

Suraj Kumar Sahu

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PERSONAL STATEMENTS

Research Interests

My interest lies at the intersection of Physical theory and Biological Systems. My PhD research focuses on how cell migration, cell-cell adhesion, and cell-ECM interactions lead to self-organization and remodeling of vascular networks. My goal is to develop multi-scale model to investigate the stability, functionality and robustness of such transport networks. My research provides insights into emergent phenomena in living systems from a physics perspective can aid in understanding various developmental cardiovascular diseases. section of physics and biology. My PhD research focuses on how cell migration, cell-cell adhesion, and cell-ECM interactions lead to self-organization and remodeling of vascular networks. My goal is to develop multi-scale model to investigate the stability, functionality and robustness of such transport networks. My research provides insights into emergent phenomena in living systems from a physics perspective can aid in understanding various developmental cardiovascular diseases.

Keywords: **Mechanobiology, Self-Organization, Agent Based Modeling, Vascular Development, Biophysics**

Outreach

I have experience organizing and designing science outreach activities for diverse audiences. I have helped develop engaging hands-on activities like toys-from-trash, Foldscope, and CellPaint. I have lead and assisted in events/talks for encouraging students to pursue graduate studies.

Keywords: **Community outreach, Toys from Trash, Science Storytelling, CellPaint, Foldscope, Science Communication, Popular Science**

Teaching

I have assisted and partially taught introductory physics courses, including experimental labs and discussions. I am passionate about teaching in ways that brings excitement and engagement to the topics. My effort goes towards motivating students who may struggle in grasping the scientific concepts. I aim to teach courses at the intersection of physics and biology in a holistic and storytelling approach. I wish to develop pedagogy that introduces numerical computation and efficient but safe use of LLMs as learning assistant.

Keywords: **Undergraduate Physics, Biophysics, Active learning, Computational Modeling**

ACADEMIC JOURNEY

Academic Positions

- Jan 21 - present **Graduate Research Assistant** at Gopinathan Group, Department of Physics, University of California Merced.
- Jan 21 - present **Graduate Teaching Assistant** at Department of Physics, University of California Merced.
- Aug 17-May 19 **Graduate Student Researcher** at Computational Biophysics Group, Department of Physics and Astronomy, National Institute of Technology Rourkela, Odisha, India.

Education

- Jan 21 - present **PhD Candidate** Department of Physics, University of California Merced, California, USA.
- Aug 17-May 19 **Master of Science in Physics** Department of Physics and Astronomy, National Institute of Technology Rourkela, Odisha, India.
- Jul 14 - Jun 17 **Bachelor of Science (Honors in Physics)** D.R. Nayapalli College, Utkal University, Odisha, India.

SERVICE

- Aug 23-Aug 25 **Trainee Leadership Council** at Center for Engineering Mechanobiology (CEMB)
Organized tutorials, research presentations, professional development workshops and webinars.
- Jun 21-Jun 23 **President at Graduate Biophysics Club**
Led science outreach events, facilitated journal club discussions in biophysics research, professional development workshops and networking events.
- Aug 24-Aug 25 **GradExcel Peer Mentor**
Mentored graduate students, supporting personal well-being and professional development.

AWARDS AND FELLOWSHIPS

- 2025 Center for Engineering MechanoBiology(CEMB) Summer Research Fellowship, Center for Celluar and Biomolecular Machines(CCBM) Travel Award, Physics graduate group travel fellowship
- 2024 Physics graduate group travel fellowship, GradExcel Peer Mentor Award
- 2023 CCBM Outreach Fellowship, CCBM Travel Fellowship, Physics graduate group travel fellowship
- 2022 Physics graduate group travel fellowship, Bobcat Summer STEM Academy Fellowship

PUBLICATIONS

Journal Articles

- Jan, 2021 **Suraj, S.**, M. Biswas, " Modeling protein association from homogeneous to mixed environments: A reaction-diffusion dynamics approach.", *Journal of Molecular Graphics and Modeling*, vol.107, pp.107936.

RESEARCH

Graduate Research Projects

- Oct 24-pres **Compaction of ECM by Multicellular Networks** in collaboration with **Dasbiswas Lab**
Computational modeling of compaction and remodeling of collagen matrix due to contractile forces by multicellular networks of fibroblasts cells. **In preparation*
- Aug 24-pres **Mechanobiology of Cell-Cell Junction Formation and Adhesion stability**
Part 1: Cadherin kinetics and actomyosin dynamics in cell junction formation and maturation. **In preparation*.
Part 2: Mechanochemical model of feedback loops leading to self-organization of cell-cell junction strength and stability.
- Jan 21 - pres **Agent-based modeling of Vasculogenesis** in collaboration with **Sindi Lab** and **Kara E. McCloskey Lab**.
Using a Agent based Network dynamics model we study the development of vascular network formation and remodeling. Quantifying the functionality, resilience and adaptability of transport networks **In preparation*
- Jan 21 - Jun 21 **DNA Target-Site Search optimization by DNA binding proteins**
We explored the reasons behind how DNA binding proteins find their target sites on a DNA faster than the diffusion limited search strategy. **Lab research rotation project*.
- Aug 18-Dec 21 **Thermodynamics and Kinetics of Macromolecular Crowding effects on Protein Reaction**
We explored how crowder size, composition and nature of interactions affects the kinetics and thermodynamics of a binary protein association by using a coarse-grained reaction diffusion system(ReaDDy).

Other Research Projects

- Summer 18 **Dynamics of Indian Languages and Language Competition** in collaboration with **Rashi Agarwal**
Nearly 90% of indigenous languages in India are facing direct threat of extinction. Using a non-linear dynamical model we predicted the missing data of certain scheduled languages languages like Kashmiri, Tamil, Dogri and Assamese.
- Fall 18 **Steiner Problem in collaboration with Rashi Agarwal**.
On finding the shortest distance between points on 2D using Soap films.

