Nick LaFarge

Mission Design Enginer

CONTACT

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nick-lafarge

Nicholas-Lafarge

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SUMMARY

- Experienced in trajectory design, orbital mechanics, numerical methods, and autonomous GN&C
- Technical communication and project leadership skills

DISTINCTIONS

NASA Space Technology Research Fellowship (NSTRF/NSTGRO)

Aug. 2019 - May 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

ASTRONAUTICAL ENGINEERING EXPERIENCE

Mission Design Engineer ***Jun. 2023 - Present***
Johns Hopkins Applied Physics Laboratory (APL) *Laurel, MD*
- Supporting civil space missions through trajectory design and numerical simulation in the Astrodynamics and Control Systems Group (SAC)

Graduate Pathways Intern ***Aug. 2018 - May 2023***
NASA Johnson Space Center *Houston, TX*

3x returning: GN&C Autonomous Flight Systems Branch (EG6)

- Collaborated with flight software team in investigating anomalous **trajectory targeting** behavior for Orion *Summer 2021*
- Implemented prototype **flight software** supporting state estimation, integrated module into **navigation simulation** *Summer 2019*
- Developed Orion's LIDAR retroreflector pattern generation and identification algorithm for onboard **relative navigation** *Fall 2018*

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

3x returning: Navigation and Mission Design Branch (Code 595)

- Applied research to NRHO **low-thrust maneuver planning** based on the conceptual NRHO segment of Lunar IceCube *Summer 2022*
- Spearheaded investigation into autonomous low-thrust maneuver planning for multi-body orbit **stationkeeping** *Winter 2021*
- Led research investigation into neural network efficacy for autonomous **cislunar G&C** given operational constraints *Summer 2020*

Mission Design & Navigation Intern (392C) ***May 2017 - Jul. 2017***
NASA Jet Propulsion Laboratory (JPL) *Pasadena, CA*
- Developed prototype for an interactive **multi-body trajectory design** tool in **Monte** (`monte.poincare`) to connect orbits in three-body systems
- Formulated an automated method for **libration point orbit transfers** using high-dimensional tree structures with Poincaré maps

EDUCATION

PhD - Aeronautics & Astronautics Engineering ***Exp. May 2023***
Purdue University *West Lafayette, IN*
- Advisor: Prof. Kathleen Howell, GPA: 4.0/4.0.
- Dissertation: *"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*
- Advisor: Prof. Kathleen Howell, GPA: 3.74/4.0 Thesis: *"Autonomous Guidance for Multi-Body Orbit Transfers using Reinforcement Learning"*

B.A. - Mathematics (Computational) and Japanese ***Aug. 2014***
University of Colorado Boulder *Boulder, CO*
- Minor in computer science, academic year (2011-12) in Osaka, Japan, GPA: 3.56/4.0

TECHNICAL SKILLS

Software Engineering
- Version control (git)
- Unit testing
- Object-oriented architecture
- Agile development

Numerical Computing
- High-performance simulation
- Distributed computing

Communication
- LaTeX (expert)
- Technical writing
- Public speaking/presenting

Tools & Platforms
- Unix systems (Linux & macOS)
- Android app development
- Build systems (CMake, Python)

FAA Licensed Private Pilot
- Airplane single engine land (2018)

ACADEMIC ACTIVITIES

Journal Peer Reviewer
Acta Astronautica (2020), Journal of Spacecraft and Rockets (2022), Journal of Guidance, Control, and Dynamics (2023)

Conference Session Chair
2022 AIAA SciTech Forum. *AI and Machine Learning for Astrodynamics*

CAMPUS INVOLVEMENT

Graduate Teaching Assistant
Spring 2019
Managed virtual lab development with the Purdue innovation center.

Grader (Graduate Aerospace)
Fall 2017, Spring 2018
Graded homework for orbital mechanics & attitude dynamics

FOREIGN LANGUAGE

English	Native
Japanese	Proficient
Spanish	Beginner
Latvian	Basic

SOFTWARE ENGINEERING EXPERIENCE

Founder / Software Engineer ***Sep. 2015 - Jul. 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 ***Nov. 2014 - Feb. 2016***
Amadeus Consulting *Boulder, CO*
- Built custom software for **numerous stakeholders** in Java and Python
- Engineered **data analytics** tools for Google, supporting cloud computing, web scraping, and API management
- Participated in **agile software development** cycles with git version control, object-oriented architecture, unit testing, and continuous integration

GRADUATE RESEARCH EXPERIENCE

- Researching novel onboard guidance and control techniques for low-thrust spacecraft under **multi-body dynamics** via machine learning
- Providing regular feedback on **advanced trajectory design** techniques to the Multi-Body Dynamics Research Group at Purdue
- Implemented research on MIT's **high-performance computing** cluster with efficient C++/Python interfacing

PROJECT MANAGEMENT EXPERIENCE

- **Managed inter-university project** for three years between Purdue and the ARCLab at MIT (2017-2020)
- Leading a **10-person team** and overseeing development of Purdue-led open-source software: forest (fast orbital environment simulation toolkit)

JOURNAL AND CONFERENCE PUBLICATIONS

- **LaFarge, N. B.**, Howell, K. C., and Folta, D. C., "Adaptive Closed-Loop Maneuver Planning for Low-Thrust Spacecraft using Reinforcement Learning". *Acta Astronautica*, Vol. 211, Oct. 2023, pp. 142-154
- **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, 2021
- **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