Aditya Rohan Sengupta

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Research Interests

Sparse statistical inference methods for exoplanet population studies
Time-series light curve analysis and detrending, information-theoretic methods
Noise characterization and optimal control in adaptive optics

Education

University of California, Berkeley; Bachelor of Science   Aug 2017-May 2021
B.S., Engineering Physics, B.S., Engineering Mathematics and Statistics; GPA 3.815
  Relevant Coursework (*graduate-level)

  Math/Stat - Probability & Random Processes, Differentiable Manifolds*, Abstract Algebra, Analysis
  EECS - Information Theory*, Machine Learning, Feedback Control Systems, Signals, Optical Engineering
  Physics - Quantum Mechanics, Analytic Mechanics, Electromagnetism and Optics, Relativistic Astrophysics
  and Cosmology, Statistical Mechanics

Research and Projects

Exoplanet Probabilistic Modeling with *TESS*   2020-present
 Advisor: Prof. Courtney Dressing
Senior year project: analyzing exoplanet populations using *TESS* data products and time-series analysis.
- Improved models and optimization framework to fit the *TESS* point-spread-function to light curves in the *eleanor* Python package.
- Developing methods for probabilistic inference from *TESS* full-frame images, through Markov chain Monte Carlo analysis of injection/recovery testing results.
- Assessing impact on occurrence rates using Approximate Bayesian Computing.

Coding and Information Analysis for the *SPRIGHT* Algorithm   2020
 Advisor: Prof. Kannan Ramchandran, Orhan Ocal
Final project for EECS 229A: Information Theory and Coding.
- Implemented the *SPRIGHT* sparse Walsh-Hadamard transform algorithm in Python and Julia.
- Created information-theoretic extensions for improved time and sample efficiency.
- Registered implementation as the [SparseTransforms.jl](#) Julia package.

Optimal Tip-Tilt Correction for Adaptive Optics   2019
 Advisor: Dr. Rebecca Jensen-Clem (now Assistant Prof., UC Santa Cruz)
- Simulated control schemes for the tip and tilt modes of aberrations in an adaptive optics system.
- Demonstrated improved correction through model predictive control using a Kalman filter.
- Analyzed telemetry and outlined plans for future lab testing to adapt to Keck II.

Pyramid Wavefront Sensor Simulation for the Keck Telescopes   2018
 Advisor: Dr. Rebecca Jensen-Clem
- Simulated an adaptive optics loop with a pyramid wavefront sensor, newly installed at Keck II.
- Demonstrated imaging quality improvements due to predictive control algorithms.
- Conducted testing and QA for the *hcipy* Python package.

Publications, Talks, and Posters

6. **Aditya R. Sengupta**, Benjamin T. Montet, Kaiming Cui, Adina D. Feinstein, Courtney D. Dressing, 2021. "Improved PSF Fits for TESS Lightcurve Detrending." Poster, *AAS 237*, Virtual.

5. **Aditya R. Sengupta** and Rebecca Jensen-Clem, 2020. "Kalman Filtering for Tip-Tilt Correction in Adaptive Optics." *Research Notes of the American Astronomical Society*, DOI [10.3847/2515-5172/abd47a](10.3847/2515-5172/abd47a).

4. Samantha Guzmán, Jesus Martinez and 5 others including **Aditya R. Sengupta**, 2020. "Accessible Balloon RAdiometer: Detecting the Cosmic Microwave Background." Poster, *Undergraduate Lab at Berkeley Final Presentations*.

3. **Aditya R. Sengupta** and Rebecca Jensen-Clem, 2019. "Optimal Filtering for Tip-Tilt Correction in Adaptive Optics." Talk to Dressing research group.

2. **Aditya R. Sengupta** and Rebecca Jensen-Clem, 2019. "Optimal Filtering for Tip-Tilt Correction in Adaptive Optics." Poster, *Center for Adaptive Optics Fall Retreat*, 2019.

1. **Aditya R. Sengupta**, Eden McEwen, Shide Dehghani, Rebecca Jensen-Clem, "Demonstrating Predictive Wavefront Control at Keck II: Simulating a Pyramid Wavefront Sensor." Poster, *UC Berkeley Astronomy Poster Summer Intern Symposium*, 2018.

Teaching and Mentorship

Instruction and Tutoring   Jan 2018-present
- Instructor, Democratic Education at Cal, Spring 2021. *Physics 198: Physics-based High-Performance and Scientific Computing and Technology (physcat-decal.com)*. (sponsor: Yury Kolomensky.)
- Undergraduate Student Instructor, Fall 2020 and Spring 2021. *EECS 126: Probability and Random Processes* (instructors: Shyam Parekh, Thomas Courtade). Developed new Jupyter notebook lab assignment on the Kalman filter; wrote new official course notes.
- Study Group Facilitator, UC Berkeley Student Learning Center, Spring 2020. *Math 53: Multivariable Calculus*, (instructor: Emiliano Gomez, supervisor: Michael J. Wong). Developed and taught twice-weekly problem solving worksheets.
- Tutor, Spring 2018-present, UC Berkeley Student Learning Center (SLC), for Mathematics 1A, 1B, 16A, 16B (single-variable calculus), 53 (multivariable calculus), 54 (linear algebra).
- Tutor/Reader, Summer 2019-Spring 2020, for Data Structures, Control Systems, Probability.
- Personal expository papers and course notes available at aditya-sengupta.github.io/notes.html.

Curriculum Chair, Undergraduate Lab at Berkeley   May 2020-present
Created instructional modules, gave lectures, oversaw content development to introduce new researchers to essential skills: programming/Git, research literacy, communication, statistics.

Mentor, Undergraduate Lab at Berkeley   Aug 2019-May 2020
Led an independent research team of freshman/sophomore-level physics students to construct a Cosmic Microwave Background detector. Ran subgroups for detector printed-circuit-board design, mechanical construction, data denoising and inference algorithms. Progress halted due to COVID-19.

Simulations Co-Lead, STAR at Berkeley   June 2018-April 2019
Established Simulations subteam of UC Berkeley's high-powered rocketry team. Ran structural finite-element and computational fluid analyses, established standard tools, wrote internal club documentation.

Technical Skills

Python, Julia, Java, Matlab, LaTeX, SQL, ANSYS Structural, ANSYS CFD, Solidworks, Zemax, KiCAD; MCMC, open-source software, high-performance computing, amateur radio.