# SHASHANK KUMAR ROY

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## Research interests

Sequential state estimation, modeling and simulation, bayesian data assimilation, gaussian processes, markov chain monte-carlo methods, machine learning, generative modeling for probability distributions, optimal transport applications, dynamical systems, time series analysis and prediction, climate modeling and data science.

## Education

**PhD in Physics, International Center for Theoretical Sciences** Bangalore, India
Advisors: Prof. Amit Apte and Prof. Samriddhi Sankar Ray July 2020 – Present
Title: Computational approach to demonstrating filter stability and the sensitivity of covariant lyapunov vectors of a dynamical system for their possible applications in data assimilation.

**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

## 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)**
Dr.N.Rathnasree(Ex-Director,Nehru Planetarium), Dr Ashok Kumar (Ramjas College).
University of Delhi under Innovation Project Scheme 2015-2016 (RC302) Oct 2015 – Nov 2016

## Teaching experience

**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)

## References


Prof. Amit Apte, ICTS Bangalore and IISER Pune apte@iiserpune.ac.in

Prof. Vishal Vasan, ICTS Bangalore vishal.vasan@icts.res.in

Prof. Samriddhi Sankar Ray, ICTS Bangalore ssray@icts.res.in