Glebe - 2037, NSW
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# PINAK MANDAL

## 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
- Jadavpur University, Kolkata — *Msc (Mathematics)* 2014 - 2016
- Jadavpur University, Kolkata — *Bsc (Mathematics)* 2011 - 2014

## Some Past 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.

**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/.

## Current Projects
I'm currently working on ideal sampling of non-trainable parameters in machine learning and a transformer-based fast solver for Grad-Shafranov equation in collaboration with MIT.

## Publications


- 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.
- Pinak Mandal, Shashank Kumar Roy, and Amit Apte. Probing robustness of nonlinear filter stability numerically using Sinkhorn divergence. Physica D: Non-linear Phenomena, 451:133765, 2023.
- Pinak Mandal and Amit Apte. "Learning zeros of Fokker-Planck operators". In: arXiv preprint arXiv:2306.07068 (2023).
- 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. "Learning solutions to some toy constrained optimization problems in infinite dimensional Hilbert spaces". In: arXiv preprint arXiv:2401.01306 (2024).


## Referees


- Vishal Vasan (email: vishal.vasan@icts.res.in)
- Amit Apte (email: apte@iiserpune.ac.in)
- Sreekar Vadlamni (email: sreekar@tifrbng.res.in)
- Georg Gottwald (email: 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.