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Sensing, Communication and Analytics Real-time River Water Quality Monitoring

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Editor-in-Chief Rajiv Kumar Tayal Executive Director, IUSSTF

**Editor** Nishritha Bopana Principal Science Officer, IUSSTF

> Associate Editor Pushpa lyer Program Officer, IUSSTF

**Editorial Consultant** Manoj Dabas

> Layout Design / DTP Pramod Jha

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Cover Photo : Life along the River Ganges at Varanasi, INDIA Source: Shutterstock



# From the **Editor-in-Chief**

As another year comes to an end, it is indeed gratifying to look back at the many accomplishments of IUSSTF in 2018! IUSSTF celebrated its 18th Anniversary earlier this year in the presence of Dr. Harsh Vardhan, Union Minister for Science & Technology, Environment, Forest and Climate Change and Earth Sciences, Govt. of India and Mr. Kenneth Juster, Ambassador of the United States to India. In the course of our 18-year journey, IUSSTF has developed a vibrant program portfolio largely conceived and driven by the scientific and entrepreneurial community from both countries. We can emphatically say that we have been able to fulfil our mandate to promote cooperation between the two great nations and seamlessly bring together the diverse engagements in the U.S.-India collaborative arena in science, technology and innovation to fruition.

Water and Air Quality Monitoring are more important now than it has ever been in the past. In order to deal with this immensely complex challenge in an efficient and effective manner, the Department of Science and Technology, Govt. of India (DST) and Intel® have collaborated to initiate a research program titled "Research Initiative for Real-time River Water and Air Quality Monitoring". The overall objective is to develop tools and constituent blocks that will enable end-to-end water and air quality monitoring systems on smart, networked, lowcost, low-power sensor nodes with large-scale cloud-based data analysis. The program is implemented by IUSSTF and in this issue, we cover the progress of two projects in the water quality monitoring space.

Our program in the Innovation and Entrepreneurship space is growing steadily and we are currently in the process of wrapping up the 9th Call that received an overwhelming response from our stakeholders. In this edition of *Connect*, we cover two of USISTEF's most recent awardees.

Looking ahead, we see an ocean of possibilities for IUSSTF to grow and become increasingly relevant and valuable to the very fabric that binds the scientific enterprises of India and the United States together. On behalf of the Indo-U.S. Science and Technology Forum, I wish all our readers an inspired and productive New Year!

**Rajiv Kumar Tayal** Executive Director, IUSSTF

# Water Sensors for Real-Time River Water Monitoring and Decision Making SENSING THE STREAM

Environmental Engineering Research Institute, Nagpur

#### INDIA

Sandeep Kumar Jha\*, Arun Kumar\*, V. Ramgopal Rao\*, A. K. Gosain\*, A. K. Nema\*, C. T. Dhanya\*, Vamsi Krishna Komarala\*, V. Dutta\*, Subrat Kar\*, B. K. Panigrahi\*, B. R. Mehta\*, V. Perumal\*, Ajit K. Panda, Mrinal Das#, Siba K. Udgata^, Poonam Prasad<sup>s</sup>, Shalini Tandon<sup>s</sup>, Rakesh Kumar<sup>s</sup> \*Indian Institute of Technology Delhi; "National Institute of Science and Technology, Berhampur; 'University of Hyderabad, Hyderabad <sup>s</sup>National

Ashok Mulchandani\*, Bipin Rajendran<sup>s</sup>, Durgamdhab Misra<sup>s</sup>, Joan Rose^, Krishna Saraswat<sup>®</sup> \*University of California Riverside; <sup>§</sup>New Jersey Institute of Technology, Newark; <sup>^</sup>Michigan State University; <sup>§</sup>Stanford University

USA



his project focuses on providing solutions to combat the lack of field-adjusted, low-cost and energy-sufficient sensors for measuring water quality parameters (primarily chemical oxygen demand (COD), microbial indicators, temperature, turbidity and nitrogen content) and water resource-related parameters (water flow rate, elevation, depth, pH etc.).

The Indo-U.S. team aims to achieve this goal using four interconnected work packages (*Figure 1*) that focus on the following research vectors (RV):



water for meeting needs of human settlements all across the world. With emergence of cities/industrial centers along the banks of all rivers, the issue of pollution of river waters has become a major concern for a variety of reasons. Development of strategies for amelioration of pollution of rivers requires real time information on the nature and extent of degradation of water quality. This brings to fore the need to develop sensors that measure water quality parameters that are critical for water-related decision making processes.



The proposed prototype early-warning system will use real-time field data from sensors and modelling for predicting water quality at different locations.

A team of experts from IIT Delhi (India) and University of California Riverside (USA) will work on developing sensors for COD, microbial indicators and water flow (WP1). The choice of COD over conventional biological oxygen demand (BOD) stems from the fact that the water of the River Yamuna is so polluted at certain places that BOD is not a true indicator of the pollutant load. The froth on the water surface emanates from detergents and other organic wastes, which destroy microbial and other flora and fauna in water, including fish and other species. This leads to a cascade of damaging effects, leading to extremely dangerous water quality, unsuitable even for contact with the human body. A monitoring system for such water with provide impetus to decision making on types of purification systems and strategies to be deployed. A team from National Institute of Science and Technology (NIST, India) and New Jersey Institute of Technology (NJIT, USA) shall develop an application-specific integrated circuit (ASIC) chip to collect data from independent sensors (newly developed sensors as well as commercial ones) onto a single board of electronic circuit. The experts involved

in supporting sensor development (WP1) are supported by another team of experts from IIT-Delhi, NIST and Stanford University (USA), who will work on developing energy harvesting systems using solar energy (IIT-Delhi) and piezoharvester-based water flow-based energy (IITD and NIST) (WP2). Information on energy requirements of different sensors and electrical units will be provided to WP2. IIT Delhi and Centre for Materials for Electronics Technology (CMET, Pune, India) teams will work together to develop the sensor system which will be deployed in the field. A group of experts from NIST, University of Hyderabad (India) and IIT-Delhi will collaborate together on field installation of sensors and operational aspects and low-cost wireless networking with LoRa comprising of wake-up radios integrated with low power, long-range radios and mesh networking. (WP3). Further, a team of experts from IITD, National Environmental Engineering Research Institute (NEERI, India) and Michigan State University (MSU, USA) will work on laboratory analysis of field samples and validation of sensor- provided data with data obtained in the laboratory (WP4). Lastly, all experts will be involved in integrating the information for developing the proposed "SensorWarn" system for predicting water quality and quantity using distributed analytics and sense making.

