



Shaping the Future with Human and Artificial Intelligence

70 Years of Fraunhofer - 70 Years of Future

Fraunhofer celebrates a decade of glorious existence in India

Artificial Intelligence Strategy of Two Nations

An interview with Ms. Anna Roy, Senior Advisor, NITI Aayog

Decoding Artificial Intelligence with Prof. Dr. Stefan Wrobel

Fraunhofer bets big on Big Data

Artificial Intelligence in Healthcare

Content

70 years of Fraunhofer – 70 years of Future	3-4
Fraunhofer celebrates a decade of glorious existence in India!	5-7
Artificial Intelligence Strategy of Two Nations	8
An interview with Ms. Anna Roy, Senior Advisor, NITI Aayog	9-10
Will Artificial Intelligence replace the Human Intellect?	11-12
Fraunhofer bets big on Big Data	13-14
Machine Learning helps Physicians in Cancer Monitoring	15-16
Artificial Intelligence in Healthcare	17-18
Information Integration and AI for Better Therapy decisions	19-20
Going Global with AI and Health	21-22
Cognitive Agriculture	23-24
ML2R for Modular ML Applications	27-28
Smart Mobility - Intelligently Connecting Open Databases	29

FOREWORD



Dear Readers,

2018- 19 has been a milestone period for us at the Fraunhofer. Not only did Fraunhofer Gesellschaft Germany celebrate 70 years of its pursuit for research excellence, Fraunhofer India too clocked in 10 years of a glorious journey in India! These two milestones have encouraged us to renew our commitment, passion and vigour to march forward in our chosen field of applied research for the future of humanity.

While we relentlessly pursue new signposts of tomorrow, we also don't lose sight of the technologies of today. The fact that technology applications are increasingly multidisciplinary and overarching is well recognised in Fraunhofer, and we therefore build alliances within and outside of Fraunhofer to address these challenges in the most efficient manner. The most exciting topic of today (and tomorrow!) is that of Artificial Intelligence. It is the fastest growing technology in the world, is highly multidisciplinary and will significantly impact the way Humankind works and lives. It is the simulation of human intelligence processes (learning, reasoning and self-correction) by machines. Fraunhofer is making strides to understand, research and implement the myriad aspects of AI, with global partners and clients.

India and Germany are also working the alliances to come together in a synergistic manner, combine the strengths and opportunities so that together we can make a bigger impact. Both the countries recently brought out their respective strategy paper and roadmap for the field of Artificial Intelligence. The documents are remarkably aligned in their interests, and reinforce the strong partnership opportunity that already exists. German companies like SAP, BASF, Siemens, Bosch, XenonStack, Atos, Innoplexus, SAS India, Axiscades, ArStudioz, ClecoTech, Pimenta Group, and Integration InfoTech are actively working on Artificial Intelligence in different states of India.

India's potential to be one of the key global players in the future of Artificial Intelligence (AI) is very strong as it firmly backs its strengths. Indian BPO services (Business Process Outsourcing) providers could potentially be attractive in terms of skills and cost for tasks like cleaning and tagging of data in the near future. The cost-competitive talent in India will also play a big role in attracting big global companies to setup their companies in India. In addition, India is the third largest start-up ecosystem. in the world. There is a strong existence of Information Technology (IT) competencies, and premier institutes produce many talented engineers, mathematicians, coders and statisticians. The Indian Government is rapidly pushing towards digitization, with timely government funding initiatives to create good building blocks for an Artificial Intelligence (AI) ecosystem.

Healthcare, Smart mobility, Industry 4.0 and Agriculture could be the immediate topics of foci for the two countries to cooperate. There are several reasons why a strategic cooperation in this field could pave the way for a powerful lighthouse project. Germany and India have complementary strengths, and similar value systems. Both follow the social democratic model of governance. While Germany is a world leader in Engineering and Product development, India has proven leadership in software skills. Both India and Germany are not Leaders in AI, and need to catch up quite a lot vis-a vis countries like Japan, US and China. This collaboration can help to leapfrog the technology gap. Data is the new oil, while Germany had a very strict policy on data access and usage, India has a more pragmatic approach to use of data. This can be a powerful tool to work further on AI.

We at Fraunhofer strongly believe that AI will shape the future and hence are putting together a strong programme of collaborative research and development, that will contribute immensely to our future generations. This issue carries a glimpse into our work and experiences in this field as well as a look into our work in India.

We hope you enjoy reading it as much as we did in putting it together for you. Happy Reading!

Anandi Iyer



70 years of Fraunhofer – 70 years of future

Ceremony to mark the start of the anniversary year / Statement of intent to set up Institute for Cognitive Systems.

The Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. was founded in Munich on March 26, 1949, to help rebuild Germany's economy. It celebrated its 70th anniversary on March 26th 2019. With its clear focus on new key technologies and markets, the Fraunhofer-Gesellschaft has become German economy's innovation engine and Europe's leading organization for applied research. The anniversary year is an occasion for the Fraunhofer-Gesellschaft not only to look back, but also to look ahead to the future by preparing strategic initiatives for Germany and Europe.

This occasion also set the stage for a joint statement of intent by the Fraunhofer-Gesellschaft, LMU and TUM. The three organizations aim to establish an Institute for Cognitive Systems in Bavaria to find solutions to pressing questions about Artificial Intelligence (AI), Machine Learning and Cyber Security. The idea is to pool the expertise in these cutting-edge fields to build the bridge needed to cross the divide between basic and applied research. Joining forces with other players, this Munich-based alliance aims to develop the outlines of a concept to be implemented as a key component of the German Government's AI strategy. Research and development efforts will focus on AI in combination with resilient cognitive systems and specific AI solutions for autonomous systems.

The Fraunhofer-Gesellschaft – a model for success and a success story

On March 26, 1949, State Secretary Hugo Geiger invited 210 scientists, entrepreneurs and members of society to the Bavarian Ministry of Economic Affairs. He aimed to help revive the economies of Bavaria and Germany by setting up the Fraunhofer-Gesellschaft. While children played amid the rubble, and the Wirtschaftswunder – Germany's post-war economic miracle – was yet a distant prospect, the Munich office's staff of just three people took up the challenge of advancing applied research in Germany. Electing Hermann von Siemens President in the mid-1950s and founding the first of its institutes, Fraunhofer-Gesellschaft gradually evolved to become a mainstay of research in Germany. In the mid-1960s, Fraunhofer was officially designated the German science community's umbrella organization for applied research. In the mid-1970s, the Fraunhofer model of performance-based funding sparked the dynamic success that shows no signs of slowing. Germany's reunification presented unexpected opportunities to expand. Moving swiftly and resolutely, Fraunhofer-Gesellschaft was quicker than other research organizations to seize the day, setting up more than 20 new institutes and facilities in the states that had newly joined the Federal Republic.

1. At the ceremonial act marking the 70th anniversary of the Fraunhofer-Gesellschaft (from left to right): Mr. Hubert Aiwanger, Minister of State, Prof. Reimund Neugebauer, President Fraunhofer-Gesellschaft, Dr. Markus Söder, Minister President, Bavarian, Ms. Anja Karliczek, Germany's Federal Minister of Education and Research, Mr. Bernd Sibler, Minister of State
Image Credit: Mr. Marc Müller



“As a pioneer of applied research, the Fraunhofer-Gesellschaft is an excellent catalyst for the German and European economy. I hope the Fraunhofer-Gesellschaft will carry on exploring new avenues to ensure research outcomes and new technologies reach industry and society quickly and efficiently”.

Ms. Anja Karliczek, Germany’s Federal Minister of Education and Research

Bavaria and Fraunhofer are the dream-team for cutting-edge research and innovation. Founded in Bavaria, Fraunhofer set out from Munich to create a research network unlike any other worldwide. This is no random happenstance; it is the result of a resolute effort to rise to ever-new challenges. We are proud of Fraunhofer and will continue to ensure that research remains our priority in the future.

Dr. Markus Söder, Minister President, Bavarian

On its 70th anniversary, the Fraunhofer-Gesellschaft is Europe's largest organization for applied research and has evolved to become our economy’s innovation engine. Fraunhofer is an important partner for companies engaging in research and development, and for medium-sized enterprises especially. This is how Fraunhofer is doing its part to secure the future viability of business in Germany and Europe.

Mr. Hubert Aiwanger, Bavarian Minister of State for Economic Affairs

Excellence in research is essential, but it is no less important to identify emerging issues early on and set the course for the future with fresh ideas. This enables us to respond that much faster to market demands. Our employees are the key to our success. Like our eponymous founder, they strike the right balance between research and entrepreneurship, take responsibility for the future, develop solutions for tomorrow's challenges, and keep asking: What's next?

Prof. Reimund Neugebauer, President, Fraunhofer Gesellschaft

“It is very important for us to walk the sustainability talk. Energy and resources, health and the environment, manufacturing and services – these important topics are among the Fraunhofer-Gesellschaft’s key fields of research, alongside mobility, communication and security.”

Prof. Heinz Jörg Fuhrmann, Chairman of the Executive Board at Salzgitter AG and Chairman of the Senate of the Fraunhofer-Gesellschaft

“Innovative power is a key success factor for industry. The Fraunhofer-Gesellschaft, like no other organization, stands for application-oriented research and the successful transfer of new insights and technologies to the market. Research organizations and companies in Germany and Europe must further accelerate the transfer of knowledge to achieve enduring success against competition from other regions of the world in the innovation stakes.”

Dr. Reinhard Ploss, CEO, Infineon Technologies AG

2. Presentation of the prize "The Fraunhofer", the highest honour of the Fraunhofer-Gesellschaft: Mr. Günther Oettinger, EU Commissioner for the Budget and Human Resources, and Prof. Reimund Neugebauer, President of the Fraunhofer Gesellschaft.
Image Credit: Mr. Marc Müller



Fraunhofer celebrates a decade of glorious existence in India!

Achievements of Fraunhofer in past 10 years.

Fraunhofer has been active in India since the past several years, bringing innovative technologies and research competence to India. Fraunhofer offers applied R&D services in various fields such as technology, textiles and new materials, aviation, food technology, aerospace and ICT. Fraunhofer is the chosen R&D and innovation partner of some of the giant players in the field of Material Science, Energy, Environment, Automotive, Electro-mobility, Production Technology and Smart Cities of Government and private organisations.

Fraunhofer came to India in the middle of 2008 and since then has achieved huge credibility and respect among its Industry clients, Government and Research organisations in India. They have been a long time trusted innovation partner in India, collaborating with some of the major players in the field of Material Science, Energy, Environment, Automotive, Electro-mobility, Production Technology and Smart Cities, working with Industry, Government and Public Sector. Fraunhofer's industry clients have grown tremendously over the last years and they are earning nearly 5 Million Euros annually from Indian clients for R&D projects.

HIGHLIGHTS: Partnerships in the Past Decade

Smart City Innovation Labs in Coimbatore and Kochi, 2017.

In Coimbatore:

- Smart City Innovation Lab on Mobility with Coimbatore City Municipal Corporation (CCMC)

Fraunhofer is in cooperation with Coimbatore City Municipal Corporation to set up a Smart City Innovation Lab, funded by KfW to develop sustainable solutions in Mobility. The objectives are to develop smart urban mobility solutions for clean and green development of Coimbatore by reduction of emissions and resource consumption and creating urban data platform.

- Water Competence Network >>Smart Water Future India<<

Fraunhofer is coordinating a project Smart Water Future India, funded by German Federal Environment Ministry's (BMU) Export Initiative Environmental Technologies to develop intelligent water and wastewater management strategies in Coimbatore. This network will serve as a potential Water Innovation Hub for entire South India.

In Kochi:

- Smart City Innovation Lab on Sustainability and Resilience with Cochin Smart

1. Signing of MoU between Fraunhofer and Coimbatore City

2. Launch of Kochi Smart City Innovation Lab
L to R: Mr. APM Mohammed Hanish - MD, CSML, Mr. Damian Wagner - Sr. Project Manager, Fraunhofer IAO, Prof. KV Thomas - MoP, Ernakulum District, Smt. Soumini Jain - Kochi Mayor, HE. Dr. Martin Ney - German Ambassador, Shri. TK Jose - ACS, LSGD, Ms. Anandi Iyer, Director, Fraunhofer Office India.



- Project cooperation with Core Group of Automotive Research (CAR) to the tune of nearly Euro 1 Million, October 2012

One of the four projects under this cooperation agreement is working with Indian Automotive Industry for advanced ecological and economical production of automobiles with the project volume of nearly a Million Euros, and among the participants are the Fraunhofer Institutes for Machine Tools and Forming Technology IWU, for Material and Beam Technology IWS, for Manufacturing Technology and Advanced Materials IFAM and for Non-Destructive Testing IZFP. The project was completed successfully.

