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About IGSTC

The year 2019 for IGSTC had been with vibrant activities and achievements for research institutions, industries and other stakeholders. IGSTC will be entering into its 10th year of establishment in the year 2020.

2+2 Projects – the flagship program of IGSTC - is currently supporting 21 projects in areas of advanced manufacturing, new materials, water and wastewater technologies, medical devices etc. The support to these projects stands at € 18 million/₹ 130 Crore. The projects have created a network of 84 research institutions and industries across India and Germany. Around 200 research personnel at the level of post-doctoral, doctoral, masters and bachelors are working on these projects creating capacity building of high-quality research manpower significantly.

Revamped Open call for workshops which was launched in 2018 received great momentum this year. Significant bilateral Indo-German workshops in high tech areas of additive manufacturing, nanotechnology, groundwater resource harvesting, solar reactors, computational mathematics, membrane technology, etc. were held in different parts of India & Germany. Around 8 such workshops with a grant of ₹ 13 million. These workshops aimed for networking resulted in research collaborations of around 800 scientists, researchers, technologists and policy makers of both the countries.

A major workshop, Helmholtz-Indian Platform on Science, Technology, Education and Research (HIPSTER) was organized in February in Bangalore to create a platform connecting young scientists of the Helmholtz Institutes with Indian counterparts. The workshop was organized by IGSTC on behalf of Department of Science & Technology (DST), Govt. of India and Helmholtz Association, Germany. Nearly 100 scientists from India and Germany had participated in the event. The key outcome of the workshop is a White Paper in the topics viz. Georisks/Landslides-Marine Biochemistry, Physics of

the Atmosphere, Plant Sciences, Epidemiology/ Infectious Diseases/Oncology, Renewable Energy, Material Sciences and Artificial Intelligence. The resulted white paper will help initiating joint research programmes between Helmholtz and India for which consultations are going on.

A marquee workshop on “Research and innovation towards leapfrogging in frontier technologies (RILEAP)” was funded by IGSTC. It was coordinated by CSIR, India and Fraunhofer, Germany and convened at various places in India. It will result in several long-standing, concrete and mutually beneficial collaborations in the areas of Sustainable Buildings, Water, Advanced Production Technologies and Battery Technologies.

During the fifth round of Inter-Governmental Consultations (IGC) between India & Germany from 31st October to 1st November 2019 both the governments decided to strengthen cooperation in the field of Artificial Intelligence and Digital transformation. This was mentioned in the Joint statement by Chancellor Merkel and Prime Minister Modi. Both sides have drawn out their country strategies on AI and recognise its potential on research and innovation as well as on society in general. The potential synergies in focus areas such as Health, Mobility, Environment and Agriculture offer immense opportunities for enhancing cooperation and building on our comparative advantages. The German Federal Ministry of Education and Research and the Department of Science and Technology, through IGSTC, agreed to organize a bilateral workshop in Berlin in 2020 in order to identify areas of mutual interest.

Dr Roshan Paul completed his tenure as Director of IGSTC on 30th November 2019. IGSTC wish him all the best for his future.

IGSTC looks forward to 2020 with enthusiasm on exciting collaborations and challenges.

IDC-Water

Integrated diagnostics of contaminants in water supply and management system

Project Investigators



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IISc Bangalore



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Bigtec Labs Pvt. Ltd.
Bangalore



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BAM
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Sifin diagnostics GmbH
Berlin

In this 2+2 project, an integrated hardware platform with different microfluidic assays for pathogen cell/DNA and pharmaceuticals will be developed as an IoT device for remote monitoring of water quality.

IDC-Water project partner meeting was held on 21st October 2019 in Berlin, Germany. The discussions during the meeting were aimed towards understanding the outcome of the on-going experiments on different component level proof-of-concepts to be incorporated into the integrated platform. The partners also discussed plans related to various design activities, platform integration approach, and reviewed device requirements specification. Work progress on cell culture sample handling in a microfluidic chip, detection method, system prototype testing, and validation were discussed by project team from IISc. Bigtec team is currently focusing its effort on the development of a PCR assay for the detection of total bacteria and target pathogens such as shigella, salmonella and E. coli with selective primer/probe with high specificity. Test results regarding linearity and limit of detection for shigella and salmonella

were presented by Bigtec during the meeting. German partners BAM and Sifin are currently focusing their effort on diclofenac (a widely used analgesic) and amoxicillin (an important antibiotic) immunochemical detection technique development using magnetic beads and column-based immunoaffinity chromatography. The discussions at the meeting in this regard were aimed at achieving higher sensitivity of the assays, stability of synthesized conjugates and reference compounds for amoxicillin and diclofenac detection.