# Sustainable Aquatic Autonomous Observatory **REJUVENATING RIVERS**

INDIA

Bishakh Bhattacharya, Indra S. Sen, Ketan Rajawat and Mangal Kothari Indian Institute of Technology, IIT-Kanpur, INDIA

> Zhaohui Aleck Wang Woods Hole Oceanographic Institution, WHOI, USA

USA

Rivers are the lifelines of human civilizations. India has taken up the task of cleaning and rejuvenating the health of its rivers that have faced considerable degradation in the past decades due to rapid industrialisation and growth of urban centers with inadequate provision for treatment of effluents generated before they are released into streams and rivers. Technologies that help gather, collate and analyze data on a sustained basis are of critical significance in this context.

Subservations of the system as it provides water security to billions of people. In the Indian subcontinent, cleaning and rejuvenating the health of the Ganges river ecosystem is the focal point with some of the major challenges including inadequate skilled manpower, poor time-series resolution, integrated data fusion and ondemand water sampling capacity. The way forward to address these challenges is to develop state-of-the-art

*in-situ* river monitoring observatories that can provide real-time data. Such observatories not only produce high-frequency data that can be used as early warning systems in case of environmental disasters, but also train local operators by making them responsible for the operation and maintenance of the sensing and sampling equipment.

We therefore propose to design and develop low-cost, multi-parameter, water quality monitoring platforms that would consist of array of sensors and an Auto Sampler



A 3D CAD Model of the NSVS to be integrated with Optical and Printed MEMS Sensors

placed on a stationary platform for all-weather, robust, stable and semi-submersible mechanical system. For self-sustenance, the platform will be equipped with different energy harvesting systems. Long-ranged, low -power, Wireless communication technology that can work in open-source ecosystem will be adopted for data communication. At the final phase, a mobile platform will be developed for the inspection of pollution sources from the river tributaries. The project is being implemented by a team of multi-institutional, multi-investigator, international network of river scientists, mechanical, electrical, civil and aeronautical engineers from IIT Kanpur and Woods Hole Oceanographic Institution (WHOI), who are committed in making sustained realtime observations on river ecosystems.

The Autonomous Aquatic Observatory (NSVS) will be deployed in rivers to monitor water quality. The river dynamics is itself varied, with calm and shallow water conditions at different places, to turbid and deep water at other places in the river. Also, the structure is subjected to several wind and water conditions. All these factors are taken into account, when designing the buoy, accounting for its stability in these dynamic conditions.

The buoy structure is designed so as to keep the centre of gravity low. It will help increase the metacentric height and will also increase the maximum angle to which

the body can tilt without capsizing. The buoy structure is also moored at the bottom so as to restrict it to a particular region, without any drift due to the river flow. It will be fitted with Lenz-type Vertical Axis Wind Turbine, to produce usable electrical energy in a generator, and supply power for the sensors deployed in the Autonomous Aquatic Observatory.

One key component of the project is to develop a suite of low-cost and miniaturized *in situ* water quality sensors and an auto-sampler for deployment on the proposed observing platform in river systems. These sensors can make highresolution measurements at real-world conditions underwater, including important water quality parameters of dissolved oxygen (DO; measure how 'breathable' water is for organisms), pH (measure of acidity), conductivity (measure of total ions concentration), total carbon dioxide (CO<sub>2</sub>) (measure of a major greenhouse gas), and dissolved trace metals (toxic to human). The DO sensor is based on the fluorescence quenching method, and is designed and engineered to be small in size (sensing part  $\sim 1$  cm<sup>3</sup>), low power, and deployable underwater. The conductivity sensor is developed from a micromechanoelectrical system (MEMS) for *in situ* measurements of conductivity (salinity), and the sensing part is basically printed on a ~3×3 cm<sup>2</sup> circuit paper, which makes it compact and easy to integrate with other sensing components. Both DO and MEMS sensors are originally designed to be used as 'animal tags' on jellyfish and squids in the ocean. pH sensor consists of a conventional glass type pH sensor, but is engineered to cost only a fraction of commercial pH sensors. A newly developed in situ sensing system, Channelized Optical System II (CHANOS II) by WHOI, will also be integrated into the sensing package for this project. It is designed for *in-situ* high-frequency measurements of total CO<sub>2</sub> and trace metals (e.g. copper) based on spectrophotometric principles.

In addition, an auto-sampler for *in-situ* collecting water samples for *E. coli* and major ions from rivers is





Figures showing the Spectrophotometry based Optical Sensor CHANOS II

being designed which is particularly useful to measure parameters that are currently challenging to measure *in situ*.

Low-power communication technologies form the backbone of any real-time monitoring framework. The ability of the system to provide accurate water quality measurements in real-time with minimal human assistance holds the key to making the approach scalable. We will consider the LoRaWAN protocol for enabling the communication between the sensors and the cloud. Since communication technologies are often powerhungry, standard protocols must generally be tuned to minimize the power consumption. Various components of the protocol are evaluated on the basis of power consumption, and only the options providing the perfect balance between reliability and lifetime are retained. Salient aspects of the LoRaWAN backend include ultralow power authentication and device discovery; optimal rate of transmission for long-range upload; and ultra-low power sleep mode.