MoU with ACMA, SIAM and NATRiP for the Automotive sector, March 2010

The MoU was signed between Fraunhofer and Industry body, Automotive Components Manufacturers Association (ACMA), Society of Indian Automobile Manufacturers (SIAM) and National Automotive Testing and R&D Infrastructure Project (NATRiP) to enable faster implementation of light weighting technologies in Indian Automotive sector through collaborative Research & Development.

Technology Partner status (applied for) to the International Solar Alliance, October 2018

The ISA is an alliance of 121 solar resource rich countries jointly launched by the Indian Prime Minister, Shri. Narendra Modi, and the then President of France, H.E. Francois Hollande with a mission and vision to provide a dedicated platform for cooperation among solar resource rich countries, global stake holders, including bilateral and multilateral organisations , corporates, and industry to make a positive contribution to assist and help achieve the common goals of increasing the use of solar energy in meeting energy needs of prospective ISA member countries in a safe, convenient, affordable, equitable and sustainable manner. This partnership is aimed at accelerating the worldwide effort to scale up renewable energy and connect the global investment community with Indian energy stakeholders.

Over the last 10 years Fraunhofer has generated several Million Euros in contract research in India and developed an extensive network of partners and clients from the Government, Research Institutions and Industry. The journey continues with renewed vigour and commitment.

5. Signing of MoU between Fraunhofer and Ministry of New and Renewable Energy (MNRE), Govt. of India

6. Signing of MoU between Fraunhofer and Hindustan Machine Tools (HMT)

Artificial Intelligence Strategy of the Two Nations: An illustrative summary

Germany and India:

That Artificial Intelligence “AI” is growing faster than ever before, is no surprise. Since 2010, it has grown at a compounded annual growth rate of almost 60%. Germany and India have set out a framework for a holistic policy on the future development and application of “Artificial Intelligence.”

Germany

- The Federal Government’s Artificial Intelligence (AI) strategy was jointly developed by the Federal Ministry of Education and Research, the Federal Ministry for Economic Affairs and Energy, and the Federal Ministry of Labour and Social Affairs
- The strategy aims to make Germany and Europe to a leading centre for AI and thus help safeguard Germany’s competitiveness in the future.
- Develop existing Centres of Excellence for AI at supra-regional level, establish additional ones, and develop them into a national network of at least twelve centres and application hubs
- Increase AI-specific support for small and medium-sized companies. The Mittelstand 4.0 centres of excellence will have ‘AI trainers’ contact at least 1,000 companies per yearA European innovation cluster providing funding for cooperative research projects over the next five years
- Initiate a European and transatlantic dialogue on the human-centric use of AI in the world of work.
- Development of innovative applications that support self-determination, social inclusion, cultural participation and the protection of citizens’ privacy.
- Improve the policy framework for the voluntary sharing of data in compliance with data protection rules.
- The 2019 Federal budget has allocated a total of € 500 million to beef up the AI strategy. Up to 2025, the Federation intends to provide € 3 Billion for the implementation of the strategy.

India

- AI for All - The brand proposed for India implies inclusive technology leadership, where the full potential of AI is realised in pursuance of the country’s unique needs and aspirations.
- Five Sectors to be focussed
 - Healthcare
 - Agriculture
 - Education
 - Smart Cities and Infrastructure
 - Smart Mobility and Transportation
- Centre of Research Excellence (CORE) focussed on developing better understanding of existing core research and pushing technology frontiers through creation of new knowledge.
- International Centers of Transformational AI (ICTAI) with a mandate of developing and deploying application-based research
- “Moonshot Research Projects” a specialised team to channel research in solving big, audacious problem of AI – “CERN for AI”
- Common platform called the National AI Marketplace (NAIM) to effectively addressed the barriers of AI development.
- Establishing data protection frameworks and sectorial regulatory frameworks, and promotion of adoption of international standards.

Source Credit: AI Strategy NITI Aayog

Made in Germany, The National AI Strategy of the Federal Government

An interview with Ms. Anna Roy, Senior Advisor, NITI Aayog



What is the policy focus of India on AI?

Application of Artificial Intelligence, more specifically Machine Learning, has emerged as a transformative new way to address some of the biggest societal and business challenges. India's approach to leveraging AI is underpinned by a combination of three inter-related factors: (a) the economic opportunity, (b) technology aimed at pursuing inclusive growth and (c) establishing India as the technology garage for the world. #AIforAll embodies our aspirations and our priorities.

Our focus is on utilizing AI based solutions in sectors that are characterized by the greatest externalities. We are keen to solve the challenges of access, affordability and availability in our priority sectors viz. Healthcare, Agriculture, Education, Mobility, Urbanization etc. through AI. The dominant theme of India's ~USD 1 trillion AI opportunity by 2035 is augmentation of human capabilities, not automation.

What are India's inherent strengths in AI?

As the world's fastest growing large economy that has demographics dividends in its favour by virtue of being a nation with average age of its population less than 30 years and a burgeoning middle class expressing its consumer preferences, India provides the ideal playground for AI solutions. The diversity of use cases, the richness of datasets and the strength of large STEM population act as the requisite essential fundamentals for India's march towards AI leadership. India's transformation to a truly digital nation and emphasis on developing billion-scale technology infrastructure platforms viz. Unified Payments Interface, Ayushman Bharat etc. will act as the building blocks for our AI interventions.

If you evaluate our research and development capabilities in AI, while we are some way behind the runaway leaders US and China, our academicians and researchers have powered India to be amongst the top 5 publishers of citable documents in AI, as measured by SJR for the time period 2010-16. Institutions like IISc Bangalore, IIT Madras, IIT Bombay, IIT Delhi and IIIT Hyderabad have been the flag bearers of our AI research capabilities. India also has a rapidly evolving AI startup ecosystem, with more than 500 startups in various stages of their journey.

Roadmap for the Future: how is NITI Aayog shaping AI in India?

India's National Strategy for Artificial Intelligence (Strategy), developed by NITI Aayog and released in June 2018, benchmarks our current capabilities in AI and lays down the essential roadmap for realising India's AI aspirations. We are in the process of developing the institutional framework and funding mechanism for implementing the recommendations of the Strategy through a national program titled NSAI. NSAI aims at building India's capabilities in AI research, both fundamental and applied research. NSAI has recommended setting up 5 Centres of Research Excellence in AI (COREs), focused on creating new knowledge through

Ms. Anna Roy is in charge of Frontier Technologies and has been instrumental in preparing the discussion paper on Artificial Intelligence Strategy for India.

NSAI also recommends developing a centralized cloud-based AI computing and storage facility, called AIRAWAT. AIRAWAT, with more than 100 petaflops of computing infrastructure, is aimed at addressing the need for computing and storage infrastructure for researchers, academicians and startups across the nation; thus averting siloed infrastructural efforts that typically lead to islands of limited.

basic research, and 10 International Centres for Transformational AI (ICTAIs), focused on creating AI based applications for, and accelerating early adoption in, domains of societal importance. These two sets of institutes are designed to develop India's research capabilities both in the short term and the long run. In the short term, given the paucity of large pool of research expertise in India; incentivizing the best of academicians, researchers, PhDs and PostDoc aspirants from across the globe to make India their preferred professional destination, by providing the best of research infrastructural facilities, use-case based research opportunities and best-in-class remuneration, is our priority. In the long run, we envision COREs and ICTAIs to exponentially enlarge our PhD and PostDoc pool.

Through NSAI, India will also pursue Moonshots, ambitious explorations that push the technology frontier. These Moonshots i.e. use-case defined research interventions characterized by the Pasteur's Quadrant, are aimed at developing exponential solutions to tackle some of the biggest challenges India has. An example of such a Moonshot, which NITI Aayog is currently developing, is the Imaging Biobank for Cancer. The Biobank is envisaged to be the largest atlas for cancer data capsules globally, more expansive than the TCGA and the EGA. This Biobank will have radiology and pathology images combined with patient information (profile, follow-up history, treatment schedule, genomic information if available etc.) of more than 20,000 patients for a longitudinal period of more than 10 years, all digitalized and annotated. Through this Biobank, we aim to incentivise our researchers and startups to develop India specific AI-based cancer diagnosis and treatment solutions, thus truly democratising access to quality and affordable cancer treatment in India. Other Moonshots that we are pursuing include BharatBhashaStack, natural language processing library for top 8 Indian vernacular language and AgriStack, a comprehensive repository of agridata and agronomic APIs.

The effort of NITI Aayog has been to foster a collaborative approach where various stakeholders converge and collaborate to achieve the size and scale required to realize the targets set in NSAI. We have also proposed AI for All Alliance, a multi-disciplinary multi-national collaboration aimed at tackling the most audacious challenges of AI viz. ethical, fair and transparent implementation, with critical elements of security and privacy built in. The Alliance also envisions changing the adoption narrative from the current bottomline based paradigm to areas that offer transformative potential such as universal healthcare, access to nutrition, education and financial products etc.

In this regard, I am pleased to note that the governments of India and Germany, through NITI Aayog and Fraunhofer Gesellschaft, are exploring a Joint Declaration of Intent, for collaboration in AI in defined focus areas: Mobility, Health, Agriculture, Information Technology and Manufacturing. Through joint research exercises and collaborative products, the two countries are committed to developing AI solutions aimed at greater good.

Decoding Artificial Intelligence with Prof. Dr. Stefan Wrobel



Will Artificial Intelligence replace the Human Intellect?

An Interview with Prof. Dr. Stefan Wrobel, Institute Director, Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS and spokesperson, Fraunhofer Big Data and AI Alliance

Everyone is talking about AI, but what exactly is artificial intelligence?

We humans see and hear, we make plans and we adapt them to changes. AI is when we replicate these kinds of cognitive achievements using machines or computers. We still don't know exactly how the human brain actually does these things, but in some areas we can devise mathematical processes that produce similar results. A machine uses algorithms to analyse sample data from which it then derives models and thereby gradually improves its behaviour.

So that's the reality. Where do the myths begin?

Many fears stem from one assumption: that artificial intelligence thinks the way humans do. We see how AI beats humans at chess and Go, or how it translates human language from German to Italian and calls the hairdresser to make an appointment, and we conclude that if AI can do all that, then it can also do everything else we humans can do. But that's precisely where we're wrong. Artificial intelligence today still lacks the integrated understanding that we humans possess when it comes to certain processes.

What can AI do?

It's definitely not a myth that AI can replace humans in certain domains. If a task is clearly defined and delimited and there is sufficient data or human knowledge available, artificial intelligence can accomplish feats that rival those of human experts. It may even exceed them.

And what can AI not do?

Each artificial intelligence system is developed for a specific purpose. It's currently not possible to automatically apply these systems to other purposes. For example, if a system has been trained to translate sentences from German to Italian, it can't automatically also answer questions in German or Italian. Another fundamental issue concerns self-reflection: artificial intelligence doesn't yet know what it cannot do. If an AI system for diagnosing milling machines is suddenly asked to analyse a punch machine, it won't refuse – but it also won't produce any meaningful results.

When will AI overcome these limits?

Everyone wants to know what the future will bring and when. Much in the field of AI has

Prof. Stefan Wrobel is the Director of the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS and spokesperson for the Fraunhofer Big Data and Artificial Intelligence Alliance. The German Informatics Society recently named him one of the ten "most influential minds in German AI history."



2

happened faster than even we imagined possible. Other things, however, are taking longer. What we can say is that we are seeing advances monthly, almost even weekly. Even next year's AI systems won't be like the ones we have today. But there's no way to reliably predict when artificial intelligence will have come far enough that it can use global knowledge and context the way we do. It may be ten or 20 years or more before AI is generally as flexible as human intelligence. It's important not to get caught up in thinking about the future possibilities of AI. Rather, we should take advantage of the opportunities it already offers. Only by using AI today can we remain competitive!

2. Building trust in Artificial Intelligence - interdisciplinary team from IT, Philosophy and law defines priorities for the certification of AI

Image Credit: Fraunhofer IAIS

Dr. Dirk Hecker, Managing Director, Fraunhofer Big Data Alliance, Germany



Fraunhofer bets big on Big Data

Fraunhofer Alliance Big Data and Artificial Intelligence

Big data is more than a hype. Big Data is essentially defined as very large amounts of diverse data being generated at exceptionally high speed as is increasingly happening anywhere and everywhere throughout the world – in companies, in urban infrastructures and in private households. Big data is a key technology and as such is of great importance to the economy, science and society as a whole.

