

# Keidai Iiyama

PHD CANDIDATE · STANFORD AERONAUTICS AND ASTRONAUTICS

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## Education

### Stanford University

PHD CANDIDATE - AERONAUTICS AND ASTRONAUTICS

Stanford, CA

2021.9 - present

- GPA: 4.13/4.30
- Research Area: Positioning, Navigation, and Timing of Lunar Satellites (Advisor: Grace Gao)

### The University of Tokyo

ME - AERONAUTICS AND ASTRONAUTICS

Tokyo, Japan

2019.4 - 2021.3

- GPA: 4.00/4.00
- Thesis: System Design and Autonomous Orbit Determination Strategy for Lunar Navigation Satellite System (Advisor: Ryu Funase)

### The University of Tokyo

BE - AERONAUTICS AND ASTRONAUTICS

Tokyo, Japan

2015.4 - 2019.3

- GPA: 3.53/4.00
- Thesis: Navigation Satellite Constellation and Monitoring Station Arrangement for Lunar Global Navigation Satellite System (Advisor: Ryu Funase)

## Awards, Fellowships, & Grants

### AWARDS

- |        |  |
|--------|--|
| 2024.9 | ION GNSS+ 2024 Best Presentation of the Session (as first-author), for the paper (C17) |
| 2023.9 | ION GNSS+ 2023 Best Presentation of the Session (as co-author), for the paper (C12)    |

### FELLOWSHIPS & GRANTS

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|-----------------|--|
| 2022.1          | Student Registration Grant, 2022 ION ITM Conference              |
| 2021.9 - 2022.8 | Ph.D. Student Fellowship, Stanford Aero/Astro Department         |
| 2021.9 - 2025.8 | Nakajima Foundation Study Abroad Fellowship, Nakajima Foundation |
| 2019.9 - 2021.8 | WINGS CFS Fellowship, WINGS CFS, The University of Tokyo         |

## Research Experience

### Navigation and Autonomous Vehicles (NAV) Lab, Stanford University

Stanford, CA

ADVISOR: PROF. GRACE GAO

Sep, 2021 - Present

- Developed Diffusion Kalman Filter framework for time transfer from terrestrial GPS to lunar surface communication networks (C9)
- Developed a positioning and timing algorithm of lunar rovers and satellites using terrestrial GPS time-differenced carrier phase (TDCP) measurements (J2), (C10), (C11), (C13)
- Developed an open-source simulator for lunar positioning, navigation, and timing (C14)(C19)
- Developed ephemeris optimization framework for lunar navigation satellites (C12)(J3)
- Developed Distributed orbit determination and timing framework for satellite networks using covariance intersection (C16)
- Developed an autonomous fault detection algorithm for satellite constellation using inter-satellite links and rigid graphs (C17)

### Section 332H, Jet Propulsion Laboratory

Pasadena, CA

ADVISOR: DR. KAR-MING CHEUNG, DR. WILLIAM W. JUN

Jul, 2024 - Sep, 2024

- Constellation design for future communication + PNT constellation around Mars
- Developed an orbit determination and time synchronization frameworks that combines inter-satellite link and surface station link
- Related Publications: (C18)

### Space Rendezvous Lab, Stanford University

Stanford, CA

ADVISOR: PROF. SIMONE D'AMICO

Sep, 2021 - May, 2022

- Developed an angles-only navigation framework for spacecraft swarms in lunar orbits
- Related Publications: (C8)

## Space Systems Optimization Group, Georgia Institute of Technology

Atlanta, GA

ADVISOR: PROF.KOKI HO

Jan, 2021 - Feb, 2021

- Developed an autoencoder + deep reinforcement learning + feedback controller framework that autonomously selects safe landing target site and plans divert maneuver from Lidar DEM observations during powered descent to planetary bodies.
- Related Publications: (C5), (C6)

## Intelligent Space Systems Laboratory, The University of Tokyo

Bunkyo-Ku, Tokyo, Japan

ADVISOR: PROF. RYU FUNASE

Apr, 2018 - Aug, 2021

- Developed decentralized autonomous orbit determination and clock offset estimation algorithm for LNSS navigation satellites connected by crosslinks using a Schmidt Kalman Filter.
- Implemented a user positioning simulator for LNSS. Conducted positioning performance analysis for several constellations and lunar monitoring station arrangement patterns.
- Related Publications: (C3), (C7)