LoRaWAN backend

Proposed architecture of the Communication System: LoRaWAN backend







# SCHOLARS PROGRAM



To nurture future innovators and thought leaders, 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 partnered to develop a dynamic and transformative student exchange program between premier institutions in India and the United States. The program is named in honor of *Satyendra Nath Bose* (1894 - 1974), a visionary Indian physicist best known for his work on quantum mechanics in the early 1920s. The class of particles that obey Bose-Einstein statistics, *Bosons*, was named after him.

#### ELIGIBILITY:

- US Citizens/Permanent Residents/ Indian Citizens
- Students pursuing a Bachelor's or Master's degree at an accredited institution of higher education in the United States
- Open to students from all disciplines of Science & Engineering

#### **SCHOLARSHIP INCLUDES:**

- Stipend
- Airfare
- Placement at leading Universities and Research Laboratories in India

#### THE MISSION OF THE PROGRAM IS TO:

- Introduce talented American students to the long-standing tradition of scientific inquiry and innovation in India;
- Encourage students to consider a career in Science and Technology;
- Foster interactions between next generation of pioneers in Science and Technology; and,
- Build long-term R&D linkages and collaborations across disciplines, cultures and geographical boundaries.

#### Submission Deadline: January 15, 2019

For program information contact:

Prof. Aseem Z. Ansari University of Wisconsin Madison Madison, WI 53706 E-mail: azansari@wisc.edu; qnaveeda@winstepforward.org

Dr. Nishritha Bopana Indo-US Science and Technology Forum Fulbright House, 12, Hailey Road New Delhi - 110001 E-mail: bose@indousstf.org

#### www.iusstf.org

For application guidelines, please visit http://iusstf.org/program/for-us-students

### Generating Tissue-Engineered Organs and Controlling Cell Behaviour

# **HEALING TRAUMA**, **REBUILDING LIVES**

Regenerative Medicine research is emerging as a challenging field as it addresses the unique requirement of Defence medical services in the management of combat-related trauma.

The speciality of this field is coupling the unified approaches of various trans-disciplinary research into a single window to meet Defence medical needs.

address this issue, a multiinstitutional network project on "3D **Nanoengineered Constructs to Control** and Pattern Cellular Behaviour" between IIT Kanpur, University of California-Los Angeles (UCLA) and Texas A&M University has recently been funded by the Indo-U.S. Science and Technology Forum.



Raju Kumar Gupta Indian Institute of Technology Kanpur, India



University of California Los Angeles, USA



Ali Khademhosseini Akhilesh K. Gaharwar Texas A&M University College Station, USA

The outcome of this project would certainly be a major achievement and will provide

promising therapeutic options in the field of plastic surgery and wound management in a cost-effective way which shall be highly beneficial for advantageous to countries like India and the United States. The study will not only be helpful to the scientists working on materials science, but also to the researchers working in the biomedical field. A unique electrospinning technique, which allows the production of a large number of organic and inorganic nanofibers scaffolds for repairing tissue with good biocompatibility and conformability will be explored. It is expected that the electrospun nanofiber scaffolds for repairing and regenerating orthopaedic tissue enables the recovery of functional loss along with the capability of mimicking their microstructures, compositions, and mechanical properties.

The current need for an ideal bone substitute is a material that can promote the survival, migration, proliferation and in-situ differentiation of encapsulated human stem cells without the addition of growth factors. In this project, it is aimed to improve the mechanical strength and bioactivity of nanoclay enriched polymeric materials using electrospinning (ES) technique. This technique has advantages towards enhanced control over diameter, composition, structure, alignment, order and porosity as compared to other fabricating methods, that produce fibres. Another advantage is the simplicity of the process that does not require any complicated and expensive equipment and can be easily up scaled for mass productions. ES fibre dimensions and spatial organization resemble the fibrous component of extracellular matrix, making ES a technology to produce morphologically biomimetic scaffolds. Therefore, this kind of scaffolds



Deportunities for RESEARCH INTERNSHIPS IN SCIENCE AND ENGINEERIN India

Indo-US Science and Technology Forum (IUSSTF) announces the **Research Internships in Science and Engineering (RISE)** to provide 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. Objective 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.

#### Internship duration

#### Internship provides

• Monthly stipend • Accommodation • Airfare

#### Eligibility

3 months

- U.S. Citizens or permanent residents and Indian Citizens
- Open to science, engineering, technology and medical disciplines
- Ph.D and Master students currently enrolled at a regionally accredited institution of higher education in U.S.

### US institutions interested in sending students and Indian institutions interested in hosting under the RISE program may contact us.

For program information contact: Indo-US Science and Technology Forum 12 Hailey Road, Fulbright House New Delhi-110 001 internship@indousstf.org

Submission deadlines 31 May 30 November For Application Guidelines & Format WWW.iUSStf.org

> Award announcements 15 July 15 January

## Test4safety: An innovative system to instantly test for adulteration DETECTING ADULTERATION

It is estimated that food fraud (mislabelling, adulteration & counterfeit products) costs the global food industry \$30-\$40 billion annually. The 2015-16 annual report of the Food Safety & Standards Association of India declared that 1 in 5 food samples analysed was adulterated. The problem is not restricted to developing markets alone. In the first four months of 2017, Europol & Interpol seized EUR230 million worth of fake food products. The identification of food fraud and enforcement against offenders is hindered by the high costs and long lead times involved in food testing.



Deepa Bhajekar d technology Pvt. Ltd. Mumbai, INDIA



Deepak Mehrotra Oak Analytics Agoura Hills, USA

he manufacturer's distribution channels are becoming complex and hard to monitor. This allows an easy entry of adulterated products in the pipeline. It is an economically driven crime that is hard to detect and difficult to prosecute. Cooking oil is basis of most food products in our diet. Mixing or substituting healthy oils with contaminants poses long-term health risks to the

consumer. The need of the hour is a low-cost & instant food testing method.

