अनुसंधान
IIITD IRD Newsletter

INDRAPRASTHA INSTITUTE of INFORMATION TECHNOLOGY DELHI

IIITD IRD NEWSLETTER

VOLUME 3 SEPTEMBER 2021

Director's Message

Dear readers,

I hope that you are not only safe but also doing great!
While the pandemic has slowed things down, the IRD division at IIITD has chosen to embrace the uncertainty with optimism, rolling out various initiatives to help faculty members turn the immediate challenges into opportunities. One such initiative is a 'research grant writing' workshop for the faculty members.
External research funding is an essential instrument for the sustainability of the research ecosystem. Sponsored projects are necessary for strengthening a curiosity-driven and applications-inspired research culture in higher education institutes. Competitive grants also have a positive impact on the quality of research and often result in research collaborations. External research funding also creates a multiplier effect. The principal investigators can support more Ph.D. students, often resulting in more publications at suitable venues. Substantial grants are often contingent on the past track record, and frequently it is seen that 'money follows the money.' The Institute has always emphasized the importance of sponsored research, and I am sure more grant-writing workshops will be organized in the near future.
This newsletter will provide you with more information about our current research, development, and innovation activities. As the circumstances are gradually returning to normalcy and research activities are picking up in the second half of 2021, we look forward to novel research questions, innovative technology development, and new partnerships.
As always, your feedback and suggestions are most welcome.
Stay safe!
Best wishes,
Ranjan

Dean IRD's Message

Greetings from IIITD!

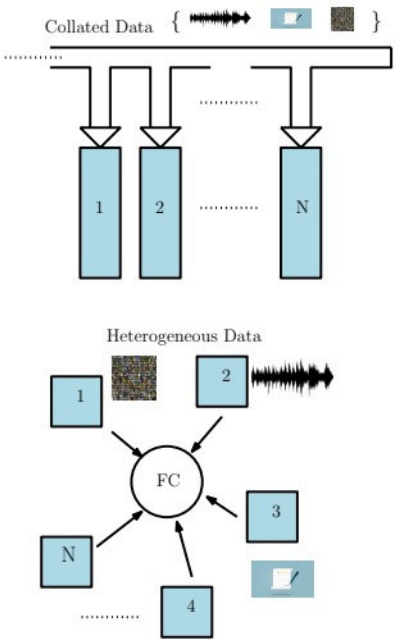
I hope you all are doing well.
We are happy to bring out the third edition of the IIITD IRD Newsletter. In the last 4 months, our faculty members have received several large research grants from various Government agencies and industries. We have established a new 'Centre of Sustainable Mobility' focusing on solving the current challenges of urban transportation in Delhi and the NCR. In the First Half of FY 21-22, our faculty members have published more than 39 quality research papers in top Transactions and Conferences signed 15 MoUs with various Government Organisation and Industries, and transfer research technologies to Industry.

As always, we welcome your feedback. Enjoy reading this newsletter.

RESEARCH HIGHLIGHTS

Major Research Fundings

On Personalized Federated Learning using Meta-learning and Bayesian Neural Networks



The proliferation of the Internet of things (IoT) devices in smart homes, hospitals, and enterprise networks is increasingly common and continues to rise everywhere. The tremendous success of Deep Neural Networks (DNN) in a wide range of practically relevant applications has triggered a race to incorporate DNNs to solve learning problems in IOTs and similar applications.

Deep learning-based designs require a substantial amount of training data, while, in networked systems, small amounts of data are available from heterogeneous sources. Hence, to employ DNNs in IoT-type applications, several modifications are required. The ability to adapt and learn new models from small amounts of data is critical for such systems. There is a growing interest in the learning-to-learn in the machine learning community, also known as the meta-learning paradigm, where models infer based on tasks, each consisting of a few training examples. In this project, the researchers study the feasibility of utilizing the learning-to-learn paradigms in distributed IoT frameworks.

Dr. Ranjitha Prasad is leading this project funded by SERB.

