

Keidai Iiyama

PHD CANDIDATE · STANFORD AERONAUTICS AND ASTRONAUTICS

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Education

Stanford University

Stanford, California

PHD CANDIDATE - AERONAUTICS AND ASTRONAUTICS

2021.9 - present

- Research Area: Lunar Positioning, Navigation, and Timing (Advisor: Grace Gao)

The University of Tokyo

Tokyo, Japan

ME - AERONAUTICS AND ASTRONAUTICS

2019.4 - 2021.3

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

The University of Tokyo

Tokyo, Japan

BE - AERONAUTICS AND ASTRONAUTICS

2015.4 - 2019.3

- 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+ 2025 Best Presentation of the Session (as first-author), for the paper (C23) |
| 2024.9 | ION GNSS+ 2024 Best Presentation of the Session (as first-author), for the paper (C18) |
| 2023.9 | ION GNSS+ 2023 Best Presentation of the Session (as second-author), for the paper (C13) |

FELLOWSHIPS & GRANTS

- | | |
|-----------------|--|
| 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

- Designed distributed time transfer algorithm from terrestrial GPS to lunar surface communication networks (C9)
- Designed Positioning and timing algorithm of lunar satellites and rovers using terrestrial GPS time-differenced carrier phase (TDCP) measurements (J2), (C11), (C12), (C14)
- Developed pen-source simulator for lunar positioning, navigation, and timing (C15)(C20)
- Proposed satellite ephemeris optimization algorithms for lunar orbits (C13)(J3)
- Created distributed orbit determination and timing framework for satellite networks using covariance intersection (C17)
- Designed autonomous fault detection algorithm for satellite constellation using inter-satellite links and rigid graphs (C18)
- Proposed staged development algorithm for lunar navigation satellite constellations (C22)
- Analyzed plasmaspheric delays on GNSS signals received at lunar orbit and surface (C23)

Jet Propulsion Laboratory (332H), California Institute of Technology

Pasadena, CA

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

Jul, 2024 - Sep, 2024

- Designed Mars constellation for communication and PNT
- Proposed orbit determination and time synchronization algorithm that combines inter-satellite link and surface station link
- Related Publications: (C19)

Space Rendezvous Lab, Stanford University

Stanford, CA

ADVISOR: PROF. SIMONE D'AMICO

Sep, 2021 - May, 2022

- Created angles-only navigation algorithm for spacecraft swarms in lunar orbits
- Related Publications: (C8)

Space Systems Optimization Group, Georgia Institute of Technology (Research Collaboration)

COLLABORATOR: PROF. KOKI HO

2020

- Designed guidance, navigation, and control algorithm that combines autoencoder, deep reinforcement learning, and feedback controller that autonomously selects a safe landing target site and plans a 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

- Designed decentralized autonomous orbit determination and clock offset estimation algorithm for lunar navigation satellites connected by crosslinks using a Schmidt-Kalman filter.
- Developed a user positioning simulator for a lunar navigation satellite system. 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. It was selected as the secondary payload of the EM-1 Mission and achieved a successful lunar flyby.
- Designed and implemented flight software to control heaters and detect faults of the thermal sub-system.
- Related Publications: (J1), (C1), (C2), (C4)

Publications

ARTICLES UNDER REVIEW

(J4) **Iiyama, K.**, Neamati, D., and Gao, G., “Satellite Autonomous Clock Fault Monitoring with Inter-Satellite Ranges Using Euclidean Distance Matrices”, Navigation: Journal of the Institute of Navigation, Under Review

JOURNAL PAPERS

(J3) Cortinovis, M., **Iiyama, K.**, 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, <https://doi.org/10.33012/navi.664>

(J2) **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>

(J1) Funase, R., Ikari, S., Miyoshi, K., Kawabata, Y., Nakajima, S., Nomura, S., Funabiki, N., Ishikawa, A., Kakihara, K., Matsushita, S., Takahashi, R., Yanagida, K., Mori, D., Murata, Y., Shibukawa, T., Suzumoto, R., Fujiwara, M., Tomita, K., Aohama, H., **Iiyama, K.**, et al., “Mission to Earth-Moon Lagrange Point by a 6U CubeSat: EQUULEUS”, IEEE Aerospace & Electro. Systems Magazine, Vol.35, No.3, pp.30-44, 2020, <https://doi.org/10.1109/MAES.2019.2955577>

CONFERENCE PROCEEDINGS *: Equal Contribution

(C23) **Iiyama, K.**, and Gao, G., “Plasmaspheric Delay Characterization and Comparison of Mitigation Methodologies for Lunar Terrestrial GNSS Receivers”, Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2025), Baltimore, MD, 2025, **Best Presentation of the Session Award**

