**Glebe - 2037, NSW**

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**Website:** [**https://pinakm9.github.io/**](https://pinakm9.github.io/)

**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**

**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**](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**](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**](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**](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**](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/**](https://pinakm9.github.io/gallery22/%20)**.**

**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**](https://www.icts.res.in/people/vishal-vasan) **(email: vishal.vasan@icts.res.in)**
* [**Amit Apte**](https://www.iiserpune.ac.in/research/department/data-science/people/faculty/regular-faculty/amit-apte/359) **(email: apte@iiserpune.ac.in)**
* [**Sreekar Vadlamni**](http://math.tifrbng.res.in/~sreekar/Site/Home.html) **(email: sreekar@tifrbng.res.in)**
* [**Georg Gottwald**](https://www.maths.usyd.edu.au/u/gottwald/) **(email: georg.gottwald@sydney.edu.au)**

**Skills**

* **A decent Python coder with years of experience in Tensorflow and PyTorch. Most of the projects mentioned here can be found at my Github** [**https://github.com/pinakm9**](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****.**