Nick LaFarge

Astrodynamics Researcher | Software Engineer

CONTACT

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SUMMARY

- Diverse skills in astrodynamics, autonomy, trajectory design, machine learning, and GN&C.
- Experienced software engineer, passion for numerical methods.
- PhD candidate in aeronautical and astronautical engineering.

DISTINCTIONS

NASA Space Technology Research Fellowship (NSTRF/NSTGRO)
2019 - 2023
For "graduate students who show significant potential to contribute to NASA's goal of creating innovative new space technologies."

NASA Pathways Intern Award
Fall 2018
Awarded for outstanding work at NASA Johnson Space Center on LIDAR retroreflector identification and pattern generation for Orion.

PROGRAMMING

Python	Expert
Matlab	Advanced
Java	Advanced
C++	Intermediate
Julia	Intermediate

EDUCATION

Ph.D. - Aeronautics & Astronautics Engineering   *Exp. May 2023*
Purdue University - West Lafayette (IN)   *GPA: 4.0/4.0*

- NASA Space Technology Research Fellow (NSTRF/NSTGRO).
- Major area: Astrodynamics, Advisor: Prof. Kathleen Howell.

  Research title: *"Reinforcement Learning Approaches for Autonomous Guidance and Control in a Low-Thrust, Multi-Body Dynamical Environment."*

M.S. - Aeronautics & Astronautics Engineering   *May 2020*
Purdue University - West Lafayette (IN)   *GPA: 3.74/4.0*

- Major area: Astrodynamics, Advisor: Prof. Kathleen Howell.

B.A. - Mathematics (Computational) and Japanese   *May 2014*
University of Colorado Boulder - Boulder (CO)

- Minor in computer science, academic year (2011-12) in Osaka, Japan.

WORK EXPERIENCE

Graduate Pathways Intern   *2018 - Present*
NASA Johnson Space Center, Houston (TX)

3x returning intern: GN&C Autonomous Flight Systems Branch

- Collaborated with flight software team in investigating anomalous trajectory targeting behavior for Orion.   *Summer 2021*
- Developed prototype flight software for **state estimation** for Orion. Integrated component into docking simulation.   *Summer 2019*
- Implemented a distributed **optimization** library in Julia for LIDAR retroreflector pattern generation for Orion prox. ops.   *Fall 2018*

Flight Path Control Intern   *Summer 2017*
NASA Jet Propulsion Laboratory, Pasadena (CA)

- Developed an automated **trajectory design** tool for multi-body orbits and introduced a novel tree partitioning approach for Poincaré maps.
- Supported **Monte development** for multi-body mission design.

Founder / Software Engineer   *2015 - 2017*
TookTech LLC, Boulder (CO)

- Led Android app development for OpenSnow meteorologist team, helping client surpass **20,000 active** Android users.
- Supported client business growth via **creative custom software** solutions within an allocated budget.

Software Engineer   *2014 - 2016*
Amadeus Consulting, Boulder (CO)

- Built custom software for **numerous stakeholders** in Java and Python.
- Engineered data science solutions for Google and VidVita, supporting **cloud computing**, web scraping, and data analytics tools.

FOREIGN LANGUAGE

English	Native
Japanese	Intermediate
Spanish	Beginner
Latvian	Beginner

Activities

Journal Peer Reviewer

2020, 2022

Acta Astronautica and the Journal of Spacecraft and Rockets.

Conference Session Chair at the AIAA SciTech Forum

Jan. 2022

Session: AI and Machine Learning for Astrodynamics.

Private Pilot License

July 2013

Airplane single engine land license.

Speech Contest: 1st place

2013, Colorado/Wyoming

Japanese speech contest: entered top non-native category.

CAMPUS INVOLVEMENT

Multi-body dynamics research group member

2017 - Present

Activities: weekly presentations, providing feedback to peers on multi-body dynamics research, mentorship to graduate students.

Graduate teaching assistant

Spring 2019

Managed virtual lab development with the Purdue innovation center (AAE 204, AAE 352).

Grader (Graduate aerospace)

Fall 2017, Spring 2018

Graded student homework for graduate orbital mechanics and attitude dynamics courses.

RESEARCH EXPERIENCE

Graduate Researcher *2016 - Present*
Purdue University, West Lafayette (IN)

- Introduced novel onboard guidance and control techniques for low-thrust spacecraft under **multi-body dynamics** via machine learning.
- **Managed inter-university project** for 3 years between Purdue & MIT.
- Implemented research on MIT's **high-performance computing** cluster.
- Created a **C++ package** for trajectory propagation in Python/Matlab.
- **Presented research** at four international conferences.

Visiting Technologist (NSTRF/NSTGRO) *2020 - 2022*
NASA Goddard Space Flight Center, Greenbelt (MD)

3x returning technologist: Navigation and Mission Design Branch

- Consulted with mission design engineers to apply research in higher-fidelity **maneuver planning** simulation. *Summer 2022*
- Spearheaded investigation into autonomous low-thrust maneuver planning for multi-body orbit **stationkeeping**. *Winter 2021*
- **Led research team** in evaluating reinforcement learning efficacy for low-thrust guidance and control in cislunar space. *Summer 2020*

TECHNICAL SKILLS

- **Specialties**: High-performance scientific computing, data visualization.
- **Software engineering**: Agile development, code review, debugging.
- **Programming**: Object-oriented design, parallel processing.
- **Communication**: Technical presenting & writing, LaTeX (expert).
- **Tools & Platforms**: Version control (git), Linux, SQL, Android development.

PUBLICATIONS

JOURNAL PUBLICATIONS

- **LaFarge, N. B.**, Miller, D., Howell, K. C., & Linares, R., "Autonomous Closed-Loop Guidance using Reinforcement Learning in a Low-Thrust, Multi-Body Dynamical Environment". *Acta Astronautica*, vol. 186, 1–23, 2021.

CONFERENCE PUBLICATIONS

- **LaFarge, N. B.**, Howell, K. C., and Folta, D. C., "Adaptive Closed-Loop Maneuver Planning for Low-Thrust Spacecraft using Reinforcement Learning", *International Astronautical Congress*, Paris, France, 2022.
- **LaFarge, N. B.**, Howell, K. C., and Folta, D. C., "An Autonomous Stationkeeping Strategy for Multi-Body Orbits Leveraging Reinforcement Learning," *AIAA SciTech Forum*, San Diego, CA, 2022.
- **LaFarge, N. B.**, Howell, K. C., and Linares, R., "A Hybrid Closed-Loop Guidance Strategy for Low-Thrust Spacecraft Enabled by Neural Networks," *AAS Spaceflight Mechanics Meeting*, Charlotte, NC (Virtual), 2021.
- **LaFarge, N. B.**, Miller, D., Howell, K. C., and Linares, R., "Guidance for Closed-Loop Transfers using Reinforcement Learning with Application to Libration Point Orbits," *AIAA SciTech Forum*, Orlando, FL, 2020.