

MAY 2023

अनुसंधान

IIITD RESEARCH NEWSLETTER



ILLUMINATING THE PATH OF RESEARCH AT IIIT-DELHI

Unveiling the Latest Insights into Research @ IIIT-Delhi

Welcome to the latest edition of Anusandhan, the research newsletter of IIIT-Delhi. As a leading research institution, we are dedicated to pushing the boundaries of knowledge and fostering a culture of innovation. In this issue, we bring you a comprehensive overview of the diverse and impactful research happening within our institution and its wider impact on society.

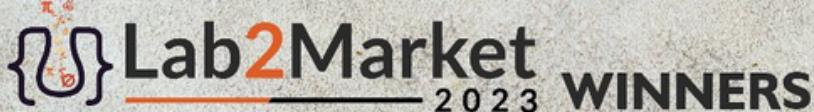
This is an in-depth exploration of our groundbreaking research projects, highlighting the exceptional work being conducted across various disciplines. The newsletter will keep you updated on the exciting conferences, symposiums, and workshops that bring together renowned scholars and experts to exchange ideas and drive collaboration.

We hope this edition of Anusandhan ignites your curiosity, inspires you to engage with our researchers, and showcases the transformative impact of research conducted at IIIT-Delhi. We invite you to explore the exciting topics covered in this newsletter and join us in our quest for knowledge and innovation.

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Research in Focus



Title: "AI-Driven Heart Disease Diagnosis"

Prof. Anubha Gupta, IIIT Delhi, and

Dr. Manu K. Shetty, Maulana Azad Medical College, New Delhi



Dr. Shetty and Prof. Gupta are renowned in AI and healthcare, having conducted extensive research on the subject. They believe that a combined effort between doctors and engineers can effectively address healthcare challenges and have been working together to develop practical AI solutions.

Prof. Anubha Gupta, IIIT-Delhi, and Dr. Manu K. Shetty, Associate Professor at Maulana Azad Medical College, New Delhi, have won the first prize at the Lab2Market2023 event organized by INDIAai.

Diagnostic processes

The winning project is an explainable AI model that diagnoses heart disease using ECG data. The model boasts an impressive 95% accuracy and offers a unique feature: it provides explanations for the decisions it makes. This ability to offer a rationale for its decisions is critical in fostering trust among doctors, who can then feel confident in incorporating the AI model into their diagnostic processes. Furthermore, by demystifying the traditionally opaque nature of AI models and shedding light on the inner workings of the decision-making process, this groundbreaking innovation transforms the AI model from a black box to a transparent and accountable tool.

This transparency in decision-making allows doctors to understand the AI's recommendations better and ensures that patients receive accurate diagnoses based on reliable data. The explainable AI model not only promotes the responsible use of AI in healthcare but also encourages further collaboration between medical professionals and AI researchers, paving the way for a new era of innovative and trustworthy AI-driven medical solutions.

ECG devices

The innovative AI model has the potential to revolutionize healthcare in areas where trained cardiologists are scarce, such as Primary Health Centers (PHCs) and Community Health Centers (CHCs). ECG is one of the most important screening tools for heart disease, and early diagnosis is crucial for effective treatment and management.

By integrating this AI model into existing ECG devices, healthcare professionals at PHCs and CHCs can rely on accurate diagnoses and save precious time in critical situations. Furthermore, with prompt diagnosis using the AI model, doctors at PHCs and CHCs can quickly refer patients to appropriate tertiary care centres for specialized treatment without delay, significantly improving the chances of successful outcomes and saving lives.

Conclusion

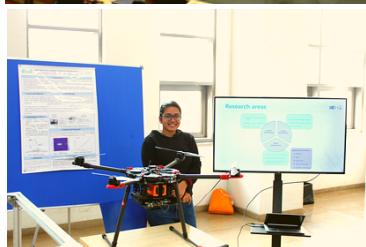
Dr Shetty and Prof. Gupta emphasize that for AI models to be effectively utilized in healthcare, they must be able to provide a clear rationale for their decisions. This transparency not only develops trust among medical professionals but also ensures that patients receive the highest standard of care. In addition, this initiative demonstrates the effectiveness of interdisciplinary teamwork in tackling real-world problems. It will also play an essential role in influencing the future of healthcare, making it more accessible, efficient, and reliable for everybody.