IDC-Water project team members at the networking meeting at facility of Sifin in Berlin.

SMART & WISE

Smart and reliable water and wastewater infrastructure systems for our future cities in India and Germany

Project Investigators



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The overall project goal is to support the implementation of reliable and sustainable water and wastewater infrastructure systems with added value in terms of smart cities. The main targets of the project are to develop planning methods and tools to face current and future challenges on the three linked levels of conventional, advanced and smart water and wastewater infrastructures. These methods and tools will be sampled in pilot areas in India (e.g. Coimbatore) and Germany.

The project team met at the TU Kaiserslautern for discussions about the project tasks and an excursion to sustainable and smart projects already implemented in that region from during 22-26 September 22nd to September 26th, 2019.

The meeting was organised in workshop style with intensive discussions about the planning procedures. Currently, the team is working on detailed flowcharts 6 topics: water supply;

water reuse; stormwater management; sewerage systems; heavy rain and flood protection and resource orientated wastewater treatment.

The team visited different stormwater management measures in Kaiserslautern. During a visit to the Stadtentwässerung Kaiserslautern, the project team entered the sewage system to watch a smart real time-controlled weir system that controls several sewers with a huge storage capacity. These real time-controlled sewerage systems are smart measures mainly used in combined sewerage systems.

Re-cultivation of water bodies is a current topic in Germany and India and helps to protect the environment as well as offers recreational space for the city population. Therefore, the river restoration downstream of the wastewater treatment plant was visited.



Project team and engineers of Stadtentwässerung Kaiserslautern with full safety equipment necessary for the onsite visit of a controlled weir system in a combined sewerage system



Excursion: Water Supply, Urban Drainage and Wastewater Treatment in the City of Kaiserslautern and Pirmasens

A guided tour in the waterworks was organized by Stadtwerke Kaiserslautern and the current status in the automation of water supply systems in Germany was demonstrated. In the civil engineering department of the city of Pirmasens the digital database was examined and the difference between India and Germany were discussed with the authorities. On the sewage treatment plant Pirmasens Felsalbe the construction of the phosphorus recovery plant out of sewage sludge, developed by Prüf- und Forschungsinstitut (PFI) Pirmasens, was visited.

The two-day workshop has reinforced several ideas of the team about infrastructure measures, what sort of planning tools are suitable for the project and how the work carried out by all the partners can be integrated. The field visit has helped to appreciate the practical utility of the measures and to identify the constraints one may face while planning.

TRANSLEARN

Robot skill transfer from simulation to real world deployment in manufacturing industries and warehouses

Project Investigators



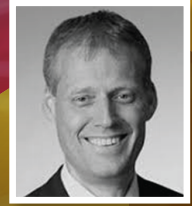
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Industry 4.0 will be driven by two basic technologies: AI and Robotics – and especially the combination of both – allowing robots to learn skills and tasks without explicitly programming them. Learning and optimizing complex and interactive robot manipulative skills through reinforcement learning algorithms is a multifaceted challenge and an unsolved problem. With the goals of (i) significantly reducing robot programming costs and (ii) reducing robot cycle times, project plans to develop reinforcement learning algorithms running in massively parallelized, cloud-based physics engines. This system learns and optimizes task-specific robot and machine skills that can be transferred to and deployed on physical robots. Project plans to develop concrete demonstrations of novel solutions for real use cases stemming from the manufacturing industry and warehouse automation. The solutions will rely on robot

