# BENJAMIN L. HANSON

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## EDUCATION

**University of California San Diego - La Jolla, CA** **Current Ph.D., Expected Spring 2027**
***Major:*** *Aerospace Engineering*
***Field:*** *Dynamic Systems and Controls*

**University of California San Diego - La Jolla, CA** **M.S., June 2024**
***Major:*** *Aerospace Engineering* *GPA: 3.744*
***Field:*** *Dynamic Systems and Controls*

**Colorado School of Mines - Golden, CO** **B.S., May 2022**
***Major:*** *Engineering Physics* *Summa Cum Laude, GPA: 3.93*
***Minor:*** *Robotics and Intelligent Systems*
***Area of Special Interest:*** *Space and Planetary Sciences Engineering*

## SKILLS

- **Astrodynamics & GNC Frameworks:** Orbit determination, nonlinear state estimation/uncertainty propagation, Kalman filtering (EKF/UKF), particle filtering, grid-based finite volume methods
- **Astrodynamics Software & Catalogs:** Monte, GMAT, REBOUND, ASSIST, SPICE, JPL Horizons System, CNEOS Small-Body Database (SBDB), Three-Body Periodic Orbit Catalog (3BPOC)
- **Programming & HPC:** C/C++, Python, MATLAB, CUDA / GPU Computing, Linux / Bash, LaTeX, Mathematica, Git / GitHub, `curl` / REST APIs (JSON), Parallel Computing (OpenMP/MPI)

## RELEVANT EXPERIENCE

**NSTGRO Visiting Technologist Experience - Jet Propulsion Laboratory** **Summer 2024, 2025, 2026**
- 10-week summer internships in Section 392K/324G: Mission Design and Navigation System Engineering
- **Summer 2026**: Evaluated linear filtering efficacy for Enceladus trajectories by analyzing the evolution of state uncertainty across polar and near-rectilinear halo orbits (NRHOs).
- **Summer 2025**: Discovered a strong relationship between the validity time of the Gaussian assumption and the unscented transform's skewness for low-fidelity astrodynamic systems, which can be used for efficient-yet-accurate hybrid estimation
- **Summer 2024**: Applied non-Gaussian ensemble and grid-based techniques to the state uncertainty propagation of distant prograde orbits in the Saturn-Enceladus system as a proof of concept for outer planetary orbilander estimation and navigation; facilitated efficient communication between JPL's Monte library and C source code via Python wrapper

**Air Force Office of Scientific Research (AFOSR) Summer Faculty Fellowship Program** **July 2023 - September 2023**
- Performed research at the Air Force Maui Optical and Supercomputing (AMOS) site, the 15th Space Surveillance Squadron
- Developed a thorough validation of the landscape of numerical integrators and their respective accuracies relating to the state propagation of cislunar satellites in near-rectilinear halo orbits (NRHOs)
- Used publicly available ephemerides of CAPSTONE to detect orbital-maintenance maneuvers (OMMs) for numerical integration accuracy analysis, specifically comparing REBOUND, ASSIST, and GMAT

**Auger@TA Ultra High Energy Cosmic Ray Detector Simulation Analysis** **August 2021 - May 2022**
- Pierre Auger Observatory, Argentina/Telescope Array, Utah collaboration to calibrate energy detection method variations
- Collected data using Linux Offline simulations with a varying number of photomultiplier tubes to determine if results were similar
- Visualized simulation data on the reliability of a single PMT detector vs. a triple PMT detector via Python
- Principal Investigator: Dr. Frederic Sarazin, Colorado School of Mines Physics Department

**National Science Foundation REU - University of Florida, Astronomy Department** **May 2021 - August 2021**
- Developed and gave presentation on decomposing galactic spectral energy distributions and inferring properties from the simple stellar populations that make up the galaxies
- Utilized Bayesian statistics programming, specifically Markov Chain Monte Carlo to find spectrum best fit for age/metallicity
- Used HiPerGator, UF supercomputer, along with other Python simulation tools and techniques to model galactic behavior
- Principal Investigator: Dr. Paul Torrey, University of Florida Astronomy Department

**UC San Diego MAE143B Linear Control Teaching Assistant** **August 2025 - September 2025**
- Held office hours, developed solutions sets to homeworks and exams, graded homework and exams, and presented in lecture

## HONORS AND AWARDS

- **2026 ASME Graduate Student Video Competition, 1st Place**, "Predicting a Potential Lunar Impact: A Hybrid, Measurement-free Approach to Tracking Asteroid YR4" (March 2026)
- **Student Travel Award for the 2026 SIAM Conference on Uncertainty Quantification**, "A Parallel Grid-based Algorithm for Orbital Uncertainty Propagation" (March 2026)

- **NASA Space Technology Graduate Research Opportunities (NSTGRO) Fellow** (Grant # 80NSSC23K1219), "A Grid-Based Bayesian Approach to Uncertainty Propagation for Icy-Moon Missions" proposal (August 2023 - August 2027)
- **Chambliss Astronomy Achievement Student Award Honorable Mention**, 240th AAS Meeting Presentation on "A Flexible Approach to Fitting Galactic Spectral Energy Distributions" (June 2022)
- **Colorado School of Mines Physics Undergraduate Research Symposium: Best Individual Technical Research Project**, "Optimizing the Selection of Reconstructed Events in Auger@TA for Cross-Calibration Purpose Through Simulations" (April 2022)
- **Colorado School of Mines Dean's List** (August 2018 - May 2022)

## PUBLICATIONS

**Refereed Journal Publications**

[J7] **Hanson, B.L.**, Carton, L., Bewley, T.R., Ely, T.A., Rosengren, A.J.: Hybrid, ephemeris-quality, measurement-free prediction of the potential 2024 YR4 lunar impact. Journal of Astronautical Sciences, **73**(78) (2026), https://doi.org/10.1007/s40295-026-00627-6