Access to big data is particularly important in business as it can give companies a significant knowledge-based and value creation head start. This is one of the key findings of a Fraunhofer study analysing big data and its potential to innovate in the corporate environment. Companies are increasingly looking to reap benefits from big data in terms of competitive advantages, increased turnover and higher levels of productivity. This goes hand in hand with a growing demand for big data expertise and tailored technical support solutions.

The Fraunhofer Big Data Alliance sees itself as an independent big data process chain adviser providing technological support to partner businesses from the initial roadmap to the effective roll-out of specific solutions – in business processes, in production and logistics and research and development.

Our experts can provide support in every significant sector. We use powerful IT infrastructures and are able to control core technologies including data management and real-time processing of data, machine learning, visual analytics and data protection and safety.

We support young talented »big data experts« and managerial staff by offering extensive training programmes to help expand their big data skills. Our programmes not only cover big data basics but also sector-specific big data strategies, technology and applications.

Business Area

- Production & Industry 4.0
- Energy & Environment
- Logistics & Mobility
- Data Security
- Life Sciences & Healthcare

Machine Learning to Ease the Fight for Cancer Patients



Machine Learning Helps Physicians in Cancer Monitoring

Fraunhofer Institute for Digital Medicine MEVIS

Has a tumour shrunk during the course of treatment over several months, or have new tumours developed? To answer questions like these, physicians often perform CT and MRI scans. Tumours are usually evaluated only visually, and new tumours are often over-looked. "Our program package increases confidence during tumour measurement and follow-up," explains Mark Schenk from the Fraunhofer Institute for Medical Image Computing MEVIS in Bremen, Germany. "The software can, for example, determine how the volume of a tumour changes over time and supports the detection of new tumours." The package consists of modular processing components and can help medical technology manufacturers automate progress monitoring.

The computer learns on its own:

The package is unique in its use of deep learning, a new type of machine learning that reaches far beyond existing approaches. This method is helpful for image segmentation, during which experts designate exact organ outlines. Existing computer segmentation programs seek clearly defined image features such as certain grey values. "However, this can often lead to errors," according to Fraunhofer researcher Markus Harz. "The software assigns areas to the liver that do not belong to the organ." These errors must be corrected by physicians, a process which can often be quite time-consuming.

The new deep learning approaches promise improved results and should save physicians valuable time. To demonstrate their self-learning methods, Fraunhofer scientists trained the software with CT liver images from 149 patients. Results showed that the more data the program analysed, the better it could automatically identify liver contours.

Finding hidden metastases:

A further application of the approach is image registration, in which software aligns images from different patient visits so that physicians can easily compare them. Machine learning can aid the particularly difficult task of locating bone metastases in the torso in which hip bones, ribs, and spine are visible. Currently, these metastases are often overlooked due to time constraints in clinical practice. Deep learning methods can help reliably discover metastases and thus improve treatment outcomes.

Researchers focus on a combination of classical approaches and machine learning. Fraunhofer MEVIS builds upon years of experience in practical application: for example, the

Physicians have long used visual judgment of medical images to determine the course of cancer treatment. A new program package from Fraunhofer researchers reveals changes in images and facilitates this task using deep learning.

How do machine learning and deep learning work?

Machine learning methods comb through large data sets and identify common features and patterns. After training, the system can then analyse and evaluate new data sets of the same type. These methods are often employed for the automatic recognition of images, text, and speech.

1. 3D Visualization of a patient CT image with highlighted metastases of the spine. Deep learning methods help discover bone metastases, which can be overlooked in clinical routine.

Image Credit: Fraunhofer MEVIS



2

**Mark Schenk, Fraunhofer
Institute for Medical Image
Computing MEVIS**

“For automatic image recognition, deep learning is already head and shoulders above conventional approaches. We predict that we will achieve similar success for medical applications.”

algorithms for highly precise lung image registration have been integrated into several commercial medical software applications.

About Fraunhofer Institute for Digital Medicine MEVIS

Fraunhofer MEVIS develops real-world software solutions for image and data supported early detection, diagnosis, and therapy. Strong focus is placed on cancer as well as diseases of the circulatory system, brain, breast, liver, and lung. The goal is to detect diseases earlier and more reliably, tailor treatments to each individual, and make therapeutic success more measurable.

In addition, the institute develops software systems for industrial partners to undertake image-based studies to determine the effectiveness of medicine and contrast agents. To reach its goals, Fraunhofer MEVIS works closely with medical technology and pharmaceutical companies, providing solutions for the entire chain of development from applied research to certified medical products.

2. Deep learning algorithms autonomously find interesting spots in new digital images of tissue samples based on an automated analysis. Starting with the highest resolution, these neuronal networks compress the data until information and image interpretations emerge. They help doctors perform faster and safer diagnoses. When doctors correct the computer diagnosis, new knowledge flows in the self-learning algorithm.

Meeting Unmet Health Needs with Intelligence



1

Artificial Intelligence in Healthcare

Fraunhofer Institute for Computer Graphics Research IGD

Medicine of the future seeks to take this point into account and treat each patient according to an individually optimized strategy. This is based on large data volumes from different data sources. Intelligent systems are increasingly relied upon to analyse and evaluate the data mountains. But how can humans make the right use of the data generated and processed by artificial intelligence? Visual computing technologies are an essential approach. At Fraunhofer IGD, researchers have been using methods and processes of machine learning and artificial intelligence for years to analyse and evaluate vital and health data as well as disease-related patient data and to develop technologies along the entire treatment chain.

Medicine is changing: A journey from general treatment methods to individual therapy. Artificial intelligence in conjunction with visual computing technologies offers completely new possibilities.

- **Artificial Intelligence for Diagnoses:**

Artificial intelligence can do a lot at the beginning of the diagnosis. For example: When the patient visits the doctor. First of all, it is important to determine and diagnose the cause of symptoms – which is about recognizing and marking the shape, position and structure of body parts, organs, tissue or cells in medical image data. If the image data is three-dimensional such as MRI or CT, this is a complex undertaking that is virtually impossible to master manually. The scientists at Fraunhofer IGD have, therefore, developed corresponding machine learning processes: These can segment anatomical structures into image data simultaneously, completely and automatically, and graphically present the results to aid in the diagnosis.

- **Artificial Intelligence in Analysis: Effectively Learning from Patient and Treatment Data**

Once this step is complete, the physician compares the patient's findings with those of other people. If physicians want to analyse large amounts of patient data and thus make a more robust statement on their findings, they form cohorts, that is, patient groups with relevant similarities. But does the educated cohort produce what it promises? Or could it be refined? These questions can be answered using individually adapted visual analysis tools from Fraunhofer IGD which visualize the attributes, analyse them in detail and provide the attending physician with important insights for the treatment of the patient.

- **Augmented Reality During Operation:**

The knowledge gained from the previous image and data analysis simplifies the determination of suitable treatment, which also uses visual computing technologies from Fraunhofer IGD. In the operating room, physicians have to prove their skill by being able to estimate the exact location of organs, blood vessels and diseased tissue during a procedure.

1. Image Credit : Fraunhofer Institute for Computer Graphics Research IGD



The integration of an augmented reality system helps to remedy this situation and supports the physician with visual markings during the operation. In this case, the position of the organ is virtually superimposed using AR glasses.

- **Artificial Intelligence in Follow-Up Care: Detecting Anomalies In Vital Data:**

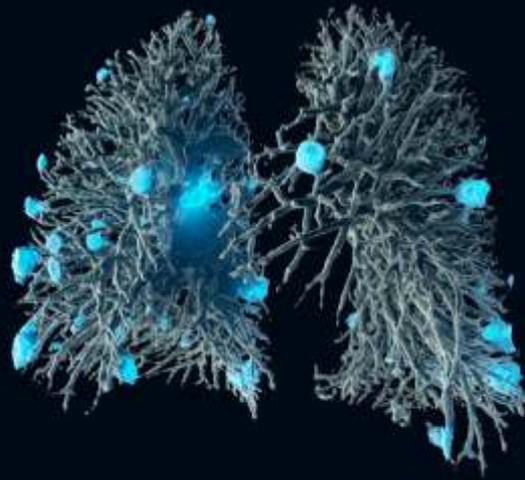
The patient continues to receive care after the operation – based on their vital signs. What about, for example, the quality of sleep and the stress level of the patient? Do anomalies such as sleep apnea or unconsciousness occur? This can be determined by analysing vital signs, such as heart rate, heart rate variability or respiratory rate. A solution from Fraunhofer IGD comprehensively records the data, evaluates it continuously, and detects anomalies quickly. Multiple sensors and situation-dependent algorithms increase the robustness of the detection. The data is used to support in-home care but can also be incorporated into a visual control station for hospital staff also developed by Fraunhofer IGD, thus ensuring the central observation of the patient.

About Fraunhofer Institute for Computer Graphics Research IGD

Founded 30 years ago, Fraunhofer IGD has become the world's leading institution for applied research in the field of visual computing. Visual computing means image and model-based IT. In simple terms, it describes the capability of transforming information into images (computer graphics) and extracting information from images (computer vision). The numerous application scenarios include human/machine interaction, interactive simulation, and modelling situations.

2. Digital patient models save a huge amount of costs in the healthcare industry

Photo Credit : Fraunhofer Institute for Computer Graphics Research IGD



Information Integration and Artificial Intelligence for Better Diagnosis and Therapy Decisions

Fraunhofer Institute for Digital Medicine MEVIS

With the joint research alliance, Siemens Healthineers and the Fraunhofer Institute for Medical Image Computing MEVIS will support physicians in finding the right course of therapy for the patients. Both Fraunhofer MEVIS and Siemens Healthineers are jointly developing artificial intelligence software systems to facilitate diagnosis and therapy decisions with the help of advanced data integration, comprehensive databases, and automatic recognition of patterns and regularities in data (deep machine learning). The goal is to support physicians to define the best possible treatment approach for their patients fast and ensure that they receive the maximum benefit with minimum side effects.

Research alliance between Fraunhofer MEVIS and Siemens Healthineers develops decision support systems for physicians based on deep machine learning.

All Relevant Information in One Central System:

Today, most of the information in clinics and medical practices is stored digitally. Until now image data, findings, lab values, digital patient records, and surgery reports are handled separately. However, there is a current trend aimed at gathering this information in one unified software framework. This data integration enables faster handling of medical information and lays the foundation for more efficient interaction between different specialties and to enable more precise and personalized clinical decisions. It also promises added value: New self-learning computer algorithms can detect hidden patterns in the data and give physicians valuable support for their diagnosis and therapy decisions.

Focus on Tumour Diseases:

Based on comprehensive databases, the research partners will develop software systems that support clinicians in finding the best possible course of therapy. The work focuses on tumour diseases, such as lung cancer, for which physicians have to determine the necessity of a biopsy, a procedure known to be stressful for patients. The systems of Fraunhofer MEVIS and Siemens Healthineers would support physicians' decisions in the future. The goal is to let the software display all the information that could be relevant for decision-making. A physician would not have to gather information from separate sources, saving valuable time. Additionally, the guidelines of medical specialist societies will be integrated automatically, providing physicians with valuable support. Ultimately, the algorithms will link the case at hand with a comprehensive database. Which methods have provided the greatest benefit in similar cases? Does a nuclear medicine method such as PET/CT make more sense than a biopsy? Most of all, the new system will help determine the best possible course of therapy. It

1. Volume rendering of vascular tree and metastases in the lung.
Image Credit: Fraunhofer MEVIS

will enable physicians with different specialties to access one central system to view all relevant information, including e.g. X-ray and MR images, tissue analyses, genetic parameters, lab values, and important data from the patient's medical history. Computer programs will search for patterns in comprehensive databases that could deliver helpful insight into the case at hand: Did surgery outperform radiation therapy in similar cases? Does an ongoing course of chemotherapy bring the anticipated success, or should it be ceased? The partners already have elementary access to necessary reference databases, but much will be developed and completed after the project commences. A leader in medical technology, Siemens Healthineers is constantly innovating its portfolio of products and services in its core areas of diagnostic and therapeutic imaging and in laboratory diagnostics and molecular medicine. Together with its customer network, the company is able to develop new methods for computer-assisted medicine and transfer them to the market. Fraunhofer MEVIS brings important fundamental technology to the collaboration. The institute is excellently established in the international research community and cooperates closely with physicians from university clinics.



