Dr. SHASHANK KUMAR ROY

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Research interests

Deeplearning for data assimilation, Weather and Climate modeling, Sequential state estimation, Physics based Modeling and Simulation, Bayesian data assimilation, gaussian processes, Markov chain monte-carlo methods, Generative modeling for probability distributions, Optimal transport applications, dynamical systems, Time series analysis and prediction and data science.

Seminars/ Talks

Automatic differentiation for 4DVar: some results in Pytorch with qg-model Space Application Center, ISRO — Ahmedabad, India

Workshop lecture: AI for Data Assimilation - 4DVar & 4DVarNet for Ocean dataset, National Atmospheric Research Laboratory, Department of Space, GOI. — Tirupati, India.

4DVarNet: A neural network model for data assimilation Seminar, Department of Data Science, IISER Pune. — India

Academic Visits

PhD, Physics, International Center for Theoretical Sciences — Bangalore, India
Advisors: Prof. Amit Apte and Prof. Samriddhi Sankar Ray — July 2020 – Jan 2025
Title: A study of dynamical instability and filter stability using ensemble Kalman filter. Thesis submitted Jan 2024, PhD awarded, Jan 2025.

International Center for Theoretical Sciences — Bangalore, India
Masters in Physics, *GPA: 7/10* — July 2017 – December 2020
Mentors: Prof. Amit Apte, Prof R. Loganayagam

University of Delhi — New Delhi, India
Bachelors in Physics (Honours) *Percentage: 87 %* — July 2014 – July 2017

Education

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Publications

[1] Sensitivity of Covariant Lyapunov Vectors and their reconstruction using Data Assimilation, Shashank Kumar Roy, Amit Apte. *In Preparation, 2022.*

[2] Probing robustness of nonlinear filter stability numerically using Sinkhorn divergence Pinak Mandal, Shashank Kumar Roy, Amit Apte, *Submitted, Physica D, 2022. doi:10.48550/arXiv.2208.10810*

[3] Stability of nonlinear filters - numerical explorations of particle and ensemble Kalman filters Pinak Mandal, Shashank Kumar Roy, Amit Apte, *2021 Seventh Indian Control Conference (ICC), Mumbai, India, 2021, pp. 307-312, doi: 10.1109/ICC54714.2021.9703185.*

Research Eexperience

A generative adversarial network model for distribution of Sea Surface Temperature
Ecole Polytechnique, BNP Paribas and Fondation de l'Ecole polytechnique and Mercator Ocean
Modeling distribution of the sea surface temperaure at 6 different locations Oct – Dec 2022

Sequential state estimation for high-dimensional chaotic system with partial and noisy observation , Mentor: Prof. Amit Apte, Semester Project, ICTS August – Dec 2019
Implementing ensemble kalman filter for Lorenz-96 ode to compute conditional distribution.

LSTM model to predict spatial time series for climate model emulation
3rd NOAA AI Workshop - Climate Informatics Joint Hackathon 7- 14 Sep 2021
Predict annual mean global distributions of temperature and precipitation given emissions and concentrations of key anthropogenic climate forcing: SO2, BC, CH4, and CO.

Cytoplasmic streaming driven by Surface flows using Vector Spherical Harmonics
Mentor: Prof Vijay Kumar Krishnamurthy, Biophysics Group at ICTS
Analytical solution of Stokes equation for spherical geometry for bulk flow inside a sphere driven by a surface flow May – August 2018

An Interdisciplinary Study of Light Pollution in Indian Context (Extension)
The Late Dr.N.Rathnasree, Ex-Director, Nehru Planetarium) and Dr Ashok Kumar, Department of Physics, Ramjas College .
University of Delhi under Innovation Project Scheme 2015-2016 (RC302) Oct 2015 – Nov 2016

Teaching experience

Teaching assistant, Computational Tools for Climate Science, Climatematch Academy, US A course on climate data analysis and modelling for understanding and answering questions through coding in python and jupyter notebook. My role as a teaching assistant was to initiate discussions, motivate questions and guide students though the coding exercises. July 2023

Teaching assistant, Department of Data Science, IISER Pune, India, DS4233: Time Series Course on basic time series analysis and modelling. Curating Jupyter notebooks for demonstrations and taking tutorial sessions. Jan-April 2023

Advanced Physics Subject Matter Expert (Chegg.com) July 2020- July 2021
Freelance Tutor for solving university level doubts and problems for students.

Licences and Certifications

NVIDIA, Deep Learning Institute Summer 2022
[1] Applications of AI for Anomaly Detection Issued on July 2022
[2] Accelerating Data Engineering Pinelines Issued on Feb 2022

[3] Fundamentals of Deep Learning — Issued on Feb 2022

IBM, Qiskit

[1] Quantum Computation -Certified Associate Developer — Januray 2022

[2] IBM Quantum Challenge 2021 Achievement - Advanced — June 2021

Neuromatch Academy - Deeplearning Course and Project view — August 2021

Imperial College London-Online course on Data Assimilation view — 11-15 July 2022

Achievements

Secured 10th best score in IBM Quantum Challenge — 2021

Department of Atomic Energy Fellowship for pursuing PhD in Physics — 2019

Joint Entrance Screening Test AIR-95, Percentile-98.8 and IIT-JAM 2017, AIR-259 — 2017

Awarded ISC-2014 School Topper in Science, 3rd at district level, Senior Secondary Exam — 2014

Conferences and Workshops

Conference on Nonlinear Systems and Dynamics 2022, IISER Pune, India, Presented a poster titled,*"Reconstructing Covariant Lyapunov Vectors using Nonlinear Filtering"* Dec 2022

ECMWF–ESA Machine Learning for Earth Observation and Prediction 14-17 Nov 2022
Workshop on machine learning and data assimilation on using earth observations data.

Qiskit Global Summer School on Quantum Machine Learning, IBM July-August 2021
Summer School focusing on quantum machine learning formalisms and algorithms with hands-on experiemnts via IBM-Quantum lab.

ICTS Workshop on Climate Studies July-Aug 2021
Talks and lectures on climate modeling, topics relevant to climate change and related policies.

Indo-US Workshop on Recent Advances in AI ML for Climate Sciences Nov 13-15 2021
Technology Innovation Hub, Indian Statistical Institute, Kolkata and IEEE GRSS Kolkata Chapter, on the problems and applications in climate data science

Meta- Heuristic Optimization, Machine Learning and AI-Workshop March 8-12 2021
Talks and tutorials organized by SAMSI, on the theory and practical applications of metaheuristic optimization methods in statistics such as swarm and evolutionary algorithms.

Numerical Analysis in Data Science Workshop August 26-27 2021
Workshop on inverse problems and uncertainty quantification, sensitivity analysis, Reinforcement Learning and dimension Reduction in time series.

The Fields Institute Second Symposium on Machine Learning and Dynamical Systems
On the intersection of machine learning and dynamical systems theory to solve problems in representation leanring, analysis and prediction. September 2020

Technical Skills

Programming languages and frameworks

Experienced with Python, Numpy, Pandas, Scipy, Pytorch, Tensorflow, Jax, Mayavi, FEniCS

Familiar with Matlab, C++, Fortran

Experienced with Latex, Linux, Windows, MS Office

Languages

English (advanced), Hindi (fluent)