[J6] **Hanson, B.L.**, Ely, T.A., Bewley, T.R., Rosengren, A.J.: Bayesian benchmarking of GBEES applied to outer planet orbiter estimation. Journal of Guidance, Control, and Dynamics **49**(1), 240-246 (2026), https://doi.org/10.2514/1.G009146

[J5] **Hanson, B.L.**, Rubio, C., García-Gutiérrez, A., Bewley, T.: GBEES-GPU: An efficient parallel GPU algorithm for high-dimensional nonlinear uncertainty propagation. Computer Physics Communications **317**, 12 (2025), https://doi.org/10.1016/j.cpc.2025.109819

[J4] **Hanson, B.L.**, Zhao, M., Bewley, T.R.: An extensible framework for the probabilistic search of stochastically-moving targets characterized by generalized Gaussian distributions or experimentally-defined regions of interest. Communications in Statistics - Theory and Methods **54**(17), 5480-5505 (2025), https://doi.org/10.1080/03610926.2024.2439999

[J3] Haque, M.A., Maestas, J.R., Zhu, X., **Hanson, B.L.**, Wu, D.T., Wu, N.: High-density and well-aligned hierarchical structures of colloids assembled under orthogonal magnetic and electric fields. ACS Nano (2025), https://doi.org/10.1021/acsnano.4c11957

[J2] Floriano, B.R., **Hanson, B.L.**, Bewley, T., Ishihara, J.Y., Ferreira, H.C.: A novel policy for coordinating a hurricane monitoring system using a swarm of buoyancy-controlled balloons trading off communication and coverage. Engineering Applications of Artificial Intelligence **139**, 109495 (2025), https://doi.org/10.1016/j.engappai.2024.109495

[J1] Zhu, X., Gao, Y., Mhanna, R., Yang, T., **Hanson, B.L.**, Yang, X., Gong, J., Wu, N.: Synthesis and propulsion of magnetic dimers under orthogonally applied electric and magnetic fields. Langmuir **37**, 9151-9161 (2021), https://doi.org/10.1021/acs.langmuir.1c01329

**Submitted Journal Publications**

[S1] **Hanson, B.L.**, Ely, T.A., Bewley, T.R., Rosengren, A.J., "Autonomous Hybrid State Estimation of Circular Restricted Three-Body Periodic Orbits," *Journal of Guidance, Control, and Dynamics*, submitted 09/2026.

**Conference Publications**

[C4] **Hanson, B.L.**, Rosengren, A.J., Bewley, T.R., Ely, T.A.: Gaussianity Validity and Hybrid Estimation in the Circular Restricted Three-Body Problem. In: AAS/AIAA Astrodynamics Specialist Conference (2026)

[C3] **Hanson, B.L.**, Bewley, T.R., Rosengren, A.J.: Autonomous Hybrid State Estimation in the Perturbed Two-Body System. In: 30th International Symposium on Space Flight Dynamics (2026)

[C2] **Hanson, B.L.**, Rosengren, A.J., Bewley, T.R., Ely, T.A.: Non-Gaussian recursive Bayesian filtering for outer planetary orbilander navigation. In: AAS/AIAA Space Flight Mechanics Meeting, p. 194 (2025), https://doi.org/10.13140/RG.2.2.33100.73603

[C1] **Hanson, B.L.**, Rosengren, A.J., Bewley, T.R.: State estimation of chaotic trajectories: A higher-dimensional, grid-based, Bayesian approach to uncertainty propagation. In: AIAA SCITECH 2024 Forum, p. 0426 (2024), https://doi.org/10.2514/6.2024-0426

## SEMINARS AND ABSTRACTS

[P10] *On the efficacy of linear uncertainty propagation for low-probability asteroid impacts*, 7th International Workshop on Key Topics in Orbit Propagation Applied to SSA, Université de Toulon, Toulon, France (May 2026)

[P9] *A Parallel Grid-based Algorithm for Orbital Uncertainty Propagation*, SIAM UQ26: Uncertainty Quantification in Astrodynamics Minisymposium, Minneapolis, Minnesota (March 2026)

[P8] *Efficient Prediction of the Gaussianity Validity Time in the Circular Restricted Three-Body Problem*, COPERNAICUS Seminar, Online (September 2025)

[P7] *GBEES-GPU: An efficient parallel GPU algorithm for high-dimensional nonlinear uncertainty propagation*, Cassyni Computer Physics Seminar Series, https://doi.org/10.52843/cassyni.m84f85 (September 2025)

[P6] *Predicting the Temporal Limits of Gaussianity in the Saturn-Enceladus System with the Unscented Transform*, Jet Propulsion Laboratory, Pasadena, CA (July 2025)

[P5] *Non-Gaussian Recursive Bayesian Filtering for Outer Planetary Orbilander Navigation*, Jet Propulsion Laboratory, Pasadena, CA (August 2024)

[P4] *xGEO Numerical Integrator Analysis and Maneuver Detection*, REBOUND Conference 2024, Online (July 2024)

[P3] *On the Validity of the Gaussian Assumption in the Jovian System: Evaluating Linear and Nonlinear Filters for Measurement-sparse Estimation*, 6th International Workshop on Key Topics in Orbit Propagation Applied to SSA, Universite d'Artois, Arras, France (June 2024)

[P2] *A Flexible Approach to Fitting Galactic Spectral Energy Distributions*, 240th AAS Meeting, Pasadena, CA (June 2022)

[P1] *Synthesis and Assembly of Anisotropic Particles*, Colorado School of Mines Undergraduate Research Symposium, Golden, CO (April 2022)