Going Global with AI and Health: A World Health Organisation (WHO) and International Telecommunications Union (ITU) Initiative

**Establishment of a Benchmarking Process For Artificial Intelligence Algorithms
Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI**

Growing populations, demographic changes, and a shortage of health practitioners have placed pressures on the health-care sector. In parallel, increasing amounts of digital health data and information have become available. Artificial intelligence (AI) models that learn from these large datasets are in development and have the potential to assist with pattern recognition and classification problems in medicine—for example, early detection, diagnosis, and medical decision making. These advances promise to improve health care for patients and provide much-needed support for medical practitioners. Over the past decade, considerable resources have been allocated to exploring the use of AI for health. Although there is immense potential, many issues such as regulation, potential for bias, and adequate evaluation of efficacy must first be addressed for safe and ethical implementation of AI in health care. Modern AI algorithms are complex, and their performance depends on the quality of the training data and learning mechanism. If AI algorithms are poorly designed or the training data are biased or incomplete, errors can occur. There is no agreed framework for assessing or reporting the results of health AI models before deciding whether they are sufficiently robust for application in a population, as there is for new drugs or surgical interventions. The absence of confidence or quality control is a major barrier to the uptake of AI in health care. Creating a rigorous, standardised evaluation framework that leverages the advantages and addresses the limitations of AI models in health is crucial for realising the potential of this technology and limiting risks. Two UN agencies, WHO and the International Telecommunication Union (ITU), established a Focus Group on Artificial Intelligence for Health (FG-AI4H) in July, 2018. FG-AI4H is developing a bench marking process for health AI models that can act as an international, independent, standard evaluation framework.

To establish this evaluation and bench marking process, FG-AI4H is calling for participation from medical, public health, AI, data analytics, and policy experts. Topic groups are being formed by communities of stakeholders allowing FG-AI4H to develop its processes for AI evaluation and bench marking specific for each health topic. Each topic use case will be reviewed for its relevance and should impact a large and diverse part of the global population or solve a health problem that is difficult or expensive. The AI models are expected to offer

The Focus Group on "AI for Health" (FG-AI4H), with the participation of the Fraunhofer Heinrich Hertz Institute HHI, invites experts from the fields of medicine, artificial intelligence (AI), data analysis, and regulation to participate in the benchmarking processes for artificial intelligence in healthcare. To safely implement AI technologies in the healthcare sector.

1. Image Credit: Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI



improvements over current practices in quality or efficiency that would be expected to lead to better health outcomes or cost-effectiveness. Once formed, topic groups will provide a forum for open collaboration among stakeholders who agree on a pragmatic, best-practice approach for bench marking each use case, including defining the application scenario and desired output of AI models in that use case, identifying adequate sources of training and testing data, and facilitating the preparation of multisource heterogeneous data. All data for training and testing are expected to be of high quality, ethically generated, and accompanied by detailed information about their format and properties. Thus far, FG-AI4H has developed 11 topic groups in areas such as cardiovascular disease risk prediction, ophthalmology (retinal imaging diagnostics), and AI-based symptom checkers, but this approach is expected to be expanded to other tasks.

The benchmarking process will be done on secure, confidential test data. Ideally, test data will originate from various sources to determine whether the use of an AI model can be generalised across different populations, measurement devices, and health-care settings. The benchmarking process for each use case within a topic needs to be defined. For many use cases it would, at least initially, be meaningful to compare model performance against human performance, or human performance with AI assistance in the same task, whereas for other tasks, comparative performance of algorithms would be more meaningful. Once these requirements are met, AI models can be submitted via an online platform to be evaluated with the test data. Established in this way, the benchmarking process will not only provide a reliable, robust, and independent evaluation system that can demonstrate the quality of AI models, but will also provide an independent test dataset for model validation consistent with best practice recommendations for reporting multivariable prediction models in health. FG-AI4H has held three workshops and meetings and its ambitious task has received a positive reception from companies, academics, policy makers, software developers, and device manufacturers. The group met in Shanghai, Geneva and Tanzania. The next meeting is planned from 11 – 15 November in New Delhi (India). We invite the academia, technology, and regulatory communities to contribute to FGAI4H by sharing topics, data, expertise, use cases, and algorithms. The creation of an open and transparent process for evaluation of health AI models is key to realising the potential of AI to improve human health worldwide.

2. AI for Health" (FG-AI4H)

Image Credit: AI for Health" (FG-AI4H) workshop.



Cognitive Agriculture: Digitalisation & Automation of Agricultural Processes to Increase Productivity and Sustainability

Fraunhofer Institute for Experimental Software Engineering IESE

Digitalization as an Opportunity for The Agricultural Sector:

Industrialization has had a strong impact on agricultural technology in recent decades. Increasingly larger working widths and speeds as well as increasing degrees of automation have led not only to a significant rise in productivity, but also to heavier machines. Fertilization, excessive use of herbicides, pesticides, and fungicides, or various types of genetically modified seeds also cause permanent damage to the biosphere. Organic agriculture has evolved as an alternative. Here, the focus is on resource-friendly farming, and productivity losses are accepted deliberately.

With Fraunhofer Towards Highly Efficient and Sustainable Agriculture of the Future:

In the Fraunhofer lighthouse project "Cognitive Agriculture" ("COGNAC" for short), eight Fraunhofer Institutes are doing joint research on basic principles that will enable farmers to achieve high productivity in line with further goals such as sustainability or product quality in our digitalized world. A uniform value system shall reflect decisions regarding the key aspects sustainability, resource efficiency, costs, and product quality. For this purpose, data on factors related to the agricultural enterprise and to the environment must be collected automatically with state-of-the-art sensor technology and must be evaluated, analysed, and processed cognitively in agricultural work and business processes in order to make sustainable, fact-based decisions regarding both crop production and livestock farming.

In the lighthouse project "COGNAC", the participating Fraunhofer Institutes will design and implement an integrated platform for information-based (cognitive) agriculture. The goal is to connect the numerous isolated solutions and make them usable as a whole from end to end in order to achieve maximum productivity and sustainability. The value chain begins with crop production and livestock farming, but also includes further process and processing steps in the long term. The project is therefore expected to deliver crucial innovations in the three areas "Agricultural Data Space", "Novel Sensor Technology", and "Innovative Automation Concepts".

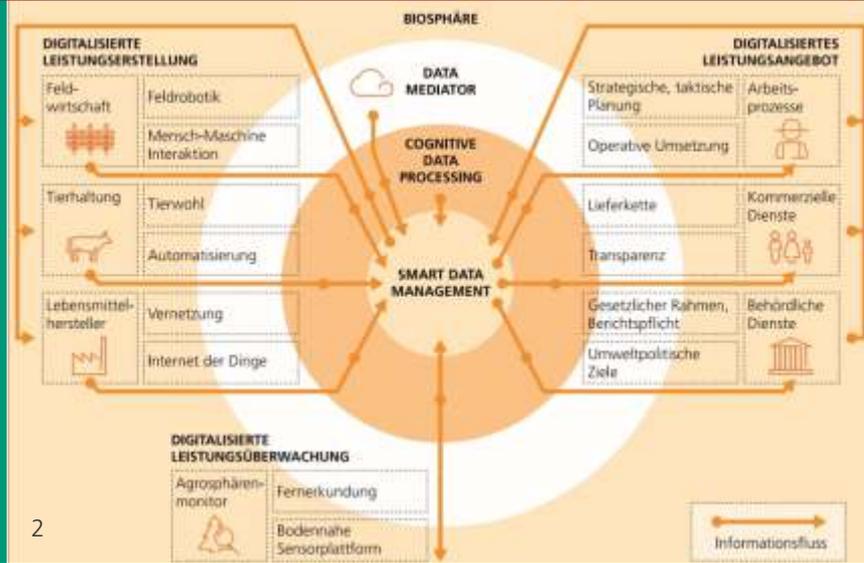
Increasing Productivity, Ensuring Sustainability:

Digitalization, automation, and electrification of agricultural processes offer numerous

Finding the right balance between sustainability and productivity is one of the goals of the United Nations 'Agenda 2030 for worldwide "Food Security and Sustainable Agriculture". This is in line with the new lighthouse project "Cognitive Agriculture" of the Fraunhofer-Gesellschaft, which aims at achieving a more efficient and at the same time more sustainable agriculture based on the comprehensive use of digital technologies. In this lighthouse project, eight Fraunhofer Institutes under the leadership of the Fraunhofer Institute for Experimental Software Engineering IESE in Kaiserslautern are jointly working on solutions for producing agricultural products in an environmentally friendly, resource-saving, and at the same time highly efficient manner.

1. Fraunhofer Lighthouse project "Cognitive Agriculture"

Image Credit: Fraunhofer Institute for Experimental Software Engineering IESE



2

Participating institutes:

- Fraunhofer IESE (leadership)
- Fraunhofer IFF
- Fraunhofer IKTS
- Fraunhofer IOSB
- Fraunhofer IPA
- Fraunhofer IPM
- Fraunhofer ITWM
- Fraunhofer IVI

starting points for resolving the conflict of goals between economy and ecology. Building on a more comprehensive understanding of the extensive cause-effect relationships in the biosphere, productivity can be further increased through optimized workflows based on comprehensive data; at the same time, sustainability can be achieved through highly automated subplot- or plant-specific field cultivation with appropriate agricultural implement technology.

The project “Cognitive Agriculture” aims to automatically collect data about complex interrelationships in farming and, based on that, to support decision-making processes in the value network.

An Agricultural Data Space as a Digital Platform:

Via a networked ecosystem of all relevant agricultural businesses, Fraunhofer wants to gain broad acceptance for “Cognitive Agriculture”. Taking into account the concept of the Industrial Data Space initiated by Fraunhofer, an Agricultural Data Space shall be designed as the platform of a digital ecosystem that overcomes the incompatibilities of existing solutions and enables data usage across the board by farmers, government agencies, environmental organizations, cooperatives, machine manufacturers, etc. while maintaining high standards of security and privacy.

The Focus Will Be On the Following Innovation Areas:

- Open data exchange in an agriculture-specific, digitally networked ecosystem that enables multivalent use and linking of complex agricultural data volumes in secure data spaces
- Automated interpretation and decision support based on high-resolution measurement data from airborne or ground-based systems using multi-channel measurement information
- Autonomous field robotics for plant-specific field work as well as robot-guided sensor platforms with specific sensor systems



Scientists from the Fraunhofer Research Centre for Machine Learning win the Syngenta Crop Challenge in Analytics

Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS

Today, industry and science rely on data driven strategies for more robust and efficient plant breeding. On the basis of environmental and growth data as well as profound expert knowledge, the Fraunhofer Research Centre for Machine Learning and the Cluster of Excellence Phenorob of the University of Bonn have now developed an Artificial Intelligence which determines environmental conditions in agriculture and their impact on plant growth.

Better seed, less fertilizer, high adaptability - intelligent data analysis can support agriculture sustainably and profitably. At the Fraunhofer Research Centre for Machine Learning, scientists are researching with the goal of developing a new generation of reliable ML processes. The centre is part of the Fraunhofer-Cluster of Excellence Cognitive Internet Technologies (CCIT) under the direction of Prof. Dr. med. Stefan Wrobel and Prof. Dr. Christian Bauckhage. In addition to the research centre, Prof. Dr. med. Mahlein the Cluster of Excellence Phenorob involved in the excellent technology: The University of Bonn, in cooperation with Fraunhofer IAIS, is researching and developing a sophisticated technique for recording and analysing data from agriculture.

Cluster of Excellence Cognitive Internet Technologies (CCIT):

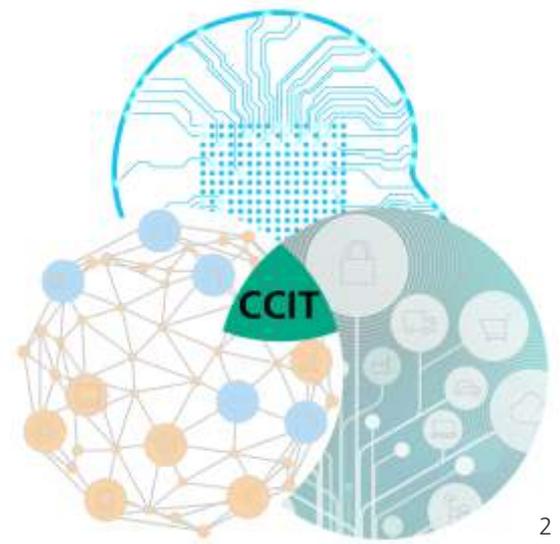
The Fraunhofer Research Centre for Machine Learning is one of three centres of the Fraunhofer Cluster of Excellence Cognitive Internet Technologies (CCIT). It researches and develops new reliable methods of machine learning that address current industry challenges and enable the integration of transparent and traceable artificial intelligence solutions into production, business and sales processes. The "Informed Machine Learning", coined by Fraunhofer, greatly expands the application and application spectrum of machine learning.