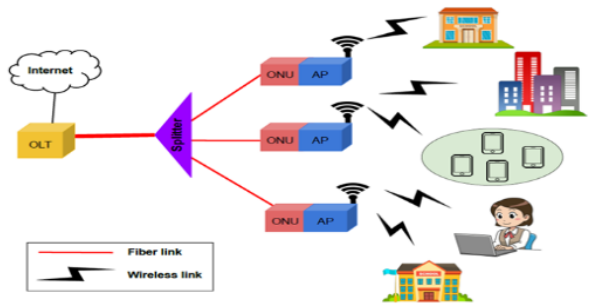
High-resolution Satellite Imagery for Modeling the Impact of Aridification on Crop Production: Paddy Cultivation in the Cauvery Delta

This is the first grant for AI + Agriculture at IIITD. The researchers from the Institute are partnering with the MS Swaminathan Research Foundation for this project, one of the most prominent NGOs working in this space and has made substantial contributions in Agriculture. The project aims at developing AI/ML models for making predictions on crop parameters like moisture availability, sowing, and harvesting dates, using satellite imagery. The projections will be helpful to identify trends in cropping behavior and make recommendations to farmers. The project is supported by Google's AI for Social Good initiative.

Dr. Saket Anand is leading this project.

Key Research Outcome

Designing a cost efficient and optimized Green Broadband Access Network for Rural India using Fiber Wireless (FiWi) Access Network Architecture appropriate for NOFN.

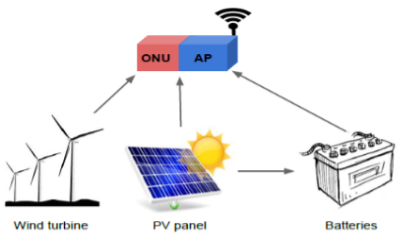


FiWi access networks have strengthened our information society while avoiding its digital divide. They combine the capacity of optical fiber networks with the ubiquity and mobility of wireless networks. FiWi networks form a powerful platform for supporting and creating emerging and future unforeseen applications and services. The project aims to design and simulate a cost-efficient and optimized Integrated FiWi architecture with enhanced throughput and reduced energy consumption for rural deployment.

The outputs of the project can be summarized as:

- In order to provide the required quality of service (QoS) to the users, the network must accommodate the high throughput requirement of the users. The throughput requirement may exceed 100 Mbps per user which can be achieved using high-end wireless and optical devices. The new WiFi standards such as IEEE 802.11 n/ac/ax pave a way to fulfil the users' requirements and XG-PON at the backend network.

- Along with enhancing network performance, and energy conservation scheme to provide a green FiWi access network is also needed. For such scenarios, renewable energy sources, such as solar and wind energy, can be used instead of traditional grid power supply.
- Moreover, to increase the reliability of the FiWi network, optimal placement of backup optical network units (ONUs) needs to be defined such that the QoS of the users are not affected even at the time of failure of network components.



Prof. Anand Srivastava led this project.

Kinetics of gastric gels: protection and transport

The project was focused on creating a new, unified, comprehensive, and experimentally guided mathematical model of gastric gels. Partial differential equations, along with dynamical systems, bifurcation theory, and asymptotic methods, were be used to understand these mucus gels' protective and transport features. The novel mathematical framework was used to establish and quantify (a) the role of the bicarbonate flux and (b) the buffering properties of the mucus gel in protecting the stomach lining, as well as the role of gastric mucus in the secretion of enzyme and acid, against the pH gradient. Based on the theories of statistical mechanics, the mathematical model of mucus gel provided a powerful predictive strategy to design treatments related to ulcerative stomach colitis.

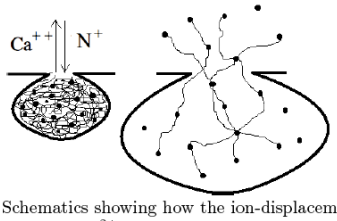


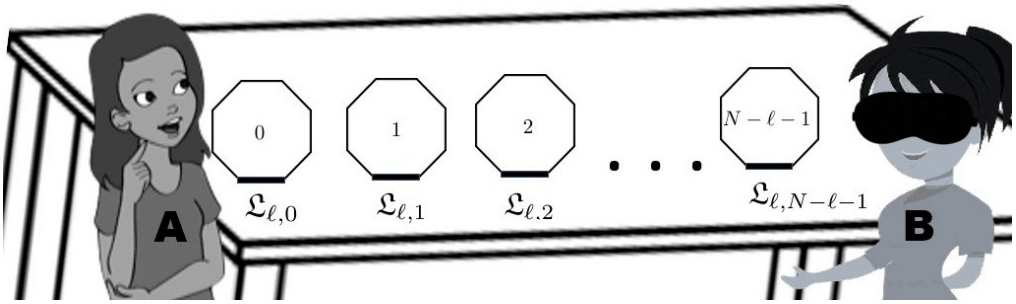
FIGURE 1. Schematics showing how the ion-displacement changes between calcium ion (Ca^{2+}) and a monovalent ion (e.g., Na^{+}) leading to changes in the network structure of the mucus matrix and its eventual expansion.

