, Harvard, MIT, and Carnegie Mellon University in order to facilitate the highest quality research at the interface of these disciplines, and to help define the techniques that will be used to analyze data in the future. Team anticipates that in the longer term, the joint center will also help to establish stronger ties between Indian and US institutions in the mathematical and engineering sciences.

The objective of the joint centers is to facilitate high quality research at the interface of machine learning, game theory and optimization, and to help establish long-term collaborations between Indian and US institutions in these disciplines.

Achievements

- Training and mentoring of several research students.
- Several high-impact publications.
- Organized Indo-US Lectures Week in Machine Learning, Game Theory and Optimization at IISc, Bangalore in January 2014; all lecture materials publicly available online at http://drona.csa.iisc.ernet.in/~indous/activities.html.

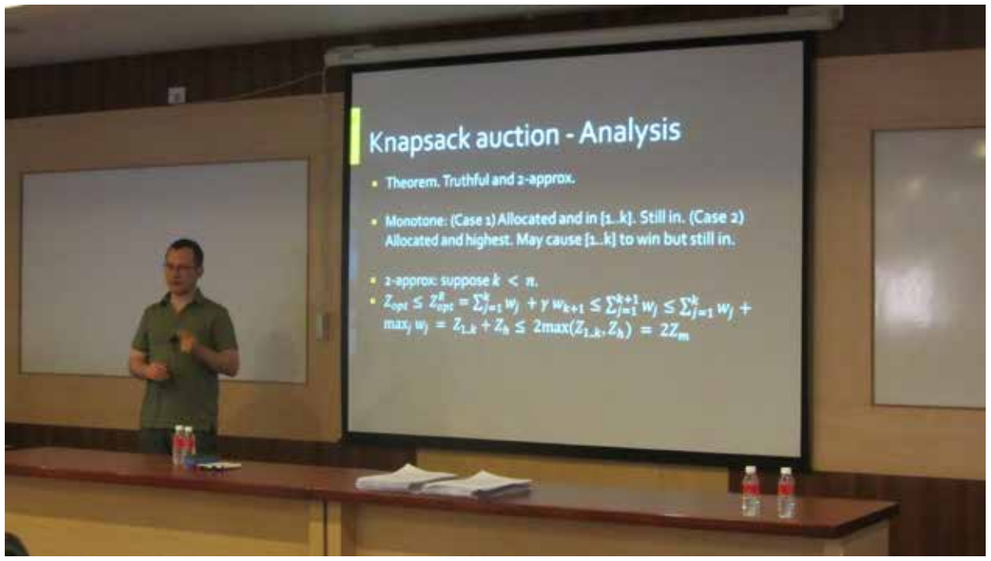
Exchange Visits during the year 2014:

S.No.	Name and Affiliation	Institute visited	Duration
1	**David Parkes** Harvard University	IISc, Bangalore	Jan 2014
2	**Devavrat Shah** MIT	IISc, Bangalore	Jan 2014
3	**Avrim Blum** CMU	IISc, Bangalore	Jan 2014
4	**John Santerre** University of Chicago	IISc, Bangalore	Jan 2014
5	**Bo Waggoner** Harvard University	IISc, Bangalore	Jan 2014
6	**Jasper Snoek** Harvard University	IISc, Bangalore	Jan 2014
7	**Alex Kulesza** University of Michigan	IISc, Bangalore	Jan 2014
8	**Shivani Agarwal** IISc, Bangalore	Harvard University	March 2014
9	**Shivani Agarwal** IISc, Bangalore	Harvard University	May 31 - July 26, 2014
10	**Harikrishna Narasimhan** IISc	Harvard University	Sep 1 - Dec 7, 2014
11	**Shivani Agarwal** IISc, Bangalore	Harvard University	Sep 6 - Dec 27, 2014

- Continuing joint interactions and upcoming publications.
- Following interactions facilitated by the Joint Centre, some of the PIs together with their current and former PhD students/postdocs (namely Shivani Agarwal, David Parkes, Devavrat Shah, Hossein Azari, Guy Bresler, Sewoong Oh and Arun Rajkumar) jointly organized a NIPS 2014 Workshop titled `Analysis of Rank Data: Confluence of Social Choice, Operations Research, and Machine Learning' at the prestigious Neural Information Processing Systems (NIPS) 2014 conference in Montreal, Canada in December 2014.

Publications in the year 2014:

- Harish G. Ramaswamy and Shivani Agarwal. Convex calibration dimension for multiclass loss matrices. In submission, 2014.
- Harikrishna Narasimhan, Rohit Vaish and Shivani Agarwal. On the statistical consistency of plug-in classifiers for non-decomposable performance measures. In *Advances in Neural Information Processing Systems* (NIPS), 2014.
- Arun Rajkumar and Shivani Agarwal. Online decision-making in general combinatorial spaces. In *Advances in Neural Information Processing Systems* (NIPS), 2014.
- Shivani Agarwal. Surrogate regret bounds for bipartite ranking via strongly proper losses. *Journal of Machine Learning Research*, 15:1653-1674, 2014.
- Harish G. Ramaswamy, Balaji S. Babu, Shivani Agarwal and Robert C. Williamson. On the consistency of output code based learning algorithms for multiclass learning problems. In *Proceedings of the 27th Annual Conference on Learning Theory* (COLT), 2014.
- Arun Rajkumar and Shivani Agarwal. A statistical convergence perspective of algorithms for rank aggregation from pairwise data. In *Proceedings of the 31st International Conference on Machine Learning* (ICML), 2014.
- Hossein Azari Soufiani, David Parkes, and Lirong Xia. Computing Parametric Ranking Models via Rank-Breaking. In *Proceedings of the 31st International Conference on Machine Learning* (ICML), 2014.
- Hossein Azari Soufiani, Denis J. Charles, David M. Chickering, and David C. Parkes. Approximating the Shapley Value via Multi-Issue Decomposition. In *Proceedings of the 13th International Conference on Automonous Agents and Multiagent Systems* (AAMAS), 2014.