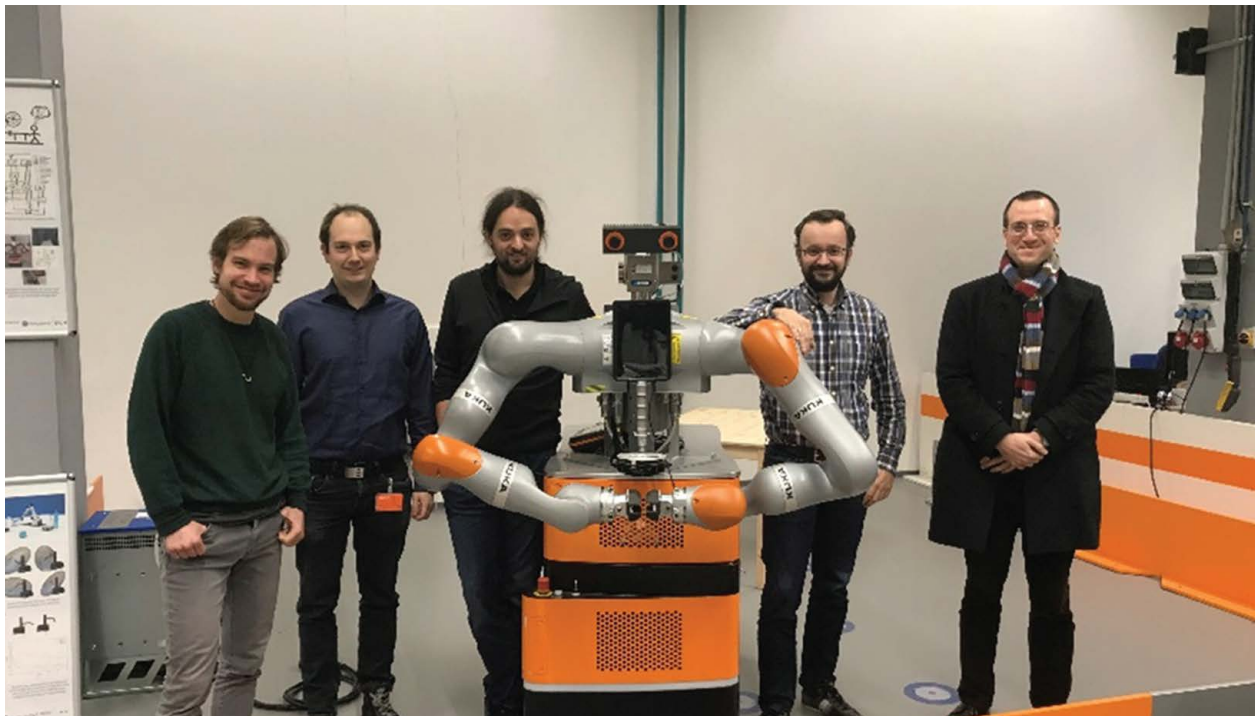
learning in a cloud-based simulation environment as well as optimization during real-world execution.

The project had two meetings and a workshop. At the 28th IEEE International Conference on Robot & Human Interactive Communication conference (IEEE RO-MAN 2019, <https://ro-man2019.org/#>) in New Delhi, the project team had a full day 'Workshop on robot skill transfer from simulation to real-world deployment in manufacturing industries and warehouses' on 17th October 2019. The speakers were Prof Mary-Anne Williams (University of Technology, Sydney), Prof Laxmidhar Behera (Indian Institute of Technology, Kanpur) and Dr Amit Pandey (Hanson Robotics). The Kick-Off meeting of the "TransLearn" was held on 18th October 2019. Several members of the partners TCS, IITK, KUKA, and KIT met there to concretize the common goals of our the Indo-German collaboration.



Project team at 28th IEEE RO-MAN conference

An interim meeting of the German partners KUKA and KIT took place in order to recap first steps while the Indian and German partners co-ordinate through monthly web meetings at KUKA GmbH, Augsburg on December 18.



German project partners at KUKA, Augsburg (Germany)

ECO-WET

Efficient coupling of water and energy technologies for smart sustainable cities

Project Investigators



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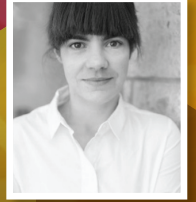
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One day workshop for the project ECOWET was held on 30th November 2019 at MMMUT, Gorakhpur, India. The aim of the workshop was to disseminate the knowledge and experiences from ECOWET project. Project partners from both the countries participated and delivered lectures to disseminate the findings with the master and early-stage Ph.D students who are at early phase of their research career.



The workshop started with an inauguration ceremony and project partners delivered their lecture as keynote speakers about project's objective, status, findings, work procedures, and results. German partner Sonnen GmbH delivered their keynote lecture via video conference on the state of art of the battery used for the project.



ECOWET project meeting was held on 1st December 2019 to discuss the work progress. During the meeting, the project timeline was revisited with the contributions and inputs of each partner and project milestones.

SELBA

Advanced lithium ion transporting solid electrolytes for solid-state lithium batteries

Project Investigators



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Maximilian Fichtner
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Andreas Hintennach
Daimler AG
Boeblingen

SELBA Project kick-off meeting was held at CECRI Chennai on 4th September 2019. The meeting was attended by the project partners Dr A S Prakash, Dr. K Ramesha (CECRI Chennai); Prof S Sampath (IISc Bangalore) and Dr M Venkateswarlu (Amara Raja Batteries Limited, Tirupati).

Project partners discussed on the importance of the project in context to the battery development in India for EV and commitment made by each partner. A detailed presentation on "Solid electrolytes for Advanced solid-state Li-ion batteries" was presented by Dr Prakash. The presentation covered the objectives of the proposal, relevance of the project & key challenges on developing solid-state Li-ion batteries.

