Curriculum Vitae

MIHIR AGARWAL

Medical Imaging • Computer Vision

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EDUCATION

Indian Institute of Technology Gandhinagar (IITGN) — CPI: 9.02/10
B.Tech in Electrical Engineering with minors in Computer Science & Engineering and Mathematics — 2021-2025

Delhi Public School, R.K. Puram — Percentage: 98.2
Class XII, Central Board for Secondary Education — 2020-2021

Delhi Public School, R.K. Puram — Percentage: 96.6
Class X, Central Board for Secondary Education — 2020-2021

CONFERENCE PROCEEDINGS

Mihir Agarwal*Progyan Das*,
Disentangling the Peptide Space: A Contrastive Approach with Wasserstein Autoencoders - *accepted in the NeurIPS 2024 Workshop on AI for New Drug Modalities* **[Paper]**

Mihir Agarwal*, Progyan Das*, Udit Bhatia
Spatially Regularized Graph Attention Autoencoder Framework for Detecting Rainfall Extremes - *Accepted at Tackling Climate Change with Machine Learning at NeurIPS 2023* **[Paper]**

Progyan Das*, **Mihir Agarwal***
Less But Better, Towards better AQ Monitoring by learning Inducing Points for Multi-Task Gaussian Processes - *accepted in the NeurIPS 2023 Workshop on Adaptive Experimental Design and Active Learning in the Real World (RealML-2023)* **[Paper]**

Progyan Das*, **Mihir Agarwal***
Focus on What's Important! Inspecting Variational Distributions for Gaussian Processes for better AQ Station Deployment - *accepted at 2023 NeurIPS Workshop on Computational Sustainability: Pitfalls and Promises from Theory to Deployment (CompSust)* **[Paper]**

Mihir Agarwal*, Lalit Chandra Routhu*, Zeel B Patel, Nipun Batra
Conformal Prediction: A Visual Introduction - *accepted at the 6th Workshop on Visualization for AI Explainability* **[Article]**

* **indicates equal contribution**

CONFERENCE PRESENTATION

Mihir Agarwal*, Shreyans Jain*, Ruchika Dhawan, Nishitakumari Prafulchandra Mistry, Himanshu Shekhar
Suppressing Streak Artifacts Generated by the Interference of Imaging and Therapy Fields: Initial findings using a Hybrid U-Net and Diffusion Model - *accepted at 2024 IEEE South Asian Ultrasonics Symposium (SAUS)*

Shreyans Jain*, **Mihir Agarwal***, Ruchika Dhawan, Nishitakumari Prafulchandra Mistry, Himanshu Shekhar
Suppressing Streak Artifacts in Ultrasound Images during Therapy Guidance by a Hybrid U-Net and Enhanced Masked Autoencoder - *Accepted at Conference International Society for Therapeutic Ultrasound, Taipei 2024.*

Ruchika Dhawan, **Mihir Agarwal***, Shreyans Jain*, Hrriday Ruparel*, Himanshu Shekhar
Reconstruction of Ultrasound Super-Resolution Images using a Hybrid Attention-based U-Net Architecture applied to sparse data - *Accepted at Conference International Society for Therapeutic Ultrasound, Taipei 2024.*

INTERNSHIPS

Evaluating AI for Predictive Neuroimaging

IUSSTF-Viterbi'24 Research Intern | Prof. Andrei Irimia | Irimia Lab, University of Southern California — *May'24-Jul'24*

- Devised a Deep Learning pipeline to predict how the brain would age using 3D T1 weighted MRI Images from the UKBB dataset. We used a convolutional autoencoders with perceptual loss achieving competitive performance.
- Worked on developing a metric for evaluation of the generated brain images to make the current metric set more robust.
- Worked on deep learning techniques for generation of brain images at specific ages, useful for test time augmentation in other application such as brain age prediction.

Air Quality Prediction in Delhi using Graph Neural Networks

Research Internship | Prof. Nipun Batra | Sustainability Lab, IIT Gandhinagar — *May'23-Jul'23*

- Conducted experiments to improve air quality predictions for Delhi and Beijing using Spatio-Temporal Graph Neural Networks (STGNNs), analyzing real-world datasets with PM2.5, PM10, and meteorological features (pressure, wind speed, direction).