Focused Events



IIT-Delhi hosted the Research Innovation and Incubation Showcase (RIISE 2023) on May 11-12, 2023. The showcase was attended by over 600 participants from academia, industry, and government agencies across India and beyond, making it a truly international event.

Glimpse of other events



The showcase featured a keynote talk, panel discussions, project demos, and poster sessions on a wide range of topics related to intelligent systems engineering, including artificial intelligence, demystifying 6G communication, EV Design, and Industry 4.0, among others. The conference also provided a platform for researchers, practitioners, and students to exchange ideas, showcase their work, and network with peers. In line with the institute's focus on technology transfer, there were sessions organized on "Routes to Monetize Research", and "Entrepreneurship – its flavors and impact on the World".

The keynote talk was given by **Prof. Manindra Agrawal** from IIT Kanpur on the topic "Research from First Principles". Many reputed panelists including **Prof. Ram Gopal Rao**, Group Vice Chancellor, BITS Pilani Campuses; **Dr. Satish Jamadagni**, Senior VP Reliance Jio; **Dr. Suchita Markan**, ICMR; **Dr. Manoj Kumar**, STMicroelectronics; **Mr. Mahendra Pratap**, Co-founder HCL; **Prof. Kaushi Saha**, IIT Delhi; **Prof. Ashwin Gummatse**, IIT Bombay; **Prof. Aravind Chandiran**, IIT Madras; **Mr. N. Mohan**, CEO Delhi EV Cell; **Mr. Suresh Arikapudi**, Tata Motors, and many more shared their insights and interacted with faculty, students, and guests during the day. Their sessions covered various topics, from the latest computer vision and robotics advances to AI's ethical and societal implications.

More than 10 budding start-ups in the institute shared their idea and strategy with the visitors. More than 80 project demos were set up to demonstrate technologies being developed at IIT-Delhi. The Research Showcase had more than 300 posters on topics like - Applications of AI, Information Processing for Socio-Economic Settings, Lab Showcase, Urban Future & Access, Emerging Technologies in Medicine & Computing, Mathematical Foundations of Computing, Smart & Intelligent World, Self-reliance in Semiconductors, Computing Systems & Security, Advances in AI.

Other Research Events

- 👉 1 Pixel Design Conference
- 👉 ECE department organized INDUSTRY DAY
- 👉 Seminar on 'Systems Biology in Single Cells: A Tale of Two Viruses' by Dr. Abhyudai Singh
- 👉 Webinar on "How AI can Transform Hiring Processes" by Mr. Rohit Narain
- 👉 Symposium on Computational Creativity
- 👉 Start-up Fair 2023
- 👉 Workshop on Public Transit Data Format using Python
- 👉 Talk on 'Use of Quantum Computing for Earth Observation' by Jitesh Lalwani



Faculty in Focus

ARJUN RAY

Dr. Arjun Ray is a computational structural biologist and earned his Ph.D. degree from CSIR-IGIB. His formal education in the field of chemistry and biophysics led him to be interested in understanding how biological processes are carried out by three-dimensional interactions. His previous researches include developing methods and tools in the field of structure prediction and force distributed analysis of lipids, deciphering mechanistic understanding of interactions between various biological molecules and working with multi-scale systems. As a structural biologist, he has been regularly working with techniques for structure prediction, molecular dynamics simulations and biomolecular docking. Along with his research endeavours, he has held several positions such former President of Regional Student Group (India) for the International Society for Computational Biology.

