

# Ethan R. Burnett

Email: ethanryan.burnett (at) polimi.it [Google Scholar](#) U.S. Citizen

## EDUCATION

- Ph.D., Aerospace Engineering Sciences** October 2021  
University of Colorado, Boulder  
Advisor: Dr. Hanspeter Schaub  
Dissertation: Novel Dynamics and Control Formulations for Multi-Spacecraft Formation Flying, Rendezvous, and Proximity Operations ([PDF](#))
- M.S., Aerospace Engineering** May 2018  
University of Arizona  
Advisor: Dr. Eric Butcher
- B.S., Aerospace Engineering and *Minor*, Physics** May 2016  
University of Arizona




## SPECIALIZATION

Researcher in spaceflight and space science. My work history includes spacecraft guidance, navigation, & control (GNC), dynamics, and planetary science (icy moons, space weathering, planetary dynamics)


## SELECTED AWARDS

- Marie Skłodowska-Curie Actions Postdoc Fellowship, European Commission, €172750 / 2 yr 2022
- NRC Postdoc Fellowship, U.S. Air Force Science & Technology Fellowship Program (declined) 2022
- Travel Award, International Workshop on Satellite Constellations & Formation Flying, £500 2019
- DoD National Defense Science and Engineering Graduate Fellowship (NDSEG), \$38400/yr × 3 2018
- National Science Foundation Graduate Research Fellowship Program (GRFP) \$32000/yr × 3 2018
- Dean's Fellowship, Department Scholarship (CU Boulder), total of \$9000 2018
- Theodore H. Troller Memorial Scholarship (University of Arizona), \$1759 2017
- Third Place, AAS Student Team Competition: Mission Design to Asteroid 2016 HO3, \$500 2017
- National Merit Scholar (Top 0.5% of scores in PSAT national standardized test), \$16000/yr×4 2012

## EXPERIENCE

-  **Marie Curie Postdoctoral Fellow,** July 2023 – present  
**Politecnico di Milano** Dipartimento di Scienze e Tecnologie Aerospaziali ([DAER](#))
- Funded by the European Commission, and hosted in Prof. F. Topputo's [DART Lab](#)
  - MSCA is the European Union's flagship fellowship program for excellent research
  - Project: FFAST, On-board orbit guidance for interplanetary CubeSats
-  **Engineer - Avionics, Instruments & GNC II,** April 2022 – July 2023  
**Blue Origin** Space Systems Development
- ADP Flight Sciences - Guidance and Control group - supporting Advanced Technology (2022)
  - Space Systems Development - Guidance/RPOD group - on loan to Lunar Transportation (2023)
  - Project: Robust drift-safe spacecraft rendezvous guidance (LEO and NRHO); linear covariance applications, uncertainty quantification
  - Technical interchanges with NASA Johnson Space Center under a Space Act agreement
-  **Planetary Science Affiliate,** March 2022 – present  
**Laboratory for Atmospheric and Space Physics (LASP)** SCI/Planetary
- Sponsor: Paul Hayne
  - Research topics: Europa tectonics, geology, tidal dissipation, and spin-orbit coupling

## INTERNSHIPS & EARLY CAREER

-  **NASA Jet Propulsion Laboratory** Summers 2020, 2021  
Section 347D: Robotics Modeling and Simulation Visiting Researcher
- Guidance and Control for ADEPT drag device for SmallSat aerocapture, using DSENDS
- Planetary Science Summer School Participant
- Simulated pre-phase A design study for New Frontiers Enceladus mission, org. by JPL Team X.
  - Propulsion design, Science team (co-developed 1 of 4 science goals), Engineering team.



## U.S. Air Force Research Laboratory

Space Vehicles Directorate, Kirtland AFB, Albuquerque, NM

- Novel techniques for spacecraft formation/orbit control and estimation.
- Supervisors: Dr. Andrew Sinclair (2017 & 2018), Dr. T. Alan Lovell (2016)

Summers: 2016, 2017, 2018

Space Scholar, SFFP



## Apollo Robotic Systems

Startup Office, Tucson, AZ

- Tech startup. Developed programs and hardware for autonomous UAV landing control.