❖ Avrim Blum, Nika Haghtalab, and Ariel Procaccia. Lazy Defenders are Almost Optimal against Diligent Attackers. In *Proceedings of the 28th AAAI Conference on Artificial Intelligence* (AAAI), 2014.

❖ Emmanouil A. Platanios, Avrim Blum, and Tom Mitchell. Estimating Accuracy from Unlabeled Data. In *Uncertainty in Artificial Intelligence* (UAI), 2014.

Fire Center for Advancing Research and Education in Structural Fire Engineering

Principal Investigators

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Partnering Institutions

India

- **Central Building Research Institute, Roorkee, India**
- **Indian Institute of Technology, Delhi**

USA

- **Michigan State University East Lansing, USA**
- **University of Texas, Austin**

Michigan State University in collaboration with University of Texas at Austin, CSIR-Central Building Research Institute, Roorkee and Indian Institute of Technology – Delhi, established an "US-India Virtual Fire Center" for enhancing fire safety in built infrastructure. The research teams at these institutions are developing methodologies, design tools and guidelines for performance based structural fire safety design. Under the virtual fire research center, the team will focus on exchanging and sharing research expertise, experimental facilities and test data for improving fire safety in two countries. Specifically, the team will develop engineering guidelines and solutions for overcoming fire problems in

reinforced concrete beams. In addition the proposed center will help in knowledge dissemination among the academia, design professionals and construction industry through seminars and workshops.

The main aim of the “Indo-US Virtual Fire Center” is to establish collaboration among the partnering institutes in US and India for exchange and dissemination of information in fire safety field with respect to fire research, education, training and technology transfer activities in India to improve overall fire safety in built environment. The center will facilitate exchange of students, scientists as faculty amongst partner Institutions.

In order to exchange and disseminate the information in the field of fire safety and the experience gathered during last one year of this project, an exchange meet had been organised during 09 – 10 March 2015 at CSIR-CBRI Roorkee, India. The topic of the meet was “Fire Safety in Buildings: Structural and Passive Fire Protection Issues & Challenges”. The researchers from different Institutes of India and US who are working in the area of Fire Engineering were invited to participate in the meet. Also experts from Industries who are involved in the fire safety issues were invited for effective interactions amongst the researchers and the professionals.

“PROTECT 2015- Fifth International Workshop on Performance, Protection and Strengthening of Structures under Extreme Loading” is planned for June - July, 2015 at Michigan State University, USA. Researchers from Indian Institute of Technology (IIT) Delhi and Central Building Research Institute (CBRI) Roorkee will attend this workshop and will deliver presentations. It is expected that researchers

from across the world will take part in this workshop through contributory research participation.

Work is in progress for the development of a dedicated fire resource website. The basic purpose of the website is to provide information to the users working for the promotion of fire safety in built environment. Accordingly a site-map of the website has been finalised and it will include:

- Details of codes/ standards/ perspectives (adhering to copyright laws and regulations);
- Technical awareness on: analysis/ design procedures and software simulations;
- Test data sharing for possible benchmarking;
- Publications (details, direct links of textbooks, journals, SIF proceedings etc.);
- Up-coming events in the area of structural fire engineering; and
- Suggestions and comments by the visitors.

For the fire performance assessment of structural elements modeling studies will be carried out. For the validation of models required test data is to be generated. Experimental studies have been carried out and the test data has been generated on the fire performance of beams under loading conditions.

To study the fire performance of reinforced concrete (RC) beams under loading conditions, experiments were carried out through a well-designed experimental set-up. The experimental set-up consists of a floor furnace to produce temperature and a reaction frame for applying loads, to which a structural member might be exposed during a fire in practice.

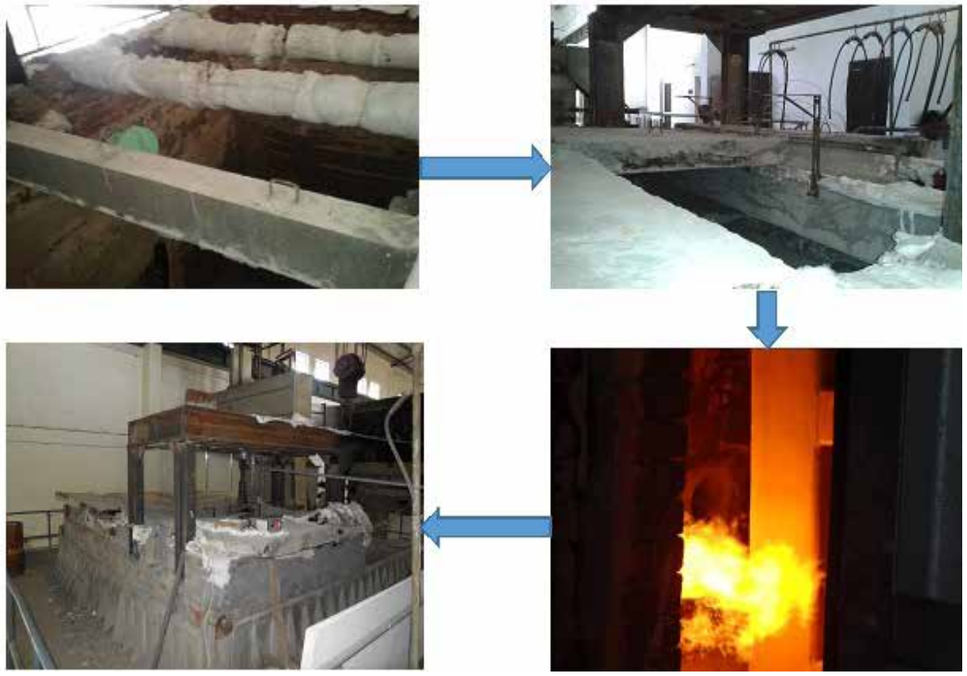
The tests include a series of eight experiments on normal and high strength concrete beams. To study the flexural behaviour of RC beams, two reference specimens of two different grades namely M30 and M60 were tested under two point loadings. The observations were made for the first cracking load, ultimate load and load at permissible deflection.