Our solution is based on the discovery of Nobel Laureate Dr CV Raman and identifies materials based on their molecular bonds and structure. Raman spectroscopy is already being used in laboratories all around the world for material identification. Our innovation lies in using patented microoptics technology and semiconductor manufacturing techniques to build a lowcost handheld Raman Spectrometer. This device, "Raman-1" feeds the spectral data to our cloud based Artificial Intelligence based machine learning algorithms for an instant decision. A user-friendly smart phone-based mobile app controls the spectrometer. A webportal that provides user services and detailed spectral details can be used for detailed analysis.

Our first challenge was manufacturing accurate and reliable hardware at low cost. Three years of engineering research



#### U.S.-India Science & Technology Endowment Fund (USISTEF)

samples,

Safety & Standards Authority

and

and development have yielded a pocket sized IOT device at costs level of a smart phone. Although the quantitative accuracy is below complex laboratory equipment, it is a simple to use field device that operates outdoors. Results are available within one minute. The best part of our solution is that testing can be done through the bottle, without opening the packaging.

The second challenge is the development 'golden of signatures'. Our solution is akin

to fingerprint matching. We match the Raman spectra of the tested sample with the verified spectra or 'golden signature' of the product being tested. The spectra of genuine products can vary with time, or change, depending on the properties of the input substances. For example, mustard oil extracted from different variants of mustard seeds are known to have different Raman spectra. Similarly, the ageing of olive oil causes its spectra to change. It is imperative that our system identifies expected variations in the spectra, and lets them pass, while zeroing in on unexpected deviations and raising a flag. Our decision algorithms need to differentiate between intrinsic and extrinsic causes of variation. We



of India and multiple manufacturers to collect spectral data of verified pure samples. We expect that the task of building our database of golden signatures & machine learning algorithms for authentication will take between 3-4 months. While the task is simple for any one type of oil, the sheer variety of edible oils used in the Indian market complicates things. Over the past two months, we have collected over 2000 spectral samples for more than 50 varieties of edible oils. Working with Food Safety Officers, we have started trials in multiple states. In addition to testing for adulteration, we are also testing for Polar compounds that are generated by repeated heating of cooking oil. These polar compounds are extremely

> carcinogenic with grave implications for public health.

We are very grateful to USISTEF for the encouragement and grants to allow us to expedite and deploy our technology. The partnership germinated by USISTEF between Oak Analytics and d technology is a powerful combination of scientific and engineering expertise, deep knowledge of food testing technology, and proven management skills. Oak is focussed on hardware and software development, d technology performs validation testing and provides valuable feedback to Oak engineers to optimize its algorithms. Our teams are working hard to deploy the first generation of our product.



Oak's Raman-1 being used at a food shop in Chandigarh.

Vectrax : A sprayable formulation for control of disease-carrying mosquitoes
TACLING THE MACAIIITA MENACI

## TACKLING THE MOSQUITO MENACE

Measured by the degree of misery and mortality inflicted on humankind throughout its existence, there are few creatures on earth more monstrous than the diminutive mosquito. While modern medicine continues to make great strides in extending lifespans and improving quality of life for people all over the globe, mosquitoes remain among the greatest global health threats. Malaria is the deadliest mosquito-borne disease (MBD) in the world, infecting up to half a billion people every year, resulting in up to 1 million deaths.



Agenor Mafra-Neto ISCA Technologies Riverside, CA, USA



Markandeya Gorantla ATGC Biotech Pvt. Ltd. Secunderabad, INDIA

engue infects 100 million people each year, making it the single most common viral MBD, leading to severe illness in ~500,000 people [1]. Other MBDs of consequence include lymphatic filariasis, yellow fever, West Nile virus, and Zika virus. Control methods for the mosquitoes that spread these diseases are limited by several shortcomings. Chemical pesticides targeting adult mosquitoes (adulticides) have been associated with multiple negative health and environmental impacts, and are vulnerable to resistance, a process by which insects gradually develop tolerance to a given killing agent over multiple generations [2][3]. Larvicides tend to be safer and more selective than adulticides, but can be challenging to implement properly: to be effective, larvicides must be used to treat all existing or potential larval habitats in a given area, and because most current larvicides are fairly short-lived, multiple applications may be necessary over the course of a season [4][5][6]. Personal protection measures, such as insecticide-treated bednets, must be used properly and consistently by all members of a community to provide effective mosquito control.



#### Development of Vectrax:

In 2013, a small biotech company in Riverside, CA (ISCA Technologies), began working to develop an alternative method of mosquito control: an attract-and-kill (A&K) formulation to provide effective control of three key global vector genera of mosquitoes, Aedes (vectors of Dengue, yellow fever, and Zika), Anopheles (malaria), and Culex (West Nile virus, lymphatic filariasis). This A&K product, called Vectrax, was designed to mimic odors produced by the sugar-rich flowers and extrafloral nectaries from which mosquitoes of all species and both sexes seek sustenance throughout their lives. Mosquitoes detect these floral attractants, released over time from the Vectrax formulation, and respond by orienting their flight toward the point source. Vectrax also contains a number of sugar- and protein-based feeding stimulants, which encourage mosquitoes to feed upon the formulation to full engorgement, resulting in a megadose intake of an incorporated insecticide. This killing agent would be selected by the user, and blended with the *Vectrax* formulation just prior to application, at drastically reduced rates compared to traditional adulticide sprays. The capacity for tank-mixing would safeguard the efficacy of *Vectrax* from the development of resistance to any one particular chemical agent. *Vectrax's* sprayable consistency provides the additional advantage of rapid, easy application, using either manual or mechanized equipment.

#### **Results:**

Vectrax has proven capable of promoting attraction and consumption of the formulation in all three target genera *Anopheles, Aedes,* and *Culex,* even when the formulation also contained one of a variety of killing agents, including cypermethrin, permethrin, fipronil, boric acid, cyazypyr, and ivermectin. One *Vectrax* prototype containing permethrin and fipronil was tested against the KDR strain of *An. gambiae,* known to be resistant to pyrethroids, and delivered a mortality rate of 78%, 48 hr after exposure.

