Suraj Kumar Sahu

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Updated February 2026

PERSONAL STATEMENT

Research Interests

My research focuses on Mechanobiology of cell-cell and cell-matrix interaction to understand collective cell motility, emergence of multicellular patterning, and biological function of multicellular networks. For my PhD thesis, I used agent-based modeling to study self-organization and remodeling of vascular networks, biophysical modeling of cell-cell adhesion dynamics, and the effect of contractile cellular forces on Extracellular Matrix (ECM) remodeling. (I have deep interest/in fgure i would like to work on ?) drawing inspiration from collective phenomena, physical learning, and biological adaptation, I would like to explore problems related to multicellular organism evolution

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

Professional Development and Community Outreach

I have experience organizing and designing science outreach activities at schools. I have developed engaging hands-on activities for high school and middle school students. I have organized professional development webinars and various career panels on mentoring students to pursue graduate studies and mental health. I have led multiple tutorials and workshops on AI tools for scientific research, coding, and data analysis for graduate students. (In future I would like to gain skills in science communication and public engagement.? and advocate sustaintable inregration fo AI tools in science research)

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

Teaching

I have assisted in introductory physics courses, including experimental labs and discussions. I was a teaching assistant for an upper division course. I aim to teach courses at the intersection of physics and biology that motivate students to pursue graduate studies in physics and life science related fields. I have advocated for safe and ethical use of AI tools in pedagogy and teaching.

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

EDUCATION

Jan 21 – present **PhD Candidate**, Department of Physics, University of California Merced, California, USA.
Advisor: **Prof. Ajay Gopinathan**, GPA: 3.84/4.00

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.

PUBLICATIONS

Peer-Reviewed Journals

Jan 2021 **Sahu, 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.

TECHNICAL SKILLS

Computation Agent-Based Modeling, Numerical Simulations, Particle-Based Simulations, Reaction-Diffusion, Network Analysis, HPC

AI AI-aided research workflow, Prompt and Context Management, Custom Agents, Skills, MCPs, Image Analysis Pipeline

Data Science Data analysis, Visualization

Tools NumPy, SciPy, NetworkX, ReaDDy, Git, GitHub

Languages Python, Julia, LaTeX

Software VS Code, Cursor, Copilot, Antigravity

RESEARCH EXPERIENCE

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.

Projects

Jan 21 – present **Cellpose-MCP**
Developed MCP server to connect AI agents Claude, Cursor, etc. to Cellpose for cell segmentation.

Oct 24 – present **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 fibroblast cells. **In preparation*.

Aug 24 – present **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 – present	**Agent-based modeling of Vasculogenesis** in collaboration with **Sindi Lab** and **Kara E. McCloskey Lab**. Using an 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).
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 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.

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.

AWARDS AND ACHIEVEMENTS

2025	Center for Engineering Mechanobiology (CEMB) Summer Research Fellowship, Center for Cellular 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

CONFERENCES AND WORKSHOPS

Conferences

Feb 2026	**BPS2026 Annual Meeting in San Francisco**, Collective Cell Motility of Fibroblasts Driven by Contractile Multicellular Network Formation during Compaction of Collagen Matrix, **Sahu S.**, Dasbiswas K., Gopinathan A.
Mar 2025	**2025 March Meeting, APS, Los Angeles**, Stability of Cell-Cell Junctions: Balancing Cortical Tension and Cadherin Aggregation at cell interface during cell-cell separation. **Sahu S**, Gopinathan A.
Dec 2024	**Cell Bio 2024, ASCB | EMBO, San Diego**, Balancing Cortical Tension and Adhesive Force for Stable Cell Junctions. **Sahu S**, Gopinathan A.
Mar 2024	**2024 March Meeting, APS, Minneapolis**, Modeling the mechanics of cell-cell junction formation and dynamics in vascular networks. **Sahu S**, Gopinathan A.

Mar 2023 **2023 March Meeting, APS, Las Vegas**, Particle-Based Simulation of the Assembly and Mechanical Remodeling of Vascular Network. **Sahu S**, Gopinathan A., Sindi S., McCloskey K., Kuhn M., Zamora J.

Mar 2022 **2022 March Meeting, APS, Chicago**, Agent Based Simulation of Vasculogenesis. **Sahu S**, Kuhn M., Zamora J., Gopinathan A., McCloskey K., Sindi S

Workshops, Webinars and Tutorials

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

CEMB Academic Career Search Workshop with Morgani

Outreach and Community Engagement

Jan 2025 Digital nalanda talk

Sept 2024 **Bahujan Scholars Network**
Panelist for the program application series: Guidance on applying for graduate schools.

Jan 2024 **Digital Nalanda**
Conducted hands-on activities on exploring the Tiny Wonders of the Living World using Foldscope. Led by Suraj Sahu and Disha Kuzhively.

Aug 2023 **Center for Engineering Mechanobiology (CEMB)**
Demonstrated tools for science outreach for mechanobiology pedagogy to high school teachers.

July 2023 **Science of Coronavirus, CCBM**
Organized science outreach event for schools using CellPaint to illustrate the science of coronavirus. Led by Joey McMertien.

Aug 2022 **The Franklin Institute**, Philadelphia
Contributed in the planning phase of a mobile museum exhibit on mechanobiology. Led by Dr. Jaytri Das.

June 2022 **Center for Cellular and Biomolecular Machines (CCBM)**
Organized an event to explore microorganisms using the Foldscope. Led by Jocelyn Ochoa, Anuvetha Govindranjan, and Bhavya Mishra.

July 2022 **Bobcat Summer STEM Academy**
Led hands-on activities on electrical circuits for middle school students. Led by Dr. Petia Gueorguieva.

Fall 2021 **Mother/Daughter Science Camp**
Volunteered with the American Association of University Women (AAUW), led by Dr. Petia Gueorguieva.

June 2021 **The Science of Flocks and Swarms**
Presented physics of flocking and ant foraging using NetLogo. Led by Prof. Ajay Gopinathan and Ritwika VPS.

SERVICE

Aug 23 – Aug 25 **Trainee Leadership Council** at Center for Engineering Mechanobiology (CEMB)
Planning and organizing tutorials, research presentations, professional development workshops for graduate students.

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.

REFERENCES

Prof. Ajay Gopinathan
Department of Physics, CCBM
School of Natural Sciences
University of California Merced

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)