At the Fraunhofer Research Centre for Machine Learning, the Fraunhofer Institutes IAIS (lead), IOSB, ITWM and SCAI combine their many years of scientific expertise and know-how from the direct transfer of ground-breaking ML research into industry. The close cooperation with the Fraunhofer Centres IoT-COMMS and Data Spaces creates a seamless chain from the collection of data through their secure storage and processing to their intelligent utilization.

Climate change and the ever-growing population pose a central question to the agribusiness: how will we be able to grow enough food to meet growing global demand?

1. From left to right Juror Nicolas Martin, Fraunhofer IAIS scientist Kostadin Cvejovski and Dr. Bogdan Georgiev and juror Greg Doonan – Winner of the Syngenta Corp Challenge. The finals took place in Austin, Texas.

Image Credit: Justin Elledge/Max Photography



In search of the best technologies, the global agribusiness Syngenta once again praises the Crop Challenge in Analytics. The First place went to the scientists. Bogdan Georgiev, Kostadin Cvejovski, Cesar Ojeda and Dr. Jannis Schücker from the Fraunhofer Research Centre for Machine Learning, headed by the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS, and the agricultural scientist Prof. Dr. med. Anne-Katrin Mahlein, Head of Research at the Cluster of Excellence Phenorob at the University of Bonn, in which the Fraunhofer IAIS is also involved.

Fraunhofer-Cluster of Excellence Cognitive Internet Technologies

Core institutes of the CCIT:

- Applied and Integrated Safety AISEC
- Intelligent Analysis and Information Systems IAIS
- Integrated Circuits IIS
- Software and system technology ISST
- Applied Information Technology FIT
- Telecommunications, Heinrich Hertz Institute HHI
- Experimental Software Engineering IESE
- Material flow and logistics IML
- Optronics, systems engineering and image analysis IOSB
- Techno- and Business Mathematics ITWM
- Traffic and Infrastructure Systems IVI
- Machine tools and forming technology IWU
- Algorithms and Scientific Computing SCAI



ML2R – The Machine Learning Rhine-Ruhr Competence Centre to Ensure Reliability of Modular ML Applications:

Competence Centre Machine Learning Rhine-Ruhr

The Competence Centre Machine Learning Rhine-Ruhr is one of four national nodes for bringing the development of Artificial Intelligence and Machine Learning in Germany to a worldwide leading level. To this end, we establish cutting-edge research, support young scientists and strengthen technology transfer in companies.

It connects pioneering research institutions in Germany: The Technical University of Dortmund, the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS in Sankt Augustin, the Fraunhofer Institute for Material Flow and Logistics IML in Dortmund and the University of Bonn. The close integration of basic and application-oriented research builds the ideal foundation for innovation. In this way, we actively shape Germany's future and contribute to securing the digital sovereignty of our country. Because Machine Learning is the key to intelligent products, new business models and a head start in international competition.

What Are the Main Areas of Research?

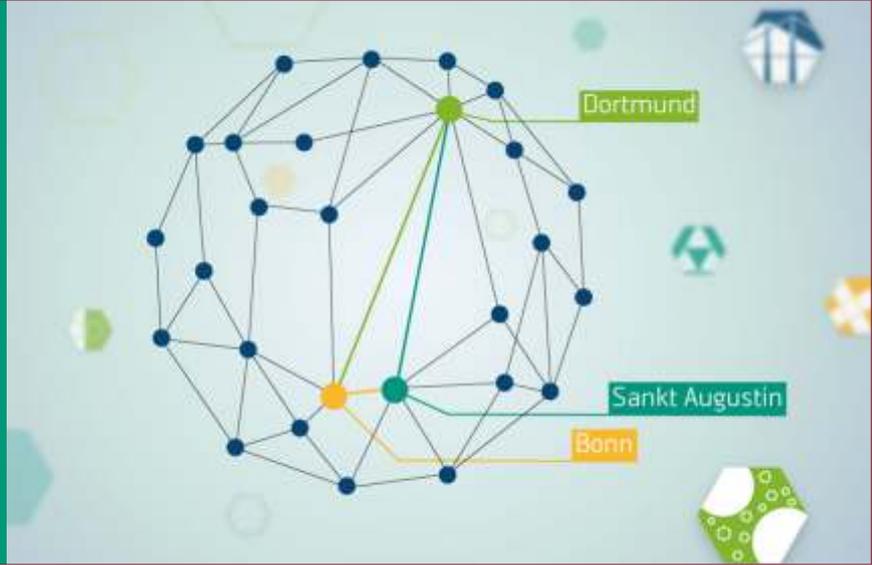
The common basis of the work in the ML2R Centre is the research and development of modular ML applications. In Modular Machine Learning, systems are built up from individual components and linked to complex architectures so that they can be used intuitively and are reusable in a flexible way.

The researchers will focus on

- Human-oriented Machine Learning focuses on humans and designs Machine Learning processes in such a way that decisions made with the help of Artificial Intelligence become understandable, traceable and valid table for human beings.
- Machine Learning with Restricted Resources makes it possible to reliably perform calculations using Machine Learning even on small devices such as smartphones or directly in sensors. This also includes learning on quantum computers, which circumvents the limitations of existing hardware.
- Machine Learning with Complex Knowledge integrates logical knowledge from various sources into learning systems to ensure reliable results even with small or insecure data sets.

The Competence Centre Machine Learning Rhine-Ruhr aims at bringing Machine Learning (ML) technologies in Germany to a worldwide leading level. The ML2R Centre is funded by the Federal Ministry of Education and Research (BMBF) as one of four nationwide ML nodes. The Technical University of Dortmund, the Fraunhofer Institutes for Intelligent Analysis and Information Systems IAIS in Sankt Augustin and for Material Flow and Logistics IML in Dortmund and the University of Bonn are involved.

1. From Left: Mr. Michael ten Hompel, Ms. Ursula Gather, Dr. Stefan Wrobel and Ms. Katharina Morik. Kick-off event for the Competence Center Machine Learning Rhine-Ruhr (ML2R)
Image Credit: ML2R Event (Web)



Technology Transfer: How Does Theory Become Practice?

ML is the key to intelligent products and processes, new business models and an advantage in international competition, which is why the research results are used for practice-oriented applications and serve as a basis for the development of new data-based services. Flagship applications from the fields of industry 4.0 and logistics as well as the automation of cognitive processes provide orientation for this. Especially for small and medium-sized enterprises, ML2R facilitates access to strategies, knowledge and data, so that they can successfully use ML technologies and survive in international competition. The research results will be published on an open source platform with curated data and models.

Spreading Machine Learning

The research results of the ML2R Competence Centre are used by short routes for practice-oriented applications and make new data-based services possible. Application examples from the fields of industry 4.0 and logistics as well as the automation of cognitive processes provide orientation. ML2R offers, to small and medium-sized enterprises in particular, access to strategies, knowledge and data so that they can successfully apply Machine Learning technologies and hold their ground in international competition. The transfer offers ranges from concrete cooperation models such as the “Enterprise Innovation Campus” and a platform with curated data and models to the promotion of training and further education for specialists in Machine Learning.

Many companies have already recognized the potential of Machine Learning (ML) applications, but are facing key challenges: They need comprehensible, trustworthy technologies that they can flexibly integrate into their business processes. They lack specialists who develop the appropriate technologies and strategically implement them in the company. Often, there is a lack of well-prepared data to optimally train learning systems and to use them profitably. In order to address these challenges, ML2R brings together excellent scientists with developers and users from businesses.

Practical Application:

- Scientists and Experts in the Think Tank – the Enterprise Innovation Campus
- Industry 4.0, Logistics and Business Process Automation
- Open Source Access to Data and Models
- Training Experts



Smart Mobility - Intelligently Connecting Open Databases

Dr. Christoph Lange-Bever

Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS

Due to imminent driving restrictions or deficiencies in the infrastructure, mobility as an integrated service is becoming more attractive. Hereby, more and more service providers are interacting in a complex way; their databases need to be intelligently linked. But individual mobility also has a future: the better a (partially) autonomous vehicle knows its surroundings and the needs of its occupants, i.e. the more data sources it uses, the more it can relieve the driver in particular. Fraunhofer IAIS is further developing both types of mobility and thus promoting freedom of choice for mobile people.

Traffic jam data, information on driving behaviour, route characteristics – in open data portals, such data is freely accessible, but so far unstructured and not linked. The aim of the project »LIMBO – Linked Data Services for Mobility« is to make this data available for as many applications as possible. The project, funded by the Federal Ministry of Transport and Digital Infrastructure (BMVI), uses semantic technologies based on the linked data principle to link data from portals such as the »mCLOUD « and the »Mobility Data Marketplace MDM« and make this linked data available. Fraunhofer IAIS hereby leads the work packages for information modelling and architecture. Based on the LIMBO architecture, the Fraunhofer team started in January 2018 to develop the Mobility Data Space, an ecosystem for mobility data and services.

At EU level, the project »bloTope – Building an IoT Open Ecosystem for Connected Smart Objects« complements these activities. The higher-order goal is to standardize data from the Internet of Things (IoT) and thus lower the entry threshold into IoT ecosystems for data providers and consumers. In the pilot project on Smart Mobility, Fraunhofer IAIS describes traffic data from Helsinki, Brussels and Lyon in a standardized and meaningful way through using semantic vocabularies. The combination and enrichment of such data with other data sets opens up new ways of providing drivers with answers to situation-dependent questions, such as »Where can I find a parking spot with a charging station near me?



Recent Research News @ Fraunhofer

Affordable and Mobile Purification of Dialysis Water

Research News / 1.10.2019

People who suffer from end stage renal disease frequently undergo dialysis on a fixed schedule. For patients this artificial washing of the blood is a major burden. To remove toxins from the blood, large quantities of dialysis water for clearance are required. Until now there has been no solution so far to recover this dialysate cost-effectively. Therefore, a cryo-purification method is being developed by Fraunhofer researchers that clears the water without losing it. This approach not only reduces costs – it may even pave the way for a wearable artificial kidney by milder long-term dialysis treatment at complete water autonomy.

Milestone in The Development of New Material Systems

Research News / 1.10.2019

Thanks to their wide range of possible applications, traditional fibre composites are popular materials in manufacturing – despite their relatively high production and disposal costs. These drawbacks can now be avoided with a new self-reinforced composite material made of polylactide (PLA), which was developed as part of the »Bio4self« project with the participation of the Fraunhofer Institute for Chemical Technology ICT. It is bio-based, easy to recycle and cheaper to produce – making it ideal for use in sporting, automotive and medical applications.

Better Treatment for Diabetic Foot Ulcers

Research News / 1.10.2019

People with type 2 diabetes often suffer from poorly-healing infected wounds on their feet. Using existing methods, however, it takes two days to grow a bacterial culture used to identify the pathogens infecting the wound and their antibiotic resistance – and thus to find an effective antibiotic. With the help of a new rapid test developed by Fraunhofer researchers, it will take just one hour to obtain this information in the future.

Moving E-Cars into The Fast Lane

Research News / 1.10.2019

Researchers have been looking into silicon carbide, a promising alternative material for the semiconductor industry, for several years now. The Fraunhofer Institute for Reliability and Microintegration IZM joined forces with partners in the SiC Module project to ramp up this type of power semiconductor for industrial manufacturing. Their effort goes to boost the efficiency of drivetrains in electric vehicles and extend these vehicles' range.

New Fraunhofer Coating Process Provides Effective Protection for Brake Discs

Research News / 2.9.2019

More than many other auto parts, brake discs are subject to repeated mechanical loads. As a result of this continual abrasion, they produce fine particulate matter, which pose a substantial environmental burden. Now, however, a new coating process developed by the Fraunhofer Institute for Laser Technology ILT and RWTH Aachen University can significantly reduce this impact. By using "Extreme High-speed Laser Material Deposition", known by its German acronym EHLA, it has proved possible to provide brake discs with an effective protection against wear and corrosion in a procedure that is both fast and economic.