- Explored graph construction techniques, including nearest neighbors and distance thresholds, to model spatial and temporal relationships in air pollution, leveraging advanced STGNN architectures like EvolveGCN and ConvGRU.
- Applied advanced techniques such as Gaussian normalization for adjacency matrices and integrated wind kernels into graph structures, achieving lower RMSE than traditional models through custom modifications.

6D Pose Estimation using Deep Learning for Robotics

Machine Learning Research Internship | Mr. Rajesh Sinha and Mr. Prakash Ambwani | Smart Machines Automation Lab, TCS Research *Oct'22-April'23*

- Worked on 6D pose estimation for various robotics applications. Furthermore, working on a semi-supervised architecture for calculating the 6D pose of the object.
- Created a tool for making BOP Datasets from object models. The tool allowed the user to generate RGBD images with the 6D pose ground truth with great flexibility to change background, textures, etc.

SELECTED PROJECTS

Streak Artifact Suppression in High-Intensity Focused Ultrasound and Histotripsy Images for Therapeutic Applications

Research Project | Prof. Himanshu Shekhar | MUSE Lab, IIT Gandhinagar *Ongoing*

- Designed a Fourier-Attention U-Net to suppress streak artifacts in B-mode ultrasound, enhancing artifact removal and preserving critical contrast for therapeutic imaging.
- Implemented synthetic streak generation for training data to simulate real-world artifact conditions, enhancing the model's robustness in detecting and inpainting streaks.
- Achieved a significant increase in signal-to-noise ratio (SNR) by 20 dB, showing potential for real-time clinical application.

Reconstruction of Ultrasound Super-Resolution Images using a Hybrid Attention-based U-Net Architecture applied to sparse data

Research Project | Prof. Himanshu Shekhar | MUSE Lab, IIT Gandhinagar *Ongoing*

- Developed a Hybrid Attention-Based U-Net architecture to enhance Ultrasound Localization Microscopy (ULM) by accurately tracking microbubbles in noisy image sequences, facilitating super-resolution imaging in therapeutic applications.
- Reduced the data requirements for ULM by 40 times, utilizing sparse data to achieve high-quality super-resolution images, a significant improvement over traditional methods, thus making ULM feasible for clinical ultrasound applications.
- Achieved peak signal-to-noise ratio (SNR) enhancement of 14.73 dB in simulated data, validating the model's capability to capture detailed vascular features with limited data input compared to conventional ULM reconstruction techniques.

VeriBench: Benchmarking Large Language Models for Verilog Code Generation and Design Synthesis

Research Project | Prof. Joycee Mekie | Nano DC, IIT Gandhinagar *Jan'24 - Oct'24*

- Benchmarked 3 proprietary and 14 open-source Large Language Models (LLMs) for Verilog code generation, testbench creation, and formal verification, highlighting the performance of models like ChatGPT-4 and Llama 3 on hardware design tasks.
- Developed a hybrid workflow integrating LLM-based Verilog code generation with human verification, achieving 93%+ accuracy in Verilog synthesis and efficient power and latency evaluations on AMD Vivado and Cadence Genus.
- Submitted the work to the **IEEE International Symposium on Circuits and Systems (ISCAS) 2025**.

SmartAccel: Constraint-Aware Machine Learning for Hardware Design Optimization

Research Project | Prof. Joycee Mekie | Nano DC, IIT Gandhinagar *Ongoing*

- Use Reinforcement learning for design space exploration to explore and optimize four hardware accelerator architectures - Eyeriss, Simba, Gemini, and Hella, targeting diverse deep learning workloads such as CNNs, MLPs, and transformer models.
- Incorporated physical constraints into the design space exploration process, enabling ML optimization algorithms to identify feasible, manufacturable configurations while balancing performance, power, and area for efficient hardware design.
- Submitting the work to the **IEEE/ACM International Conference on Computer-Aided Design (ICCAD) 2025**, demonstrating the potential for ML-driven optimization in practical and efficient hardware accelerator designs.

