Keidai Iiyama

kiiyama@stanford.edu | https://www.linkedin.com/in/keidai-iiyama/ |
https://kdricemt.github.io/ | U.S. Permanent Resident

Education

Stanford University Sep. 2021 – June. 2026
Ph.D Candidate - Aeronautics and Astronautics Stanford, CA

- **Thesis**: Design and Algorithms for Lunar Navigation Satellite System (Advisor: Grace Gao) **GPA**: 4.1/4.3

The University of Tokyo Apr. 2019 – Mar. 2021
Master of Engineering - Aeronautics and Astronautics Tokyo, Japan

- **Thesis**: System Design and Autonomous Orbit Determination Strategy for Lunar Navigation Satellite System **GPA**: 4.0/4.0

The University of Tokyo Apr. 2015 – Mar. 2019
Bachelor of Engineering - Aeronautics and Astronautics Tokyo, Japan

- **Thesis**: Navigation Satellite Constellation and Monitoring Station Arrangement for Lunar GNSS **GPA**: 3.5/4.0

Research and Engineering Experience

Navigation and Autonomous Vehicles (NAV) Lab, Stanford University Sep. 2021 – Present
Graduate Research Assistant (Advisor: Prof. Grace Gao) Stanford, CA

- Developed positioning and timing algorithms for lunar satellites and rovers using terrestrial GPS time-differenced carrier phase (TDCP) measurements, achieving meter-level positioning and sub-mm/s velocity accuracy in high-fidelity Monte-Carlo simulations
- Proposed almanac and ephemeris representations for lunar navigation satellites balancing data size and accuracy
- Designed autonomous clock jump detection algorithms for satellite constellations using inter-satellite links and rigid graph theory
- Analyzed trade spaces for lunar GPS constellation design (coverage, DOP, insertion ΔV) and staged deployment strategies
- Designed ray-tracing algorithms to simulate plasmaspheric delays on GNSS signals received at lunar distances with Global Core Plasma Model (GCPM)
- Developed an open-source simulator (LuPNT) in C++/Python for lunar positioning, navigation, and timing

Jet Propulsion Laboratory (332H), California Institute of Technology Jul. 2024 – Sep. 2024
Visiting Researcher (Advisors: Dr. Kar-Ming Cheung, Dr. William W. Jun) Pasadena, CA

- Designed a Mars satellite constellation architecture for communication and positioning, navigation, and timing (PNT)
- Proposed an orbit determination and time synchronization algorithm combining inter-satellite links and surface station links

ArkEdge Space
Research Consulting Remote and Tokyo, Japan

- Research consulting for the conceptual design of the Lunar Navigation Satellite System (LNSS) for a contract with JAXA

Space Rendezvous Laboratory, Stanford University Sep. 2021 – May 2022
Graduate Research Assistant (Advisor: Prof. Simone D'Amico) Stanford, CA

- Developed angles-only navigation algorithm for spacecraft swarms in lunar orbits as potential extension to NASA Starling Mission

Space Systems Optimization Group, Georgia Institute of Technology 2020
Research Collaboration (Collaborator: Prof. Koki Ho) Remote

- Designed guidance, navigation, and control algorithms integrating autoencoders, deep reinforcement learning, and feedback control for autonomous powered descent and safe landing site selection using LiDAR DEM observations

Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (JAXA) Oct. 2017 – Aug. 2021
Assistant Researcher Tokyo, Japan

- Implemented flight software for thermal subsystem and water-based propulsion unit of EQUULEUS, a 6U CubeSat lunar mission selected as a secondary payload of NASA Artemis I (EM-1), achieving successful lunar flyby with water-based propulsion
- Organized system-level trade-offs for the conceptual design of OPENS-0, a Smallsat mission to explore Saturn's ring system

Intelligent Space Systems Laboratory, The University of Tokyo Apr. 2018 – Aug. 2021
Graduate Researcher (Advisor: Prof. Ryu Funase) Tokyo, Japan

- Designed a decentralized autonomous orbit determination and clock offset estimation algorithm for lunar navigation satellites using crosslinks and a Schmidt Kalman filter
- Conducted performance analyses across constellation designs and lunar ground station configurations

Selected Awards and Fellowships

3x Best Presentation of the Session at ION GNSS+ Conference Sep. 2025, 2024, 2023
Institute of Navigation