1. Affordable and Mobile Purification of Dialysis Water

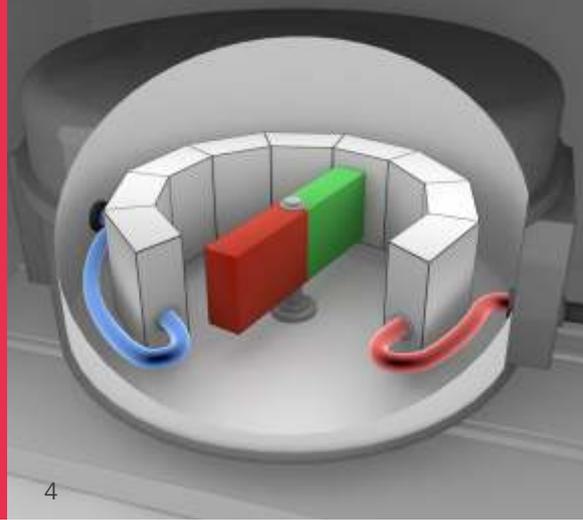
Image Credit: Fraunhofer IZI

2. Milestone in The Development of New Material Systems

Image Credit: Fraunhofer ICT

3. New Fraunhofer Coating Process Provides Effective Protection for Brake Discs

Image Credit: Fraunhofer ILT



Biocompatible Stents Provide Better Protection Against Occluded Blood Vessels

Research News / 2.9.2019

Cardiovascular stents are special implants used to widen blood vessels that have become constricted as a result of calcium deposits. In some cases, the body's immune system can reject these implants in a process known as foreign-body reaction. In a joint project with partners, Fraunhofer researchers in Dresden have now developed enhanced coatings that substantially improve the biocompatibility of stents.

A Cooling System Without Harmful Refrigerants

Research News / 1.8.2019

A discovery from 1917 becomes viable for the future. A team of researchers at the Fraunhofer Institute for Physical Measurement Techniques IPM is developing efficient magnetocaloric cooling systems that make do without harmful refrigerants. The researchers hope to achieve 50 percent of the maximum efficiency level with their process. Comparable existing magnetocaloric systems reach only approximately 30 percent.

Photovoltaic Power from Textiles

Research News / 1.8.2019

Imagine a truck tarp that can harvest the energy of sunlight! With the help of new textile-based solar cells developed by Fraunhofer researchers, semitrailers could soon be producing the electricity needed to power cooling systems or other on-board equipment. In short, textile-based solar cells could soon be adding a whole new dimension to photovoltaics, complementing the use of conventional silicon-based solar cells.

Sliding Along On Water

Research News / 1.7.2019

Machine bearings are usually lubricated with various oils. But today large quantities of these oils still end up in the environment. The Fraunhofer Institute for Mechanics of Materials IWM has developed a method which will in the future make it possible to lubricate slide bearings using water, a much more environmentally friendly approach.

Economical Energy Storage for The Electric Car of Tomorrow

Research News / 3.6.2019

Researchers at the Fraunhofer Institute for Material and Beam Technology IWS in Dresden have developed a new production process with the aim of efficient and environmentally friendly future battery production. They coat the electrodes of the energy storage cells with a dry film instead of liquid chemicals. This simplified process saves energy and eliminates toxic solvents. A Finnish company is currently successfully testing the new IWS technology in practice.

4. A Cooling System Without Harmful Refrigerants

Image Credit: Fraunhofer IPM

5. Photovoltaic Power from Textiles

Image Credit: Fraunhofer IKTS

6. Economical Energy Storage for The Electric Car of Tomorrow

Image Credit: Fraunhofer IWS



1



2

Recent Activities

Jan 5th - 11th 2018

Visit of Prof. Dr. Karlheinz Brandenburg, Director, Fraunhofer IDMT to India

Prof. Brandenburg delivered a lecture at SHAASTRA 2018 organized by Indian Institute of Technology Madras (IIT - M) in Chennai. He met Researchers of Innovation Lab from TATA Consultancy Services (TCS) in Chennai. Prof. Brandenburg gave a presentation to the industry council of National Association of Software and Services Companies (NASSCOM) in Bangalore. He also spoke at the Science Circle Lecture organized by German Embassy in New Delhi.

Jan 24th - 30th 2018

Representation of Fraunhofer at Indian Metal Cutting Machine Tools Exhibition (IMTEX) 2018 and visit of Fraunhofer IWU Delegation

Fraunhofer Office India held a booth at IMTEX 2018 to showcase the capabilities of Fraunhofer IWU in Light weighting of Automotive components, forming technology and additive manufacturing along with select exhibits.

Jan 23rd 2018

Launch of German Innovation and R&D Forum

Fraunhofer Office India in cooperation with Indo-German Chamber of Commerce launched the German Innovation and R&D Forum with a view to strengthen German R&D in India.

Feb 15th 2018

Visit of German Research Foundation (DFG) Delegation to Fraunhofer Office India

The DFG Delegation led by Prof. Dorothee Dzwonnek, Secretary General, DFG visited Fraunhofer Office India and had bilateral discussions on the activities of DFG and Fraunhofer in India with a view to explore collaboration.

Feb 19th - 24th, 2018

Visit of Dr. Thomas Tradler, Head of Business Development / Patent management, Fraunhofer IZI to India

Dr. Thomas Tradler visited India to explore business opportunities in life sciences for Fraunhofer IZI. Ms. Anandi Iyer and Mr. Aditya Fuke organized several meetings for him in Bangalore and Hyderabad with premier companies working in the life science.

April 23rd and 24th 2018

India Highlights at Hannover Messe 2018

1. Prof. Brandenburg (C) along with the participants of roundtable at Confederation of Indian Industry (CII) in Chennai

2. Prof. Dirk Landgrebe, Former Director, Fraunhofer IWU delivering the keynote address at IMTEX 2018



April 23rd 2018: Signing of MoU between Fraunhofer IMW and the State of Andhra Pradesh, Govt. of India at Hannover Messe 2018

April 24th 2018: Visit of a High-level Indian Delegation comprising of representatives from Industry, Research Institutions and Government, led by Dr. Asha Ram Sihag, Secretary, Dept. of Heavy Industry (DHI), Govt. of India to Fraunhofer stand at Hannover Messe.

July 26th 2018

Stakeholder Workshop on Indo-German Cooperation on Water Management in Smart Cities in Coimbatore

Under the project Smart Water Future India, Fraunhofer IGB has set up a Water Competence Centre in Coimbatore on July 26th 2018 kicking off with a stakeholder's workshop on "Indo-German Cooperation on Water Management in Smart Cities".

Aug 1st 2018

Fraunhofer Office India coordinated workshop between Fraunhofer IWU and Indian Institute of Technology, Madras (IIT M) in Bangalore

Fraunhofer Office India coordinated the first joint workshop between Fraunhofer IWU and Indian Institute of Technology, Madras (IIT M) on "Efficiency Enhancement in the Operations and Manufacturing Process of Automobile and Allied Industries".

Sept 4th to 7th 2018

European Union Circular Economy Mission to India and Confederation of Indian Industry (CII) 13th Sustainability Summit

Circular Economy Mission (CEM) to India was organized under the European Union – Resource Efficiency Initiative (EU-REI) to create awareness about circular economy, mobilizing demand creation and sensitizing businesses in India. Ms. Anandi Iyer was one of the six panellists in the session on "Circular Economy & Solar Supply Chains".

Sept 13th and 14th 2018

Workshop on training on Charging Communication jointly organized by Fraunhofer Office India and CharIn India in Fraunhofer Office India

Fraunhofer Office India and CharIn India jointly organized a workshop on training on Charging Communication Systems for electric vehicles.

Sept 18th and 19th 2018

Indo-German Energy Symposium Day at Renewable Energy India (REI) - Expo 2018 and Visit of Mr. Maximilian Trommsdorff, Junior Scientist, Fraunhofer ISE

Mr. Maximilian Trommsdorff delivered presentation on 'Global Best Practices in Agro PV for Emerging Economies' at REI Expo 2018. He also met Confederation of Indian Industry on Agro PV.

3. Group photograph of the Smart Water Future India project team with Dr. K. Vijayakarhikeyan Commissioner, Coimbatore City (Centre)

4. Mr. Peter Blau, Division Director - Machining and Removal, Fraunhofer IWU, Ms. Anandi Iyer, Director, Fraunhofer Office India, Dr. Andreas Sterzing, Division Director - Bulk Metal Forming, Fraunhofer IWU and Mr. Rohit Rohilla, Manager - Production Technology, Fraunhofer Office India with senior representatives from IIT Madras.



5



6

Sept 24th to 27th 2018

Confederation of Indian Industry (CII) - Automotive Industry 4.0 Summit

Mr. Peter Blau, Fraunhofer IWU delivered presentation on 'Fraunhofer & Industry 4.0: Development of adaptive manufacturing processes' at Automotive Industry 4.0 summit organized by CII.

Sept 2018

Fraunhofer IVI was awarded a contract by Delhi Integrated Multi Modal Transit Systems Ltd. (DIMTS), a Govt. of Delhi Enterprise

Fraunhofer IVI was awarded a contract in Sept 2018 by DIMTS, a Govt. of Delhi Enterprise for conducting techno-financial assessment of the electric bus market with respect to the e-bus technology, charging systems, route planning and related infrastructure required for deployment of 1000 low floor electric buses in New Delhi.

Oct 3rd to 5th 2018

1st assembly of International Solar Alliance (ISA) and 2nd Global RE - Invest India 2018, and Visit of Dr. Thomas Schlegl, Head of Department Energy System Analysis, Fraunhofer ISE and Prof. Eicke Weber, Former Director, Fraunhofer ISE

Dr. Thomas Schlegl and Ms. Anandi Iyer represented Fraunhofer in the First Assembly of International Solar Alliance (ISA) on Oct 3rd 2018 to discuss the application of Fraunhofer ISE to be the technical partner to ISA.

Fraunhofer Office India held a booth at RE - Invest Exhibition as a part of the 'German Pavilion'- organized by The Indo-German Energy Forum (IGEF) in collaboration with the Indo-German Chamber of Commerce (IGCC).

Nov 12th 2018

Visit of the Delegation of the Federal Ministry of Economic Affairs and Energy (BMWi) to Fraunhofer Office India

A high level BMWi delegation comprising of Dr. Andreas Goerdeler - Head of Subdivision National and European Digital Agenda, Dr. Alexander Tettenborn - Head of Unit Development of Convergent ICT, Dr. Christine Kahlen, Head of Division Digital Economy, Start-ups, Digital Summit along with Dr. Matthias Kuom, International Co-operations Manager, German Aerospace Center (DLR) visited Fraunhofer Office India on Nov 12th 2018. The delegation participated in a roundtable on "Trends in Digital Innovation in India" for discussing the roadmap for a strong Indo-German cooperation.

Nov 19th 2018

Fraunhofer IGB was awarded a contract by City of Solapur in Maharashtra

Fraunhofer IGB was awarded a contract by Solapur to conduct analysis of the city's present Water Infrastructure and feasibility study to identify measures and sites for future infrastructure development. The feasibility study is financed by Land Baden-Württemberg.

5. Mr. Peter Blau, Fraunhofer IWU presenting on 'Fraunhofer & Industry 4.0: Development of adaptive manufacturing processes' at Automotive Industry 4.0 summit organized by CII

6. German Federal Ministry Delegates at Fraunhofer booth, RE-Invest Expo, India



7



8

Nov 28th 2018

Smart City: Mobility Innovation Workshop with Coimbatore City Municipal Corporation (CCMC)

Under the Smart City Innovation Lab on Mobility, Fraunhofer IAO conducted a Mobility Innovation Workshop with CCMC and important stakeholders on Nov 28th 2018 to present the project ideas developed for sustainable mobility in Coimbatore. 24 project ideas were developed and 4 project ideas were shortlisted by KfW for further elaboration for a pre- feasibility study.

Nov 29th 2018

Representation of Fraunhofer in the German country session of 7th Foundation Day of Global Innovation & Technology Alliance (GITA) - a partnership between the Confederation of Indian Industry (CII) and Department of Science & Technology (DST), Govt. of India

Ms. Anandi Iyer delivered a presentation on “Fraunhofer: What has Europe’s largest application oriented research organization to offer for India?” in the Country Session in Germany at 7th Foundation Day of GITA.

Dec 1st 2018

Bengaluru Tech Summit 2018

Ms. Anandi Iyer represented Fraunhofer in the German pavilion at Bengaluru Tech Summit organized by Govt. of Karnataka

Dec 3rd 2018

Fraunhofer Office India coordinated the second joint workshop between Fraunhofer IWU and Indian Institute of Technology, Madras (IIT M)

Fraunhofer Office India coordinated the second joint workshop between Fraunhofer IWU and IIT M on “Efficiency Enhancement in the Operations and Manufacturing Process of Automobile and Allied Industries” in Chennai.