It was agreed to work on the interface materials for cathode/solid electrolyte and Lithium/solid electrolyte interfaces. (IISc Bangalore); synthesis of electrodes/ electrolyte materials in collaboration partners, (Amara Raja Battery Limited) and Developing cathode coating, characterization of the coated foils and electrochemical studies (CECRI Chennai). CECRI will coordinate with IISc and Amara Raja Batteries Ltd., to collect developed components and integrate and fabricate solid-state Li-ion battery in a pouch cell format and performance evaluation.



Fig. 1 (PI names from L to R): Dr. K Ramesha (CECRI Chennai), Dr. M Venkateswarlu (Amara Raja Batteries Ltd, Tirupati), Prof S Sampath (IISc Bangalore) and Dr. A S Prakash (CECRI Chennai).

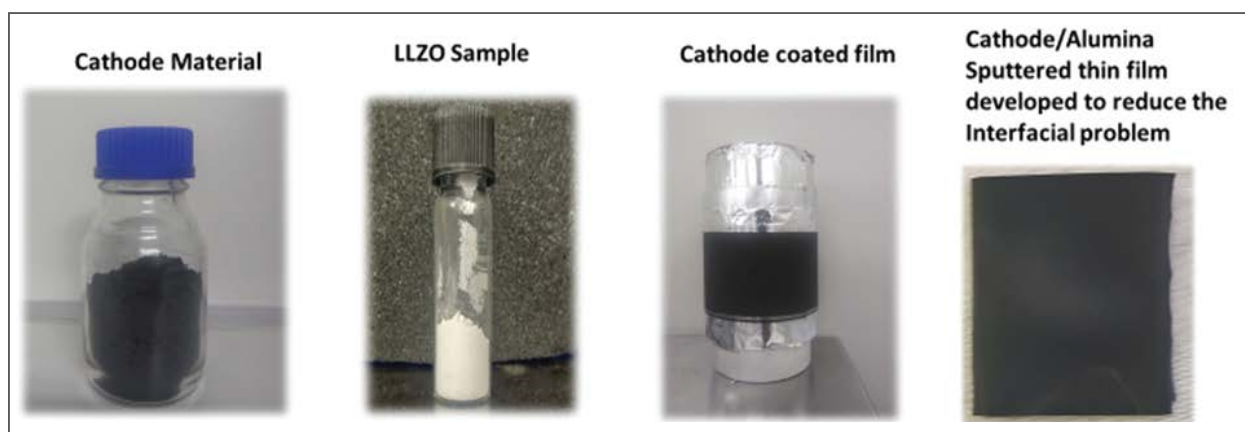


Figure: 2 Key components developed under SELBA project for fabricating Solid State Li-ion batteries

Bio-CuInGe

Biotechnology for the recovery germanium, indium and copper from industrial copper dust waste

Project Investigators



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The BioCuInGe project proposes to develop environmentally friendly and commercially viable technology for the recovery of Germanium (Ge) and Indium (In) while decreasing the volume of industrial wastes.

The project team is currently working on the characterization of samples from Khetri Copper Complex (KCC), Hindustan Copper, Khetri, Rajasthan and Central Research and Development Laboratory (CRDL) at Hindustan Zinc Limited (HZL), Udaipur, Rajasthan. These samples are being characterized for their mineralogical characteristics.

A mid-review meeting of the project with all the partners except Indian Industrial Partner (LLS) was held in HZDR, Dresden, Germany on 18th-19th November 2019. The meeting was attended by 4 IIT Delhi members (i.e. Prof T. R. Sreekrishnan, Dr Z. A. Shaikh, Dr Rohan Jain and Dr Anirudh Gupta), 4 HZDR members (i.e. Dr Katrin Pollmann, Dr Sabina Matys, Dr Sabina Kutschke and Ms Sylvi

Schrader) and GEOS member (Dr René Kermer). All the members updated on their progress and the next steps for the project were finalized.

In the context of networking, a short meeting between Bio-CuInGe academic group members (IIT Delhi and HZDR) and DAAD delegation of the Council of Scientific and Industrial Research (CSIR) directors was held in HZDR, Freiberg, Germany on 19th November.