Further to determine the fire resistance rating, the experiments were carried out by exposing the reinforced concrete beam specimens to standard ISO 834 fire. The beams were preloaded with two point loads to a fixed percentage of ultimate strength at room temperature. After applying the loads on the beams, the beams were exposed to standard heating conditions. During the entire period of fire exposure the predefined load was maintained. The temperature of the furnace as well as that in concrete and rebars and deflection of beams were recorded during fire exposure.

On comparison of the results of normal and high strength concrete beams it was found that the temperature at all locations in high strength concrete beam was higher as compared to normal strength concrete beam during the entire period of fire exposure.

Similarly for the same loading of 15kN during fire exposure, the fire resistance rating of normal strength concrete beam was higher as compared to high strength concrete beam.

To develop high temperature properties of concrete the material property tests are planned. The material properties that may have significant influence on fire resistance and spalling are high temperature thermal and mechanical properties. The specimen of cubes and cylinders are under preparation at CBRI and will be shipped to IIT-D for undertaking property tests.



Exchange Visits

Sl. No	Name and Affiliation	Institute visited	Duration of stay
1.	**Pratik Bhatt** *Research Student, IIT-Delhi*	Michigan State University (MSU)	25th Feb-25th April 2014
2.	**Vasant Matsagar** *IIT Delhi*	Michigan State University (MSU)	1st July-15th July, 2014
3.	**S. K. Bhattacharya** *Director, CSIR-CBRI, Roorkee*	Michigan State University (MSU)	29th September-12th October 2014
4.	**Suvir Singh** *Senior Principal Scientist, CSIR-CBRI, Roorkee*	Michigan State University (MSU)	29th September- 19th October, 2014
5.	**Venkatesh Kodur** *Michigan State University*	IIT, Delhi	July 2014

Advanced Modeling of Tropical Land-Atmosphere-Ocean Systems

Principal Investigators

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Partnering Institutions

India

- **Indian Institute of Technology, Bhuwaneshwar, India**
- **Indian National Centre for Ocean Information Services (INCOIS), Hyderabad**

USA

- **National Oceanic and Atmospheric Administration, Miami, USA**
- **Purdue University, West Lafayette**
- **National Oceanic and Atmospheric Administration (NOAA), Maryland**

The Center addresses the problem of improved forecasts of severe weather events over tropical regions within the Framework for India-U.S. Cooperation on Weather and Climate Forecasting and Agriculture. The aim of the center is to advance the Hurricane Weather Research and Forecasting System to a Regional Tropical Prediction System over India for improved forecasts of high impact weather events.

During the past two-three years, significant progress has been accomplished in the tropical cyclone (TC) track, intensity and structure forecasts under the auspices of and support from the United States (US) National Oceanic and Atmospheric Administration (NOAA)'s Hurricane Forecast Improvement Project (HFIP, Gall et al. 2013). In particular, for the first time, a very high-resolution (3 km) deterministic numerical weather prediction (NWP) model, known as the Hurricane Weather Research and Forecast (HWRF) modeling system, developed as a joint project by the Environmental Modeling Center (EMC) and the Hurricane Research Division (HRD) of NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) and implemented at the National Centers for Environmental Prediction (NCEP), has shown comparable and at times superior TC intensity forecast skills compared to the best performing statistical models. The HWRF model is now paving the way for removing the roadblocks to improvements in the operational TC intensity forecasts, which have had virtually stagnant skill for the last two decades (http://www.emc.ncep.noaa.gov/HWRF/IWTC_VIII/IWTC.html). This modeling system was implemented in operations at the India Meteorological Department under the implementation agreement (IA) between MOES and NOAA. In order to share NOAA's advanced understanding and forecasting techniques acquired in the last few years, an Indo-US workshop on Advanced modeling and data assimilation for tropical cyclone predictions with special reference to the hurricane weather research and forecasting (HWRF) system was organized