Dec 5th 2018

5th Fraunhofer Innovation and Technology Platform (5th FIT) - Digitalization: The Game Changer

Fraunhofer Office India had organized the 5th edition of its biennial flagship event Fraunhofer Innovation and Technology Platform (FIT) in Bangalore. 5th FIT thematically focused on Digitalization across the sectors Manufacturing, Energy, Buildings, Mobility, Space, Healthcare and Cultural Heritage with a view to catalyze the collaboration in this very important subject between India and Germany. Fraunhofer experts from various Fraunhofer institutes participated and showcased technology needs/solutions from a global perspective and suggested the road ahead for India-Fraunhofer cooperation. 5th FIT 2018 was supported by Federal Ministry for Economic Affairs and Energy (BMWi), Govt. of Germany.

7. Ms. Anandi Iyer along with other panellists in the country session on Germany at 7th Foundation Day of GITA

8. Ms. Anandi Iyer, Prof. Dr. Thomas Magedanz, Dr. Gunther Grathwohl, Smt. Sukriti Likhi, Dr. Gopichand Katragadda, Dr. Eckart Bierduempel



Dec 5th 2018

Fraunhofer Office India Decennial and Panel Discussion on Innovation - the Fulcrum of a Global Industry

On the occasion of completing 10 years in India, Fraunhofer Office India had organized a high-level panel discussion in Bangalore on 'Innovation - the Fulcrum of a Global Industry' with marquee leaders from the industry and government namely Mr. Thomas Fuhrmann, Managing Director and CEO, TUV Rheinland India Pvt. Ltd., Dr. Makarand Sr. Vice President - Innovations, Reliance Industries Ltd., Mr. Anantha Sayana, Vice President & Head - Digital, Larsen & Toubro Ltd., Ms. Saloni Malhotra, Vice President - Innovations, Invest India, Govt. of India and Ms. Anandi Iyer, Director, Fraunhofer Office India.

Dec 6th 2018

Fraunhofer - Wipro Technology Day

Fraunhofer-Wipro Technology Day was organized in Wipro Campus, Electronic City, Bangalore to explore cooperation in the areas of Industry 4.0, ICT / IoT for Smart Energy, Smart Buildings and Smart Cities.

Dec 6th 2018

Forum on Social Innovation, Technology and Enterprise (FORSITE)

Fraunhofer Office India and Rotary International had jointly organized a Forum on Social Innovation, Technology and Enterprise with an objective of combining humanitarian efforts with innovation to deliberate the impacts Social Innovation on society and organization, and its need in India.

Dec 10th 2018

Launch of Kochi Smart City Innovation Lab

Fraunhofer partnered with Cochin Smart Mission Ltd. to setup a Smart City Innovation Lab in Kochi with funding from the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) Climate Initiative (IKI). The Innovation Lab was launched in Kochi in presence of H.E. Dr. Martin Ney - German Ambassador to India, Prof. KV Thomas - Member of Parliament, Ernakulum District, Smt. Soumini Jain - Hon. Mayor, Kochi Municipal Corporation and Shri. TK Jose, Additional Chief Secretary, Local Self Government Department Kerala. The Innovation Lab aims to provide state-of-the-art and long term vision tools to support and strengthen Kochi's current approach towards Smart Cities Mission and leverage Kochi to become a successful model to showcase the Indo-German Cooperation in Smart Cities.

Dec 11th - 13th 2018

Intersolar India 2018, Bangalore

During Intersolar 2018, Fraunhofer ISE and Solar Energy Corporation of India (SECI), Govt. of India had jointly organized a Workshop on 'Solar Energy in India - PV Manufacturing and Quality Assurance & Standards'.

9. Ms. Saloni Malhotra, Mr. Anantha Sayana, Ms. Anandi Iyer, Mr. Thomas Fuhrmann, Dr. V. Sumantran, Dr. Makarand Phadke

10. Ms. Anandi Iyer along with other panellists in the inaugural session of "Forum on Social Innovation, Technology & Enterprise (FORSITE)"



Jan 24th to 30th 2019

Indian Metal Cutting Machine Tool Exhibition (IMTEX) 2019

This year Fraunhofer was the knowledge partner to IMTMA for Industry 4.0 pavilion at IMTEX 2019. Under this partnership, Fraunhofer had organized a conference on 'Factory of the Future' on Jan 25th 2019 at IMTEX 2019. Fraunhofer institutes IWU and IPT participated and showcased their competencies along with select exhibits in lightweight materials, additive manufacturing, industrial process automation, human-machine interaction, autonomous systems, digital twins etc.

Prof. Frank Treppe, Managing Director Political and International Affairs & Associate Board Member, Fraunhofer Gesellschaft, Dr. Eckart Bierduempel, Head - Multinational Networking, Fraunhofer Gesellschaft, Dr. Andreas Sterzing, Division Director - Bulk Metal Forming, Fraunhofer IWU, Mr. Peter Blau, Division Director - Machining and Removal, Fraunhofer IWU and Dr. Kristian Arntz, Head of Department Non-conventional manufacturing processes and technology integration, Fraunhofer IPT were the visiting Fraunhofer delegates for IMTEX 2019.

Feb 18th 2019

Fraunhofer receives 'Global Top 51 Smart City Leaders Award' at World CSR Day

Fraunhofer's recent strides in Smart Cities, particularly in Kochi, Coimbatore and Solapur, were recognized by the international jury, its members being Dr. Indira Parikh, Ex. Dean, IIM Ahmedabad, Dr. Arun Arora, Ex. President & CEO, Economic Times, Mrs. Nina Woodward, President, Independence Inc, New York and Dr. R L Bhatia, Founder World CSR Congress. Fraunhofer's exciting work in these cities such as Smart City Innovation Lab in Kochi and Coimbatore each, a Water Competence Centre in Coimbatore and a contract to conduct a feasibility study for intelligent water management in Solapur, were greatly appreciated by the World CSR Congress. On behalf of Fraunhofer, Ms. Anandi Iyer, Director, Fraunhofer Office India received 'Global Top 51 Smart City Leaders Award' from Ms. Sally Lee, Mayor of Sorsogon City, Philippines at the World CSR Congress.

Feb 18th 2019

Visit of Mr. Maximilian Trommsdorff, Project Manager Agro-Photovoltaics (APV), Fraunhofer ISE and Mr. Maximilian Vorast, Student Assistant, Fraunhofer ISE to India

Fraunhofer Office India had coordinated the visit of Mr. Maximilian Trommsdorff and Mr. Maximilian Vorast to Bangalore and Mumbai, and organized several meetings with potential clients namely Jakson Solar, GIZ - Green Innovation Centres for the Agriculture and Food Sector – India, Dexler Energy, Rotary International, The Energy and Resources Institute (TERI), Soham Renewable Energy and Agami Infra to explore co-operation for development of APV business model w.r.t feasibility study and pilot projects.

Mar 4th - 5th 2019

Visit of a high-level delegation of Council of Scientific and Industrial Research (CSIR), Govt. of India to Fraunhofer Institutes

11. Prof. Frank Treppe delivering the keynote address at IMTEX 2019

12. Ms. Anandi Iyer with 'Global Top 51 Smart City Leaders Award'



Ms. Anandi Iyer, Director, Fraunhofer Office India had coordinated a visit of a very high-level delegation of senior scientists from CSIR led by Dr. Shekhar Chintamani Mande, Director General, CSIR to Fraunhofer Institutes in Germany.

Mar 19th - 20th 2019

Visit of Dr. Moritz Haemmerle, Head of Research Cognitive Engineering and Production, Fraunhofer IAO to India

As one of the supporters of DWIH (German House for Innovation and Research), Fraunhofer received an invitation to be a speaker at DWIH's Annual Symposium 2019 focusing on Future of Work, held on Mar 19th and 20th 2019 in New Delhi. Fraunhofer Office India coordinated the visit of Dr. Moritz Haemmerle to this symposium, in which he delivered a presentation on 'The Future Work Lab' in the session on 'Artificial Intelligence and New Working Environment'.

Apr 3rd 2019

India Highlights at Hannover Messe 2019

Ms. Anandi Iyer, Director and Mr. Rohit Rohilla, Manager - Production Technology represented Fraunhofer Office India at Hannover Messe 2019. They coordinated several meetings and visits of high-level delegations of Govt. of India and Indian Industry.

Visit of the delegation of Dept. of Heavy Industry (DHI), Govt. of India and delegation of Confederation of Indian Industry (CII) to Fraunhofer stand in Hannover Messe 2019 on Apr 3rd 2019: To embark on next steps under the MoU between Fraunhofer and DHI, Engineering Exports Promotion Council (EEPC) India had expressed its interest to Fraunhofer Office India to support and organize a visit of a very high level Indian delegation comprising of the senior representatives from Indian Industry, Research Institutions and Govt. bodies led by Dr. Asha Ram Sihag, Secretary, DHI to Fraunhofer Pavilion at Hannover Messe 2019. The delegation was given an exposure to select Fraunhofer exhibits to experience futuristic technologies of Fraunhofer in manufacturing. A senior delegation of CII also visited the Fraunhofer stand this year.

Apr 3rd 2019

India Investment Meet ñ New Business and Collaboration Opportunities in India

India Invest Meet was jointly organized by Department of Heavy Industry (DHI), Govt. of India and Engineering Exports Promotion Council (EEPC) at Hannover Messe 2019. EEPC had invited Fraunhofer to participate and present an example of a successful R&D cooperation resulting in Investment for India particularly in manufacturing sector. Dr. Mihails Kusnezoff, Head of Department - Materials and Components, Fraunhofer IKTS spoke on a successful case study of R&D cooperation with an Indian company Jain Irrigation Systems Ltd. that resulted in the formation of a new company h2e Power Systems Ltd.

Apr 3rd 2019

Visit of the Urban Governance Innovation Team from Fraunhofer IAO to

13. CSIR delegation at Fraunhofer IPA

14. Dr. Asha Ram Sihag, Secretary, DHI, Ms. Sukriti Likhi, Joint Secretary, DHI, Ms. Anandi Iyer, Director, Fraunhofer Office India along with important representatives from Govt. of India, EEPC and Indian Embassy in Berlin



15



16

Coimbatore for a workshop with Coimbatore City Municipal Corporation (CCMC) and KfW

The final workshop of the project 'Coimbatore Smart City Innovation Lab on Mobility', funded by KfW, was held on Apr 3rd 2019 in Coimbatore. Ms. Marielisa Padilla, Ms. Nikita Shetty, Mr. Vladyslav Latypov from the Urban Governance Innovation Team of Fraunhofer IAO, along with Mr. Aditya Fuke, Manager - Smart Cities & IoT, Fraunhofer Office India, had jointly organized this workshop with Coimbatore City Municipal Corporation (CCMC). The final results of the Coimbatore Smart City Innovation Lab was presented, and the final report on identified projects and solutions for improving urban mobility in Coimbatore, was submitted to KfW and CCMC.

Apr 29th - May 1st 2019

Visit of Dr. Torben Seemann, Managing Director, Fraunhofer Project Centre Wolfsburg (Fraunhofer IFAM) to New Delhi for the Conference on 'Light Weighting' organized by Automotive Component Manufacturers Association of India (ACMA)

ACMA had invited Fraunhofer to New Delhi on April 30th to be a speaker in the knowledge session on development of new light-weight materials and its application in Automotive Industry. Fraunhofer Office India coordinated the participation of Dr. Torben Seemann in this conference, and he delivered a presentation on 'Lightweight design and Electro-mobility'.

May 7th - 15th 2019

Visit of Dr. Marius Mohr, Head of Group Bioprocess Engineering in Water Management and Circular Economy, Fraunhofer IGB, to India.

Stakeholders Workshop with Cochin Smart Mission Ltd. (CSML), May 9th 2019:

Dr. Marius Mohr and Mr. Aditya Fuke, Manager - Smart Cities & IoT, Fraunhofer Office India, had coordinated a stakeholder's workshop with Cochin Smart Mission Ltd. (CSML) on May 9th 2019 to define the sectors of focus for the lab and draw out the critical areas of interventions.

