Rupa Kurinchi-Vendhan

AI Researcher for Scientific Discovery and Biodiversity Monitoring

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Research Statement: My research focuses on expert-in-the-loop AI systems for scientific discovery, integrating domain knowledge with remote sensing images and abstract soundscapes to address conservation and biodiversity monitoring.

Education

Doctorate of Philosophy in Electrical Engineering and Computer Science

The Massachusetts Institute of Technology

September 2024 – Present

Advised by Sara Beery, supported by the NSF Graduate Research Fellowship (GFRP) and the MIT Tina Chan Fellowship

Bachelor of Science in Computer Science

The California Institute of Technology

September 2020 – June 2024

Awarded study abroad opportunity at the University of Cambridge, St. Catharine's College for Michaelmas Term 2022-23

Work Experience

MIT CSAIL, Beery Lab

Computer Vision Researcher

September 2024 – Present

- Developed PRISM, a prompted conditional diffusion framework that enables expert-guided, controllable restoration of complex, real-world degradations in scientific and environmental imagery, outperforming existing methods while preserving signal fidelity and interpretability.
- Currently, develpoing active labeling to identify, analyze, and document vocalizations in rare, under-represented, and novel environments to advance species discovery and biodiversity understanding.

Coral Gardeners – Benthic Classification for Coral Restoration

Computer Vision Researcher

March 2023 – January 2024

- Using human-in-the-loop derived labels, developed an aerial benthic composition mapping dataset and a transformer-based benthic classification architecture, which takes processed aerial drone imagery as input and identifies pixels as coral cover, rocks, rubble, sand, algae, etc. Model achieves up to 93% accuracy, and is deployed to inform and monitor restoration efforts.

Computational Vision Laboratory – Species Distribution Modeling

Undergraduate Researcher

December 2021 – June 2023

Advisor: Pietro Perona

- Created a land cover classification model which identifies landscapes such as open ocean and deciduous forests from satellite imagery with 95% accuracy using the GeoCLEF Life 2020 dataset.
- Independently extended this work to explore using high-resolution satellite imagery and citizen science species observation data to infer the joint distribution of species as a function of their geographic location.

Apple – Atlas Packing for Volumetric Rendering

Technology Investigation Intern

June 2022 – September 2022

- Designed a novel algorithm for texture/bin packing which improves computational and power demands by 20%. This will improve the efficiency of the scene and video rendering pipeline for the Apple Vision Pro.

- Selected from internship cohort to present work to member of Apple's advisory board, Mike Rockwell.

NASA – Estimating Solar Potential for Washington, D.C.

DEVELOP National Program Intern

September 2021 – November 2021

- Partnered with the Washington DC Department of Energy & Environment and a team of geospatial researchers to create solar potential maps to inform solar panel installations for communities outside of DC at a 1-ft resolution.
- Independently developed a vision-based model for estimating roof tilt from LiDAR-derived digital surface models and satellite images to provide more accurate urban solar potential estimates.

Netlab – WiSoSuper: Benchmarking Super-Resolution Models for Wind and Solar Data

Research Fellow

June 2021 – September 2021

Advisors: Steven Low and Dava Newman

- Modified and identified novel deep learning-based super-resolution models, and applied them to satellite data to achieve 5x super-resolution of wind speeds and solar irradiance fields for informing short-term, local energy planning.
- Published datasets and modules for benchmarking assessment and spatial analysis for wind and solar data fields.

Publications

- Kurinchi-Vendhan, R., Sharma, P., Torralba, A., & Beery, S. (2025). PRISM: Controllable Diffusion for Compound Image Restoration with Scientific Fidelity *arXiv pre-print arXiv:2311.13661. Under review at ICLR 2026.*
- Kurinchi-Vendhan, R., Gray, D., & Cole, E. (2024). BenthIQ: a Transformer-Based Benthic Classification Model for Coral Restoration. *arXiv pre-print arXiv:2311.13661*.
- Kurinchi-Vendhan, R., Lütjens, B., Gupta, R., Werner, L., & Newman, D. (2021). WiSoSuper: Benchmarking Super-Resolution Methods on Wind and Solar Data. *NeurIPS CCAI Tackling Climate Change with Machine Learning 2021 Workshop*.
- Cronin, E.*, Fernando, A.*, James, J.*, & Kurinchi-Vendhan, R.*, (2021). Washington, D.C. & Maryland Energy: Estimating Solar Potential Using NASA POWER Data to Inform Renewable Energy Policy. *NASA Technical Reports*.

Talks

- PRISM: Expert-in-the-Loop Image Restoration for Complex Real-World Distortions *7th NOAA AI Workshop - Generative AI for Earth and Space Science Applications*. September 2025.
- Mapping Corals: Monitoring Reefs with Aerial Drones. *Break Through Tech AI*. July 2025.
- Mapping Corals: Monitoring Reefs with Aerial Drones. *MIT Ocean Engineering Seminar*. April 2025.
- BenthIQ: Benthic Classification Reef Restoration. *Berkeley AI Research Climate Initiative*. November 2023.
- Mapping Corals: Reef Restoration and Citizen Science. *Caltech International Education Week*. November 2023.
- BenthIQ: a Transformer-Based Benthic Classification Model for Reef Restoration. *California Institute of Technology Doris S. Perpall Speaking Competition*. October 2023.
- WiREDiff: a Wind Resolution-Enhancing Diffusion Model. *Caltech Maching Learning Showcase.* July 2023.
- Atlas Packing for Volumetric Rendering — Apple Board of Technology Directors. *Apple Board of Technology Directors Meeting.* September 2022.
- WiSoSuper: Benchmarking Super-Resolution Methods on Wind and Solar Data. *NeurIPS CCAI Tackling Climate Change with Machine Learning 2021 Workshop Poster Session*. December 2021.
- Estimating Solar Potential Using NASA POWER Data to Inform Renewable Energy Policy for Washington, D.C. *NASA Earth Science DEVELOP National Symposium*. November 2021.

Teaching Experience

Deep Learning for Ecology

Visiting Lecturer

December 2024

African Institute of Mathematical Science, Cape Town, South Africa

Organized week-long lectures and coding sessions for 10 students on fundamentals of computer vision and its applications in ecology. Assisted students on an object detection-based African Penguin activity heat-mapping pipeline in collaboration with the Two Oceans Aquarium in Cape Town.

Data, Algorithms, and Society

Teaching Assistant

September 2023 – March 2024

Department of Computing and Mathematical Sciences, California Institute of Technology

Learning Systems I & II

Teaching Assistant & Head Teaching Assistant

March 2023 – June 2024

Department of Computing and Mathematical Sciences, California Institute of Technology

Leadership

- **2nd Computer Vision for Ecology (CV4E) Workshop** | *ICCV 2025*
- **Joint Workshop on Marine Vision** | *ICCV 2025*
- **President of Graduate Women in Course 6 Org.** | *2025*
- **Board Member & President of the Caltech Y** | *May 2023 - June 2024*

Awards

- **NSF Graduate Research Fellowship** | April 2025
- **Mabel Beckman Leadership Award** | *June 2024*
- **Doris S. Perpall Speaking Competition, 3rd Place Finalist** | *February 2024*
- **Samuel P. and Frances Krown Fellowship** | *June 2023*
- **Advocating Change Together (ACT) Award** | *May 2023*
- **Rise Teaching Award** | *May 2023*
- **Mari Peterson Ligocki Memorial Award for Community Service, Semi-Finalist** | *April 2023*
- **Jack E. Froehlich Memorial Award for Academic Excellence, Semi-Finalist** | *April 2023*