

# Pinak Mandal

Glebe - 2037, Sydney, NSW

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## Professional Summary

PhD in Applied Mathematics and Deep Learning with 8+ years of experience developing advanced algorithms for dynamical systems, generative AI, and data-driven optimization. Expert in designing and executing computational experiments to validate ideas. Author of several software projects that deliver scalable ML systems with a strong emphasis on usability and performance.

## Education and Employment

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|--|-------------|
| • <b>University of Sydney, Sydney</b>  | 2023 - 2025 |
| Postdoc (Machine Learning and Dynamical Systems)   |             |
| Supervisor: <a href="#">Georg Gottwald</a>   |             |
| • <b>International Centre for Theoretical Sciences, Bengaluru</b>  | 2017 - 2023 |
| PhD (Applied Mathematics and Deep Learning)  |             |
| Supervisors: <a href="#">Amit Apte</a> , <a href="#">Vishal Vasan</a>  |             |
| Thesis: Numerical Filter Stability, Fokker-Planck Equations and Infinite Dimensional Optimization with Deep Learning |             |
| • <b>Jadavpur University, Kolkata - MSc (Mathematics)</b>  | 2014 - 2016 |
| • <b>Jadavpur University, Kolkata - BSc (Mathematics)</b>  | 2011 - 2014 |

## Work Experience

I have worked on a broad range of applied problems with a recent focus in fundamental machine learning. Some of them are listed below.

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|--|-----------|
| • <b>Unlearning via orthogonalization in generative models, USyd</b>   | 2025      |
| Developed new model-agnostic algorithms for forgetting undesired training data in generative models that are $\sim$ 10-20x faster than gradient surgery.   |           |
| <a href="https://arxiv.org/pdf/2506.04712.pdf">https://arxiv.org/pdf/2506.04712.pdf</a>  |           |
| • <b>Learning dynamical systems from data with Random Feature Maps, USyd</b>   | 2024      |
| Developed data-driven sampling for tanh random feature maps; implemented deep and local variants of RFMs, achieving state-of-the-art forecast times for chaotic dynamical systems with $\sim$ 15-20x smaller models than traditional ML architectures. |           |
| <a href="https://www.nature.com/articles/s41467-025-61195-1">https://www.nature.com/articles/s41467-025-61195-1</a>  |           |
| • <b>Solving partial differential equations and constrained optimization problems with deep learning, ICTS</b>   | 2021-2023 |
| Developed deep learning algorithms for solving high-dimensional Fokker-Planck equations and problems in calculus of variations and identified a special failure mode of physics-informed neural networks for parabolic equations.                      |           |
| <a href="https://arxiv.org/pdf/2306.07068.pdf">https://arxiv.org/pdf/2306.07068.pdf</a> ,  |           |
| <a href="https://arxiv.org/pdf/2401.01292.pdf">https://arxiv.org/pdf/2401.01292.pdf</a>  |           |
| • <b>Data Assimilation, ICTS</b>   | 2020-2021 |
| Developed a fast, scalable method for assessing the stability of numerical filters, including EnKF and particle filters, and demonstrated exponential stability in both cases.   |           |
| <a href="https://www.sciencedirect.com/science/article/abs/pii/S0167278923001197">https://www.sciencedirect.com/science/article/abs/pii/S0167278923001197</a>  |           |

<https://ieeexplore.ieee.org/document/9703185>

- Predicting Visual Stimuli from fMRI Data, Neuromatch Academy 2021  
Used fMRI data to predict images seen by human subjects (in collaboration with an international group of graduate students).
- Atmospheric Plume Modelling, ICTS 2019  
Developed a PDE-based model for atmospheric plume, and combining with it open-source data from OpenStreetMap, estimated air pollution levels in [Peenya](#).
- I have also worked as a consultant for [Adam Spencer](#). 2024

## Selected Conferences and Seminars

- Mathematical and Computational Foundations of Climate Modeling - **BIRS, CMI** | **Talk:** Unlearning via orthogonalization in generative models 2025
- Co-organized minisymposium titled: Data-driven reconstruction and forecasting of dynamical systems - **SIAM DS25, Denver** 2025
- Machine learning seminar - **USyd** | **Talk:** Learning dynamical systems with hit-and-run random feature maps 2025
- Numerical methods for complex high dimensional systems - **Jervis Bay** | **Talk:** From Random to Reliable: Good sampling for random features in ML 2024
- New directions for SDE and machine learning - **ICMS, Edinburgh** | **Poster:** Success and failure of PINNs and solving Fokker-Planck equations 2024
- Variational principles of plasma confinement in 3D magnetic fields - **ANU** | **Talk:** Deep learning for stellarator design (with Zhisong Qu) 2023
- 7th Indian Control Conference - **IIT Bombay** | **Talk:** Stability of nonlinear filters - numerical explorations of particle and ensemble Kalman filters 2021

## Achievements

- 2nd place at national level mathematics exam IIT-JAM 2014
- 9th place at national level mathematics exam TIFR-GS 2016
- 15th place at national level math exam (for lecturership in India) NET 2016
- Future Research Talent Fellow (Australian National University) 2021
- Recipient of Infosys-TIFR Leading Edge travel grant 2023

## Publications and Visualizations

- First author of several articles in high-impact journals, including **Nature Communications**, **Foundations of Data Science**, **Physica D**, and **IEEE**. A list of my research articles can be found [here](#).
- A gallery of visualizations illustrating snippets from my projects is available on my [GitHub page](#).

## Technical Skills

- **Languages:** Python (primary), C, MATLAB, SQL
- **Libraries:** PyTorch, TensorFlow, NumPy, SciPy, Pandas, Matplotlib
- **AI/ML:** Deep Learning (AutoDiff, SGD, LSTM, CNN), Generative Models (VAE, GAN, WGAN, WGAN-GP, Diffusion Transformer, Flow Matching), Fine-tuning (LoRA), Model Compression (Quantization, Mixed Precision Training)
- **Other:** Git, GPU Computing, Data Visualization, Google Colab, Hugging Face
- **Some open-source GitHub projects authored by me:** [DeepRFM](#), [forget](#), [fp-solvers](#) DeepRFM has garnered significant [interest from the climate modelling community](#), and is slated for integration with other climate modelling systems.

**Referees**

**Georg Gottwald**

University of Sydney, Sydney

**Vishal Vasan**

ICTS, Bengaluru

**Tarun Malviya**

Commonwealth Bank, Sydney

**Amit Apte**

IISER Pune, India

**Sreekar Vadlamani**

TIFR-CAM, Bengaluru