

## SHASHANK KUMAR ROY

PhD Research Scholar, International Centre for Theoretical Sciences,  
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**Citizenship:** India

### 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

### 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.

[3] **Stability of nonlinear filters - numerical explorations of particle and ensemble Kalman filters** Pinak Mandal, Shashank Kumar Roy, Amit Apte, *Indian Control Conference 2020, Published in IEEEExplore*, 2021.

### Research Experience

**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 temperature 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: SO<sub>2</sub>, BC, CH<sub>4</sub>, 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 Pipelines**

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 Science School Topper and 3rd topper at district level

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

Name of conference, workshop, seminar, venue, etc., or a description

**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 learning, 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

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Prof. Vishal Vasan, ICTS Bangalore

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Prof. Samriddhi Sankar Ray, ICTS Bangalore

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