Somrita Banerjee

Machine Learning Researcher at Apple · Space Robotics PhD at Stanford · Former Researcher at NASA Ames

Cupertino, California, USA

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Education

Stanford University

September 2018 - June 2024

Doctor of Philosophy (PhD) & Master of Science (MS) - Aeronautics and Astronautics — *Stanford, CA*

- Conducted research at the intersection of aerospace robotics, controls, and machine learning in Prof. Marco Pavone's group.

Cornell University

August 2013 - May 2017

Bachelor of Science (MS) - Mechanical and Aerospace Engineering — *Ithaca, NY*

- Earned summa cum laude (GPA 4.033) with minors in Computer Science and Aerospace Engineering.

Experience

Apple

August 2024 – Present

Machine Learning Research Engineer — *Cupertino, CA*

- Fine-tuning vision-language-action (VLA) models using compact world models learned through imitation learning, improving task-specific roll-out success and guiding targeted data collection.
- Leading the development of a reinforcement learning-based decision-making agent that steers large language model behavior for user-facing assistive coaching in an RLHF pipeline.
- Integrated out-of-distribution (OOD) detection into vision-language models (VLMs) using CLIP embedding distances, enabling few-shot semantic grounding in limited-label regimes.
- Built training infrastructure for automated detection of misannotated data using contrastive embedding drift and model uncertainty, helping direct re-annotation and data collection efforts.

KBR Wyle at NASA Ames

March 2021 – June 2024

Decision Support Research Engineer (part-time during PhD) — *Moffett Field, CA*

- Developed POMDP algorithms in Julia for automated traverse and contingency planning for NASA's VIPER lunar rover, unlocking ability to achieve full mission success within first lunar day with >95% probability.
- Published framework for contingency planning using bi-level Markov decision processes (IEEEAero 2024).

Autonomous Systems Lab (Prof. Marco Pavone), Stanford University

April 2019 – June 2024

Doctoral Research Assistant — *Stanford, CA*

- Active learning for subselection of diverse out-of-distribution inputs.
  - Developed method to iteratively adapt to evolving input distributions by choosing a subset that maximizes collective information gain, and fine-tuning a PyTorch deep learning model.
  - Achieved performance equivalent to labeling 100% of images, while only labeling 50% of OOD images
  - Won best paper award at AI4Space workshop, European Conference on Computer Vision (ECCV 2022)
- Adaptive Bayesian meta-learning for online identification of rover-terrain dynamics.
  - Augmented physics-based model with online Bayesian regression model, which is adapted quickly using meta-learning and interpretably by mapping model parameters to true terrain parameters.
- Learning-based warm-starting for trajectory optimization, sequential convex programming.
  - Accelerated an SCP-based trajectory optimization solver by training a model to predict a near-optimal state and control trajectory used for initialization, reducing iterations required for convergence by 57%.

Wisk Aero (formerly Kitty Hawk)

June – September 2019

Intern, Guidance Navigation & Controls Team — *Mountain View, CA*

- Assessed control allocation algorithm's worst-case computation time for 12-rotor aircraft, to meet DO-178B software certification.
- Developed new cost function for controll allocation algorithm, reducing max torque by 15%.

Applied Predictive Technologies (now Mastercard)

August 2017 – August 2018

Software Engineer — *Arlington, VA*

- Designed statistical analysis software in full-stack production environment used by 20+ Fortune 500 clients.
- Developed front-end ReactJS interfaces and back-end C# code, as part of a team of 13 engineers.

ASML

August – December 2015; June – August 2016

Co-op Intern, Mechatronic Modules — *Wilton, CT*

- Developed empirical models of the relationship between viscoelastic moduli and stiffness for industrial grommets, leading to MATLAB design tools adopted company-wide.
- Led the design and testing of a tuned mass damper prototype, reducing machine vibrations by over 70%.

Space Systems Design Studio (Prof. Mason Peck), Cornell University *August 2013 – May 2017*

Undergraduate Research Assistant *Ithaca, NY*

- Co-led the Structures and Survivability subteam on a student CubeSat project, designing and fabricating flight hardware, performing structural and thermal analyses in ANSYS, and drafting AFRL-quality testing procedures.
- Conducted hardware integration and testing, including battery characterization, FlatSat, and mission simulations, while enforcing clean room and ESD safety protocols.
- Designed and programmed experiments for flux pinning research, developing Python and MATLAB scripts for wireless data collection and analysis across embedded systems.