From left to right: Dr René Kermer (GEOS), Dr Sabine Matys (HZDR), Dr Anirudh Gupta (IIT Delhi), Dr Katrin Pollmann (HZDR), Dr Rohan Jain (IIT Delhi), Dr Ziauddin Ahammad (IIT Delhi) and Prof T R Sreekrishnan (IIT Delhi)

Multi-WAP

Multiplexed, label-free fiber optic biosensor array system for waterborne pathogen detection

Project Investigators



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Chennai



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ubio Biotechnology Systems Pvt Ltd
Cochin



Claus-Peter Klages
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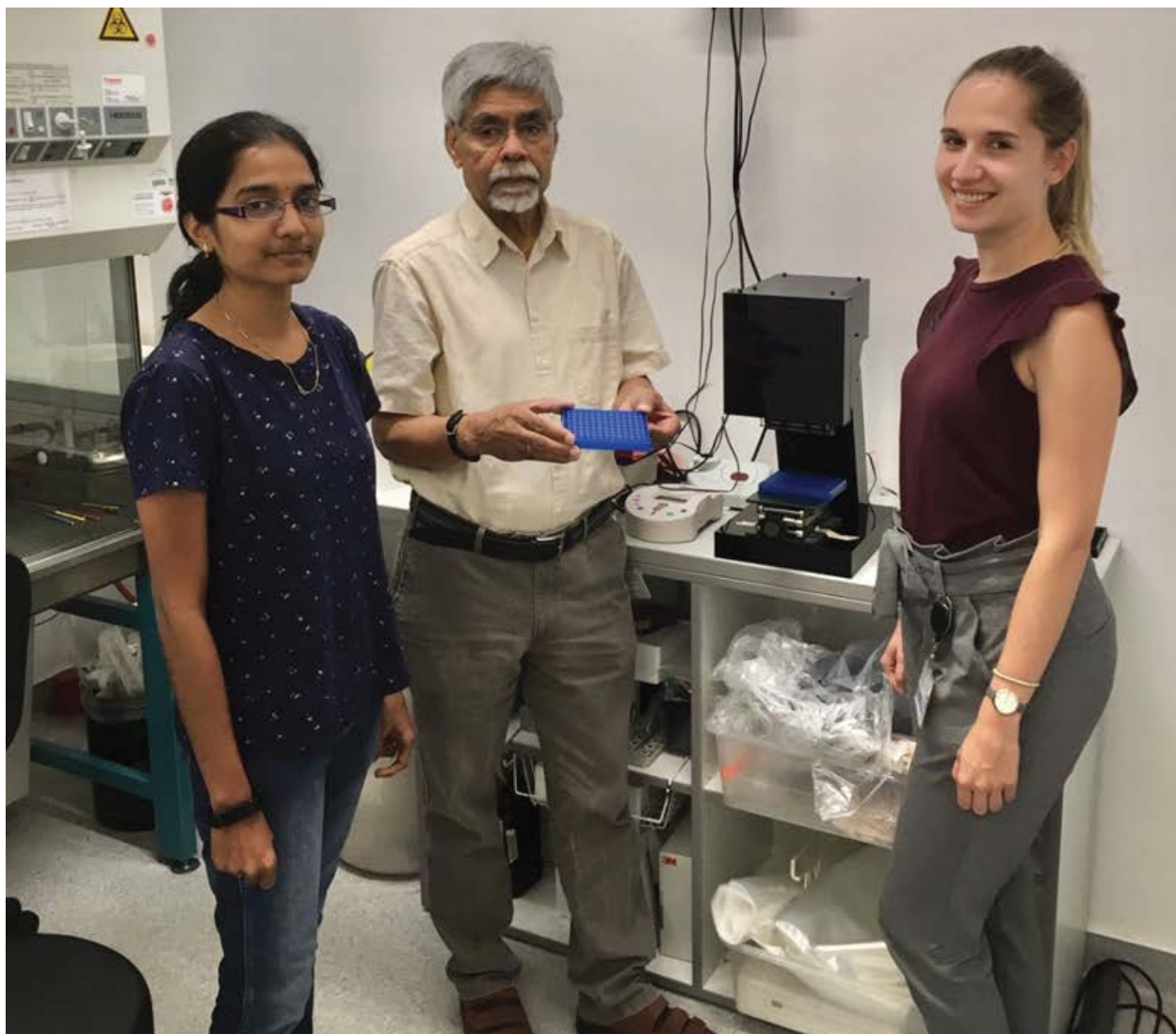
The final meeting of partners involved in the 2+2 project Multi-WAP was held virtually on 14th November 2019. The main objective of this collaboration is to develop a cost-effective fiberoptic biosensor for multiplexed detection of microbial pathogens in water (up to seven waterborne pathogens).

The meeting focused on presentation and discussion of work package 6 on the evaluation of the biosensor system for waterborne pathogens as well as the future. Moreover, the meeting also discussed the final progress of the work packages: (2) Surface plasma treatment and functionalization (IOT), (3) Production of further specific antibodies for WAPs (Lionex).

