Abhishek Singh

Bhubaneswar, India

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Personal Profile

A physics undergraduate fascinated by complex systems across diverse domains like neural networks, developmental biology. Eager to learn about frameworks of statistical physics, dynamical systems and information theory so as to develop tools for modeling the dynamics of these complex systems.

Education

National Institute of Science Education and Research *Bhubaneswar, India*

BSMS Major in Physical Science *Aug. 2021 -*

- Minor in Computer Sciences
- Current GPA: 8.68/10
- **Relevant Coursework:**
  Classical Physics, Quantum Mechanics, Statistical Mechanics, Nonlinear Dynamics, Non-equilibrium Statistical Mechanics, Computational Physics
  Theory of Computation, Graph Theory, Algorithm Design, Complexity Theory, Machine Learning (Theory)

Research Experience

Tata Institute of Fundamental Research *Mumbai, India*

Summer internship | Single-File Diffusion *May 2025 - July 2025*

- Under the supervision of Dr. Tridib Sadhu
- Analytic calculations to derive large Deviation functions from appropriate models.
- **Technical Skills:** Diffusion, Large-deviation functions

Simons Centre for the Study of Living Machines @ NCBS *Bangalore, India*

Summer internship | Ising-like Interaction Model for Cell Fate Decisions *May 2024 - July 2024*

- Under the supervision of Dr. Archishman Raju
- Developed and analyzed a model based on Ising-like interactions to study population-level dependent cell-fate decisions.
- Performed stability analysis of fixed points and studied their dependence on cell population size.
- Simulated bifurcations and robustness analysis to understand how noisy parameters affect emergent cell-fate decision.
- Report can be found *here*.
- **Technical Skills:** Mathematica, Python with NumPy, Matplotlib, Nonlinear Dynamics

Indian Institute of Science Education and Research *Thiruvanathapuram, India*

Summer internship | HNN *May 2023 - July 2023*

- Under the supervision of Dr. Chandrakala Meena
- Studied various Physics-informed ML algorithms for prediction of dynamics of non-linear systems.
- Implemented Hamiltonian Neural Network for prediction of dynamics of systems like simple pendulum, Van der Pol oscillator. Report can be found *here*.
- **Technical Skills:** Python with PyTorch, NumPy, SciPy, Matplotlib

University Projects

Secure communication with Chua circuit

NISER *Aug. 2024 - Nov. 2024*

- Project as a part of Open Lab Course at NISER.
- Design and Analysis of Chaotic circuits like Lorenz and Chua using easily available electronics item.
- Synchronization of two Chua circuit using passive element and study of its stability at various paramter values.
- Use of synchronized Chua circuits to securely communicate digital and analog information.

ML for solving advection and diffusion equations

NISER *Oct. 2023 - Nov. 2023*

- Project as a part of course on Computational Physics.
- Use PINN to solve the advection and diffusion equations in 1-D. The PDEs can impose strong constraint on Loss function and can be used optimize the solution to replicate physics.
- Codes can be accessed from *GitHub Repository* and report can be found *here.*

Workshops Attended

Unifying Theories in High-dimensional Biophysics *Bengaluru, India*

International Centre for Theoretical Sciences - TIFR *July 2025*

Spins, Games & Networks *Chennai, India*

Understanding Collective Coordination in Complex Systems

Institute of Mathematical Sciences *December 2024*

Skills

Programming Python (Pandas, PyTorch, NumPy, Scipy, Matplotlib), Mathematica *(beginner)*

Soft Skills Time Management, Teamwork, Problem-solving, Engaging Presentation, Scientific Writing.

Miscellaneous LaTeX, Microsoft Office.

Highlights

2025 **Co-ordinator,** Fisher's Fishes,*a Theo. Bio Club* *India*

2024 **Chief Co-ordinator,** Yantriki, Club Magazine of RTC, NISER *India*

2023 **Speaker,** Talk on 'PINN to learn Physics from data' at Physics Club, NISER *India*

2022 **Editor,** Yantriki, Club Magazine of RTC, NISER *India*

2021 **Scholarship,** DAE- DISHA *India*

2021 **AIR 251,** National Entrance Screening Test(NEST) *India*

Interests

Sci. Comm. Contributed to outreach activities, sharing complex ideas in simple manner to high-school students.

Robotics Active member in RoboTech Club (RTC) at NISER.

Debating I am member of Debating Club *'Vaktavya'* at the institute and participate in various events through the club.

Reference

Dr. Archishman Raju
Faculty, Simons Centre for the Study of Living Machines, NCBS
Bangalore, India