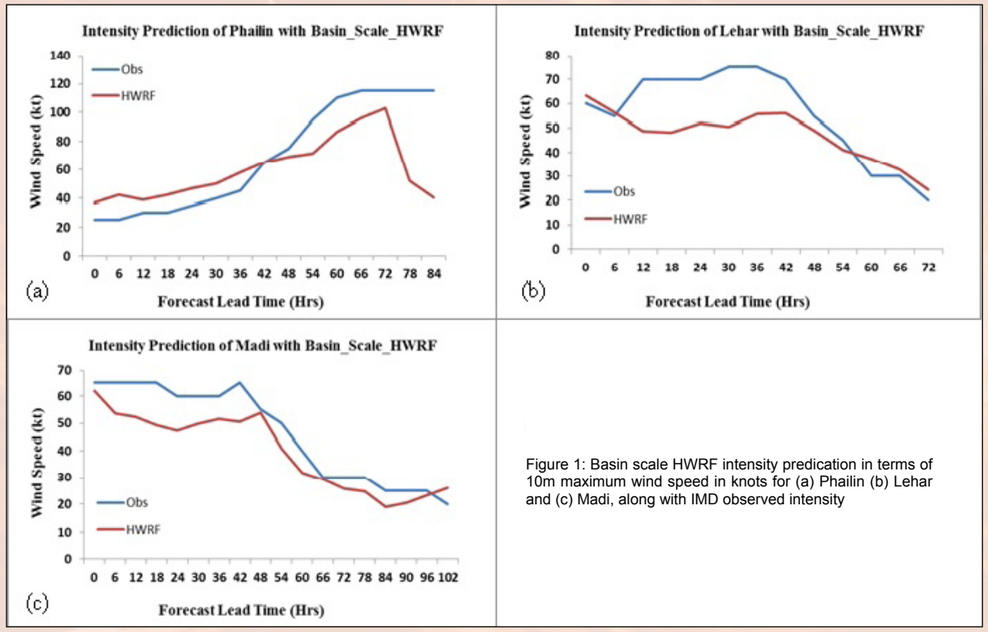

Figure 1: Basin scale HWRF intensity predication in terms of 10m maximum wind speed in knots for (a) Phailin (b) Lehar and (c) Madi, along with IMD observed intensity

by U.C. Mohanty (IIT, Bhubaneswar) and Sundararaman Gopalakrishnan (NOAA). The Indo-US Science & Technology Forum (IUSSTF) provided support to hold a joint workshop in Bhubaneswar, on July 09-14, 2014. This workshop seeded the research effort for advancing HWRF developments in India. In the meanwhile the scientists at HRD have developed a more advanced version of the HWRF. This version, dubbed as the basin scale HWRF, has the potential to be used for forecast applications beyond tropical cyclones. In Indian context, this system will be extended to severe weather forecast applications with a very high potential for research to operations (R2O). Since the IMD is using one version of the HWRF system, it is envisioned the R2O process may be a seamless one.

Achievements

Based on the 2013 version of operational HWRF system, the Hurricane Research Division (HRD) of the Atlantic Oceanographic and Meteorological Laboratory (AOML) with its partners at Environmental Modeling Center (EMC), National Centers for Environmental predictions (NCEP) have developed a basin scale HWRF system that can operate with multiple moving nests spanning at resolution down to 3 km over the Atlantic Ocean. We have configured the same system for North Indian Ocean [outer domain covers Westpac, north Indian Ocean) with the help of US counter partners.

Initial testing and experimental runs have been conducted with the recent very severe cyclonic storms (VSCS), Phailin (Oct' 2013),Lehar (Nov' 2013)and Madi (Dec' 2013) over Bay of Bengal. This model clearly showed overall superiority at longer range forecast (4-5 days) in terms of track, intensity, size and structure. In all the cases, HWRF showed significant improvements in the evolution of intensity (Figure 1). Figure 2a provides wind swath of Phailin demonstrating that the system made landfall with very severe cyclonic storm intensity in advance of 3 days.The rainfall amount and structure is improved significantly, in case of Phailin showing peak rainfalls activity over Northern parts of Odisha as observed (Figure 2b). In case of Lehar, model indicated the dry air incursion into TC environment when the TC started interacting with the land which causes weakening of Lehar

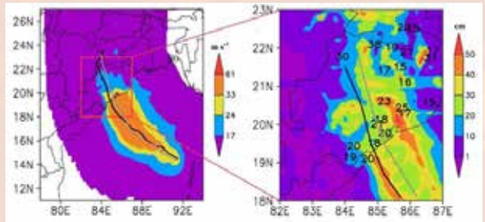

Figure 2: HWRF forecast of (a) 10m maximum wind speed in m s^{-1} and (b) rainfall swath in cm lines represent the JTWC best and HWRF model track respectively. Rainfall swath accumulated over 126 hr of forecast is zoomed over the rectangular region highlighted in (a) and the numbers in (b) represents the IMD station-observed accumulated rainfall for the landfall day (03UTC 12-13 Oct 2013) period.

over the Bay of Bengal itself before making landfall. The rarest track and intensity evolution (maximum intensification to VSCS and dissimilation over the Bay of Bengal without landfall) of Madi was also predicted more accurately.

Scientific value addition

The basin scale HWRF system has scientific capabilities

- To study multi-scale interactions such as large scale – storm scale and storm scale – storm scale.
- As quality of initial conditions (storm intensity, position and structure) are important, this system has state-of-the-art vortex initialization and relocation technique to correct initial intensity, position and structure based on observations.
- Assimilation of environmental and storm scale observations can be done within this system using advanced Hybrid EnKF data assimilation system which provides background error flow.
- Provides guidance much in advance whether the West Pacific/China Sea typhoons are emerging into Bay of Bengal and its movement and intensity.
- Provides sufficient large scale environment at high resolution.

Way forward

- Initial testing is underway to study the sensitivity of updating SST (6hrly) during model integration on model performance.
- Hybrid data assimilation
- Development of customized land surface data assimilation system for Indian region to represent and characteristics (soil moisture and temperature profiles with depth) when a cyclone start interacting with the land for better structure of wind and rainfall during landfall.
- Coupling of ocean model with atmospheric HWRF model for North Indian region

Exchange Visits

Thanks to travel support from Indian Institute of Technology, New Delhi and NASA's jet propulsion lab, two visits, both related to the above effort were completed by Indian scientists in the past 6 months paving a way for future exchange visits under the Indo-US network proposal and accelerated advancement of this project. Prof.U.C. Mohanty visited HRD for 4 days in July, 2014 to discuss strategy related to the future directions for the project and Dr. Krishna Kishore visited HRD for about 2 months to learn the Basin Scale HWRF system. Dr. Kishore has been instrumental in implementing an Indian configuration of the Basin Scale HWRF system.

Publications

Apart from advanced man power generation from the Bhubaneswar workshop, another significant outcome of that workshop was the compilation of lectures that has led to the text book entitled "Advanced Modeling and Data Assimilation Techniques for Tropical Cyclone Predictions over Indian Seas (Editors: Prof. U. C .Mohanty and Sundararaman Gopalakrishnan)" has been reviewed and is under printing.