CONFERENCES AND WORKSHOPS

Organizer/Lead

- Spring, 2025 **Workshop on AI Tools for Research and Data Analysis**, University of California Merced, Organizer and Instructor
- Summer, 2024 **Center for Engineering and Mechanobiology Boot camp** Project Leader and Instructor, University of Pennsylvania, Philadelphia

Attendee

- Mar 2025 **2025 March Meeting, American Physical Society**, Los Angeles, 2025
Presentation: Stability of Cell-Cell Junctions: Balancing Cortical Tension and Cadherin Aggregation at cell interface during cell-cell separation. Author: Sahu S, Gopinathan A.
- Dec 2024 **Cell Bio 2024, ASCB | EMBO Meeting**, San Diego, 2024
Poster: Balancing Cortical Tension and Adhesive Force for Stable Cell Junctions. Author: Sahu S, Gopinathan A.
- Mar 2024 **2024 March Meeting, American Physical Society**, Minneapolis, 2024
Presentation: Modeling the mechanics of cell-cell junction formation and dynamics in vascular networks. Author: Sahu S, Gopinathan A.

Mar 2023	2023 March Meeting, American Physical Society , Las Vegas, 2023 Presentation: Particle-Based Simulation of the Assembly and Mechanical Remodeling of Vascular Network. Author: Sahu S, Gopinathan A. Sindi S. McCloskey K. Kuhn M., Zamora J.
Mar 2023	National Society of Black Engineers (NSBE) Exhibition: Research opportunities in the Center for Engineering Mechanobiology (CEMB)
May 2023	NSF site visit at Center for Engineering Mechanobiology (CEMB), University of Pennsylvania, Philadelphia Poster: Overview of research projects at Gopinathan Group, University of California Merced.
2022	2022 March Meeting, American Physical Society , Chicago, 2022 Presentation: Agent Based Simulation of Vasculogenesis. Author: Sahu S, Gopinathan A. McCloskey K. Kuhn M., Zamora J.
Feb 2022	Emerging Researcher National Conference Exhibition: Research opportunities in the Center for Engineering Mechanobiology (CEMB) .
July 2022	Center for Engineering and Mechanobiology Boot-camp , Washington University St. Louis

Outreach Activities

Aug 24-Aug 25	Research in Motion (RiM) Series The CEMB Trainee Leadership Council hosts a monthly series Research in Motion (RiM) for trainees to share their research.
Sept 2024	Speaker at Bahujan Scholars Network Graduate program application series: Guidance on applying for graduate schools.
Jan 2024	Presenter at Digital Nalanda Microscopic Marvels: Exploring the Tiny Wonders of the Living World using Foldscope. Led by Suraj Sahu and Disha Kuzhively.
Aug 2023	Presenter at Center for Engineering Mechanobiology (CEMB) Demonstrated tools for science outreach for mechanobiology pedagogy to High School teachers.
July 2023	Organizer at Science of Coronavirus Hosted a science outreach event for schools using CellPaint to illustrate the science of coronavirus. co-led by Joey McMertien
Aug 2022	Planning Committee at The Franklin Institute , Philadelphia Contributed to designing mobile museum exhibit on mechanobiology.
June 2022	Presenter at Center for Cellular and Biomolecular Machines (CCBM) Explored microorganisms using the Foldscope. Led by Jocelyn Ochoa, Anuvetha Govindranjan, Bhavya Mishra.
July 2022	Instructor at Bobcat Summer STEM Academy Taught electrical circuits to middle school students through interactive demonstrations.
Fall 2021	Volunteer at Mother/Daughter Science Camp Served with the American Association of University Women (AAUW), led by Dr. Petia Gueorguieva.
June 2021	Presenter at The Science of Flocks and Swarms Demonstrated the physics of flocking and ant foraging using NetLogo, alongside Prof. Ajay Gopinathan, Suraj Sahu, and Ritwika VPS.

GRADUATE COURSEWORK

Physics	Classical Mechanics, Electrodynamics, Statistical Mechanics, Quantum Mechanics, Non-linear Dynamics and Chaos, Condensed Matter Theory, Atomic and Molecular Physics
Life Science	Cell and Cellular Techniques, Basics in Molecular Medicine, Recombinant DNA Technology, Basic Biophysics

Comp Sci	Computational Physics, Classical Molecular Simulation, Numerical Mathematical Methods for Physics, Machine Learning & Statistics for Physics and Astronomy.
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SKILLS

Research Skills

Computation	Agent-Based Modeling, Particle-Based Simulations, Reaction-Diffusion Systems, Spatial Networks, Biophysics Theory
AI	AI Aided Research Workflow, Context Management, Agentic tools(MCPs, Skills, Custom Agents), Image analysis Pipeline
Other skills	Data Visualization, Data Analysis, High-Performance Computing(SLURM),

Softwares and Tools

Languages	Python, Julia, L ^A T _E X
Softwares	ReaDDy (Molecular Dynamics), Cursor, VS Code Copilot, Antigravity, Claude Code, Github

REFERENCES

Prof. Ajay Gopinathan 
 Department of Physics, CCBM
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Prof. Suzanne Sindi 
 Department of Applied Mathematics
 School of Natural Sciences
 University of California Merced

Asst. Prof. Kinjal Dasbiswas 
 Department of Physics, CCBM,
 School of Natural Sciences
 University of California Merced

"Books! And cleverness! There are more important things! — Friendship! And Bravery!"

- Hermione Granger(Harry Potter and the Philosopher's Stone)