May 2015 – May 2016

Robotics Engineer

## SELECTED SKILLS

**Programming languages (in order of familiarity):** Python, C++, Julia. **Other software:** MATLAB, Mathematica, L<sup>A</sup>T<sub>E</sub>X. **OS:** MacOS/Linux. **Misc:** Formula SAE Lead Powertrain Engineer in undergrad.

†Note: Daggers denote planetary science items

## JOURNAL PAPERS

For a partial repository: <https://hanspeterschaub.info/journals.html> (Search “Burnett”)

- †(J1) **E. Burnett** and P. Hayne, “Spin-Orbit Coupling of Europa’s Ice Shell and Interior,” *Icarus* (2023) 115731. Online 08/02/2023.  
<https://arxiv.org/abs/2302.13226> <https://doi.org/10.1016/j.icarus.2023.115731>
- (J2) S. Albert, **E. Burnett**, H. Schaub, P. D. Burkhart, and A. Austin, “Energy Reference Guidance for Drag-Modulated Aerocapture”. *Advances in Space Research*. *Submitted April 2023. Under review.*
- †(J3) K. Marshall Seaton, Szilárd Gyalay, Gaia Stucky de Quay, **E. Burnett**, C. Adeene Denton, Bryce Doerr, Kamak Ebadi, Stephanie Eckert, Ian T. W. Flynn, Casey I. Honniball, Shayna Hume, Corbin L. Kling, Julian C. Marohnic, Julia Milton, Claire A. Mondro, Raquel G. Nuno, Caoimhe M. Rooney, Beck E. Strauss, Alfred Nash, and Jennifer E. C. Scully, “Astrobiology eXploration at Enceladus (AXE): A New Frontiers Mission Concept Study,” *Planetary Science Journal*. Published 06/29/2023.  
<https://doi.org/10.3847/PSJ/acd119>
- (J4) **E. Burnett** and H. Schaub, “Spacecraft Relative Motion Dynamics and Control Using Fundamental Modal Solution Constants”. *Journal of Guidance, Control, and Dynamics*. Online 08/31/2022.  
<https://arxiv.org/abs/2112.02678> <https://doi.org/10.2514/1.G006603>
- (J5) **E. Burnett** and H. Schaub, “Approximating Orbits in a Rotating Gravity Field with Oblateness and Ellipticity Perturbations,” *Celestial Mechanics and Dynamical Astronomy*. Online 01/20/2022.  
<https://arxiv.org/abs/2108.09607> <https://doi.org/10.1007/s10569-022-10061-z>
- (J6) **E. Burnett** and H. Schaub, “Geometric Perspectives on Fundamental Solutions in the Linearized Satellite Relative Motion Problem,” *Acta Astronautica* 190 (2022), pp. 48-61. Online 10/06/2021.  
<https://arxiv.org/abs/2108.09608> <https://doi.org/10.1016/j.actaastro.2021.09.028>
- †(J7) **E. Burnett** and P. Hayne, “Europa’s Hemispheric Color Dichotomy as a Constraint on Non-synchronous Rotation,” *Icarus* 364 (2021) 114438. Online 03/29/2021.  
<https://arxiv.org/abs/2003.06680> <https://doi.org/10.1016/j.icarus.2021.114438>
- (J8) **E. Burnett** and H. Schaub, “Spacecraft Formation and Orbit Control Using Attitude-Dependent Differential Solar Radiation Pressure,” *Advances in Space Research* 67 (2021), 3396-3408. Online 04/12/2020.  
<https://doi.org/10.1016/j.asr.2020.03.047>
- (J9) **E. Burnett** and H. Schaub, “Study of Highly Perturbed Spacecraft Formation Dynamics via Approximation,” *Advances in Space Research* 67 (2021), 3381-3395. Online 03/21/2020.  
<https://doi.org/10.1016/j.asr.2020.02.030>
- (J10) **E. Burnett**, A. J. Sinclair, and C. C. Fisk, “Unit Sphere-Constrained and Higher Order Interpolations in Laplace’s Method of Initial Orbit Determination,” *Journal of Astronautical Sciences* 67 (2020), 1116-1138. Online 11/11/2019.  
<https://doi.org/10.1007/s40295-019-00196-x>

