

JOSHUA ECKELS

PhD Student in Aerospace Engineering

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EXPERIENCE

Computational Autonomy Lab, Ann Arbor, MI
PhD student, 2021-present

- Modeling and integration lead team in NASA's JANUS institute for high-power electric propulsion testing.
- Applied reduced-order modeling and uncertainty quantification with Bayesian/machine learning methods.
- Developed fluid/hybrid particle-in-cell modeling of electrospray ion thrusters and Hall thrusters.

NASA Glenn Research Center, Cleveland, OH
Electric propulsion intern, 2024

- Development of hybrid particle-in-cell models of Hall thruster plume and spacecraft interactions.
- Analysis of transient start-up arcing during vacuum chamber electric propulsion testing.

Tesla, Palo Alto, CA
High-voltage firmware intern, 2021

- Developed Python regression test scripts to validate high-voltage battery firmware.
- Improved and upgraded battery pack testing infrastructure, hardware, software, and automation.

Los Alamos National Laboratory, Los Alamos, NM
R&D engineering intern, 2020

- Improved performance of ultrasonic wavefield imaging software for non-destructive evaluation.
- Developed and automated a new deep learning-based processing method for ultrasonic defect detection.

Assistive Robotics Lab, Blacksburg, VA
Undergraduate researcher, 2019

- Applied computer vision to localize accessibility constraints for assistive path planning and navigation.
- Integrated simultaneous localization and mapping algorithms with new deep learning-based methods.

EDUCATION

University of Michigan, Ann Arbor, MI
PhD in Aerospace Engineering, (expected) 2026

Rose-Hulman Inst. of Technology, Terre Haute, IN
BS in Mechanical Engineering, 2021

SKILLS

	(years)
Python numpy, scipy, kivy, etc.	5+
Open-source linux, vcs, ci/cd, etc.	5+
Scientific computing hpc, mpi, slurm, etc.	3
Other languages Matlab, C, C++, JS, Java	1-2
Finite-element cfd, ansys, plasmas, etc.	1-2
Fabrication cnc, laser cutting, etc.	1

AWARDS

NSTGRO fellowship, 2023
NASA space technology award

R&D100 award, 2022
Los Alamos patented technology

Heminway prize, 2019
Academic award for top of class

RESEARCH

Electric propulsion, predictive models for design, test, and optimization of Hall thrusters

Plasma physics, accelerating kinetic particle-in-cell methods for low-temperature plasmas

Reduced-order modeling, data-driven methods for accelerating complex models

Uncertainty quantification, Bayesian methods for model validation, sensitivity analysis, and experimental design

PEER-REVIEWED PUBLICATIONS

J. Eckels, T. Marks, M. Allen, B. Jorns, and A. Gorodetsky, "Hall thruster model improvement by multidisciplinary uncertainty quantification," *Journal of Electric Propulsion*, vol. 3, no. 19, 2024, doi: [10.1007/s44205-024-00079-w](https://doi.org/10.1007/s44205-024-00079-w).

J. Eckels et al., "Predicting local material thickness from steady-state ultrasonic wavefield measurements using a convolutional neural network," *Ultrasonics*, vol. 123, 2022, doi: [10.1016/j.ultras.2021.106661](https://doi.org/10.1016/j.ultras.2021.106661).

CONFERENCE PRESENTATIONS

J. Eckels et al, "Dynamic mode decomposition for particle-in-cell simulations of a Hall thruster and plume," presented at the 38th International Electric Propulsion Conference, Toulouse, France, 2024.

D. Aksoy, S. Vutukury, T. Marks, **J. Eckels**, and A. Gorodetsky, "Compressed analysis of electric propulsion simulations using low rank tensor networks," presented at the 38th International Electric Propulsion Conference, Toulouse, France, 2024.

J. Eckels et al, "Surrogate-enabled inference of high-dimensional systems through dimension reduction: applications to fluid plasma simulations," presented at the SIAM conference on Uncertainty Quantification, Trieste, Italy, 2024.

M. Allen, T. Marks, **J. Eckels**, A. Gorodetsky, and B. Jorns, "Optimal experimental design for inferring anomalous electron transport in a Hall thruster," presented at the AIAA SciTech 2024 Forum, Orlando, FL, 2024, doi: [10.2514/6.2024-2164](https://doi.org/10.2514/6.2024-2164).

C. Lipscomb, I. Boyd, K. Hansson, **J. Eckels**, and A. Gorodetsky, "Simulation of vacuum chamber pressure distribution with surrogate modeling and uncertainty quantification," presented at the AIAA SciTech 2024 Forum, Orlando, FL, 2024, doi: [10.2514/6.2024-2369](https://doi.org/10.2514/6.2024-2369).

J. Eckels, C. Whittaker, B. Jorns, and A. Gorodetsky, "Optimal experimental design to learn reduced-fidelity models for porous electrosprays," presented at the AIAA SciTech 2023 Forum, National Harbor, MD, 2023, doi: [10.2514/6.2023-0066](https://doi.org/10.2514/6.2023-0066).

J. Eckels et al, "Simulation-based surrogate methodology of electric field for electrospray emitter geometry design and uncertainty quantification," presented at the 37th International Electric Propulsion Conference, Boston, MA, 2022.

C. Whittaker, **J. Eckels**, A. Gorodetsky, and B. Jorns, "A moment-based model of multi-site emission for porous electrosprays," presented at the 37th International Electric Propulsion Conference, Boston, MA, 2022.

M. Allen, **J. Eckels**, M. Byrne, A. Gorodetsky, and B. Jorns, "Application of optimal experimental design to characterize pressure related facility effects in a Hall thruster," presented at the 37th International Electric Propulsion Conference, Boston, MA, 2022.

J. Eckels, I. Fernandez, K. Ho, N. Dervilis, E. Jacobson, and A. Wachtor, "Application of a u-net convolutional neural network to ultrasonic wavefield measurements for defect characterization," presented at the Int. Modal Analysis Conference, 2021, doi: [10.1007/978-3-030-76335-0_18](https://doi.org/10.1007/978-3-030-76335-0_18).

OPEN-SOURCE CONTRIBUTIONS

🐙 [eckelsjd/amisc](#) – Adaptive Multi-Index Stochastic Collocation

Ground-up implementation of an efficient, multidisciplinary surrogate method using sparse grids.

🐙 [eckelsjd/uqtils](#) – Uncertainty quantification utilities

Ground-up implementation of useful tools for uncertainty quantification and Bayesian methods.

🐙 [eckelsjd/copier-numpy](#) – Template repository for Python scientific computing

Customizable template for Python scientific computing numpy-based projects.

🐙 [JANUS-Institute/HallThrusterPEM](#) – Hall thruster predictive modeling

Ground-up implementation of a predictive engineering model for a Hall thruster.

🐙 [UM-PEPL/Hallthruster.jl](#) – 1d fluid simulation of a Hall thruster

Small code contributions and extensive stress testing and automation of built-in modules.