SOMNATH ROY

Phone number:(+91)9242116549 Email ID: somnath.roy262001@gmail.com
Linkedin: linkedin.com/in/somnath-roy-596136233 GitHub: https://github.com/SomnathRoy123

EDUCATION:

Indian Institute Of Science Education And Research Kolkata ***DECEMBER 2024- APRIL 2025***

Integrated Bachelor of Science and Master of Science (BS-MS Dual Degree)

- *Major in **Physical Science** and minor in **Computational and Data Science***
- *Cumulative GPA: 8.25 /10*
- *Relevant coursework: Nonlinear Dynamics, Statistical Mechanics, Soft Matter Physics, Machine Learning, Computational Physics*

RESEARCH EXPERIENCE:

1. ***MASTER THESIS : Emergent structures and clustering in active matter with non-reciprocal interactions***
   Supervisor: Prof Holger Stark
   Univerisity: Technical University Berlin, Germany and IISER kolkata, India ***AUGUST 2024- JUNE 2025***

- *Investigated emergent dynamic phases and clustering in active matter governed by non-reciprocal orientational interactions.*
- *Developed a high-performance Langevin particle simulation from in C, coupled with a comprehensive data analysis pipeline in Python.*
- *Discovered and quantified novel collective states (cluster crystals, polymer-like chains, weak hyperuniformity) using using static structure factors S(k) and dynamical correlation functions.*

2. ***MITACS Globalink Research Fellow — Hydrological time-series forecasting, Canada*** ***APRIL 2024- AUGUST 2024***
   Supervisor: Prof. Junye Wang, Dr. Mojtaba Aghjani University : Athabasca University

- *Developed predictive models to forecast nutrient availability (nitrogen concentration), a key environmental driver of algal proliferation and collective behavior.*
- *Implemented and benchmarked multiple time-series models, including SARIMA, Random Forest, and LSTMs, using weather and surrogate environmental data as predictive features.*
- *Ensured model robustness against non-stationarity and measurement uncertainty by applying rigorous feature engineering, cross-validation, and model selection techniques.*

3. ***Numerical Simulation of Nonlinear PDEs (Gross-Pitaevskii Equation)*** ***MAY 2023- AUGUST 2023***
   Supervisor : Dr. Tapio Simula University: Swinburne University of Technology, Australia

- Implemented split-step spectral methods (FFT-based) to numerically solve nonlinear PDE (Gross-Pitaevskii), utilizing imaginary time propagation for ground-state energy minimization.
- Modeled driven continuum fields to investigate hydrodynamic analogs of walker droplets, exploring the emergence of wave-mediated interactions and coherent structures in non-equilibrium systems.

4. ***Hydrodynamic Pilot-Wave Interactions & Walker Droplet Dynamics.*** ***JANUARY 2023- MAY 2023***
   Supervisor : Prof Soumitro Banerje, Dr. Rahil Valani University: IISER kolkata

- Designed and built an Arduino-controlled vibration platform with closed-loop feedback for stable walker-droplet experiment to investigated the wave-particle coupling analogous to hydrodynamic active matter systems.
- Implemented Digital Image Correlation (DIC) and image-processing pipelines (OpenCV) to extract flow fields and deformation patterns.

CONFERENCE PRESENTATIONS:

- "*Construction of an experimental set-up for walking droplet experiment*", **CNSD conference**, December 2022, IISER Pune - certificate
- "Machine Learning Algorithms in Hydrological Modelling", **TRESL Research Lab** 3rd Annual Symposium, July 2024, Athabasca University

PUBLICATIONS:

- *"Emergent Cluster Crystals in Active Matter Driven by Non-Reciprocal Orientational Interactions"*, Somnath Roy & Holger Stark.- **Manuscript in preparation.**

SELECTED MACHINE LEARNING & COMPUTATIONAL PROJECTS:

- Developed a Convolutional Neural Network-based deep learning model to classify Blue Whale A-calls from non-A calls. ***2023***
- Developed an algorithm to estimate the number of tigers in an area from data of pugmarks using Supervised K-Nearest Neighbor (KNN) clustering and feature selection using the Logit function. **2023**
- Solving the differential equations of a planet moving in the gravitational field of a heavy star for a given Hamiltonian using different numerical methods. **2022**

TECHNICAL SKILLS:

Programming & Tools:

- Python (NumPy, SciPy, pandas, matplotlib) · Julia · C/C++ · Fortran · MATLAB · LaTeX · Git · Jupyter · Docker (basic)

Modeling & Computation:

- Langevin Dynamics · Continuum Mechanics & Nonlinear PDE Modeling · Stochastic Modeling · Hydrodynamics (Navier-Stokes) · Spectral Methods (FFT) · Linear Stability Analysis · Continuum Field Theory

Machine Learning & Data-driven Modeling:

- LSTM · CNN · Random Forest · KNN · Feature extraction & denoising · Time-series analysis · TensorFlow/Keras · PyTorch · scikit-learn · Data cleaning, uncertainty quantification

Experiment & Instrumentation:

- Arduino & real-time feedback control · Digital Image Correlation (DIC) · OpenCV for flow analysis · 3D printing & CAD/CAM workflows · Laser cutting & desktop prototyping · Sensor integration · Basic control theory (PID, system ID)

SUMMER SCHOOLS, WORKSHOPS AND EXTRA COURSES:

- ***Nptel course on "Introduction to Soft Matter, IISc Bangalore" by Prof. Aloke Kumar*** ***AUGUST 2022***
- ***SUMMER SCHOOL on "Nonlinear Physics and Statistical Physics" at IIT Kharagpur.*** ***JULY 2023***
- ***PyHEP workshop on "data analysis in Particle Physics".*** ***AUGUST 2022***

TEACHING & MENTORING

Teaching Assistant, **Mathematical Methods (PH2301)** | IISER Kolkata (2023–2024)

- Mentored undergraduate students in core theoretical topics including Vector Analysis, Matrices, and Partial Differential Equations.
- Led weekly tutorial sessions to reinforce concepts and guided students through complex derivations and problem sets.

AWARDS & ACHIEVEMENTS:

- English Proficiency: **TOEFL iBT Score** of 100 (Equivalent to C1/Advanced Level)
- MITACS Globalink Research Fellowship (2024)
- Runners up among trio teams in ISI Integration Data fest

LEADERSHIP AND OUTREACH:

- ***Organizer of INQUIVESTA****(one of India's biggest college science fest)*
- ***Secretary of Trekking and Adventure club of IISER Kolkata***
- ***Volunteer at Ek Pahel****(NGO)*