A couple of manuscripts are under preparation on (i) Impact of advanced vortex initialization and relocation over Bay of Bengal using High resolution HWRF modeling system (ii) Improvements in model predictions with cold and cyclic vortex initialization.

3-D Engineered Electrodes for Electrochemical Energy Storage

Principal Investigators

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Partnering Institutions

India

- **CSIR-Central Electrochemical Research Institute (CSIR-CECRI), Karaikudi**
- **Indian Institute of Science Education & Research, Thiruvananthapuram**
- **Indian Institute of Science, Bangalore**

USA

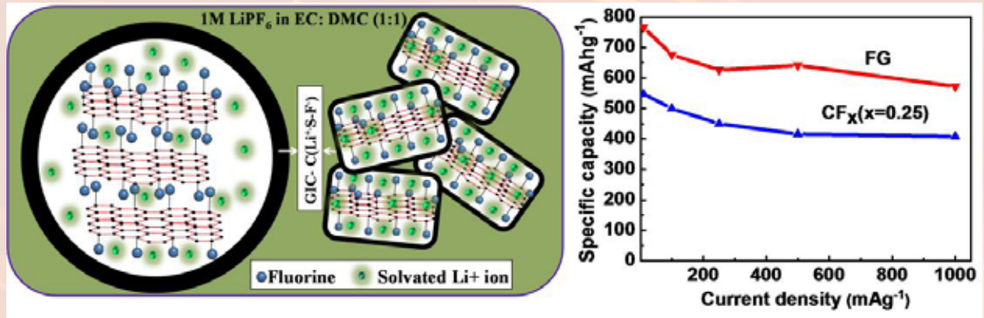
- **Rice University, Houston, USA**
- **University of Houston, Houston**
- **Southern Illinois University Carbondale**

The objective of the center is to carry out cutting edge collaborative research between the partners on innovative ideas to design and build 3-D architectures using various nanostructures (including graphene, carbon nanotubes, polymers, metal oxide nanowires/clusters etc.) in order to incorporate them as active electrode components in electrochemical energy storage devices. Specific research goals to be met by the center are:

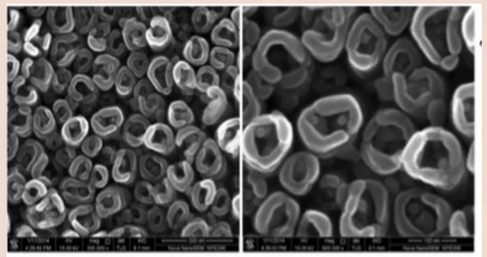
- Development of conformal and space filling methods for fabricating 3-D engineered architectures for thin film batteries and supercapacitors.
- Characterization of resulting devices in terms of their microstructures with particular reference to their electrode-electrolyte interfaces.
- Investigation of Electrochemical performance of these devices, analysis and understanding the underlying physical phenomena of the hybrid configuration of the devices.
- Model/simulate optimized hybrid nanostructures for improved electrochemical energy storage.
- Explore new configurations/designs for these devices to obtain vastly improved performances.
- Obtain easily integrated designs to build hybrid devices between storage formats based on battery and supercapacitors.

Achievements

- **Fluorinated graphene based high performance electrodes for primary lithium battery**: Although rechargeable Li ion batteries have become the dominant power source for portable electronics applications, primary batteries are still used in applications like military and defense tools, and medical implants. We have demonstrated a single-step strategy capable of improving specific capacity, power density and faradic yield of a Li/CF_x battery system using fluorinated graphene. The excellent electrochemical performance achieved using fluorinated graphene with a very low fluorine content (x = 0.22) could lead to the development of highly efficient primary battery systems perhaps with low cost and minimum environmental impact.



- **Synthesis of vertical arrays of TiO_2/$CoFe_2O_4$ hybrid nanowire electrodes for 3-D microbatteries:** We have synthesized vertical arrays of TiO_2/$CoFe_2O_4$ hybrid nanowires using a combination of electrochemical anodization and hydrothermal techniques. These hybrid nanowires are being tested for their electrochemical performance as efficient anodes for 3-dimensional microbattery applications.



- **Electrical transport studies on disordered reduced graphene oxide:** A collaborative research between Central Electro Chemical Research Institute (CECRI) and Southern Illinois University Carbondale (SIUC) has been conducted on the development of stable conductive inks of reduced graphene oxide and their electrical transport properties. This was primarily a fundamental study with an aim for the use of these inks in electrochemical devices after patterning them over substrates. This work has been reported in the journal 2D Materials.

Way Forward

Research activities in the area of 3D nanoarchitectures are being carried out for their application as efficient electrodes in energy storage devices such as electrochemical supercapacitors and rechargeable batteries. Some of the on-going and future works are summarized below:

- Development of 3-D scaffolds of graphene based nanostructures for supercapacitor applications.
- Various morphologies of 2-dimensional layered nanocrystals (MoS_2, WS_2 and their hybrids) are being synthesized using different approaches (Chemical vapor deposition, liquid phase exfoliation) and it will be interesting to study the lithium diffusion in these nanostructured materials.
- 3-dimensional nanoarchitectures using different metal oxide/polymer will be fabricated using template approach and their electrochemical performance will be studied using cyclic voltammetry, Galvanostatic charge-discharge and electrochemical impedance spectroscopy.
- In addition to the electrochemical measurements, temperature dependent electrical transport studies will be carried out in detail for these materials.
- Theoretical modeling of different materials and electrode designs are being performed with a focus on the electrode/electrolyte interface.
- Planned to organize an international workshop on ‘Advanced Electrode Materials for Electrochemical Energy Storage’ under the auspices of the joint R&D virtual center, in 2015.

