

# Keidai Iiyama

PHD STUDENT · STANFORD AERONAUTICS AND ASTRONAUTICS

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## Education

### Stanford University

Stanford, CA

PHD STUDENT - AERONAUTICS AND ASTRONAUTICS

2021.9 - present

- Advisor: Prof.Gao

### The University of Tokyo

Tokyo, Japan

ME - AERONAUTICS AND ASTRONAUTICS

2019.4 - 2021.3

- Advisor: Prof.Funase
- Thesis: System Design and Autonomous Orbit Determination Strategy for Lunar Navigation Satellite System

### The University of Tokyo

Tokyo, Japan

BE - AERONAUTICS AND ASTRONAUTICS

2015.4 - 2019.3

- Advisor: Prof.Funase
- Thesis: Navigation Satellite Constellation and Monitoring Station Arrangement for Lunar Global Navigation Satellite System

## Awards, Fellowships, & Grants

### AWARDS

- 2019.6 **Student Paper Competition Finalist**, 32nd International Symposium on Space Technology and Science
- 2017.9 **ARLIS 2017 Cansat Competition Overall Winner and Accuracy Award**, UNISEC

### FELLOWSHIPS & GRANTS

- 2022.1 **Student Registration Grant**, 2022 ION ITM Conference
- 2021.9 - 2022.8 **Ph.D. Student Fellowship**, Stanford Aero/Astro Department \$101,856
- 2021.9 - 2023.8 **Nakajima Foundation Study Abroad Fellowship**, Nakajima Foundation 10,800,000 yen
- 2020.1 - 2021.2 **Study Abroad Musha Shugyo Program Travel Award**, School of Engineering, The University of Tokyo 400,000 yen
- 2019.9 - 2021.8 **WINGS CFS Fellowship**, WINGS CFS, The University of Tokyo 4,320,000 yen

## Research Experience

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

Stanford, CA

ADVISOR: PROF. GRACE GAO

Sep, 2021 - Present

- Developed Diffusion Kalman Filter for time transfer from GPS to lunar communication networks.
- Developed a positioning and timing algorithm of lunar rovers and satellites using terrestrial GPS time-differenced carrier phase measurements
- Related Publications: (J1)(C1)(C2)(C3)(C4)(C5)(C6)

## 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.
- Developed an angles-only batch-orbit determination algorithm using factor graphs
- Related Publications: (C7)

## 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: (C9), (C10)

## Intelligent Space Systems Laboratory, The University of Tokyo

Bunkyo-Ku, Tokyo, Japan

ADVISOR: PROF. RYU FUNASE

Apr,2018 - Aug,2021

- Developed an autonomous and decentralized autonomous orbit determination and clock offset estimation strategy for LNSS navigation satellites equipped with chip-scale atomic clocks.
- Implemented a user positioning simulator for LNSS. Conducted positioning performance analysis for several constellations and lunar monitoring station arrangement patterns.
- Related Publications: (C8), (C12)

## EQUULEUS Project Team

ADVISOR: PROF.RYU FUNASE

Oct,2017 - Present

- 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 the NASA's new rocket, 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: (J2), (C13), (C14)

## Publications

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### JOURNAL PAPERS

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|------|---|
| 2023 | (J1) <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, 2023 (Submitted) |
| 2020 | (J2) 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                           |

### CONFERENCE PROCEEDINGS \*: Equal Contribution

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| 2023 | (C1) <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 (Abstract Submitted)                              |
|      | (C2) <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 (Abstract Submitted)    |
|      | (C3) 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 (Abstract Submitted) |
|      | (C4) <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  |

- (C5) **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 (C6) 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. (\*:Equal Contribution)
- (C7) **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 Travel Grant**
- 2021 (C8) **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 (C9) 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
- (C10) **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
- (C11) 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 (C12) **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, June, 2019, **Student Session Finalist**
- (C13) 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.
- (C14) 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 2019 **Astrodynamics (Undergraduate course)**, taught by Prof. Ryu Funase, Graduate Teaching Assistant, The University of Tokyo

## Miscellaneous

### LANGUAGE

English (Fluent), Japanese (Native)

### SOFTWARE SKILLS

**Programming Language:** C, C++, Python, MATLAB

**Trajectory Design:** SPICE Toolbox, jTOP (spacecraft trajectory design software)

**Engineering:** Thermal Desktop, Autodesk Inventor

**Machine Learning:** Pytorch, Open AI Gym

**Web:** React, Jekyll

**Version Control:** Git, Subversion

## PROFESSIONAL MEMBERSHIPS

AIAA, ION