In the final project phase, Ms Kuzhandai Shamlee James performed joint experiments especially on the validation of the prototype

platform at the laboratories of Lionex GmbH and TU Braunschweig. The main objective of these experiments is to test the device with 2-7 bacterial pathogens using the developed multi-channel array system. The device has been validated and has a warm-up time of 3 hours. The assay had a significant absorbance change when the cells were dropped cast directly on to the U-bent surface of the sensor. The absorbance response was not significant during dip type assay. For better results, certain changes in the device can be implemented like continuous shaking of the sample platform, casing to protect the external light entering the sensor. In addition to that, LIONEX will continue the work of selecting further batches of the final arrays' biomarkers and biofunctionalized plasma-treated and silanized fibers in collaboration with IOT.

The consortium agrees that the future steps will focus on bringing to the market a device and ready-to-use test kits ('plug & play' cartridges) for waterborne pathogens detection. As evidenced by the success of the Multi-WAP project, there is a clear unmet need to move our technology from TRL 4 (current status) to TRL 6-7. The platform is a multiplexed, rapid, label-free, and real-time method for continuous monitoring of the multiple waterborne pathogens present in water samples at low cost and high sensitivity (>90%).



Ms. Kuzhandai Shamlee (left) (IIT Madras), Prof. Mahavir Singh (middle) and Selina Schrader (right) (Lionex) performing the validation of the prototype platform at the laboratories of Lionex GmbH.

Innovative technologies for assessment and mitigation of groundwater contamination

16-18 September 2019, Chennai

The workshop “Innovative technologies for assessment and mitigation of groundwater contamination (TEC4WATER)” was held from 16-18 September 2019 at Anna University, Chennai. The workshop coordinators were Prof Elango Lakshmanan, Anna University and Prof Michael Schneider, Freie University, Berlin. The workshop was held primarily to brainstorm on groundwater pollution and development of new techniques to mitigate the scenario.

The sessions were grouped under different aspects of groundwater contamination and its remediation. The major themes of the conference were geogenic contamination of groundwater, anthropogenic contamination of groundwater, modelling techniques and mitigation strategies.



Welcome Session



Technical Session

Contamination of water results in high costs for water treatment, high costs for alternative water supplies, potential health problems etc. During this workshop the researchers from academia, industries and research institutes from both Germany and India along with the practicing engineers from different government departments have addressed these issues for arriving at sustainable methods to prevent and mitigate water contamination. The research gaps that exist in these areas especially in bringing out affordable and easy to use techniques were arrived at. The workshop served as a platform for the cross fertilisation of ideas between the Indian and German experts on the following broad sub- themes aimed at both the current state of the art and the future directions,

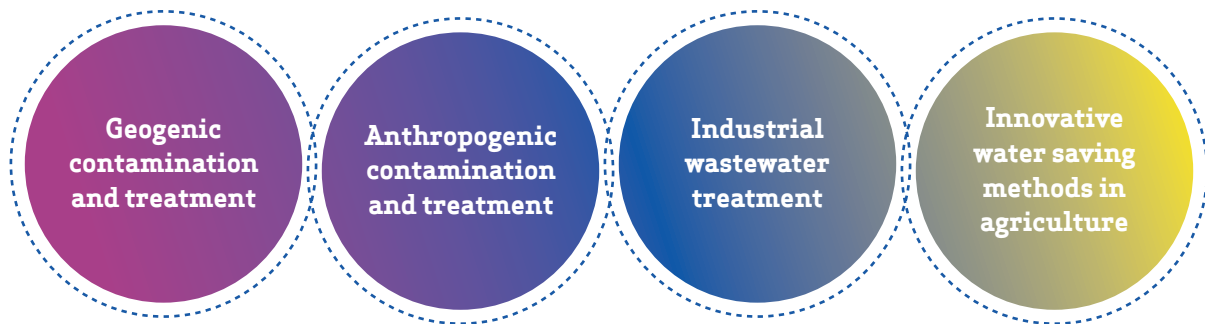
Developing better analytical methods to measure the presence of geogenic and human-induced contaminants in water

Investigating their fate and transport in water and soil

Developing methods for remediating or mitigating groundwater contamination due to these pollutants

The workshop “Innovative technologies for assessment and mitigation of groundwater contamination (TEC4WATER)” was held from 16-18 September 2019 at Anna University, Chennai. The workshop coordinators were Prof Elango Lakshmanan, Anna University and Prof Michael Schneider, Freie University, Berlin. The workshop was held primarily to brainstorm on groundwater pollution and development of new techniques to mitigate the scenario.