Dr. Sarthok Sircar led this project.

Repeated-root constacyclic codes over finite commutative chain rings and over non-principal ideal rings $\mathbb{Z}_{ps}[u]/\langleu"e \rangle$

In this study the researchers introduced and studied three new turn-based two-player roulette games and provided optimal winning strategies for these games in terms of depths of finite sequences over finite commutative rings with unity. They further discussed the feasibility of these winning strategies by studying the depths of codewords of repeated-root constacyclic codes of prime power lengths over finite commutative chainrings. Consequently, they explicitly determined depth distributions of all repeated-root constacyclic codes of prime power lengths over finite commutative chainrings.

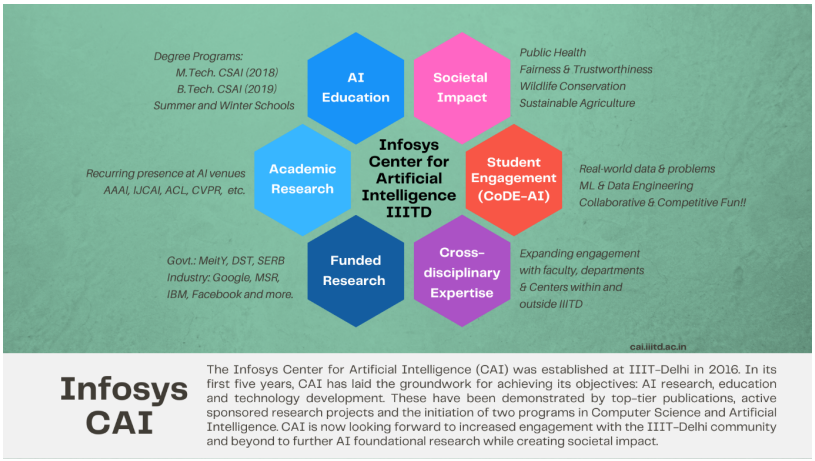
Dr. Anuradha Sharma led this project.



Infosys Center for Artificial Intelligence

The Infosys Center for Artificial Intelligence (CAI) at IIITD was established in April 2016 with the generous support of the Infosys Foundation. The objectives of the Center are to perform cutting-edge research in Artificial Intelligence (AI) and support education and technology development in AI. Starting with ten members, CAI has grown to 20 members in just five years. The CAI members have expertise in interdisciplinary areas like Machine Learning, Speech and Natural Language Processing, Computer Vision, Knowledge Representation, and verticals like Healthcare, Social Computing, Autonomous Driving, Software Engineering, and Human-Computer Interaction.

This expertise is evident as CAI members have produced demonstrable outcomes across all standards of high-quality research. With over 150 publications in the last five years, CAI members have established a recurring presence at various top-tier AI venues like AAAI, IJCAI, ACL, SIGKDD, CVPR, INTERSPEECH, The WebConf, among others, including contributions through senior program committee and editorial roles. CAI's Ph.D. scholars have also received accolades by securing various reputed fellowships, including the PM Fellowship, IBM, Google, Microsoft and TCS fellowship. CAI members have acquired many sponsored research grants from govt. Agencies like MeitY, DST, SERB, and industry sponsors like Google, Facebook, Microsoft, to name a few. Some of these projects have also resulted in technology transfer and field deployments.



CAI has played an integral part in facilitating AI education at IIITD by assisting the CSE department in launching and running two AI specialization programs (B.Tech. and M.Tech. CSAI). Designed to build solid foundations and engineering skills, a consequence of these programs is a diverse set of regularly offered AI-related courses that benefit the broader IIITD student community through more overall exposure to AI techniques and their applications.