## CONFERENCE PAPERS AND PRESENTATIONS

For a partial repository: <https://hanspeterschaub.info/conferences.html> (Search “Burnett”)

- (C1) A. W. Berning, **E. Burnett**, and S. Bieniawski, “Chance-Constrained, Drift-Safe Guidance for Spacecraft Rendezvous”, Blue Origin work, 2023 AAS Rocky Mountain GNC Conference
- (C2) **E. Burnett**, S. Albert, and H. Schaub, “A New Guidance Technique for Discrete-Event Drag Modulation for Aerocapture Missions,” 2022 AAS Rocky Mountain GNC Conference.
- (C3) **E. Burnett** and H. Schaub, “Spacecraft Relative Motion Dynamics and Control Using Fundamental Solution Constants,” 2022 AIAA SciTech Forum: Spaceflight Mechanics Group.  
<https://doi.org/10.2514/6.2022-2462>

- (C4) M. J. Grace, **E. Burnett** and J. McMahon, “Quasi-Initial Conditions as a State Representation for Aerocapture,” 2022 AIAA SciTech Forum: Hypersonic and Spacecraft Flight Mechanics Group.  
<https://doi.org/10.2514/6.2022-1652>
- (C5) A. J. Sinclair, Scott Norrix, **E. Burnett**, and E. A. Butcher, “Coordinate-Invariant Kalman Filtering,” 2022 U.S. National Congress on Theoretical and Applied Mechanics.
- (C6) **E. Burnett** and H. Schaub, “Satellite Relative State Uncertainty Dynamics in the Vicinity of a Poorly Tracked Target Object,” 2021 AAS Astrodynamics Specialist Conference.
- (C7) **E. Burnett** and H. Schaub, “Modal Decomposition of Spacecraft Relative Motion in Quasi-Periodic Orbits,” AAS 20-506, 2020 AAS Astrodynamics Specialist Conference
- (C8) **E. Burnett** and H. Schaub, “Analytic Approximations of Orbit Geometry in a Rotating Higher Order Gravity Field,” AAS 19-684, 2019 AAS Astrodynamics Specialist Conference
- (C9) **E. Burnett**, A. Harris, and H. Schaub, “Desensitized Optimal Spacecraft Rendezvous Control with Poorly Known Gravitational and Solar Radiation Pressure Perturbations,” AAS 19-685, 2019 AAS Astrodynamics Specialist Conference
- (C10) A. Harris, **E. Burnett**, and H. Schaub, “Desensitized Optimal Attitude Guidance for Differential-Drag Rendezvous,” AAS 19-651, 2019 AAS Astrodynamics Specialist Conference
- (C11) **E. Burnett** and H. Schaub, “Spacecraft Formation and Orbit Control Using Attitude-Dependent Solar Radiation Pressure,” IWSCFF 19-28, 2019 International Workshop on Satellite Constellations and Formation Flying
- (C12) **E. Burnett** and H. Schaub, “Study of Highly Perturbed Spacecraft Formation Dynamics via Approximation,” IWSCFF 19-27, 2019 International Workshop on Satellite Constellations and Formation Flying
- (C13) **E. Burnett**, A. J. Sinclair, and E. A. Butcher, “Coordinate-Invariant Linear Quadratic Control,” GAMM 2019, 90<sup>th</sup> Annual Meeting of the International Association of Applied Mathematics and Mechanics
- (C14) **E. Burnett** and E. A. Butcher, “Linearized Relative Motion Dynamics in a Rotating Second Degree and Order Gravity Field,” AAS 18-232, 2018 AAS Astrodynamics Specialist Conference
- (C15) **E. Burnett**, E. A. Butcher, A. J. Sinclair, and T. A. Lovell, “Linearized Relative Orbital Motion Model About an Oblate Body Without Averaging,” AAS 18-218, 2018 AAS Astrodynamics Specialist Conference
- (C16) **E. Burnett** and A. J. Sinclair, “Interpolation on the Unit Sphere in Laplace’s Method,” AAS 17-793, 2017 AAS Astrodynamics Specialist Conference
- (C17) K. Drozd, **E. Burnett**, E. Sahr, D. McNeely, V. Franzese, N. R. Morón, “Block-Like Explorer of a near-Earth Body by achieving Orbital Proximity (BEEBOP),” AAS 17-846, 2017 AAS Astrodynamics Specialist Conference
- (C18) E. A. Butcher, **E. Burnett**, J. Wang, and T. A. Lovell, “A New Time-Explicit J2-Perturbed Nonlinear Relative Orbit Model with Perturbation Solutions,” AAS 17-758, 2017 AAS Astrodynamics Specialist Conference
- (C19) E. A. Butcher, **E. Burnett**, and T. A. Lovell, “Comparison of Relative Orbital Motion Perturbation Solutions in Cartesian and Spherical Coordinates,” AAS 17-202, 2017 AAS Spaceflight Mechanics Meeting