Semi-field trials carried out on three continents (North America, Africa, and Asia) also showed encouraging results for *Vectrax*. In one trial conducted in the large mesocosms at Ohio State

University, a point source of *Vectrax* containing 2% permethrin, applied to a leaf within the mesocosm, eliminated virtually every *Aedes aegypti* mosquito in the treated mesocosms within 48 hr. ISCA performed similar mesocosm trials with mosquitoes of different ages, species, and physiological states, and the results were similar in each case: *Vectrax* killed virtually all released mosquitoes. A permethrin-based *Vectrax* formulation was also tested in Tanzanian mesocosms against *Anopheles gambiae*, where the application reduced the mosquito population in the mesocosm by 98% within 48 hours.

Field trials with Vectrax are ongoing, but the results of one small field trial in a heavily infested area of Vero Beach, FL, indicate that this technology has potential to act as an effective mosquito control strategy. Despite the challenging conditions at this site (mosquito populations measured at up to 50,000 mosquitoes captured/day; heavy rainfall; small plot size, allowing for migration from untreated areas), treatment with Vectrax suppressed trap captures in the treatment plot compared to the untreated control plot, indicating that this treatment reduced the overall mosquito population in the field, though this effect was not statistically significant over the duration of the trial (differences were significant on four individual dates). Preliminary results from a trial in progress in Tanzania, where 93% of the human population is at risk for malaria, show that treatment with Vectrax reduced local mosquito populations by roughly two-thirds in the 2 weeks following application.

#### **Conclusions & Future Research:**

Throughout research and development on *Vectrax*, this formulation has performed as an effective A&K technology against multiple vector mosquito species, in

### "

Vectrax has proven capable of promoting attraction and consumption of the formulation in all three target genera Anopheles, Aedes, and Culex.

multiple geographies, and with multiple killing agents incorporated. The team is currently working to improve Vectrax's field hardiness and ease of application, developing a thicker formulation that better retains its hold on application substrates. In addition, Vectrax is being evaluated as a delivery mechanism for an alternative strategy of vector control: an autodissemination strategy for an insect growth regulator (IGR). Rather than directly targeting adult vectors via A&K, Vectrax-IGR is designed to attract adult mosquitoes to the formulation and induce them to consume and interact with it, contaminating themselves with the IGR. Mosquitoes will then carry the IGR to larval habitats, which will prevent the offspring deposited therein from ever developing into adults; and to other adults with whom they interact (via mating), reducing their reproductive capacity. Vectrax, as well as other technologies using behavior-modifying chemicals (semiochemicals), could provide an effective, safe, and sustainable alternative for the control of mosquito vectors, a group of organisms that poses one of the greatest public health challenges of the modern age.

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Initiative for Research and Innovation in STEM (IRIS)

# **INNOVATION FEST 2018**

**nnovation Fest 2018** held from 2-4 December 2018 at Sam Manekshaw Center, New Delhi saw the culmination of two mega innovation programs - *Initiative for Research and Innovation in STEM (IRIS)* and *Make Tomorrow for Innovation Generation (MTIG)* focused on research, techcreation and tinkering.

**Initiative for Research and Innovation in STEM (IRIS)** encourages young minds in and around the nation to take on scientific research that brings out the best from the country. The public-private partnership program between Dept. of Science & Technology (DST), Intel® and IUSSTF promotes and nurtures young Indian innovators and recognizes outstanding projects in the field of STEM thereby providing a platform to be at global stage through Intel International Science & Engineering Fair (ISEF) held in USA every year.

At the three-day event, a total of 78 projects selected from 1500 applications through a two level evaluation process, were showcased by 106 students vying for the IRIS Grand Awards. An expert jury comprising of 25 judges, including members of the IRIS Scientific Review Committee, and external Judges and experts selected the top 20 projects.

#### Feature





The winning projects will now be mentored to represent the country as Team-India and compete against young innovators from 80 other countries at ISEF to be held during May 2019 at Phoenix, Arizona, USA.

Another new public-private initiative - Make Tomorrow for Innovation Generation (MTIG) is also a program of Dept of Science & Technology and Intel with IndoU.S. Science and Technology Forum (IUSSTF) as the implementation partner. The program is supported by NITI Aayog - Atal Innovation Mission (AIM). Designed to work with schools, teachers and maker spaces to skill youth on creating indigenous technology based solutions for local communities, the program was initiated with an aim to provide an insight into the making and innovative skills the skills fast becoming pre-requisite for future generation and backbone of 4th Industrial Revolution. The program reached out to youth from 17 Indian states in a span of 30 days. After a two-tier screening and review process, from a pool of 415 online submissions received, a total of 50 projects were shortlisted for showcasing at the Innovation Fest 2018. An eminent jury of Makers from various Maker labs and expert members of Joint Steering Committee (JSC) reviewed all 50 projects from which 10 projects were selected for award.

**Dr. Arabinda Mitra**, Scientific Secretary Office of the Principal Scientific Advisor to GOI was the chief guest for Inaugural Day of the event. He interacted with students and encouraged them to come up with more indigenous solutions for solving global societal problems. **Prof. Ashutosh Sharma**, Secretary, Department of Science and Technology, GOI graced the Award ceremony of the FEST and motivated young brigade of budding scientists & technologists to be more dynamic in their approach and develop an innovation ecosystem in the country. **Ms. Meenakshi Lekhi**, Member of Parliament from New Delhi constituency and **Mr. J. Robert Garverick**, Counsellor for Economic Affairs, Environment Science and Technology, US Embassy, Delhi were amongst the other dignitaries present during the award ceremony.

# Giving wings to TALENT

o address the need for human resource development and capacity building in science and technology, IUSSTF is committed to nurture contacts between scientists and students from India and the United States. It has been unambiguously demonstrated that providing students and young scientists with an exposure to cutting-edge scientific research experiences at a formative stage not only broadens their intellectual horizons but also leads to increased engagements in scientific and technological research careers. In this section of Connect, we share with you the experiences of some of our bright, young Interns and Fellows in their own words!