Recently, several CAI members have been focusing on creating social impact through AI technology. Ongoing efforts comprise projects including detecting misinformation and hate speech on social media, using AI for public health, education, agriculture, and wildlife conservation. Multiple CAI faculty members are actively pursuing research in a multi-disciplinary, nascent, and yet undeniably important problem area of Ethics in AI, which deals with fairness, accountability, and trustworthiness in AI systems. These efforts have garnered support from various sponsors, including large corporate AI research labs and government funding agencies.

With CAI's research footing firmly established, the Center is excited to expand its reach further by solving core research problems in AI and tackling challenging applied issues that could have a lasting impact on society and the world. At this stage, CAI is keen on engaging closely with the broader IIITD community and is starting a few new initiatives, which will be executed in the coming months:

1. Revamping compute infrastructure to enable the highest quality of AI research and education.
2. Engaging further with more faculty researchers within and outside IIITD to foster cross-disciplinary expertise and solve challenging problems with AI.
3. Establishing a student wing, dubbed as Competitive Data Engineering and Artificial Intelligence (CoDE-AI), to tackle real-world problems through exciting activities, competitive, collaborative, and fun!

We expect our students and alumni will extend the same support with enthusiastic participation to the new initiatives of CAI as they have been redefining the standards of creativity and technical prowess elsewhere to harness AI technology and change the world for a better tomorrow.

INDUSTRY COLLABORATION

IIITD has made various collaborations with many Industrial and academic Organizations, few of them are:

1. D.kraft Private Limited.
2. GS1 India
3. Linkedin Technology
4. Optum Global Solutions (India) Pvt Ltd
5. THALES
6. Quality Healthcare Access Private Limited
7. Intello Labs Private Limited.
8. Electreefi

MoUs SIGNED

1. Great Lakes E Learning
2. Fast Retailing
3. IIT Delhi

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MoU Signed

AWARDS, HONORS, AND RECOGNITION

Dr. Sanjit K Kaul has been awarded the Rise Prize by Mahindra Group of worth Rs. 25 lakhs

TECHNOLOGY TRANSFER

- Dr. Debarka Sengupta and Dr. Gaurav Ahuja have done the first technology transfer (INR 40 Lakhs; Tumor Educated Platelet Gene Panel to Chief Scientific Advisor and Partner, CareOnco Biotech Pvt. Ltd.: Details are available at https://bmcgenomics.biomedcentral.com/articles/10.1186/s12864-020-07147-z)

- The project on Fiber-Wireless (Fi-Wi) network with renewable energy (Solar PV Cells + Battery + Wind energy) was completed by Prof. Anand Srivastava and Dr. Vivek Bohara from IIITD. This project received funding from the Ministry of Electronics and Information Technology (Government of India). Velmenni, a startup in light communication research-based in India and the EU, is an industrial / deployment partner for the Fi-Wi project and jointly works towards achieving specific deployment and Go-To-Market goals for the FiWi project. Fi-Wi project with proposed renewable energy infrastructure can undoubtedly reap benefits for the telecom operators and telecom infrastructure providers.

OTHER ACTIVITIES

- An Education Session on Patent was organized on 9th August 2021
- Dr. Anuj Grover is appointed as the new Associate Dean IRD w.e.f. 28th July 2021 for two years

26

TOTAL NUMBER OF PROJECTS

Rs. 5.39 Cr.