## EQUULEUS Project Team

ADVISOR: PROF.RYU FUNASE

Oct, 2017 - Aug, 2021

- EQUULEUS is a 6U cubesat lunar mission jointly proposed by JAXA and the University of Tokyo to NASA. It is selected as the secondary payload of the EM-1 Mission (First flight of NASA's Space Launch System (SLS))
- Designed and Implemented flight software for heater control and FDIR of the thermal sub-system.
- Contributed on environment tests and result analysis with MATLAB and Thermal Desktop.
- Related Publications: (J1), (C1), (C2), (C4)

## Publications

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### JOURNAL PAPERS

- |      |  |
|------|--|
| 2024 | (J3) Cortinovis, M., <b>Iiyama, K.</b> , and Gao, G., "Satellite Ephemeris Parameterization Methods to Support Lunar Positioning, Navigation, and Timing Services", Navigation: Journal of the Institute of Navigation, Vol. 71, Issue 4, 2024, <a href="https://doi.org/10.33012/navi.664">https://doi.org/10.33012/navi.664</a>          |
|      | (J2) <b>Iiyama, K.</b> , 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, <a href="https://doi.org/10.33012/navi.635">https://doi.org/10.33012/navi.635</a> |
| 2020 | (J1) Funase, R., Ikari, S., Miyoshi, K., et al., ( <b>as 20th author</b> ) "Mission to Earth-Moon Lagrange Point by a 6U CubeSat: EQUULEUS", IEEE Aerospace & Electro. Systems Magazine, Vol.35, No.3, pp.30-44, 2020, <a href="https://doi.org/10.1109/MAES.2019.2955577">https://doi.org/10.1109/MAES.2019.2955577</a>                   |

### CONFERENCE PROCEEDINGS \*: Equal Contribution

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|------|--|
| 2025 | (C19) Vila, G.C., <b>Iiyama, K.</b> , and Gao, G., "LuPNT: An Open-Source Simulator for Lunar Communications, Positioning, Navigation, and Timing", 2025 IEEE Aerospace Conference (AERO), Big Sky, MT, March 2025 (Abstract Accepted)   |
|      | (C18) <b>Iiyama, K.</b> , 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 (AERO), Big Sky, MT, March 2025 (Abstract Accepted)                        |
| 2024 | (C17) <b>Iiyama, K.</b> , and Gao, G., "Autonomous Constellation Fault Monitoring with Inter-satellite Links: A Rigidity-Based Approach", Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2024), Baltimore, MD, September 2024, <b>Best Presentation of the Session</b> |
|      | (C16) <b>*Iiyama, K.</b> , *Vila, G.C., and Gao, G., "Contact Plan Optimization and Distributed State Estimation for Delay Tolerant Satellite Networks", 2024 IEEE Aerospace Conference (AERO), Big Sky, MT, March 2024  |
| 2023 | (C15) *Shimane, Y., and <b>*Iiyama, K.</b> , "Methods for Dual-Objective High Energy Tour Design", 2023 AAS/AIAA Astrodynamics Specialist Conference, Big Sky, MT, 2023  |