#### **Student Speak**

### Water Advanced Research & Innovation Fellowship



**Paromita Chakraborty** SRM Institute of Science and Technology, Kattankulathur

The WARI Fellowship was much more than what I expected, as it provided ample instrumental training and exploration

opportunities and provided room for original thoughts and work. This fellowship provided a wonderful opportunity to extend methodological knowledge to adjacent fields and from mainly technique-driven exploration to modelling and fast-screening methodologies for trace organics in human blood. Such research may lead to application of our research in human health risk assessment of endocrine disrupting compounds. International recognition of our work was also strengthened.

The objectives of my research was to elucidate the environmental occurrence of potential Endocrine Disrupting Compounds (EDCs) and in particular to study the spatial trend of widely used organochlorine pesticides (OCPs), Triclosan, Bisphenol A and selected pharmaceutical compounds along the GRB; Characterize the sources and source pathways that determine contaminant release to the environment; and, Estimate potential Eco-toxicological effects from exposure to these chemicals ultimate transfer to the food chain a model can be established to reveal the movement of EDCs within GRB.

Under the mentorship of Prof. Daniel Snow, a renowned and experienced environmental and analytical chemist, I got trained in quantifying pharmaceutical compounds using Liquid Chromatography and Mass Spectometry. Frequent discussions with Prof. Dan and Prof. Chittaranjan Ray helped me to develop a complete understanding of the quantified datasets. Prof Dan also helped me to collaborate with Prof. Jim Wang from Lousiana State University, USA and Dr. Nancy Shappell from USDA-ARS.



Water Advanced Research and Innovation Program:

Webpage: https://www.iusstf.org/program/water-advanced-research--innovation-fellowship E-mail: water.fellowship@indousstf.org



**Omkar Damle** Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar

irstly, I would like to thank IUSSTF and the University of Southern California for organizing the IUSSTF-Viterbi Program and for the continuous support which they provided, making our travel and stay comfortable. It was through this program that I got the opportunity to work at a toplevel research university in the United States. The internship was an enriching experience for me in terms of exposure to high quality research in the field of Data Science and understanding

### **IUSSTF-Viterbi Program**

U.S. work culture. I worked with Prof. Viktor Prasanna on the project titled 'Safer Connected Communities'. Specifically, I worked on crime modeling and prediction. We built a Linear regression model for crime data in Los Angeles, California. In order to improve prediction accuracy by feature addition, we used a couple of methods like DBSCAN clustering of grid cells, correlation between grid cells. However, these approaches failed to improve accuracy on our dataset. We designed a naive grid clustering algorithm. In order to compare our prediction results with uniform grid cell model, we devised a new police resource allocation metric. This metric was devised because current metrics such as Area Under Curve (AUC), Root Mean Square Error (RMSE) and Weighted Absolute Percentage Error (WAPE) were found to be lacking in comparing prediction accuracy across models with different grid structure.

Along with working in the labs on weekdays, our group of around 20 interns had a wonderful time together on weekends. We visited nearby places such as Universal Studios, Hollywood, Malibu and downtown Los Angeles. I would definitely recommend students from Indian Universities to consider this internship opportunity.

IUSSTF-Viterbi Program: Webpage: https://www.iusstf.org/program/iusstf-viterbi-program E-mail: viterbi-india@indousstf.org

#### Healing Trauma, Rebuilding Lives

Contd. from pg. 10

can be used to produce different responses from the same cell due to their particular topography.

Current therapeutic approaches have revolutionized the surgical treatment of musculoskeletal injuries and include transplantation of autografts and utilization of the synthetic substitute made of various organic and inorganic materials. However, these strategies suffer from plenty of limitations including donor site morbidity and limited harvest site, while artificial bone grafts also have connected tissues created using biomaterials, covering immunogenicity, biodegradation or strength limitations. The focus of this Joint Center is design and fabrication of nanofiber scaffolds and molecular-level understanding of the interactions *in vitro* between nanofibrous scaffolds and different cells. It will have great potential to add new dimensions to biomedical research. Also, interface research between the fields of nano-bio engineering and medicine will be created to address the challenges on *Tissue-Engineered Organs and Controlling Cell Behaviour*.

### Khorana Program for Scholars



**Dolly Jain** Dr. B.R. Ambedkar Centre for Biomedical Research, University of Delhi

ventually, everything will fall into its place." This is exactly what happened with me. Being a biomedical science student, I always wanted to work on something that would ultimately improve public health, but I didn't know whether research is what I want to pursue or not. The Khorana Program gave me this opportunity to explore my interests in biological research. Getting selected for this fellowship program was itself a big win for me, but there were still a lot of hurdles to cross. To start with, finding a good lab that matches your interests and getting acceptance from host mentor was stressful initially, but all this was worth it in the end. I found myself lucky enough to be given a chance to work in Prof Daniel Klionsky's lab (University of Michigan). Next in line was getting your visa done, seeing my fellow scholars having their visa on hold for weeks made me a bit scared and nervous. Fortunately, it went smoothly, and I landed in the U.S. with a lot excitement and nervousness too. Coming with another scholar (Chesta Jain) didn't make me feel that I am alone, which was like a cherry on the cake.

"You never get to know the real thing until you are into it." This

Khorana Program for Scholars: Webpage: https://www.iusstf.org/program/khorana-program-for-scholars E-mail: scholar@indousstf.org

sums up my whole research experience in the lab. Finding unfamiliar faces everywhere, a Khorana Scholar 2015 (Vikramjit Lahiri) came to my rescue who was supervising me on my project. He is more of a friend than a teacher and treated me like a family member. I adjusted very well in the lab but what was tougher was making my strains work and I couldn't start my work until I have my strains happy and healthy. It took me almost a month to prepare my yeast strains. I remember what a relief it was, to finally start with my ride. However, when you plan to go right, life (in my case, my yeast cells) takes you left! But this is what research is all about, a negative result or something different from what you expect is itself a positive result. Though, this was stressful, it got me engrossed so much into my project that I loved every bit of it, be it a negative result or no results at all. Vikramjit and all the lab members made me realize that science and research is so much fun. I am grateful to them for being so helpful and amazing. And I can't thank Dan (my mentor) enough for having me there and giving me a chance to learn and gain some experience in his lab.