TOTAL VALUE OF PROJECTS

1

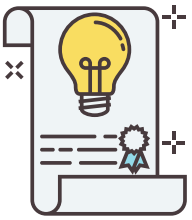
TOTAL NUMBER OF PATENTS FILED

15 PhD

25 RA

EMPLOYMENT GENERATED

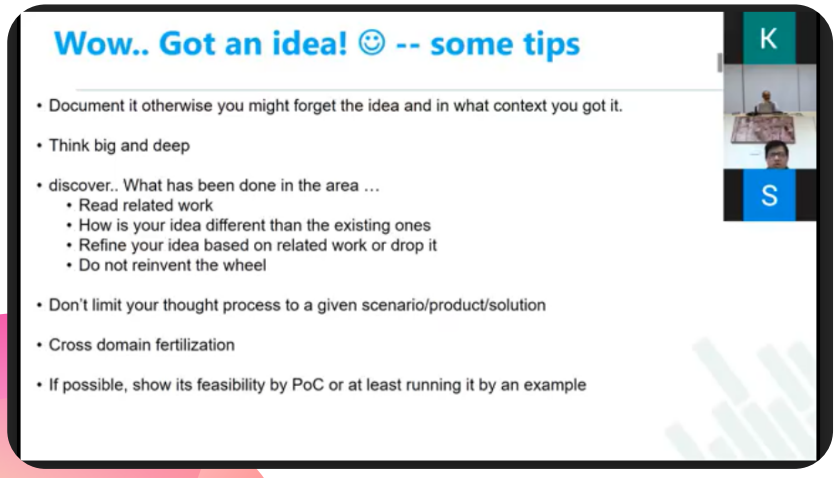
Patent Education Session

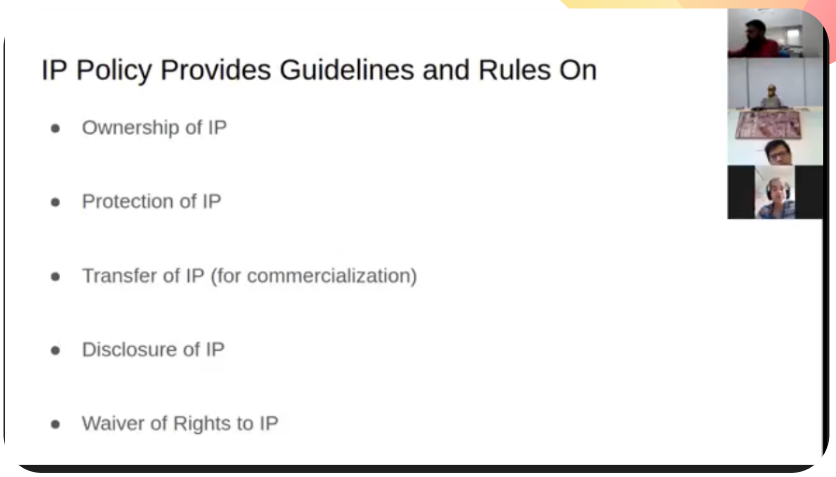


Education Session on patent was scheduled on 9th August and more than 100 participants attended the same

SPEAKERS

- Ranjan Bose
- Sanjit K. Kaul
- Mukesh Mohania and Anupam Saronwala





TOPICS

- Importance of generating the Intellectual Property (IP) and file Patents
- Patent Policy at IIITD
- What can be Patented?

FACULTY FOCUS

Dr. Pravesh Biyani is an Associate Professor at IIITD. He received his B.Tech. from IIT Bombay in 2002 and MS from McMaster University in the year 2004. In late 2012, he was a post-doctoral researcher at the University of Minnesota, Minneapolis. He also won the INSPIRE Faculty award by the Govt. of India in 2012. His research interests lie in the intersection of signal processing and machine learning with applications in urban transportation and speech/audio processing. He is passionate about public transportation and is interested in building systems and policy research to improve urban mobility. He has specifically been an active supporter of the open transit data systems.

Dr. Rajiv Ratn Shah currently works as an Assistant Professor in the Department of Computer Science and Engineering (joint appointment with the Department of Human-centered Design) at IIITD. He is also the director of the MIDAS lab at IIITD. He received his Ph.D. in computer science from the National University of Singapore, Singapore. Before joining IIITD, he worked as a Research Fellow in Living Analytics Research Center (LARC) at the Singapore Management University, Singapore. Before completing his Ph.D., he received his M.Tech. and M.C.A. degrees in Computer Applications from the Delhi Technological University, Delhi, and Jawaharlal Nehru University, Delhi, respectively. He has also received his B.Sc. in Mathematics (Honors) from the Banaras Hindu University, Varanasi. Dr. Shah has received several awards, including the prestigious Heidelberg Laureate Forum (HLF), European Research Consortium for Informatics and Mathematics (ERCIM) fellowships, and the best paper/poster in many conferences. He is involved in organizing and reviewing many top-tier international conferences and journals. His research interests include multimedia content processing, natural language processing, image processing, speech processing, multimodal computing, data science, and social media computing.