- 2025: *Ionospheric and Plasmaspheric Delay Characterization and Mitigation Methodologies for Lunar Terrestrial GNSS Receivers*
- 2024: *Autonomous Constellation Fault Monitoring with Inter-satellite Links: A Rigidity-Based Approach*
- 2023: *Satellite Ephemeris Approximation Methods to Support Lunar Positioning, Navigation, and Timing Services*

Lunar Autonomy Challenge Top Prize May 2025
NASA, Applied Physics Laboratory (Awarded top prize among 31 competing teams, News)

Doctoral Studying Abroad Fellowship Sep. 2021 – Jun. 2026
Nakajima Foundation

Selected Publications

Out of 9 Journal Papers (6 Under Review), 23 Conference Proceedings, and 1 Magazine Article.
Full list available at my personal website or Google Scholar

- **Iiyama, K.**, and Gao, G., "GNSS-based Lunar Orbit and Clock Estimation With Stochastic Cloning UD Filter", Submitted to Journal of Guidance, Control, and Dynamics, Under Review, https://doi.org/10.48550/arXiv.2601.16393
- **Iiyama, K**., and Gao, G., "Ephemeris and Almanac Design for Lunar Navigation Satellites", Submitted to IEEE Transactions on Aerospace and Electronic Systems, Under Review, https://doi.org/10.48550/arXiv.2510.25161
- **Iiyama, K**., and Gao, G., "Ionospheric and Plasmaspheric Delay Characterization for Lunar Terrestrial GNSS Receivers with Global Core Plasma Model", Submitted to NAVIGATION: Journal of the Institute of Navigation, Under Review https://doi.org/10.48550/arXiv.2510.10059
- **Iiyama, K**., and Gao, G., "Trade-off Analysis for Lunar Augmented Navigation Service (LANS) Constellation Design", Submitted to NAVIGATION: Journal of the Institute of Navigation, Under Review, https://doi.org/10.48550/arXiv.2510.16030
- **Iiyama, K**., Jun, W.W., Bhamidipati, S., Gao, G., Cheung, K.-M., "Orbit Determination and Time Synchronization for the Future Mars Relay and Navigation Constellation", 2025 IEEE Aerospace Conference, Big Sky, MT, 2025, https://doi.org/10.1109/AERO63441.2025.11068793
- **Iiyama, K**., Bhamidipati, S., and Gao, G., "Precise Positioning and Timekeeping in Lunar Orbit via Terrestrial GPS Time-Differenced Carrier-Phase Measurements", NAVIGATION: Journal of the Institute of Navigation, Vol. 71, Issue 1, 2024 https://doi.org/10.33012/navi.635

Teaching and Mentoring Experience

Co-Instructor Spring 2026 (Upcoming)
AA278: Lunar Positioning, Navigation, and Timing, Stanford University

Course Assistant
AA272: Global Positioning Systems (Stanford University, 2024, 2025), Orbital Mechanics (UTokyo, 2019)

Research Mentorship
Mentored 7 Ph.D. and Masters students at Stanford University

Skills

Languages :English (Fluent), Japanese (Native)

Programming Languages : Python, C++, C, Matlab, Fortran
Spacecraft Navigation and Estimation :Orbit determination and time synchronization (ODTS), EKF, UKF, UD-KF, SRIF, Schmidt KF, batch-least-squares, Kalman-smoothing, factor graphs, GNSS modeling, spacecraft dynamics modeling, Chi-squared Test
Mission Analysis : General Mission Analytics Tool (GMAT), SPICE Toolkit, pykep, pygmo
AI, Optimization : Pytorch, PyG, OpenAI Gym, CVXPY, Gurobi, SNOPT, GTSAM
Others : Linux, Bash, Microcontrollers (Raspberry Pi, H8), Git, LaTeX, CMake, pybind11, React, Jekyll, Excel

Leadership :ION GNSS+ 2026 Session Chair for "Cislunar, Lunar, and Martian Positioning, Navigation, and Timing (Upcoming)", Thermal Subteam lead for EQUULEUS Project, Lunar PNT Research Subgroup Lead at Stanford NAVLab
Peer Review :IEEE Transaction on Aerospace and Electronic Systems, NAVIGATION: Journal of the Institute of Navigation

Hobbies :Badminton (>15 years, played in national tournament as a member of Stanford Badminton Team), Running, Hiking, Reading