## PEER-REVIEWED ABSTRACTS

- †(A1) **E. Burnett** and P. Hayne (2023), “Dynamical Study of the Tidal Locking of Europa.” 54th Lunar and Planetary Science Conference (LPSC), [Abstract 2804](#)
- †(A2) **E. Burnett** and P. Hayne (2022), “Tides and the Spin States of the Icy Ocean World Europa.” 53rd Lunar and Planetary Science Conference (LPSC), [Abstract 1723](#)
- †(A3) K. M. Seaton, **E. Burnett**, C. A. Denton, B. Doerr, K. Ebadi, S. Eckert, I. T. W. Flynn, S. Gyalay, C. I. Honniball, S. Hume, C. L. Kling, J. C. Marohnic, J. Milton, C. A. Mondro, R. G. Nuno, C. M. Rooney, B. E. Strauss, G. Stucky de Quay, A. Nash, and J. Scully (2022), “Science Objectives for a Mission Concept to Enceladus: The Astrobiology Exploration at Enceladus (AXE).” 53rd Lunar and Planetary Science Conference (LPSC), [Abstract 2152](#)
- †(A4) K. M. Seaton, **E. Burnett**, C. A. Denton, B. Doerr, K. Ebadi, S. Eckert, I. T. W. Flynn, S. Gyalay, C. I. Honniball, S. Hume, C. L. Kling, J. C. Marohnic, J. Milton, C. A. Mondro, R. G. Nuno, C. M. Rooney, B. E. Strauss, G. Stucky de Quay, A. Nash, and J. Scully (2022), “Mission Implementation for a New Frontiers Mission Concept: The Astrobiology Exploration at Enceladus (AXE).” 53rd Lunar and Planetary Science Conference (LPSC), [Abstract 2168](#)

## CONFERENCE HISTORY

- †1. 54th Lunar and Planetary Science Conference, March 13 - 17, 2023, The Woodlands, TX
- 2. AAS Guidance, Navigation, and Control Conference, February 2023, Breckenridge, CO
- †3. 53rd Lunar and Planetary Science Conference, March 6 - 11, 2022, The Woodlands, TX
- 4. AAS Guidance, Navigation, and Control Conference, February 2022, Breckenridge, CO
- 5. AIAA SciTech Forum, January 3 - 7, 2022, San Diego, CA
- †6. 53rd Annual Meeting of the Division for Planetary Sciences, October 3 - 8, 2021, virtual

7. AAS Astrodynamics Specialist Conference, August 8 - 12, 2021, virtual
8. AAS Astrodynamics Specialist Conference, August 9 - 12, 2020, virtual
9. AAS Astrodynamics Specialist Conference, August 11 - 15, 2019, Portland, ME
10. International Workshop on Satellite Constellations and Formation Flying, July 16 - 19, 2019, Glasgow, Scotland
11. 90th Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), February 18 - 22, 2019, Vienna, Austria
12. AAS Astrodynamics Specialist Conference, August 19 - 23, 2018, Snowbird, UT
13. AAS Astrodynamics Specialist Conference, August 20 - 24, 2017 Stevenson, WA
14. 27th AAS/AIAA Spaceflight Mechanics Meeting, February 5 - 9, 2017, San Antonio, TX

