

Glebe - 2037, NSW

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## PINAK MANDAL

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### Some Academic Highlights

- 2nd place at national level mathematics exam IIT-JAM(2014)
- 9-th place at national level mathematics exam (for my current employment) TIFR-GS(2016)
- 15-th place at national level math exam (for lecturership/professorship in India) - NET(2016)
- Selected for Future Research Talent program hosted by Australian National University (2021)

### Education

- **The University of Sydney - Sydney** – *Postdoc (Machine Learning and dynamical systems)* 2023 - Present
- **International Centre for Theoretical Sciences (ICTS) - Tata Institute of Fundamental Research, Bengaluru** – *PhD (Mathematics)* 2017 - 2023  
**Thesis Title** - Numerical Filter Stability, Fokker-Planck Equations and Infinite Dimensional Optimization with Deep Learning
- **Jadavpur University, Kolkata** – *Msc (Mathematics)* 2014 - 2016
- **Jadavpur University, Kolkata** – *Bsc (Mathematics)* 2011 - 2014

### Some Completed Projects

#### Data Analytics and other projects, Indian Institute of Science (2018)

At the Indian Institute of Science, I have worked on several projects. Some of them are

- analyzing Prof Ramesh Hariharan's chromosome data and determining the most likely gene configurations that cause color blindness
- finding social structures in a group of dolphins that reside in Doubtful sound, a fjord in New Zealand
- music genre classification with machine learning
- approximately solving computationally challenging problems with genetic algorithms eg the travelling salesman problem

#### Atmospheric plume modelling, ICTS (2019)

Under Prof Vishal Vasan I have worked on atmospheric plume modelling which included solving a PDE model and integrating the solution on the road network obtained from OpenStreetMap data to estimate air pollution caused by traffic around Peenya, Bengaluru.

#### Predicting visual stimuli from fMRI data, Neuromatch Academy (2021)

I worked with several other international students with varied backgrounds (ranging from neuroscience to chemistry) and we showed that fMRI data can be used to predict images seen by human subjects.

#### Data Assimilation, ICTS

I have written my own module (available at <https://github.com/pinakm9/filters>) for simulating generic stochastic processes, Markov chains and implementing popular filtering algorithms eg Particle and Kalman filters with many different variations.

#### Nonlinear filter stability, ICTS

- Under Prof Amit Apte I devised an efficient way to compute stability of nonlinear filters which I presented at the 7th Indian control conference, 2021 <https://ieeexplore.ieee.org/document/9703185>.
- In a separate paper, we showed that filter stability is related to filter convergence, <https://www.sciencedirect.com/science/article/pii/S0167278923001197>.

### Solving Fokker-Planck equations with machine learning, ICTS

I have written my own module for solving Fokker-Planck equations (<https://github.com/pinakm9/fp-solvers>) which is applicable to dimensions traditionally thought of as challenging (tested in 10 dimensions).

### Solving constrained optimization problems with machine learning, ICTS

In 2022 I was selected as a part of the Future research talent program hosted by Australian National University. In collaboration with them I explored the possibility of solving constrained optimization problem in Hilbert spaces.

### GAN based sampling of strange attractors

I have also worked on sampling stranger attractors with generative models.

### State-of-the-art reconstruction of dynamical systems with Random feature maps

In an ongoing work with Prof Georg Gottwald I show that reservoir computers can be replaced with random feature maps for state-of-the-art reconstruction of dynamical systems from data with the added benefits of lower memory requirements and fewer hyperparameter optimizations. First part of this work is available here: <http://arxiv.org/pdf/2408.03626>.

### A gallery of examples from my projects

A gallery of examples from some of my projects is available at my Github page: <https://pinakm9.github.io/gallery22/>.

## Publications

- Pinak Mandal and Georg Gottwald. “On the choice of the non-trainable internal weights in random feature maps”. In: arXiv preprint arXiv:2408.03626 (2024).
- Pinak Mandal. “Learning solutions to some toy constrained optimization problems in infinite dimensional Hilbert spaces”. In: arXiv preprint arXiv:2401.01306 (2024).
- Pinak Mandal and Amit Apte. “Solving Fokker-Planck equations using the zeros of Fokker-Planck operators and the Feynman-Kac formula”. In: arXiv preprint arXiv:2401.01292 (2024).
- Pinak Mandal and Amit Apte. “Learning zeros of Fokker-Planck operators”. In: arXiv preprint arXiv:2306.07068 (2023).
- Pinak Mandal, Shashank Kumar Roy, and Amit Apte. “Probing robustness of nonlinear filter stability numerically using Sinkhorn divergence”. In: Physica D: Non-linear Phenomena, 451:133765, 2023.
- P. Mandal, S. K. Roy, and A. Apte, “Stability of nonlinear filters-numerical explorations of particle and ensemble Kalman filters”. In: 2021 Seventh Indian Control Conference (ICC), pp. 307–312, IEEE, 2021.

## Referees

- [Vishal Vasan](#) (email: [vishal.vasan@icts.res.in](mailto:vishal.vasan@icts.res.in))
- [Amit Apte](#) (email: [apte@iiserpune.ac.in](mailto:apte@iiserpune.ac.in))
- [Sreekar Vadlamni](#) (email: [sreekar@tifrbng.res.in](mailto:sreekar@tifrbng.res.in))
- [Georg Gottwald](#) (email: [georg.gottwald@sydney.edu.au](mailto:georg.gottwald@sydney.edu.au))

## Skills

- A competent Python coder. Most of the projects mentioned here can be found at my Github <https://github.com/pinakm9>.
- Fluent in English, Bengali, Hindi.
- A decent chess player. Winner of the annual chess tournament at ICTS (2022).
- A decent long-distance runner.