(C22) **Iiyama, K.**, Vila, G.C., and Gao, G., “Constellation Design and Staged Development for the Lunar Navigation Satellite System”, Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2025), Baltimore, MD, 2025

(C21) Dai, A., Wu, A., **Iiyama, K.**, Vila, G.C., Coimbra, K., Carlhammar, A., Wu, B., Gao, G., “Full Stack Navigation, Mapping, and Planning for the Lunar Autonomy Challenge”, Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2025), Baltimore, MD, 2025

(C20) *Vila, G.C., ***Iiyama, K.**, and Gao, G., “LuPNT: An Open-Source Simulator for Lunar Communications, Positioning, Navigation, and Timing”, 2025 IEEE Aerospace Conference, Big Sky, MT, 2025

(C19) **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

- (C18) **Iiyama, K.**, Neamati, D., 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, 2024, **Best Presentation of the Session Award**
- (C17) ***Iiyama, K.**, *Vila, G.C., and Gao, G., “Contact Plan Optimization and Distributed State Estimation for Delay Tolerant Satellite Networks”, 2024 IEEE Aerospace Conference, Big Sky, MT, 2024
- (C16) *Shimane, Y., and ***Iiyama, K.**, “Methods for Dual-Objective High Energy Tour Design”, 2023 AAS/AIAA Astrodynamics Specialist Conference, Big Sky, MT, 2023
- (C15) ***Iiyama, K.**, *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, 2023
- (C14) **Iiyama, K.**, 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, 2023
- (C13) Cortinovis, M., **Iiyama, K.**, 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, 2023, **Best Presentation of the Session Award**
- (C12) **Iiyama, K.**, Bhamidipati, S., and Gao, G., “Terrestrial GPS Time-Differenced Carrier-Phase Positioning of Lunar Surface Users”, 2023 IEEE Aerospace Conference, Big Sky, MT, 2023
- (C11) **Iiyama, K.**, 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, 2023
- (C10) Murata, M., Koga, M., Nakajima, Y., Yasumitsu, R., Araki, T., Makino, K., Akiyama, K., Yamamoto, T., Tanabe, K., Kogure, S., Sato, N., Toyama, D., Kitamura, K., Miyasaka, K., Kawaguchi, T., Sato, Y., Kakihara, K., Shibukawa, T., **Iiyama, K.**, Tanaka, T., “Lunar navigation satellite system: Mission, system overview, and demonstration”, 39th International Communications Satellite Systems Conference (ICSSC 2022), Stresa, Italy, 2022
- (C9) Bhamidipati, S., ***Iiyama, K.**, *Mina, T., and Gao, G., “Time-Transfer from Terrestrial GPS for Distributed Lunar Surface Communication Networks”, 2022 IEEE Aerospace Conference, Big Sky, MT, 2022
- (C8) **Iiyama, K.**, 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, 2022, **Student Registration Grant**
- (C7) **Iiyama, K.** 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, 2021
- (C6) Tomita, K., Skinner, K., **Iiyama, K.**, 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
- (C5) **Iiyama, K.**, 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, 2020
- (C4) Shibukawa, T., Matsushita, S., **Iiyama, K.**, 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, 2020 (conference postponed)
- (C3) **Iiyama, K.**, “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, 2019
- (C2) Matsushita, S., Shibukawa, T., **Iiyama, K.**, 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, Boston, MA, The United States, 2019

(C1) Shibukawa, T., Matsushita, S., **Iiyama, K.**, 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, 2019

Teaching Experience _____

Fall 2024, 2025	AA272: Global Positioning Systems , taught by Prof. Grace Gao, Graduate Course Assistant, Stanford University
Fall 2019	Orbital Mechanics , taught by Prof.Ryu Funase, Graduate Teaching Assistant, The University of Tokyo

Mentoring _____

2025.1 - 2025.3	Pauline de la Hougue Moran , M.S. Student, Stanford University
2024.9 - Current	Kaila Coimbra , Ph.D. Student, Stanford University
2023.1 - Current	Guillem Casadesus Vila , Ph.D. Candidate, Stanford University
2023.1 - 2024.9	Marta Cortinovis , Ph.D. Candidate, Stanford University
2022.9 - 2023.3	Guillem Rueda Oller , Ph.D. Student, Stanford University

Miscellaneous _____

PROFESSIONAL MEMBERSHIPS

American Institute of Aeronautics and Astronautics (AIAA),
Institute of Navigation (ION)

PEER REVIEW

IEEE Transaction on Aerospace and Electronic Systems,
NAVIGATION: Journal of the Institute of Navigation