Research Interests

- 👉 Deciphering the mechanism of CRISPR-Cas9
 - 👉 Elucidating molecular interactions in the reverse cholesterol pathway
 - 👉 Structural genomic problems
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N. ARUL MURUGAN

Dr. N. Arul Murugan, is a Ph.D. from Solid State and Structural Chemistry unit at Indian Institute of Science, Bangalore, India). He was awarded a Ph.D. degree in the year 2005 for his thesis contribution entitled "Molecular simulations of temperature induced disorder and pressure induced ordering in organic molecular crystals." After Ph.D., he was on postdoctoral visits to various institutes in Europe such as ULB (Brussels, Belgium), KTH (Stockholm, Sweden), and UPC (Barcelona, Spain) until 2011, and his research stays were supported generously by the prestigious fellowships from Belgian national fund for scientific research (FNRS), Wenner-Gren foundation and Spanish Ministry of Science and Innovation (for Juan de La Cierva fellowship). From the year 2011, he was employed as a researcher at the School of Biotechnology, KTH Royal Institute of Technology and from 2015 he was appointed as a Docent (Associate Professor) in theoretical chemistry and Biology at the same school. He has been involved in teaching and supervision at KTH since the year 2013. His research focuses on the computational development of drugs and PET tracers/optical probes for neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease and infectious diseases including Covid-19. His research is also devoted to the development of QM and machine learning based approaches for druggability prediction. He has published about 120 articles in international peer-reviewed journals including Sci.Adv., PNAS, JACS, Biosens.& Bioelectron., JMedChem, JCTC, JPClett., He has also written 3 book chapters and edited a book. He is serving as an editorial board member for Scientific Reports and IJMS.



Research Interests

- 👉 ML and DL approaches for druggability prediction
- 👉 QM fragmentation based approaches for druggability prediction
- 👉 Parallel virtual screening in HPCs and GPUs for accelerated drugs discovery
- 👉 Flexible docking assisted drugs discovery
- 👉 Atomistic simulation of virus-host cell interaction

Featured Publications

Reliable and Cost Effective All Optical Wireless Architecture for Broadband Access Network

Paper by Priyanka Singh, Dr. Vivek Ashok Bohara, and Dr. Anand Srivastava was accepted for publication in IEEE/OSA Journal of Optical Communication and Networking (JOCN).

This paper explores the benefits and trade-offs by integrating FSO based back-end with LiFi based front-end for an active optical network (AON).

Remaking Cities- Urban Reforms in Ahmedabad and Kanpur, India

Book by Dr. Praveen Priyadarshi was published by Routledge.

This book presents a systematic analysis of the differential implementation of urban reforms in two Indian cities, Ahmedabad and Kanpur.

ANROL: Autonomous Navigation based on ROS and Laser Odometry

Paper by Akshat Vikram SingH, Yash Agrawal, Dr. Rahul Gupta, Mr. Abhishek Kumar, and Prof. Vivek Ashok Bohara was presented in IEEE COMSNETS.

In this paper, the design and implementation of robust and precise localization and navigation scheme are proposed for an autonomous mobile robot.

A Sense Amplifier Based Bulk Built-In Current Sensor for Detecting Laser-Induced Currents

Paper by Debjit Batabyal, Sandeep Kumar Singh, Rajnish Kumar Mishra, Dr. Anuj Grover was presented at VLSI Design & Embedded Systems conference.

In this paper, a circuit and method to detect side-channel attacks in secure ICs are proposed. This method uses a combination of sense amplifiers that evaluates the sampled substrate current in a time-interleaved manner.

An Energy Efficient Dual IRS-aided Outdoor-to-Indoor Communication System

Paper by Mohd. Hamza Naim Shaikh, Prof. Vivek Ashok Bohara, Prof. Anand Srivastava & Dr. Gourab Ghatak was accepted in IEEE Systems Journal.

In this paper, the authors propose a dual IRS-aided communication model for outdoor-to-indoor wireless communication. The scenario comprises an outdoor base station that communicates with the indoor users with the aid of two distinct IRSs.