Conformalized Quantile Regression for Energy Disaggregation

Research Project | Prof. Nipun Batra | Sustainability Lab, IIT Gandhinagar *Aug'23 - Nov'23*

- Developed a distribution-free uncertainty quantification approach in Non-Intrusive Load Monitoring (NILM) using conformalized quantile regression, providing reliable appliance-level energy disaggregation without assumptions of Gaussian data distribution.
- Implemented conformal prediction techniques, ensuring mathematical coverage guarantees for expected calibration error (ECE) and empirical coverage, enhancing the reliability and calibration of predictive uncertainty in NILM.
- Evaluated the model using the Reference Energy Disaggregation Dataset (REDD), achieving superior calibration and computational efficiency (up to 10x faster training and inference) compared to traditional uncertainty quantification methods, such as Bayesian NNs and MC Dropout.

Uncertainty Bounds for Anomalous Geomagnetic Storm Forecasting – A Deep Learning Approach

Prof. Dibyendu Chakrabarty and Prof. Soumyabrata Chakrabarty | Physical Research Laboratory, ISRO | Poster

Jan'23-June'23

- Designed and implemented a multitask multivariate transformer architecture to forecast geomagnetic storm indices, incorporating Monte Carlo Dropout for robust uncertainty quantification.
- Trained on high-resolution datasets spanning 2000-2017, our model accurately predicted storm occurrences up to 96 hours in advance, achieving RMSE values of 3.21 for Kp, 5.79 for Sym-H, and 6.12 for Ap.
- Enhanced prediction reliability with multitask learning, capturing interdependencies between geomagnetic indices and providing 95% confidence intervals for informed space weather decision-making.

AWARDS AND ACHIEVEMENTS

- **Second Runner's Up** in the 2024 Intel Cup Undergraduate Electronic Design Contest out of 200+ participating teams.
- **6th position** in the Amazon Machine Learning Challenege 2024 out of 3000+ teams from all across India.
- **Awarded with the Dean's list** for academic excellence in semester 3 and 4.
- **Inter IIT representative** for IITGN in Machine Learning and Product Development Problem Statement.
- **Runners up** 26th Annual International Space Settlement Design Competition, 2019, NASA Kennedy Space Center, Florida, USA.

TEACHING EXPERIENCE

Instructor

SC 336: Mathematics of Machine Learning October '23

- Instructed IIT Gandhinagar's first student-led, fully accredited short course, with record registrations of 170 students across undergraduate and graduate years. Taught 1 lecture based on Convolutions, Fourier analysis, Linear Regression, Polynomial Regression, and Regularisation.

Academic Discussion Hours, Mentor

Ordinary Differential Equations • Introduction to Electrical Systems • Calculus of Single Variable and Linear Algebra • Numerical Methods Jan '23 - Nov '23

- Mentored a diverse group of first and second-year undergraduate students.
- Designed and delivered supplementary learning materials, including study guides and practice exercises.

Teaching Assistant

Networks and Complex Systems Jun '23 - July '23

- Mentored several student projects focusing on applying complex network principles in real-world systems.

Workshops

Gujarat Urja Vikas Nigam Ltd (GUVNL) Workshop Oct'23

- Conducted a workshop on Introduction to Python as part of the AI/ML Applications in Power Sector for the officers of the Gujarat Urja Vikas Nigam Ltd (GUVNL) and its subsidiary companies which is the state electricity corporation responsible for power generation, transmission, and distribution across Gujarat.

TECHNICAL SKILLS

Languages: Python | Verilog | C++

Tools: Xilinx Vivado | VS Code | LaTeX | Git | Anaconda | Autodesk Inventor | LTSpice | FreeSurfer

POSITIONS OF RESPONSIBILITY & EXTRA CURRICULAR

- **Technical Coordinator** of the Technical Council and the **Contingent Leader** for the Inter IIT Tech Meet Contingent of IIT Gandhinagar. *Apr '23 - March '24*
- Overall Coordinator of **G20-Ignite**, a Sci-Tech Fair, IITGN. Organized under India's G20 Presidency framework to promote innovation and technology in alignment with global sustainable development goals among school students. *Jan '23 - Oct '23*
- **Peer Assisted Learning (PAL)** mentor providing valuable support to first-year students with limited English proficiency. Conducted writing and speaking practice sessions to improve communication skills and build confidence. *Jan '23 - April '23*
- **Sponsorship Head for IIT Gandhinagar's cultural fest**, where I coordinated collaborations with 40 companies, securing sponsorship worth Rs. 12 lakhs, marking a remarkable two-fold increase from the previous year. *July '22 - Feb '23*