May 14th - 16th 2019

Visit of Dr. Simon Schmidt, Head of International Affairs, Fraunhofer IBP and Mr. Andreas Kaufmann, Technology expert and Former Spokesman - Building Innovation Alliance, Fraunhofer IBP to India

Fraunhofer Office India is in discussion with a real estate division of Machani Group on cooperation in implementation of advanced sustainable building technologies in real estate projects. Fraunhofer IBP is engaged in this project scope to offer advisory support on contractual engagement. As a next step, a workshop between Fraunhofer IBP and Machani Group was organized in Bangalore from May 14th - 16th 2019, to discuss potentials for Green Buildings. Dr. Simon Schmidt and Mr. Andreas Kaufmann offered advisory support in this workshop on improvements of Machani Group's two projects namely Kormangala Tech Innovation campus and Project Ananda, for future readiness and sustainability in the buildings.

15. Dr. Torben Seemann delivering presentation in the conference of Light Weighting

16. Mr. Aditya Fuke, Dr. Marius Mohr, Mrs. Soumini Jain, Representatives from CSML



June 7th- 8th 2019

Visit of Mrs. Anna Roy, Sr. Adviser, NITI Aayog to Fraunhofer Institutes SCAI, IAIS, FIT and IPT

A high-level Indian delegation from NITI Aayog, Govt. of India, led by Mrs. Anna Roy, who is leading the national mission on Artificial Intelligence visited Fraunhofer Institutes SCAI, FIT and IAIS in Schloss Birlinghoven on June 7th 2019. Ms. Anandi Iyer, Director, Fraunhofer Office India coordinated this visit in close coordination with the German Federal Ministry of Health along the lines of Indo-German Cooperation in AI / Digitalization.

June 17th - 20th

Visit of Dr. Andreas Sterzing, Division Director Bulk Metal Forming and Mr. Peter Blau, Division Director, Machining and Removal from Fraunhofer IWU to India

Dr. Andreas Sterzing and Mr. Peter Blau visited India and had project meetings with Indian Institute of Technology - Madras (IIT - M), Hindustan Machine Tool Ltd., TVS Motors Ltd., NRB Bearing, Godrej Aerospace and CRI Pumps. These meetings were coordinated in cities Chennai, Coimbatore, Bangalore and Mumbai by Mr. Rohit Rohilla, Manager - Production technology, Fraunhofer Office India.

June 28th - 29th 2019

1st International Conference on Industry 4.0 and Advanced Manufacturing (I-4AM 2019)

1st I-4AM 2019 was organised by the Centre for Product Design and Manufacturing, Indian Institute of Science (IISc) Bangalore, under its CEFC on I4.0India@IISc (Smart Factory) within the SAMARTH Udyog Bharat 4.0 programme of the Department of Heavy Industries, Government of India on June 28th - 29th 2019. Fraunhofer was the knowledge partner to this conference. Ms. Anandi Iyer, Director, Fraunhofer Office India was among the panellists in the panel discussion on "Policy Challenges/Opportunities in Industry 4.0 and Advanced Manufacturing", in which she spoke on the opportunities that Indian industry can derive with Industry 4.0. in order to compete in international market.

July 1st 2019

Visit of Mr. Frank Müller-Rosentritt - Member of Parliament-Germany to Fraunhofer Office India

Mr. Frank Müller-Rosentritt represents Free Democratic Party in the German Parliament, the Bundestag. He was accompanied by Mr. Karl Philipp Ehlerding, Deputy Consul General, German Consulate Bangalore. They visited Fraunhofer Office India on July 1st 2019 to understand activities of Fraunhofer in India.

July 22nd - Aug 1st 2019

Visit of Fraunhofer Delegation to Council of Scientific & Industrial Research (CSIR), Govt. of India and a Joint Workshop between Fraunhofer and Council of Scientific & Industrial Research (CSIR), Govt. of India on "Indo - German

17. Mrs. Anna Roy, Mr. Hinrich Thölken - Ambassador and Special Envoy for Digitalization, Federal Foreign Office, Ms. Anandi Iyer

18. Mr. Harish Nachnani, Mr. Volker Schmid, Ms. Anandi Iyer, Mr. Aditya Fuke



19



20

collaboration in Research and Innovation towards Leapfrogging in Frontier Technologies”

Fraunhofer and Council of Scientific & Industrial Research (CSIR) - an autonomous body under Ministry of Science & Technology, Govt. of India are initiating a strategic Indo-German applied research cooperation in the fields of Sustainable Buildings, Water, Advanced Production Technologies and Battery Technologies. Govt. of India has been emphasizing on learning from Fraunhofer model for technology development and commercialization, so that CSIR could emulate best practices from Fraunhofer. Dr. Eckart Bierduempel, Head - Multinational Networking, Fraunhofer HQ led a delegation of 13 experts from various Fraunhofer Institutes namely IBP, IGB, IFAM, IPA, IPT and ISE to India, who conducted technical workshops at four CSIR Institutes each in Chennai, Pune, Nagpur and Roorkee between July 22nd and 30th 2019.

July 23rd 2019

Visit of H.E. Mr. Walter J. Lindner, Ambassador, Embassy of the Federal Republic of Germany in New Delhi to Fraunhofer Office India

German Ambassador to India H.E. Mr. Walter J. Lindner is on a mission to understand the research landscape in India, and had expressed his keen interest to visit Fraunhofer Office India. With this objective, Fraunhofer Office India had organized a roundtable and invited some of its very important clients and partners - TVS Motors Ltd., TITAN Company Ltd., FESTO India Ltd., VSM Solar Pvt. Ltd., Machani Group and Indian Institute of Science (IISc) Bangalore, where they shared their thoughts and views on their cooperation with Fraunhofer.

Aug 21st - 23rd 2019

Visit of Dr. Matthias Vetter, Head of Department Electrical Energy Storage, Fraunhofer ISE to participate as a speaker in 10th World Renewable Energy Technology Congress (WRETC) in New Delhi.

The 10th edition of WRETC 2019 was organized by Energy and Environment Foundation in New Delhi from Aug 21st - 23rd 2019. The conference focussed on 'Renewable Energy Solutions for a Sustainable Future' - ensuring clean, reliable and affordable energy supply now and in the future. Dr. Matthias Vetter was invited by the organizers to participate and deliver a presentation in this conference in the session "Energy Storage - Electric Vehicles - Charging Infrastructure".

Aug 26th - 31st 2019

Visit of Fraunhofer IEE for Training Program on RE Grid Integration (Renewable Energy Management Centre REMC), at National Power Training Institute (NPTI), Govt. of India

Fraunhofer IEE has been awarded a contract to conduct training programs on "Renewable Energy and Grid Integration" in India against the tender announced by German Society for International Cooperation (GIZ) for "Technical Cooperation with India in Green Energy Corridors". The objective of this cooperation is to enable and extend support to Power System Operator Corporation (POSOCO), Govt. of India and National

19. Mr. Frank Müller-Rosentritt, Ms. Anandi Iyer, Mr. Karl Philipp Ehlerding with Fraunhofer Office India team

20. Inaugural Session of Joint Workshop on "Indo-German collaboration in Research and Innovation towards Leapfrogging in Frontier Technologies" on Aug 1st 2019 in New Delhi



Power Training Institute (NPTI), Govt. of India in designing and delivering an advanced and sustainable learning program on large scale grid integration of RE in India. The second phase of training program was held in Bangalore from Aug 26th - 31st 2019, while the first phase was conducted in New Delhi earlier this year. Dr. Bernhard Ernst, Group Manager Grid Planning and Operation, Dr. Gunter Arnold, Business Development Manager Measuring and Testing were amongst the lead trainers from Fraunhofer IEE.

Sept 12th - 18th 2019

Visit of Ms. Anandi Iyer, Director, Fraunhofer Office India to Germany for Indo-German Stakeholders Meeting on Artificial Intelligence and Indo-German Business Forum on Manufacturing Excellence & Sustainability

Ms. Anandi Iyer is a core member of the Indo-German working group on Artificial Intelligence. She was invited by the Federal Ministry of Health (Germany) to participate in the Indo-German Stakeholders Meeting to discuss the roadmap of Indo-German cooperation on AI in Health. The meeting was organized in Berlin from Sept 11th - 13th 2019 and was attended by senior representatives of Rheinische Friedrich-Wilhelms University, Berlin Health Institute (BIH), University of Heidelberg, German Cancer Research Center, Max Planck Institute of Molecular Genetics and Max Planck Institute of Psychiatry. Senior experts from Fraunhofer Institutes SCAI, IAIS and HHI also participated in this meeting.

21. Mrs. Margit Hellwig-Boette,
H.E. Mr. Walter J. Lindner, Ms. Anandi Iyer

22. Training Programme on RE Grid
Integration (Renewable Energy Management
Centre REMC), at National Power Training
Institute (NPTI), Govt. of India

Fraunhofer India: Recent Media Coverage



Fraunhofer organises 5th Innovation and Technology Platform, Digitalization - The Game Changer

Fraunhofer Europe's largest application-oriented research organization organized their 5th **Fraunhofer** Innovation and Technology (FIT) Platform on Wednesday in Bengaluru, India, where various international technology experts deliberated on and showcased cutting edge technologies, innovation and solutions. The event this year focuses on

Fraunhofer has been active in India for over 10 years, initially with a **Fraunhofer** Senior Institute and since 2012 with a **Fraunhofer** Representative Office supporting the activities of the **Fraunhofer** institutes.

With this event it will look to commemorate this milestone in the presence of industry leaders and key stakeholders from the government and industry. The 5th **Fraunhofer** Innovation and Technology Platform held in the morning was followed by a high-level panel discussion on 'Innovation - The Future of a Global Industry', featuring marquee industry leaders discussing successful innovation ecosystems across leading nations, the India scenario - challenges and opportunities, trends and ways to scale up the Indian innovation ecosystem.

Fraunhofer has been involved in India for 10 years now, and it has been such an exciting journey. Our institutes have been a long-time trusted innovation partner in India, collaborating with some of the major players in the field of Material Science, Energy, Environment, Automotive, Electronics, Production Technology and Smart Cities, while working with industry, Government and Public Sector. Our industry clients have grown tremendously over the last few years and we look forward to another successful decade of meaningful partnerships between the two great nations," said Prof. Frank Teppe, Managing Director, Public & International Affairs and Associate Board Member, **Fraunhofer** Gesellschaft.



5th Fraunhofer Innovation & Technology Platform held in B'luuru, focus on digitalization

Fraunhofer has completed 10 years of strategic projects in the country including in Energy, Environment, Automotive, Electric mobility, Smart Cities.

TNN Staff | Bengaluru, December 12, 2018 - 11:48

Fraunhofer, Europe's largest application-oriented research organization, organised their 5th **Fraunhofer** Innovation and Technology (FIT) Platform on Wednesday in Bengaluru, where various international technology experts deliberated on and showcased cutting edge technologies, innovation and solutions. The event this year focusses on Digitalization spanning the sectors such as Manufacturing, Energy, Buildings, E-mobility, Space, Smart Cities and Cultural Heritage, all seen as fundamental growth drivers in world markets.

The symposium witnessed participation from leading CEOs, CTOs, senior policy makers and innovation experts representing the Government, Industry and the Research fraternity who are also stakeholders and decision makers in the implementation of various Government programs. Some of the dignitaries included:



Kochi: German leg-up for Smart City projects

In India, the institute is already supporting CochinSmart, another smart city, project proposals and funding.

By Express News Service
KOCCHI: The Smart City Innovation Lab, which is formed with the technical support of German-based **Fraunhofer** Institute will be officially launched on Monday. The lab is formed to help implement the projects under the Center's 100 Smart City Mission.

Kochi: Germany will provide technical support for conceptualising and implementing projects in five sectors under Smart City Mission. **Fraunhofer** IAO, an autonomous agency under the German federal government, has signed an agreement with Cochin Smart Mission Limited for supporting them.

During a function held here on Monday, German Ambassador to India Dr Martin Mey launched the Smart City Innovation Lab, the intellectual platform for technology sharing. **Fraunhofer** Institute has been providing technical, financial and social support to smart cities across the globe through project details preparation and studies.

Through the Innovation Lab, **Fraunhofer** has committed to support the city in preparing the technical and financial feasibility reports for selected sectors, identify the funding partners for projects to execute pilot projects and capacity building of staffs to replicate the innovative models in other parts of the cities or in other cities.

As part of the Smart City Innovation Lab, the **Fraunhofer** team has reached Kochi on Friday and will be in the City till December 12.

Editorial

Ms. Anandi Iyer
Director, Fraunhofer Office India

Mr. Rohit Kumar Rohilla
Manager, Production Technology,
Fraunhofer Office India

Ms. Shefali Prakash
Consulting Editor

405 & 406 Prestige Meridien -II
30, M G Road, Bangalore
Pin: 560 001
Tel: +91 80 40965008/9
info@fraunhofer.in
www.fraunhofer.in / www.fraunhofer.de