Influencers as institutions: Impact of digital politics in the Global South

Paper by Karishma Sinha, Paarmita Jhalani, Aasim Khan, and Payel Chattopadhyay Mukherjee was published in the Global Policy journal.

In this paper, the researchers seek to clarify key conceptual issues with the idea of 'influence' in digital politics and develop a framework to understand its institutional impact, particularly in the Global South.

On the Optimal Assignment of Mirror Elements in UAV and OIRS-Assisted OWC based Architecture

Paper by Priyanka Singh, Prof. Vivek Ashok Bohara, and Prof. Anand Srivastava was accepted in IEEE 97th Vehicular Technology Conference

This paper aims to utilize the OIRS-assisted UAV to improve the performance of optical wireless communication (OWC) systems. In this work, multiple mirror elements of the OIRS are grouped and assigned to the user.

Future scope of research on the biodesulfurisation and biomineralisation of petroleum and coal for their utilization in environment friendly way for sustainable development

Paper by Dr. Durlabh Kumar Sharma (Visiting Faculty, IIIT-Delhi) was published in the Acta Scientific Biotechnology journal.

In this paper, future scope of research on cleaning the coal and petroleum along with the utilization of CO₂ has been discussed.

Deep Neural Network Augmented Wireless Channel Estimation for Preamble-based OFDM PHY on Zynq System on Chip

Paper by Syed Asrar ul Haq (Ph.D. Student, IIIT-Delhi), Abdul Karim Gizzini (ETIS, France), Shakti Shrey (MTech Student, IIIT-Delhi), Sumit J. Darak (Faculty, IIIT-Delhi), Sneh Saurabh (Faculty, IIIT-Delhi) & Marwa Chafii (New York University, Abu Dhabi) was accepted for publication in IEEE Transactions on VLSI Systems.

This paper considers the design and implementation of deep neural network (DNN) augmented LS-based channel estimation (LSDNN) for preamble-based orthogonal frequency-division multiplexing (OFDM) physical layer (PHY) on SoC.

A Deep Neural Network-based Space debris trajectory prediction after an elastic collision event

Paper by Harsha M, IIIT-Delhi, Ananya Ajay Dave, IIT Kharagpur Gurpreet Singh, UR Rao Satellite Centre Dr. Arun Balaji Buduru, IIIT-Delhi, Dr. Sanat K Biswas, IIIT-Delhi was accepted for oral presentation at International Conference on Spacecraft Mission Operations 2023

The paper presents a Deep Neural Network (DNN) - based approach to predict the trajectory of space debris after the occurrence of an elastic and non-destructive collision event with an active satellite.

Graph Regularized Probabilistic Matrix Factorization for Drug-Drug Interactions Prediction

Paper by S. Jain, E. Chouzenoux, K. Kumar and A. Majumdar was published in IEEE Journal of Biomedical and Health Informatics.

This paper presents a novel Graph Regularized Probabilistic Matrix Factorization (GRPMF) method, which incorporates expert knowledge through a novel graph-based regularization strategy within an MF framework. An efficient and sounded optimization algorithm is proposed to solve the resulting non-convex problem in an alternating fashion.

DeConDFFuse : Predicting drug-drug interaction using joint deep convolutional transform learning and decision forest fusion framework

Paper by Pooja Gupta, Angshul Majumdar, Emilie Chouzenoux, Giovanni Chierchia was published in the Expert Systems with Applications journal, 2023.

In this paper, the authors propose a Siamese-like architecture with two processing channels' networks based on deep convolutional transform learning. Common fused representations as well as channel-wise representations are learnt, in addition with the transform across them.

New Research Program

M.Tech. (Research) in CSE

M.Tech. (Research) is a high-value two-years' masters program focusing on nurturing talent for research-based quality employability. The core emphasis is on research from day one with a limited amount of coursework to prepare a student to develop adequate in-depth understanding of a foundational topic of today's computing technology. The aim of the program is to attract the best talent from the pool of undergraduate students available for admission to a Masters program in the country in an academic year and train them to gain skills in cutting-edge research work in computer science.

