MAMTA SAINI

Indian Institute of Science, Bangalore, India

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EDUCATION

National Institute of Technology Kurukshetra, Haryana *August 2023 - May 2025*
Master of Science in Mathematics CGPA: 8.9/10
Thesis: **Study of Fractional Physics Informed Neural Networks for Time Fractional Equations** (with *Advisors: Prof. A.S.V. Ravi Kanth*)

ARSD, University of Delhi, New Delhi *August 2020 - May 2023*
Bachelor of Science in Mathematics (Honours) CGPA: 8.5/10

PROJECTS

Latent Reciprocity Network for Neural Operators [LINK] *November 2025 – December 2025*

- Developed the Latent Reciprocity Network (LRN), a backbone-agnostic module enforcing bidirectional latent-space alignment between input and solution fields for neural PDE solvers.
- Achieved a **67.89%** relative error reduction on 2D Darcy flow with LRN-FNO (from `0.4049` to `0.1300`), demonstrating improved robustness on challenging elliptic problems.
- Diagnosed degradation on 2D Burgers' and Navier–Stokes and proposed remedies via extended contrastive pretraining, gated latent injection, larger batches, and increased data complexity.

Physics-Informed Neural Transformer Operator with Geometry Variant (PINTO-G) [LINK]
October 2025 – Present

- Developing a hybrid framework that integrates the Physics-Informed Neural Transformer Operator (PINTO) with Geometry-Informed Neural Operator (GNO) architectures to enhance spatial reasoning and physical consistency.
- Aiming to improve generalization across diverse geometries, initial, and boundary conditions by combining transformer-based attention with geometry-aware operator learning.

Study on Latent Space Behaviour of Fourier Neural Operator [LINK] *Aug 2025-September 2025*

- Introduced latent-space regularization and loss functions within the Fourier Neural Operator to enhance feature learning and convergence stability.
- Achieved relative error reductions of `13.70%` on Burgers', `11.25%` on Darcy flow, and `18.84%` on Navier–Stokes (128×128), demonstrating consistent accuracy and convergence improvements across benchmarks.

Wavelet Variant of Graph-Informed Neural Operator [LINK] *May 2025 – August 2025*

- Designed a modified version of the Geometry-Informed Neural Operator (GINO) by integrating a wavelet-based layer in place of the linear transformer within the FNO architecture.
- Achieved improved performance, recording a relative error of around 2% for the transient case.

Fractional PINNs for solving Time-Fractional Burgers–Huxley [LINK] *July 2024 – May 2025*

- Incorporated fractional-order operators in the loss formulation to accurately capture memory effects and non-local temporal dynamics.
- Achieved stable convergence and accurate reconstruction of the solution profile, validating the effectiveness of fractional PINNs for nonlinear fractional PDEs.

RESEARCH EXPERIENCE

Indian Institute of Science, Bangalore *May 2025 – Present*
Scientific Machine Learning Engineer, Zenteiq.ai
Advisors: Prof. Sashikumaar Ganesan

- Developing Physics-Informed Neural Networks (PINNs) and Geometry-Informed Neural Operators (GINOs) for accurate prediction of magnetic fields in stator geometries.

National Institute of Technology, Kurukshetra *May 2024 – May 2025*
Research Scholar
Advisors: Prof. A.S.V. Ravi Kanth

- Conducted research on Physics-Informed Neural Networks (PINNs) for solving time-fractional and nonlinear PDEs. Implemented PINNs in TensorFlow for Burgers–Huxley and Convection–Diffusion equations.

National Institute of Technology, Kurukshetra *Aug 2023 – May 2024*
Research Intern
Advisors: Dr. Harshita Madduri

- Conducted comparative study of numerical solvers for ODEs and PDEs. Analyzed accuracy, convergence, and computational efficiency. Presented results through numerical experiments on classical PDEs.

RELEVANT COURSEWORK

Mathematics: Linear Algebra, Sequence and Series, Univariate Calculus, Ordinary Differential Equations & Multivariate Calculus, Vector Calculus & Partial Differential Equations, Probability & Statistics, Discrete Mathematics, Advanced Fluid Dynamics, Dynamics system and Control
Computational Science & Programming: Computational Fluid Dynamics, Numerical Methods & Computer Programming (Python), Introduction to Machine Learning (NPTEL), Data Analytics with Python

TECHNICAL SKILLS

- **Languages:** Python
- **Scientific Computing** - Gmsh, ParaView, CUDA
- **Data Science** - TensorFlow, Scikit-learn, NumPy, Pandas, Matplotlib, SciPy, SymPy
- **Research Tools** - Git, LaTeX, VSCode, Vim, Jupyter, Markdown, GitHub Actions, ClearML

PROFESSIONAL DEVELOPMENT

- **International Conference on Applied AI and Scientific Machine Learning (CASML) 2024**, Indian Institute of Science Bangalore *18-22 December, 2024*

LEADERSHIP & ACHIEVEMENTS

- **Founder & President**, Anant: The Mathematical Society, NIT Kurukshetra (2023-2025)
- **Placement Coordinator**, NIT Kurukshetra (2024-2025)
- **Ex-Core Head**, National Service Scheme, Delhi University
- **Winner**, Tug of War Sports meet, 2023