### REVIEW HISTORY

Acta Astronautica · Advances in Space Research · Celestial Mechanics and Dynamical Astronomy · Journal of Guidance, Control, and Dynamics (Awarded “Excellent Reviewer” Oct 2021 - 2022) · International Journal of Aerospace Engineering · IEEE Access · The Planetary Science Journal

### INVITED TALKS

1. E. Burnett, “Astrodynamics”, invited lecture at *Georgia Institute of Technology* for undergrad course AE 4342, October 11, 2022, Atlanta, GA
2. E. Burnett, “Frontiers in Spaceflight and Space Science,” presented at *Georgia Institute of Technology*, February 3, 2022, Atlanta, GA
- †3. E. Burnett, “Europa’s Hemispheric Color Dichotomy as a Constraint on Non-Synchronous Rotation,” presented at *NASA JPL Europa Clipper Lecture Series*, October 15, 2021 (virtual)
4. E. Burnett, “Novel Formulations for Modern Multi-Spacecraft Proximity Operations and Rendezvous”, presented to *U.S. Air Force Office of Scientific Research* and *2018 NDSEG Fellows Class*, in *2nd Annual NDSEG Conference*, July 19, 2021 (virtual)
- †5. E. Burnett, “Europa’s Hemispheric Color Dichotomy as a Constraint on Non-Synchronous Rotation,” presented to *Exploration of Planetary Ices and Climates (EPIC) Group*, in *Laboratory for Atmospheric and Space Physics (LASP)*, *CU Boulder*, April 5, 2021, Boulder, CO (virtual)

### TEACHING AND MENTORSHIP

- Technical Lead, New Grad Rotation Program project at Blue Origin, Spring 2022
  - Wrote a winning solicitation for a 4 month internal research project (path-constrained indirect trajectory optimization) to be completed by an engineer in the competitive New Grad Rotation (NGR) Program at Blue Origin
  - Mentored the NGR engineer (Josh Stoffel) in completion of the project
- Graduate Mentor, CU Boulder “Discovery Learning Apprenticeship” Program Project: *Simulating and Studying Aerocapture Dynamics and Guidance*, Fall 2021
  - Wrote a winning solicitation for a one academic year undergrad-scoped research project on aerocapture guidance and trajectory design
  - Mentored the selected student (Sam Alvis) for one semester. I graduated from CU Boulder afterwards and ensured a smooth mentorship transition
- Tutor, “I Have a Dream” Foundation of Boulder County:
  - High school math, Boulder Broadway East Center, June 2019 – March 2020
  - Calculus I and Physics I (mechanics), CU Boulder, January – May 2021
- Teaching Assistant:
  - Introduction to MATLAB (undergraduate course), University of Arizona, 2016, 2017
  - Fluid Mechanics (undergraduate course), University of Arizona, 2017
  - Vibrations (undergraduate course), University of Arizona, 2017
  - Advanced Engineering Mathematics I & II (graduate courses), University of Arizona, 2017, 2018

## LANGUAGES

English (native) · Spanish (simple conversations and written, ~B1) · Italian (basic communication, A2)

## PROFESSIONAL REFERENCES

1. Dr. Hanspeter Schaub  
Professor, Department Chair, Schaden Leadership Chair  
Smead Department of Aerospace Engineering Sciences  
University of Colorado Boulder  
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2. Dr. Paul Hayne  
Assistant Professor  
Astrophysical and Planetary Sciences Department; LASP  
University of Colorado Boulder  
Email: paul.hayne (at) colorado.edu  
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3. Dr. Andrew Sinclair  
Senior Aerospace Engineer  
Space Vehicles Directorate  
U.S. Air Force Research Laboratory  
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