Key Highlights of the program

- 👉 Globally Coveted
- 👉 High-value Scholarships
- 👉 Lower Fees
- 👉 Research Focused
- 👉 Quality Employability
- 👉 Research Incentives



Collaborations

All India Institute of Medical Sciences



IIIT-Delhi has signed a Memorandum of Understanding with All India Institute of Medical Sciences to jointly address the challenges facing India's healthcare sector through digital health innovations. The MoU outlines the commitment of both institutions to collaborate on various aspects of digital health, including Artificial Intelligence (AI), Machine Learning (ML), and Computational Genomics for advancing clinical medicine, public health, and biomedical research.

With the generous funding of over INR 18.7 crores (2.3 million USD) from Wellcome, data.org launched the India Data Capacity Accelerator and announced the selection of three premier universities in India. In partnership with universities and the Abdul Latif Jameel Poverty Action Lab (J-PAL) South Asia, the India Accelerator will support the ambitious work of equipping emerging professionals with the interdisciplinary data skills needed to address challenges at the intersection of climate and health.

Indraprastha Institute of Information Technology Delhi (IIIT-Delhi) will provide both technical and non-technical professionals with the hybrid program Post-Graduate Diploma in Data Science in Health and Climate Change for Social Impact.

Data.org



Max Healthcare Institute Limited



IIIT-Delhi has signed a Memorandum of Understanding with Max Healthcare Institute Limited, a leading healthcare provider in India, for a strategic collaboration to advance healthcare research and education in India.

The partnership aims to leverage the strengths of both organizations to promote and conduct high-quality research, develop cutting-edge healthcare solutions, and design and deliver capability and capacity-building programs for healthcare professionals.

The healthcare industry in India is ripe for disruption, and with rapid advancements in the fields of AI-enabled analytics, genomics and computational biology, such a collaboration could not be more suitably timed. This collaboration will focus on joint research activities and academic exchanges. IIIT-Delhi will bring its expertise in data science, machine learning, and artificial intelligence to this partnership and help develop innovative solutions that can augment the depth and breadth of healthcare services while reducing costs. Additionally, IIIT-Delhi will also focus on enhancing the training of healthcare professionals, and promoting research in the field of healthcare technology in order to make a lasting impact in the healthcare space.

Funded Projects



Classical and Quantum Error Correcting Codes and Mathematics over Finite Fields for Smart Telecommunications

Recurrence -independent inference of rare and non-coding functional mutations in cancer



Spectral element solvers for stationary and non-stationary Stokes equations

Cross modal object recognition for visual surveillance



RES-ISTRAC 2022-002: Multisensor data fusion and orbit determination with nonlinear estimation for space debris RADAR

Design and Development of a Sustainable Video Streaming Framework over low and Very Low Bandwidth Network



AI - based Methods for Driving and Traffic Analysis on Indian Highways using Dashcam Videos

AI-driven tracking of hallmarks of aging mechanisms during chronological aging



Developing a work-flow for a machine learning based virtual screening



Understanding Spectral - Temporal Feature
Integration in Acoustic Modelling

Developing a Scalable, ABDM Compliant
Antimicrobial Resistance Tracker



Biocon Foundation
EMPOWERING COMMUNITIES



Strain-specific metagenomics to investigate assembly,
resilience and transmission of the gut microbiome and
enable rational design of microbe-based therapeutics for
the Indian population.