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Group photo of the participants

The delegates also have decided to look for the future calls of IGSTC (2+2), DST-DAAD and EU Horizon 2020 calls for formulation of suitable proposals. It was also decided to formulation of research group need not be restricted to the delegates who have attended, but also include all the other possible potential researchers. The field visit to northern Chennai aquifers were made to understand the impact of seawater intrusion. They also viewed the Managed aquifer recharge (MAR) structures which are prominently used for

mitigation of coastal aquifers. Along with these, visits to the ancient traditional water recharge structures were also made. A field visit to southern coastal part of Chennai was also carried out on 18th September to understand the effect of urbanization on the coastal aquifers, to see a traditional temple tank as a method of rainwater harvesting and location of the desalination plant that supplies drinking water to Chennai. Later delegates were also taken to the Mamallapuram a UNESCO's Heritage Site.

Solar thermochemical technologies for green and sustainable development

17-18 October 2019, Cologne

The Indo-German workshop on Solar thermochemical technologies for green and sustainable development was organized at EnviHab, DLR, Germany on. The workshop was coordinated by Dr K. Srinivas Reddy, IIT Madras and Dr Martin Roeb, DLR Germany.

Solar thermochemical processes can supply high-temperature process heat as the necessary energy source for the performance of endothermic chemical reactions, which can be used to produce high-value solar fuels (mostly

hydrogen and syngas) or for particles treatment (to drive calcination reaction). This workshop concentrated on the evolution and current state-of-the-art of such reactors that are used for particle treatment and solar fuel production. The main objective of the workshop was to promote the solar thermochemical process to both the industrial and research partners in Germany and India, which would enhance the cooperation between German and Indian partners in science and industry.



Discussion session

The technical presentations included the new developments in the Solar Reactor Systems – Solar Fuels, where eminent speakers from India and Germany presented their work. The recent advancements in the area of solar energy capturing, application to process industries and methods to achieve high temperatures were presented. Around 70-80 participants from various research institutes in India & Germany were present in the event. The technical topics covered in the workshop were solar reactor design & modeling and materials/technologies for fuel production, solar reactor systems – high temperature applications, solar particle treatment for the future etc.



Group photo of the participants of the workshop

The advanced developments in solar reactor designs for chemical and cement industry applications, new materials for solar thermochemical water splitting applications, and CO₂ capture through solar thermochemical looping were discussed.

One of the key highlights is development of a “Patented” pushed pellet solar thermochemical reactor (1.5 kW) irradiated using Fresnel lens tunnel used for H₂O or CO₂ splitting. This new technology has the potential to achieve high temperature in a smaller fresnel lens tunnel.

The major recommendations are to expand the research collaboration between both the countries in academia and industry from India and Germany. This collaboration is focused towards on writing new proposal for funding opportunities and proceeds beyond the current state of the art. This conference enabled both the Indian and German participants to exchange ideas and expand their research collaboration between both the countries in academia and industry.

Indo-German conference on computational mathematics: challenges and opportunities towards exascale computing

2-4 December 2019, Bangalore

The Indo-German conference on Computational Mathematics: Challenges and Opportunities towards Exascale Computing (IGCM) was held at Department of Computational and Data Sciences, Indian Institute of Science, Bangalore, India, during Dec 2 – 4, 2019. This event was jointly organized by IISc, Bangalore, MEC Hyderabad & University of Hohenheim. The workshop was coordinated by Prof Sashikumaar Ganesan, IISc Bangalore and Prof Philipp Kögler, University of Hohenheim.

The purpose of this Indo-German Workshop was to provide an interdisciplinary forum for researchers around the world to present and discuss the most recent innovations, trends, and challenges in the frontier areas of computational mathematics. IGCM was planned to foster interactions among High Performance Computing (HPC) research community and to provide a forum to present and discuss challenges in Exascale computing.



The meeting was well-attended. In addition to 13 invited speakers (9 from Germany and 4 from India) and 5 speakers from Industry (Intel, AMD, nVIDIA and Shell), 60 researchers from across India and 8 from Germany participated. Apart from Invited talks, 22 oral presentations and 20 poster presentations were made during three days of the conference.

In addition to the conference events, a round-table discussion on “Funding and Collaborative opportunities” has been arranged on 2nd December during dinner. Representatives from DFG, DAAD and Uni-Heidelberg were also participated and shared the information. It has been decided to apply to the Indo-German Call (IGP) for research collaborations between IISc and Uni-Heidelberg with Julich Supercomputing Center as a partner. Further, it has been decided to organise the next Indo-German conference in Germany.