Under the auspices of Indo-US joint R&D Network Center on '3D Engineered Electrodes for Electrochemical Energy Storage', an Indo-US workshop on "Engineered Electrodes for Electrochemical Energy Storage" has been organized during April 3-4, 2014, at Chennai. The workshop was aimed at bringing the experts in electrochemical energy storage devices, from both the countries, particularly those who work in the novel aspects of electrode materials, to a common platform and to discuss their views in novel designs and materials for electrochemical energy storage applications.

In addition to the invited talks from experts, there were oral and poster presentations by young scientists as well as Ph.D. students related to a variety of energy related issues. There were 15 invited talks by experts from India and USA, 6 short talks by Ph.D students and about 30 poster presentations. The workshop was well balanced with discussions on both experimental and theoretical aspects of the topic. Three best poster prizes and one best oral presentation prize have been awarded to the students during the concluding session. From various feedbacks expressed by the participants, the workshop is believed to be well received and very successful. All the participants, especially the students and young researchers have been benefitted and were well exposed to several new directions in the materials science and electrochemistry of 3D engineered electrodes for energy storage.

Exchange visits

The Indo-US center has undertaken exchange visits of graduate students and PIs across the partnering institutes in the last one year, as detailed below. The short stay undertaken by the students in different institutes has been very fruitful in terms of newer ideas and exposure.

Sl. No	Name and Affiliation	Institute visited	Duration of stay
1.	**P. M. Ajayan** (US-PI) *Rice University, Houston, USA*	- CECRI, Karaikudi - IISER Thiruvananthapuram	1 week
2.	**Saikat Talapatra** (US-PI) *SIUC, USA*	- IISER Thiruvananthapuram	1 week
3.	**M. M. Shaijumon** (Indian-PI) *IISER Thiruvananthapuram*	- Rice University, USA	2 weeks
4.	**Abhishek K. Singh** (Indian-PI) *IISc Bangalore*	- Rice University, USA	2 weeks
5.	**Sujoy Ghosh** (US-student) *SIUC, USA*	- CECRI, Karaikudi - IISER Thiruvananthapuram	1 month
6.	**Mohamed Kabbani** (US-student) *Rice University, Houston, USA*	- IISER Thiruvananthapuram	1 month
7.	**Soumya Vinod** (US-student) *Rice University, Houston, USA*	- IISER Thiruvananthapuram	1.5 months
8.	**Dijo Damien** (Indian-student) *IISER Thiruvananthapuram*	- Rice University, USA - SIUC, USA	1.5 months
9.	**Deya Das** (Indian-student) *IISc Bangalore*	- Rice University, USA	1.5 months
10.	**Sumana Kundu** (Indian-student) *CECRI, Karaikudi*	- Rice University, USA - SIUC, USA	1.5 months

Publications

1. Muchharla B., Narayanan T. N., Balakrishnan K., Ajayan P. M. and Talapatra S. (2014) *Temperature dependent electrical transport of reduced graphene oxide.* 2D Mater 1: 011008
2. Vinod S., Tiwary C. S., Autreto P. A., Tijerina J. T., Ozden S., Chipara A. C., Vajtai R., Galvao D. S., Narayanan T. N. and Ajayan P. M. (2014) *Low-desnity 3-dimensional foam using self-reinforced hybrid 2-dimensional atomic layers Nat. Commun* 10: 1038/ncomms5541
3. Jaison M.J., Vikram K., Narayanan T. N., and Vijaymohanan K. Pillai (2014) *Electric Field Induced Transformation of Carbon nanotube to Graphene Nanoribbons Using Solid Polymer Electrolyte.* Appl. Phys. Lett. 104: 153111.
4. D. Gopalakrishnan, D. Damien, B. Li, H. Gullappalli, Vijayamohanan K. Pillai, P. M. Ajayan and M. M. Shaijumon (2015) *Electrochemical synthesis of Luminescent MoS2 Quantum Dots.* Chem. Commun., DOI:10.1039/C4CC09826A

Elastohydrodynamic Lubrication Studies

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Partnering Institutions

India

- **Indian Institute of Technology, Roorkee, India**
- **CSIR - Indian Institute of Petroleum, Dehradun**

USA

- **Northwestern University, Evanston, USA**
- **University of Akron, Akron**

Elastohydrodynamic lubrication (EHL) is a common phenomena occurring within the non-conformal contacts of bearings, gears, cam-follower, valves etc. These tribological components are very critical and are of significant importance in the functioning of the elite mechanical systems. However, even after appropriate maintenance practices, these components fail unwarrantedly leading to severe loses. Hence, the IUSSTF funded Joint Centre on Elastohydrodynamic Lubrication envisages understanding the untouched domains of EHL and developing perspective methodology to understand the failure phenomenon in the elastohydrodynamic lubricated contacts.

The Joint centre established in 2013 in collaboration/ participation between IIT – Roorkee, CSIR – IIP Dehradun, Northwestern University and University of Akron has grown one year old. During the one year span significant achievements has been attained by the centre in terms of gaining new knowledge pertaining to EHL and also strengthening and augmenting the strengths of the partnering institutions.

Achievements

- A generalized mathematical model for one-dimensional EHL line contacts has been developed using the Finite Difference and Discontinuous Galerkin techniques. The generalized EHL line contact model represents the contact geometry in roller bearings, gears, cam-followers etc.
- The initial smooth surface EHL line contact model was upgraded to the rough surface EHL line contact lubricated with non-Newtonian lubricants. The surface roughness in the model has been incorporated using stochastic and deterministic approaches as shown in figure 1. The non-Newtonian rheology of the lubricants is represented by Power-law lubricants.
- The model provides the film thickness distribution and the contact pressures within the contact under different operating conditions. The generalized operating parameters viz. Load, Speed and Material property forms the input to the model. Figure 2 shows the film thickness and pressure distribution within the contact for a shear thinning fluid.