	<p>(C14) <b>*Iiyama, K.</b>, *Vila, G.C., and Gao,G., "LuPNT: Open-Source Simulator for Lunar Positioning, Navigation, and Timing", Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2023), Denver, CO, September 2023</p> <p>(C13) <b>Iiyama, K.</b>, and Gao,G., "Positioning and Timing of Distributed Lunar Satellites via Terrestrial GPS Differential Carrier Phase Measurements", Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2023), Denver, CO, September, 2023</p> <p>(C12) Cortinovis,M., <b>Iiyama,K.</b>, and Gao,G., "Satellite Ephemeris Approximation Methods to Support Lunar Positioning, Navigation, and Timing Services", Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2023), Denver, CO, September, 2023, <b>Best Presentation of the Session</b></p> <p>(C11) <b>Iiyama, K.</b>, Bhamidipati,S., and Gao,G., "Terrestrial GPS Time-Differenced Carrier-Phase Positioning of Lunar Surface Users", 2023 IEEE Aerospace Conference (AERO), Big Sky, MT, March, 2023</p> <p>(C10) <b>Iiyama, K.</b>, Bhamidipati,S., and Gao,G., "Precise Positioning and Timekeeping in Lunar Orbit via Terrestrial GPS Time-Differenced Carrier-Phase Measurements", Proceedings of the 2023 International Technical Meeting of The Institute of Navigation, Long Beach, CA, January, 2023</p>
2022	<p>(C9) Bhamidipati,S., <b>*Iiyama, K.</b>, *Mina,T ., and Gao,G., "Time-Transfer from Terrestrial GPS for Distributed Lunar Surface Communication Networks", 2022 IEEE Aerospace Conference (AERO), Big Sky, MT, March, 2022.</p> <p>(C8) <b>Iiyama, K.</b>, Kruger, J., and D'Amico, S., "Autonomous Distributed Angles-Only Navigation and Timekeeping in Lunar Orbit", Proceedings of the 2023 International Technical Meeting of The Institute of Navigation, Long Beach, CA, January, 2022, <b>Student Registration Grant</b></p>
2021	<p>(C7) <b>Iiyama, K.</b> and Funase, R., "Autonomous and Decentralized Orbit Determination and Clock Offset Estimation of Lunar Navigation Satellites Using GPS Signals and Inter-satellite Ranging", Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2021), St.Louis, MO, USA, September, 2021)</p>
2020	<p>(C6) Tomita, K., Skinner, K., <b>Iiyama, K.</b>, Jagatia, B.A., Nakagawa, T., and Ho, K., "Real-Time Terrain Mapping and Processing for Safe Landing via Deep Neural Networks", ASCEND, Las Vegas, NV, 2020</p> <p>(C5) <b>Iiyama,K.</b>, Tomita,K., Jagatia,B.A., Nakagawa,T., and Ho,K., "Deep Reinforcement Learning for Safe Landing Site Selection with Concurrent Consideration of Divert Maneuver", 2020 AAS/AIAA Astrodynamics Specialist Conference, Online, August, 2020</p> <p>(C4) Shibukawa, T., Matsushita, S., <b>Iiyama, K.</b>, Ishikawa, A., Nishii, K., and Funase, R. "Flight Model Thermal Design and Validation for a 6U Deep Space Cubesat EQUULEUS", 50th International Conference on Environmental Systems, Lisbon, Portugal, July, 2020. (conference postponed)</p>
2019	<p>(C3) <b>Iiyama,K.</b>, "Optimization of the Navigation Satellite Constellation and Lunar Monitoring Station for Lunar Global Navigation Satellite System", 32nd International Symposium on Space Technology and Science, Fukui, Japan, j-20s, June, 2019</p> <p>(C2) Matsushita, S., Shibukawa, T., <b>Iiyama, K.</b>, and Funase, R., "Thermal Design and Validation for a 6U Cubesat EQUULEUS under Constraints Tightly Coupled with Orbital Design and Water Propulsion System", 49th International Conference on Environmental Systems, Bostion, MA, The United States, July, 2019.</p> <p>(C1) Shibukawa, T., Matsushita, S., <b>Iiyama, K.</b>, and Funase, R., "Reflection and Verification of Thermal Design under Tightly-Coupled Constraints to the 6U Deep Space CubeSat EQUULEUS", 32nd International Symposium on Space Technology and Science, Fukui, Japan, June, 2019.</p>

## Teaching Experience

Fall 2024	<b>AA272: Global Positioning Systems</b> , taught by Prof. Grace Gao, Graduate Teaching Assistant, Stanford University
Fall 2019	<b>Astrodynamics (Undergraduate course)</b> , taught by Prof.Ryu Funase, Graduate Teaching Assistant, The University of Tokyo

## Mentoring

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2024.9-Current	<b>Kaila Coimbra</b> , Ph.D. Student, Stanford University
2023.1-Current	<b>Guillem Casadesus Vila</b> , Ph.D. Student, Stanford University
2023.1-2024.9	<b>Marta Cortinovia</b> , Ph.D. Student, Stanford University
2022.9-2023.3	<b>Guillem Rueda Oller</b> , Ph.D. Student, Stanford University

## Miscellaneous

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### LANGUAGE

English (Fluent), Japanese (Native)

### SOFTWARE SKILLS

**Programming Language:** C, C++, Python, MATLAB   **Version Control:** Git, Subversion   **Web:** React, Jekyll

**Astrodynamics:** GMAT, SPICE Toolbox, jTOP (spacecraft trajectory design software)   **Engineering:** Thermal Desktop, Autodesk

**Optimization:** CVXPY, SNOPT   **Machine Learning:** Pytorch, Open AI Gym

### PROFESSIONAL MEMBERSHIPS

AIAA, ION