Publications

Conference Proceedings

Deep Learning Warm Starts for Trajectory Optimization on the International Space Station
S. Banerjee, A. Cauligi, M. Pavone
Int. Conf. on Space Robotics, 2025

Contingency Planning Using Bi-level Markov Decision Processes for Space Missions
S. Banerjee, B. Balaban, M. Shirley, K. Bradner, M. Pavone
IEEE Aerospace Conference, 2024

Data Lifecycle Management in Evolving Input Distributions for Learning-based Aerospace Applications
S. Banerjee, A. Sharma, E. Schmerling, M. Spolaor, M. Nemerouf, M. Pavone
IEEE Aerospace Conference, 2023

Self-Supervised Model Generalization using Out-of-Distribution Detection
M. Foutter, R. Sinha, **S. Banerjee**, M. Pavone
Conf. on Robot Learning - Workshop on Out-of-Distribution Generalization in Robotics, 2023

VIPER Traverse Planning
M Shirley, E Balaban, A Colaprete, RC Elphic, H Sanchez, L Falcone, R Beyer, **S Banerjee**, K Bradner
53rd Lunar and Planetary Science Conference (LPSC), 2022

Adaptive Meta-Learning for Identification of Rover-Terrain Dynamics
S. Banerjee, J. Harrison, P. M. Furlong, M. Pavone
Int. Symp. on Artificial Intelligence, Robotics and Automation in Space, 2020, Pasadena, California

Learning-based Warm-Starting for Fast Sequential Convex Programming and Trajectory Optimization
S. Banerjee, T. Lew, R. Bonalli, A. Alfaadhel, I. A. Alomar, H. M. Shageer, M. Pavone
IEEE Aerospace Conference, 2020, Big Sky, Montana

Conference Abstracts

System Health Enabled Realtime Planning Advisor (SHERPA) and Its Use in Lunar Exploration
E Balaban, **S Banerjee**, Z Booth, J Ott, E Astle, M Shirley, K Bradner, A Colaprete, Viper Science Team
Lunar and Planetary Institute (LPI) Contributions 3063 (2024) p. 5063. 2024

A Concept for a New Frontiers Class Ceres Lander
I. Mishra, T. Plattner, **S. Banerjee**, K. Coumarbatch, S. Economon, L. Fifer, S. Gwizd, S. Gamage, R. Hinshaw, T. Kareta, W. G. Levine, A. Leeming, C. McConville, R. Moore, A. Sanchez, A. Sikka, F. Wroblewski, J. T. Keane, A. E. Nash
American Geophysical Union (AGU) (2024). 2024

Characterization of the Plasma Plume Produced by Dust and Meteoroid Impact of Different Materials
B. Estacio, N. Lee, G. Shohet, S. A. Q. Young, I. Matthews, R. Bassette, **S. Banerjee**, S. Close
AGU Fall Meeting Abstracts, 2019

Characterization of Optical Emission from Ground-Based Hypervelocity Impact Experiments
I. Matthews, N. Lee, G. Shohet, S. A. Q. Young, R. Bassette, **S. Banerjee**, H. Szybunka, S. Close
AGU Fall Meeting Abstracts, 2019

Dusty plasma effects in hypervelocity impacts on the ground and in space
G. Shohet, N. Lee, B. Estacio, I. Matthews, S. A. Q. Young, R. Bassette, **S. Banerjee**, S. Close
AGU Fall Meeting Abstracts, 2019

Electric Field Polarization of Electromagnetic Radiation from Micrometeoroid and Dust Impacts on Spacecraft
S. A. Q. Young, N. Lee, B. Estacio, I. Matthews, G. Shohet, R. Bassette, **S. Banerjee**, S. Close
AGU Fall Meeting Abstracts, 2019

Preprints

Diagnostic Runtime Monitoring with Martingales
A. Hindy, R. Luo, **S. Banerjee**, J. Kuck, E. Schmerling, M. Pavone
Preprint, arXiv:2407.21748, 2025