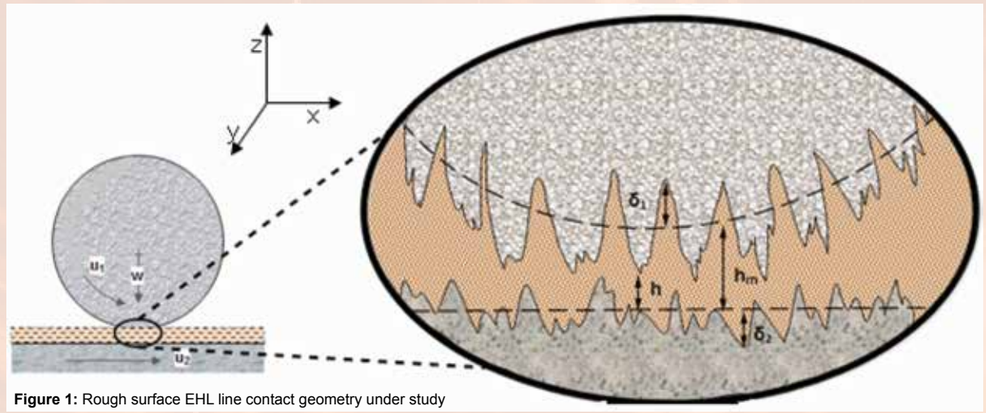


Figure 1: Rough surface EHL line contact geometry under study

The study undertaken has revealed that the speed, material parameter and the power law index have significant influence on the performance of the EHL contact as these parameters significantly influences the fluid film thickness. The sample results of this study are given in figure 3.

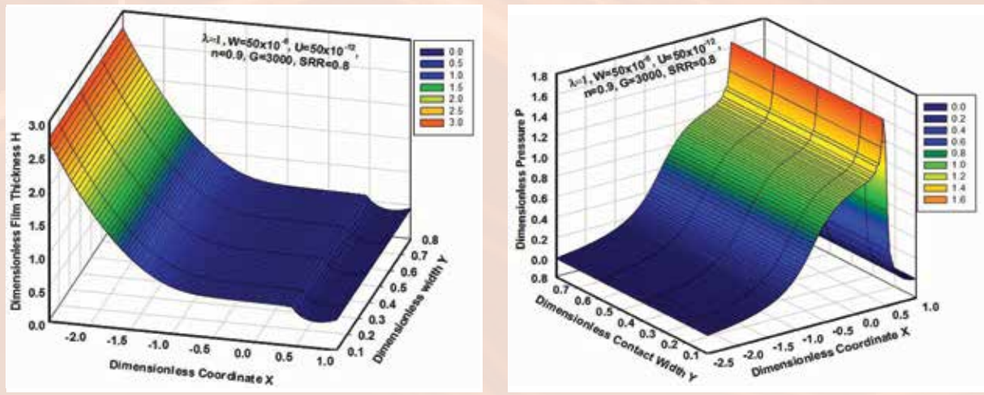


Figure 2: The film thickness and pressure distribution for ($W=50x10^{-6}$, $U=50x10^{-12}$, G=3000, SRR=0.8)

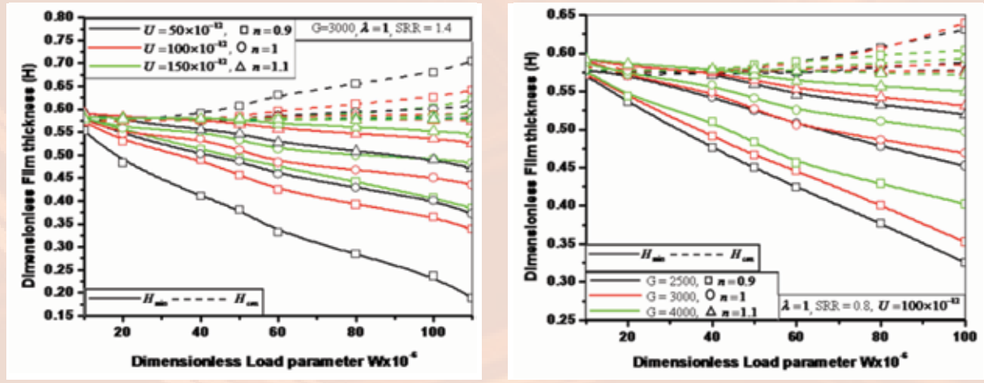
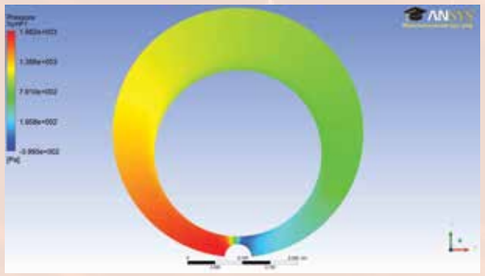


Figure 3: Influence of dimensionless load on the central and minimum film thickness at different (a) Speed parameter and (b) Material parameter



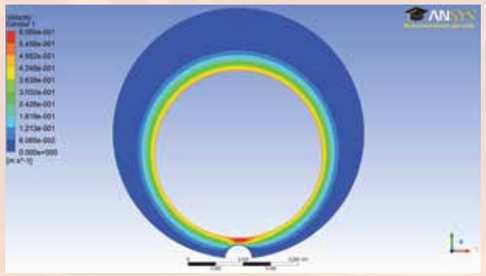


Figure 4: Pressure & Velocity distribution for Power law index n=0.8

- A CFX based model has been developed for a bump shaped asperity in an EHL contact. The contact pressure and the deformations have been investigated. The non-Newtonian rheology of lubricant has been employed using the Power Law concept. Figure 4 shows the results on the pressure distribution and velocity profile of the contact under investigation.

