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*

- GPA: 4.12/4.30
- Research Area: Lunar Positioning, Navigation, and Timing (Advisor: Grace Gao)

The University of Tokyo *Tokyo, Japan*

ME - Aeronautics and Astronautics *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 *Tokyo, Japan*

BE - Aeronautics and Astronautics *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

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*

- Diffusion Kalman Filter framework for time transfer from terrestrial GPS to lunar surface communication networks (C9)
- Positioning and timing algorithm of lunar rovers and satellites using terrestrial GPS time-differenced carrier phase (TDCP) measurements (J2), (C11), (C12), (C14)
- Open-source simulator for lunar positioning, navigation, and timing (C15)(C20)
- Satellite ephemeris optimization framework for lunar orbits (C13)(J3)
- Distributed orbit determination and timing framework for satellite networks using covariance intersection (C17)
- Autonomous fault detection algorithm for satellite constellation using inter-satellite links and rigid graphs (C18)

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

Advisor: Dr. Kar-Ming Cheung, Dr. William W.Jun *Jul, 2024 - Sep, 2024*

- Constellation design for future communication + PNT constellation around Mars
- Orbit determination and time synchronization framework 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*

- 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*

- Autoencoder + deep reinforcement learning + feedback controller framework 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*

- Decentralized autonomous orbit determination and clock offset estimation algorithm for LNSS navigation satellites connected by crosslinks using a Schmidt Kalman Filter.
- Implementing 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. It was selected as the secondary payload of the EM-1 Mission and achieved a successful lunar flyby.
- Designed and implemented flight software for heater control and FDIR of the thermal sub-system.
- Contributed to environment tests and result analysis with MATLAB and Thermal Desktop.
- Related Publications: (J1), (C1), (C2), (C4)

Publications

Preprints and Articles Under Review

(P-J4) **Iiyama, K**., Neamati, D., and Gao, G., "Autonomous Constellation Fault Monitoring with Inter-satellite Links: A Rigidity-Based Approach", Navigation: Journal of the Institute of Navigation, Under Review

(P-C23) 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, September 2025, Abstract Submitted

(P-C22) **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, September 2025, Abstract Submitted

(P-C21) **Iiyama, K**., Vila, G.C, and Gao, G., "Autonomous Constellation Design and Staged Development for the Lunar Navigation Satellite System", Proceedings of the Institute of Navigation GNSS+ conference (ION GNSS+ 2025), Baltimore, MD, September 2025, Abstract Submitted

Journal Papers

2024

(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`

2020

(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.**, Ishiwata, S., Kondo, H., Mikuriya, W., Seki, H., Koizumi, H., Asakawa, J., Nishii, K., Hattori, A., Saito, Y., Kikuchi, K., Kobayashi, Y., Tomiki, A., Torii, W., Ito, T., Campagnola, S., Ozaki, N., Baresi, N., Yoshikawa, I., Yoshioka, K., Kuwabara, M., Hikida, R., Arao, S., Abe, S., Yanagisawa, M., Fuse, R., Masuda, Y., Yano, H., Hirai, T., Arai, K., Jitsukawa, R., Ishioka, E., Nakano, H., Ikenaga, T., Hashimoto, T., "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

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 (AERO), Big Sky, MT, March 2025 (Accepted)

(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 (AERO), Big Sky, MT, March 2025 (Accepted)

2024

(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, September 2024, **Best Presentation of the Session**

(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 (AERO), Big Sky, MT, March 2024

2023

(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, September 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, September 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, September 2023, **Best Presentation of the Session**

(C12) **Iiyama, K.**, 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

(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, January 2023

2022

(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, March 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 (AERO), Big Sky, MT, March 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, January 2022, **Student Registration Grant**

2021

(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, September 2021

2020

(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, November 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, August 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, July 2020 (conference postponed)

2019

(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, j-20s, June 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, July 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, June 2019

Teaching Experience

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

Mentoring

2025.1 - Current	**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. Student, Stanford University
2023.1 - 2024.9	**Marta Cortinovis**, Ph.D. Student, Stanford University
2022.9 - 2023.3	**Guillem Rueda Oller**, Ph.D. Student, Stanford University

Extracurricular Activities

2023.9 -	**Engineering Students for Diversity, Equity, and Inclusion (ES4DEI)**, Serving as a financial officer. Also hosted a sharing stories event, with the aim to increase empathy by sharing first-hand experiences and listening to others' experiences
2022 - 2023	**XPLANE**, Mentored 6 Japanese undergrad/Master's students applying for Ph.D. program in the US

Miscellaneous

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

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