CORA: Concept Study for a New Frontiers Ceres Habitability Mission
T. A. Plattner, I. Mishra, **S. Banerjee**, K. Coumarbatch, S. Economon, L. Fifer, S. Gwizd, S. Gamage, R. Hinshaw, T. Kareta, W. G. Levine, A. Leeming, C. McConville, R. Moore, A. G. Sanchez, A. Sikka, F. Wroblewski, J. T. Keane, A. E. Nash

In preparation, 2025

Adapting a Foundation Model for Space-based Tasks
M. Foutter, P. Bhoj, R. Sinha, A. Elhafsi, **S. Banerjee**, C. Agia, J. Kruger, T. Guffanti, D. Gammelli, S. D'Amico, M. Pavone
arXiv:2408.05924, 2024

A System-Level View on Out-of-Distribution Data in Robotics
R. Sinha, S. Sharma, **S. Banerjee**, T. Lew, R. Luo, S. M. Richards, Y. Sun, E. Schmerling, M. Pavone
arXiv:2212.14020, 2022

Thesis

Learning-Enabled Adaptation and Planning for Space Robotics
S. Banerjee
PhD Thesis, Stanford University, 2024

Invited Talks

Space Robotics: Learning-enabled Adaptation and Planning

Stanford Robotics and Autonomous Systems Seminar, *May 2024*
Guest lecturer, MATSCI 82N "Science of the Impossible", Stanford University, *May 2024*
Future Leaders in Aerospace Symposium, *May 2024*
NASA Ames Intelligent Robotics Group (IRG) Meeting, *April 2024*

Space Robotics: Advances in Algorithms for Warm-Starting and Meta-Learning

Rising Stars in Aerospace Symposium, *May 2021*

Astrobee Trajectory Optimization and Warm-Starting Experiments for Gecko Phase 2

NASA Ames Astrobee Technical Interchange Meeting (TIM), *November 2024*
NASA Ames Astrobee Technical Interchange Meeting (TIM), *June 2024*
NASA Ames Astrobee Technical Interchange Meeting (TIM), *November 2023*
NASA Ames Astrobee Working Group (AWG) Meeting, *June 2023*
NASA Ames Astrobee Working Group (AWG) Meeting, *November 2022*

Contingency Planning using Bi-Level Markov Decision Processes for Space Missions

Blue Origin – Stanford Monthly Meeting, *March 2024*

Data Lifecycle Management in Evolving Input Distributions for Learning-based Aerospace Applications

Blue Origin – Stanford Monthly Meeting, *February 2024*

VIPER has a SHERPA (System Health Enabled Realtime Planning Advisor)

KBR Wyle Inc. Quarterly Meeting at NASA Ames, *May 2023*

Estimating uncertainty in DNNs and applications towards lifelong deployment of ML systems

JPL (Jet Propulsion Lab) AI Seminar, *April 2022*

Honors & Awards

NASA Ames Honor Award - Student *August 2022*
NASA Ames *Moffett Field, CA*
Awarded annually to one student as NASA Ames's highest honor; for outstanding algorithm development on the SHERPA project supporting the VIPER Moon mission (originally scheduled to launch September 2025).

Astrobee: First ML-Controlled Robot Experiment in Space *February 2025*
NASA Ames *Moffett Field, CA*
Conducted the first-ever experiment to showcase machine learning-driven control of a robot aboard the International Space Station.

Co-I, NASA Ames CIF Grant *September 2024*
NASA Ames *Moffett Field, CA*
Co-Investigator on $125,000 Center Innovation Fund grant to develop AI-based decision-making software for Enceladus missions.

Best Paper Award - AI4Space Workshop *October 2022*
European Conference on Computer Vision (ECCV) *Tel Aviv, Israel*
Awarded for outstanding contribution to AI in space applications.

Future Leaders in Aerospace - Symposium Selection *April 2024*

Stanford University *Stanford, CA*

One of 40 students selected annually across all U.S. university aerospace programs, based on academic excellence and research interest.

Rising Stars in Aerospace - Symposium Selection *May 2021*

MIT *Cambridge, MA*

One of 20 students selected annually across all U.S. university aerospace programs, based on academic excellence during early-PhD.

Stanford Graduate Fellowship (SGF) - Hugh H. Skilling Fellow *September 2018*

Stanford University *Stanford, CA*

Awarded annually to 100 outstanding students (out of 3,000+ incoming graduate students); provides stipend and tuition support.