- During the first year of the Joint center the research team from India visited the Northwestern University and University of Akron. During the visit the researchers discussed the plan of work and the future course of action of the center for successful attainment of the deliverables.

Scientific value addition

The outcome of the Joint center in the first year has resulted into development of theoretical model of EHL which has been upgraded to investigate more realistic contact conditions. The CFX approach followed is for the first time in the EHL studies. These studies will be of immense help in design and development of tribo-components and also to understand the failure phenomena associated with these components.

Way forward

The Joint center is determined to bring into more realistic approaches of mechanical systems with the help of theoretical models and experimental validation. As a way forward the activities pertaining to the development of failure models and the incorporation of real surface roughness into the investigation are planned for the second year. Further a joint collaborative workshop in order to disseminate the findings of the center is planned in the second year.

Exchange Visits

Sl. No	Name and Affiliation	Institute visited	Duration of stay
1.	**Satish C. Sharma** *Prof., IIT- Roorkee*	Northwestern University and University of Akron	**15 days**
2.	**S. P. Harsha** *Associate Prof., IIT- Roorkee*	Northwestern University and University of Akron	**15 days**
3.	**G. D. Thakre** *Research Scholar, IIT- Roorkee*	Northwestern University and University of Akron	**45 days**

Publications

- Thakre G. D, Sharma Satish C, Harsha S.P, Tyagi M.R. (2014) *A parametric investigation on the microelastohydrodynamic lubrication of power law fluid lubricated line-contact*. Proc. of IMech E Part J. (Communicated, Under Review).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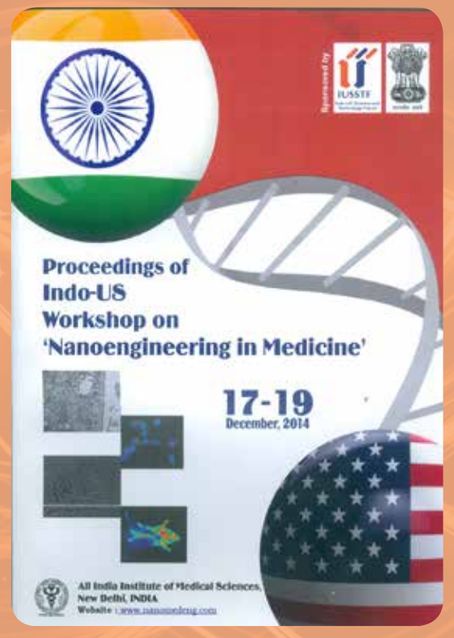
Proceedings of
Indo-US
Workshop on
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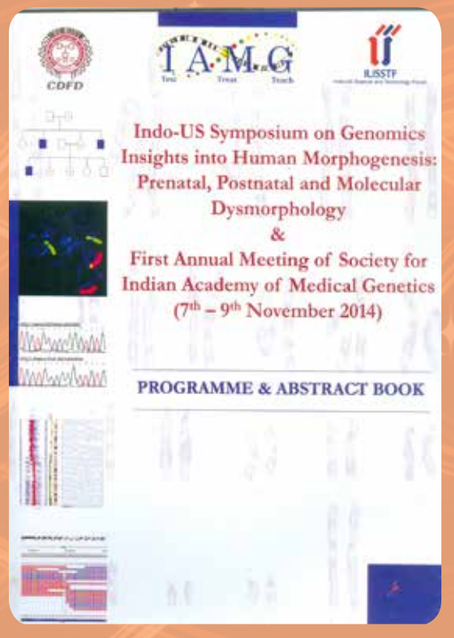
December, 2014
All India Institute of Medical Sciences,
New Delhi, INDIA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Centre for Nano Science and Engineering Building
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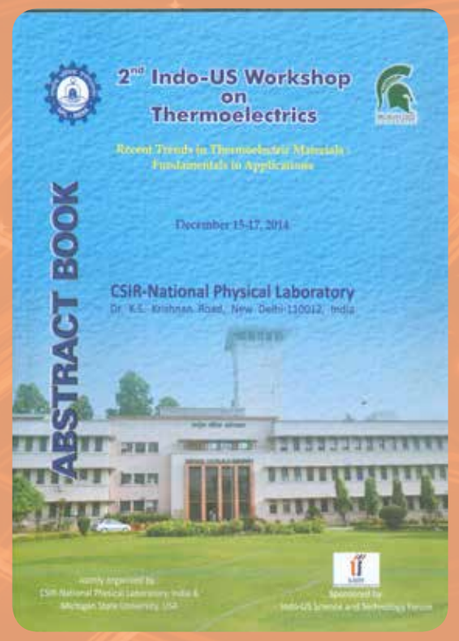
CANEUS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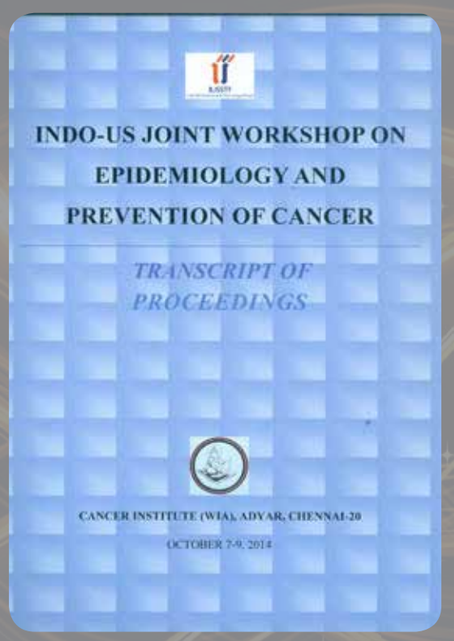
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PROCEEDINGS
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