Bayesian approaches for federated incremental
learning



Semiconductor
Research
Corporation



Developing a Robust Timing Verification and
Signoff Framework Using Machine Learning

Two, TIH-IoT Chanakya Faculty Fellowship 2022-23



TIH TECHNOLOGY
INNOVATION
HUB FOR IoT & IoE
TRUST IN TECHNOLOGY



Capacity Building in Robotics & Autonomous
Systems in India/ IRAS-HUB

Strengthening Managerial Workflows with Data
Driven Decision Support in the Aam Aadmi
Mohalla Clinic Model in Delhi



**World Health
Organization**

Research in News



IIIT-Delhi develop unCTC, a deep dictionary learning to detect circulating tumor cells in the bloodstream

There are various techniques that detect CTCs on the basis of markers. But a larger set of CTCs may otherwise be missed due to variable or no expression of protein markers. For the analysis of these data, unsupervised clustering is crucial. uHCTC, an algorithm for unsupervised clustering based on deep learning, developed can identify and characterize CTCs from single-cell transcriptomic data. When compared to current CTC capture technologies, it's like casting a wider net to capture circulating tumor cells.

New Delhi: Researchers at the IIIT-Delhi in collaboration with Rasanjana's group at Fluidigm Corporation, United States have come up with an innovative uCTC, a deep dictionary learning framework for unbiased identification of circulating tumor cells (CTCs) in the bloodstream.

The image is a composite of two photographs. The left side shows Prime Minister Narendra Modi in a white shirt and dark trousers, standing and gesturing while speaking to a group of students in a workshop setting. One student is working on a laptop. The right side shows Education Minister Atishi Maitreya in a dark suit and tie, speaking at a podium during a press conference. A large screen behind him displays his name and the text 'Minister for Education'.

A photograph of a modern, multi-story building with a glass facade and a long, low wall in front. The building appears to be a university or research institution. In the foreground, there is a paved walkway and some greenery, including small trees and shrubs.

IIIT Delhi To Conduct Annual Research Innovation And Incubation Showcase On May 11

IIIT Delhi invites everyone to its annual Research Innovation And Incubation Showcase (RISE 2023). The event is open for General Public, Students, researchers, academics and industry professionals. Here is all you need to know about it.

Authorised by: TN Education Desk | Updated May 2, 2023 | 08:33 PM IST

IIIT Delhi To Conduct Annual Research Innovation And Incubation Showcase On May 11

Indraprastha Institute of Information Technology ([IIIT Delhi](#)) will be organising this year's Research Innovation and Incubation Showcase, RISE 2023 on May 11, 2023.

In this year's discussion, panel discussions and research poster presentations will be done.

RISE 2023: Presentation On These Themes

1. Opportunities in EV Design
2. Changes in AI-Driven World
3. Shaping the future with Industry 4.0
4. Rethinking Communication in 2030
5. Routes to Monetize Research
6. Green Initiatives
7. Changes after IIIT-Delhi
8. Entrepreneurship - its Flavours Impact on the World

'All IIIT-Delhi, we strive to endeavour such research which contributes to the development of the society and RISE is one such event that will showcase some very

आईआईआईटी से अनुसंधान में मास्टर्स कर सकते हैं छात्र नहीं दिल्ली, प्रभुख संवाददाता। इंट्रोफ्रेस्थ इंस्टीट्यूट ऑफ इकार्मेशन टेक्नोलॉजी (आईआईआईटी) दिल्ली से अब अनुसंधान में भी मास्टर्स कर सकेंगे। इसके तहत इंस्टीट्यूट के कंप्यूटर साइंस और इंजीनियरिंग विभाग ने मास्टर और टेक्नोलॉजी प्रोग्राम की शुरुआत की है।

इस प्रोग्राम को प्री-डॉक्टरेट स्तर पर छात्रों को तैयार करने के लिए डिजाइन किया गया है। ये वर्षीय इस पाठ्यक्रम में पहले साल शुल्क लगेगा, जबकि दूसरे साल कोई शुल्क नहीं लगेगा। विद्यार्थी को हर माह 21 हजार का छात्रवृत्ति, लैपटॉप के लिए 50 हजार और हर साल अतिरिक्त आकस्मिक जरूरतों के लिए 10,000 रुपये देने की प्रावधान है।