ISTAT Foundation Scholarship *July 2020*

International Society of Transport Aircraft Trading (ISTAT) Foundation *Chicago, IL*

Awarded annually to 40 students globally to develop careers in aviation.

Skills

Machine Learning	PyTorch, TensorFlow, JAX, Gymnasium
Robotics	ROS, Gazebo, MuJoCo, PyBullet, OpenCV
Programming	Python, C++, Julia, Java, MATLAB, Javascript, ReactJS
Data Science	NumPy, Pandas, Seaborn, Matplotlib
Design & Simulation	ANSYS, SolidWorks, NX, AutoCAD

Teaching

Teaching Assistantships

Fall 2021	**Principles of Robot Autonomy I - Head TA**, Stanford University	*Stanford, CA*
Fall 2020	**Principles of Robot Autonomy I**, Stanford University	*Stanford, CA*
Fall 2016	**Statics & Mechanics of Solids** , Cornell University	*Ithaca, NY*
Spring 2016	**Mechanical Properties & Selection of Engineering Materials**, Cornell University	*Ithaca, NY*
Spring 2015	**Thermodynamics**, Cornell University	*Ithaca, NY*

Tutoring

Fall 2018-19	**Schwab Learning Center**, Stanford University	*Stanford, CA*
Summer 2019-20	**Athletic Academic Resource Center**, Stanford University	*Stanford, CA*
Fall 2014-16	**Engineering Tutoring Center**, Cornell University	*Ithaca, NY*

Courses

Space Systems

AA 279A	**Space Mechanics**, Stanford University
AA 271A	**Dynamics and Control of Aircraft**, Stanford University

Machine Learning and Artificial Intelligence

CME 216	**Machine Learning in Computational Engineering**, Stanford University
CS 229	**Machine Learning**, Stanford University
CS 330	**Deep Multi-Task and Meta Learning**, Stanford University
CS 329T	**Trustworthy Machine Learning**, Stanford University

Autonomy and Decision-Making

AA 228	**Decision Making Under Uncertainty**, Stanford University
AA 274	**Principles of Robot Autonomy**, Stanford University
AA 289	**Robotics and Autonomous Systems Seminar**, Stanford University
AA 273	**State Estimation and Filtering for Robotic Perception**, Stanford University
CS 223A	**Introduction to Robotics**, Stanford University

Control and Optimization

ENGR 205	**Introduction to Control Design Techniques**, Stanford University
AA 277	**Multi-Robot Control, Communication, and Sensing**, Stanford University
AA 203	**Optimal and Learning-Based Control**, Stanford University
AA 222	**Engineering Design Optimization**, Stanford University
EE 364A	**Convex Optimization I**, Stanford University

Service

Reviewing

American Control Conference (**ACC**) 2022, **AIAA SciTech** 2023, Conference on Robot Learning (**CoRL**) 2023, Learning for Dynamics & Control (**L4DC**) 2024, Robotics: Science and Systems (**RSS**) 2024, IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**) 2024, International Symposium of Robotics Research (**ISRR**) 2024, IEEE Robotics and Automation Letters (**RA-L**) 2024, **AIAA SciTech** 2025, Robotics: Science and Systems (**RSS**) 2025, IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**) 2025, Conference on Robot Learning (**CoRL**) 2025, International Conference on Space Robotics (**iSpaRo**) 2025

Mentorship

Matt Foutter (**PhD Stanford**) 2023, M. Shahir Rahman (**MS Stanford**) 2023, Isabella Torres (**MS Stanford**) 2022, Alana Sanchez (**MS Stanford**) 2020, Abla Ghaleb (**BS Stanford**) 2019, Claire Xu (**High school**) 2020-2023

Workshops

Workshop on Out-of-Distribution (OOD) Generalization at Conference on Robot Learning (**CoRL**) **2023**, 2nd Workshop on Out-of-Distribution Generalization at Robotics at Robotics: Science and Systems (**RSS**) **2025**, Workshop on Robot Evaluation for the Real World at Robotics at Robotics: Science and Systems (**RSS**) **2025**

Leadership

American Institute of Aeronautics and Astronautics (AIAA) Space Exploration and Integration Committee (SEIC) Member, Area chair for Workshop on Robot Evaluation for the Real World at Robotics at Robotics: Science and Systems (**RSS**) **2025**