# Cyndia Cao

PhD · Mechanical Engineering · University of California, Berkeley

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I am a hands-on, experimentally-driven, and theory-motivated builder who adapts to the challenge at hand. My goal is to use my research experience to creatively tackle problems from first principles in order to address technical barriers to mitigating climate change.

## Education

**University of California, Berkeley** *Berkeley, CA*

PhD - Mechanical Engineering *2018 - 2023*

- NASA Space Technology Research Fellow (2019) | Advisors: Hannah Stuart, Dennis Lieu
- Thesis: *Roving around the moon & Mars: Active weight redistribution and strategic slip control for augmenting wheeled mobility*

**Massachusetts Institute of Technology** *Cambridge, MA*

B.S. - Mechanical Engineering *2013 - 2017*

- Advisors: Alex Slocum, David Trumper
- Thesis: *Exploration of configurations of wave energy converters to mechanically drive a seawater uranium harvester*

## Skills

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|---|---|
| **Programming** | Python, MATLAB, Arduino (C/C++), Simulink/Simscape |
| **Solid Modeling** | NX, Fusion 360, SolidWorks, AutoCAD, ANSYS Structural |
| **Coursework: Mechatronics** | Electric Motor Design, Power Electronics, MEMS, Hamiltonian & Lagrangian Dynamics |
| **Coursework: Controls** | Model Predictive Control, State Estimation, Reinforcement Learning |

## Professional Experience

**UC Berkeley // NASA Glenn Research Center, Ames Research Center, Jet Propulsion Laboratory** *Berkeley, CA*

Graduate Student Researcher, NASA Space Technology Research Fellow *Aug 2018 - Aug 2023*

- Developed and experimentally validated control methods for new rover configurations with articulated suspensions to improve mobility performance and ensure robustness.
- Refined and applied wheel-terrain interaction models to explain and predict unintuitive results.
- Built sub-scale rovers and data collection setups to study the impact of internal slip control for climbing loose, sandy terrain; achieved up to 8x efficiency improvement.
- Performed mobility validation testing with NASA's VIPER (lunar rover) team, and led the test campaign and data analysis for evaluation of VIPER's load-responsive suspension controllers.

**Apple** *Cupertino, CA*

Intern, Watch Product Design *Jan 2018 - Aug 2018*

- Analyzed users' wrist interactions in various sports to quantify impact loads and environmental factors, then proposed validation tests including machine requirements and SOPs.
- Produced GD&T drawings and tolerance stacks for small, complex assemblies and fasteners.
- Designed interface-representative frames for environmental testing of individual sub-assemblies.

**SpaceX** *Hawthorne, CA*

Associate Engineer, Mechanisms *Aug 2017 - Dec 2017*

- Upgraded propulsion structures and their manufacturing tooling; verified their structural integrity via FEA in ANSYS.
- Tested electrical components under vibration, shock, and separation loads for flight qualification.

**NASA Jet Propulsion Laboratory** *Pasadena, CA*

Intern, Deployable Mechanisms *May 2016 - Aug 2016*

- Fabricated high fidelity 1/20 scale configuration models of Starshade, an external occulter for finding exoplanets, as prototyping tools for science and engineering parties

## Teaching Experience

**FIRST Robotics Team 5419** *Berkeley, CA*

Lead Technical Mentor *Sept 2019 - Present*

- Mentored 30-60 high school students as they build a high-speed, 120 pound robot to play a new game each year.
- Fostered students' critical thinking upon facing structural failures, CAD & fabrication inconsistencies, or other challenges.
- Guided the software team to integrate automation in robot control and develop comprehensive competition scouting analysis.

**Summer Science Program - Astrophysics** *Boulder, CO & Socorro, NM*

Teaching Assistant *Summer 2017 & 2019*

- Tutored high school seniors in orbital mechanics and Python to track near-Earth asteroids and calculate their orbital elements.
- Assisted students with homework and telescope observation sessions and organized social events.

## Publications

**C. Cao**, D. Moon, C. Creager, D. K. Lieu, H. S. Stuart, "Push-pull locomotion: Increasing travel velocity in loose regolith via induced wheel slip." (Under review by *Journal of Terramechanics*.)

T. M. Huh, **C. Cao**, J. Aderibigbe, D. Moon and H. S. Stuart, "Walk-Burrow-Tug: Legged anchoring analysis using RFT-based granular limit surfaces," in *IEEE Robotics and Automation Letters*, Apr. 2023, doi: 10.1109/LRA.2023.3269324.

**C. Cao**, A. Rogg, A. Tardy, "Actuated Suspension Tuning Characterization of the VIPER Lunar Rover," in *2023 IEEE Aerospace Conference*, Mar. 2023, doi: 10.1109/AERO55745.2023.10115796.

**C. Cao**, C. Creager, D. K. Lieu, H. S. Stuart, "Mobility experiments assessing performance of front-back differential drive velocity on sandy terrain," in *2021 International Society for Terrain-Vehicle Systems Conference (ISTVS)*, Sep. 2021.

**C. Cao**, D. K. Lieu, H. S. Stuart, "Dynamic Analysis of Gyroscopic Force Redistribution for a Wheeled Rover," in *Earth and Space 2021*, pp. 318–327, Apr. 2021. doi: 10.1061/9780784483374.032.
Awarded Best Student Paper.

L. K. Treers, **C. Cao**, H. S. Stuart, "Granular Resistive Force Theory Implementation for Three-Dimensional Trajectories." in *IEEE Robotics and Automation Letters*, vol. 6, no. 2, pp. 1887-1894, Apr. 2021, doi: 10.1109/LRA.2021.3057052.