In my remaining time, I ventured out to explore few beautiful places around – Riverwalk (Detroit), skyline of Chicago and Ann Arbor, where I spent my summer is prettiest of all with so many events happening all around the campus. The best part was to get to interact with completely different people from all over the world and knowing about their culture. These ten weeks went by so fast that I didn't realise that its time to go back with so many memories to take along with me. I learnt so much on a professional as well as personal level. Overall, it was a roller coaster ride with the experience of a lifetime.

### Bhaskara Advanced Solar Energy (BASE) Fellowship Program

am immensely grateful to IUSSTF for providing me this wonderful opportunity for the experience as a BASE intern in the United States. I had got an instant reply from Dr. Stuart Bowden (Research Professor, Co-Director Solar Power Laboratory) for an internship at the Solar Power Lab at Arizona State University when I requested him for letter of support for my BASE application. Once in Arizona State University, I received help from each and every faculty member and scholar there. I was amazed how easily I could convey my ideas about my work to the crystalline silicon solar cell group. I was a part of their weekly group meeting where progress of work was discussed and I was treated one of them,



**Suchismita Mitra** Chaibasa Engineering College, Kelende, Jharkhand



although I was there only for three months. I was given exclusive laboratory training on the operation of various instruments and was also involved in the complete process of fabrication of Passivated Emitter Rear Contact (PERC) cells. As a part of the BASE internship, I was also encouraged to visit other laboratories in the field of photovoltaics. I took this opportunity to visit National Renewable Energy Laboratory in Colorado and met Dr. Pauls Stradins who arranged for a complete tour of fabrication labs. Overall, it was a very gratifying professional as well as personal experience for me.

OCT.-NOV. - 2018

Nano/Micro 2D-3D Fabrication, Manufacturing of Electronic– Biomedical Devices & Applications n the present era, there is an incredible growth of new nano/micro 2D & 3D manufacturing of electronic and biomedical devices that can improve the performance and functionalities at lower costs through various advanced technologies. To deepen and broaden expertise and knowledge of new 2D & 3D manufacturing of electronic and biomedical devices and innovation to ever-increasing international needs, a workshop titled *Nano/Micro 2D-3D Fabrication, Manufacturing of Electronic–Biomedical Devices & Applications* was organized by Kenneth Gonsalves (Indian Institute of Technology-Mandi), Nan Marie Jokerst (Duke University, Durham) and Satinder Kumar Sharma (Indian Institute of Technology-Mandi).

31 October to 2 November 2018 Indian Institute of Technology-Mandi, INDIA

NOV. - 2018

Water-Food-Energy-Climate nexus: A perspective towards a sustainable future

16-21 November 2018 Varanasi, INDIA

∧ **/** ater is the basic element of life, livelihood, food security and sustainable development. Escalating global populations and climate change are placing immense pressure on water and food security. Sustaining a high rate of food production will require innovations in water productivity and soil health, crop cultivar developments, agrochemical inputs, alternative energy sources for irrigation and other cuttingedge agricultural activities. An effective and sustainable solution of global environmental change or climate change requires better understanding and consideration of the linkages and interdependencies between climate change, water, energy, food security and sustainability. The purpose of this workshop titled Water-Food-Energy-Climate nexus: A perspective towards a sustainable future, organized by Rajeev Pratap Singh (Institute

of Environment and Sustainable Development, Banaras Hindu University, Varanasi), Shannon L. Bartelt-Hunt (University of Nebraska, Lincoln), Akhilesh Singh Raghubanshi (Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi) and Alan S. Kolok (Idaho Water Resources Research Institute) was to address societal challenges in providing water, food and energy security in the future and how the nexus Climate-Water-Foodbetween Energy can be exploited to address sustainability challenges. Although these challenges are different in India and USA because of the scale of mechanization, resources availability, and other factors, therefore, the workshop differences addressed and similarities in these challenges to develop mutually beneficial solutions.



Epilepsy is said to be the commonest neurological disorder after headache. Cover 10 million people suffer from epilepsy in India, out of 50 million suffering from this disease worldwide. About 20% of persons suffering from epilepsy have drug resistance (DRE). The only option for DRE is surgery. In addition, epilepsy is shrouded by a lot of stigma thus characterized by a large treatment gap. There is also a limited training in the area of epilepsy at both undergraduate and postgraduate level. In addition, there have been significant achievements in this area over the past decade especially in the area of surgery with a better understanding of networks, biomarkers and neurobiology. The event titled **15<sup>th</sup>**  *National EEG workshop and Masterclass for Epilepsy Surgery: A collaborative Indo-American workshop* organized by P. Sarat Chandra (All India Institute of Medical Sciences, New Delhi), Ashwini Sharan (Thomas Jefferson University, Philadelphia) and Manjari Tripathi (All India Institute of Medical Sciences, New Delhi) is the first Indo-U.S. joint venture fostering a better collaboration for technical advancements and knowledge enhancement in this area.

NOV. - 2018 15th National EEG workshop and Masterclass for Epilepsy Surgery: A collaborative Indo-American workshop

> 21-23 November 2018 Varanasi, INDIA

ancer research has been significantly aided by advancements in proteogenomics technologies, where proteomics information derived from mass spectrometry is used to complement genomics using next generation sequencing. With the recent advent of Cancer Moonshot Project, the critical role that proteogenomics can play in improving cancer patient treatment is increasingly being recognized. This event titled Indo-U.S. Training Program & Workshop on Cancer Proteogenomics organized by Sanjeeva Srivastava (IIT-Bombay, Mumbai) and **D.R. Mani** (Broad Institute of MIT and Harvard, Cambridge) utilized advanced genomic & proteomic technologies and their data from highquality human biospecimens to identify potentially actionable therapeutic molecular targets. This was a collaborative effort by experts in the fields of proteomics and proteogenomics in cancer research. The program comprised of interactive lectures with case studies, hands-on sessions and demonstrations on proteogenomics aimed at accelerated understanding of cancer. The workshop covered the principles of proteogenomics followed by experimental sessions, where data was processed and analyzed by the participants for proteomics using LC-MS/MS. Hands-on session on computational methods was performed for statistical data analysis of proteogenomics data.