Call 2018: Scientific Committee & Due-Diligence Meetings

The Joint Scientific Committee Meeting comprising of Indian & German experts met in Bonn, Germany on 12-13 September 2019 to review the shortlisted proposals under Call 2018. The thematic area of the call was on

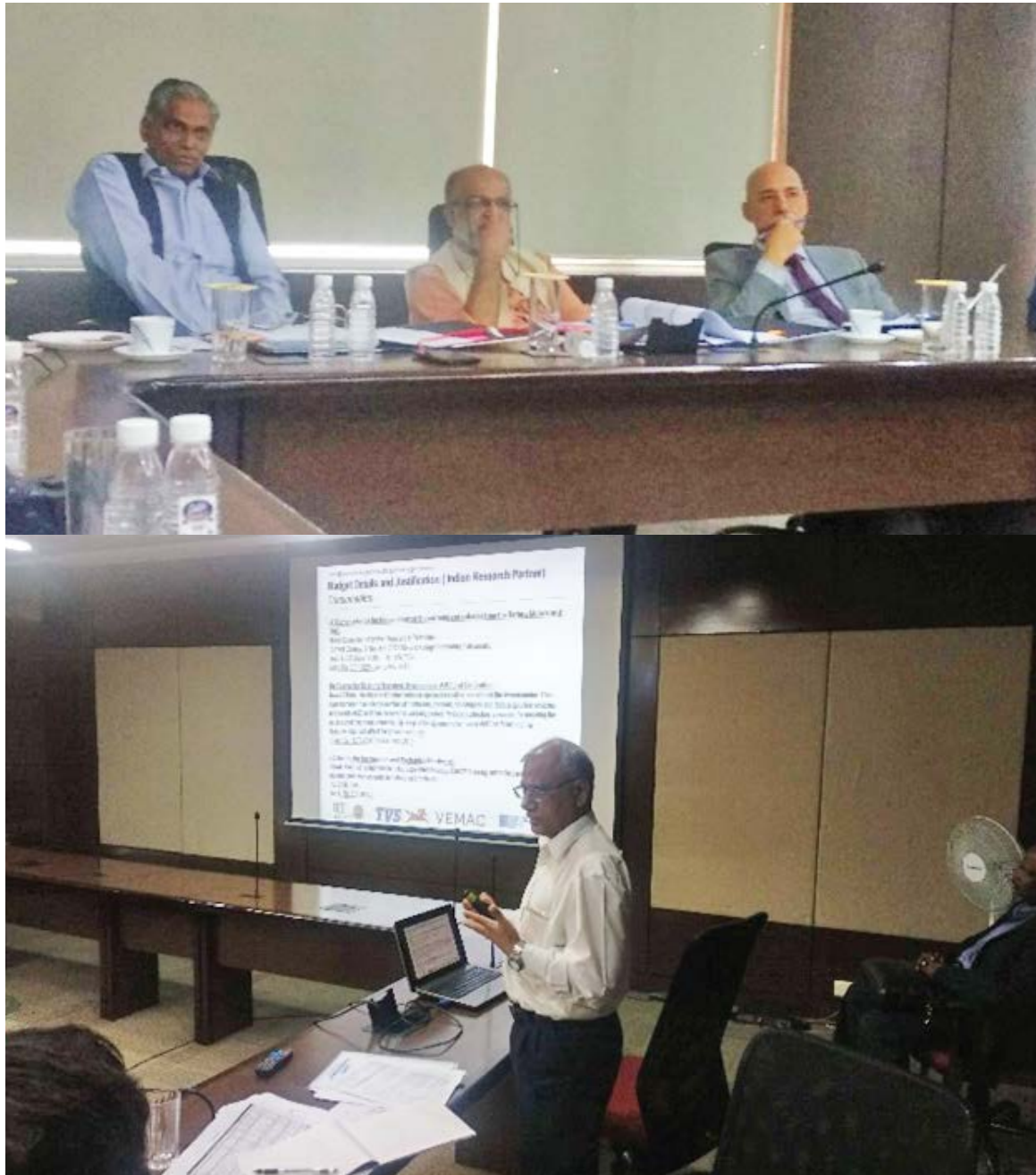
- Sustainable chemical process technologies
- Clean and Green Technologies (Technologies to reduce / mitigate water and air pollution, Solid waste management technologies).

After scrutiny, six projects were finally recommended by the Committee.



Scientific Committee meeting

Funding of the selected consortias follows the national funding rules of India and Germany. Indian funding is finalized through a due-diligence process and the German partners undergo a similar evaluation process performed by the DLR project management agency. The Due-Diligence Committee consisting of Scientific Committee members Prof A. B. Pandit, ICT Mumbai and Prof A. K. Gosain, IIT Delhi met in IGSTC, Gurgaon on 7th October 2019 to finalise the exact financial requirements for the Indian partners of the consortium.



Due-diligence meeting

Indo-German Science & Technology Centre

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