DEC. - 2018

Indo-U.S. Training Program & Workshop on Cancer Proteogenomics

> 06-11 December 2018 IIT-Bombay, INDIA

#### DEC. - 2018

Understanding Cell Biology through Proteomics and Metabolomics



10-11 December 2018 Pune, INDIA

Proteomics and metabolomics are emerging technologies used worldwide to answer key questions in cell biology research. However, these technologies are rapidly advancing with new applications in cell biology and there is a need for frequent updates to keep pace with fields. The Indo-U.S. workshop on **Understanding Cell Biology through Proteomics and Metabolomics** organized by **Srikanth Rapole** (National Centre for Cell

Science, Pune), John R. Yates III (The Scripps Research Institute, La Jolla), Shantanu Sengupta (Institute of Genomics and Integrative Biology, New Delhi) and Arun Sreekumar (Baylor College of Medicine, Houston) aimed at bringing together Indian and U.S. researchers working in the areas of proteomics and metabolomics under one umbrella to exchange scientific ideas and foster future collaborations.

#### DEC. - 2018

Advanced instrumentation and computational techniques for Nuclear Reactor Safety

15-19 December 2018 IIT-Bombay, INDIA

uclear power is considered a **N** critically important means of energy generation throughout the world, but due to high safety standards and process regulations, the cost of energy generation from nuclear fuel is much higher than natural gasbased energy generation systems. Advanced sensors and modeling techniques can dramatically improve the nuclear reactor safety while making the design of the nuclear plants simple. With the recent advances in material science, computational science, and artificial intelligence, there are ongoing development efforts in making robust sensors and computational data-driven techniques for

achieving simpler designs, online reactor safety characterization, and accident management. This is a highly inter-disciplinary field and is rich in multiple, coupled physical phenomena ranging over wide length scales and time scales. The workshop titled Advanced instrumentation and computational techniques for Nuclear Reactor Safety organized by Suneet Singh (Indian Institute of Technology Bombay, Mumbai) and Hitesh Bindra (Kansas State University, Manhattan) aimed to provide the forum necessary to synthesize such recent discoveries into clear predictions for other regions and directives for future work.

topic conditions such as eczema, allergic rhinitis, asthma, and allergies are becoming more prevalent around the world. These conditions are related through a phenomenon known as the "atopic march" where children have increased risk of developing asthma and allergies if they are diagnosed with eczema early in life. Occurrence of asthma, environmental allergies, and eczema has risen over the last few decades and remain prevalent. An emerging, worldwide trend of increasing food allergy (FA) prevalence has become a growing public health concern. In the U.S., FA affects 8% of children. FA may also slowly be on the rise in India, especially in urban areas but there is a lacuna in its awareness and monitoring. Despite the increasing prevalence of FA worldwide, factors contributing to this increase are not definitively understood. The Indo-U.S. symposium on Allergy and Asthma organized by Randeep Guleria (All India Institute of Medical

Sciences, New Delhi), Ruchi Gupta (Northwestern Feinberg School of Medicine, Chicago), Vartika Mathur (Sri Venkateswara College, Delhi University) and Lucy Bilaver (Northwestern Feinberg School of Medicine, Chicago) aimed to present the differences in prevalence and trends of atopic conditions in the U.S. and India; understand the biology of the development of atopic conditions; discuss factors that may impact atopic conditions and their relationship to the microbiome - hygiene hypothesis, timing of infant food introduction in different cultures, diet influenced by geographical location and culture, genetics, environmental exposures, pre- and postnatal risk factors, etc.; explore emerging microbiome research to determine factors contributing to and protecting against atopic conditions in India and the U.S.; and, enhance existing Indo-U.S. partnerships in the field of atopic conditions and the microbiome.

DEC. - 2018

### Indo-U.S. Symposium on Allergy and Asthma

15-16 December 2018 New Delhi, INDIA



IUSSTF Indo-US S&T Forum	Indo-US Science & Technology Forum
Who we are	<b>The Indo-US Science and Technology Forum (IUSSTF),</b> established under an agreement between the Governments of India and the United States of America, is an autonomous, not for profit society in India, co-funded and co-governed by both the governments. IUSSTF promotes and catalyzes Indo-US collaborations in science, technology, engineering, biomedical research and innovation through substantive interaction among government, academia and industry.
What we do	Foster excellence by capitalizing on the scientific and technological synergy Disseminate information and create awareness through scientific exchanges Build linkages through networking between academia and industry Explore new frontiers by nurturing contact between young and mid-career scientists Pave way to sustainable interactions and establish long term relationships Encourage public-private partnership to inculcate elements of innovation and entrepreneurship
We support	Exciting and innovative collaborative programs cutting across disciplines and institutionsAcademia-Industry Connect Programs Advance Schools & Training Programs Bilateral Workshops & Symposia Flagship Events Knowledge R&D Networked Joint CentresPrograms on Innovation and Entrepreneurship Public-Private Networked R&D Joint Centres Research Fellowships for Faculty Special Initiatives for Strategic Partnerships Student Internships & Visiting Professorships
We invite	Proposals which are peer reviewed both in India and USA for awardsBilateral Indo-US Workshop/Symposia & Indo-US Training/Advanced SchoolsSubmission DeadlinesAward Announcements1 March31 July31 August31 JanuaryIndo-US Public-Private Networked Centres & Indo-US Knowledge R&D Networked CentresSubmission DeadlineAward Announcement31 August31 January
How to contact us?	Indo-US Science and Technology Forum Fulbright House 12 Hailey Road, New Delhi - 110 001 For program details visit: www.iusstf.org

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