

Kento Tomita

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RESEARCH INTERESTS

My research expertise includes perception-aware GN&C and optimal tasking/scheduling for safety-critical systems. My PhD topic is Hazard Detection and Avoidance for Autonomous Spacecraft Landing, where I have developed a reachability/perception-aware optimal guidance algorithm with real-time Bayesian hazard detection.

EDUCATION

Georgia Institute of Technology, Atlanta, GA

Ph.D. in Aerospace Engineering — AUG 2019 – *Present*

Cumulative GPA: 3.8 / 4.0, Advisor: Dr. Koki Ho

Topic: Hazard Detection and Avoidance for Autonomous Safe Planetary Landing

The University of Tokyo, Tokyo, Japan

Enrolled in M.E. Program in Aerospace Engineering — APR 2018 – MAR 2019

Cumulative GPA: 4.0 / 4.0, Advisor: Dr. Ryu Funase

ADCS Engineering for 6U Deep Space Cubesat, **EQUULEUS**

Kyushu University, Fukuoka, Japan

B.S. in Aerospace Engineering — APR 2014 – MAR 2018

Cumulative GPA: 3.8 / 4.0, Advisor: Dr. Mai Bando, Research Field: Astrodynamics

Thesis: Network Analysis of Space Debris in Low Earth Orbits

RESEARCH EXPERIENCE

Graduate Research Assistant

Present
AUG 2019

Space Systems Optimization Group, GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, GA

- Perception-Aware Optimal Guidance for Safe Planetary Landing
 - Developing perception-aware optimal guidance algorithm via a surrogate model of reachable set/visible space based on deep neural network.
 - Developed efficient and theory-proved data generation pipeline for reachable set via lossless convexification and convex optimization.
 - Formulated perception-aware optimal guidance problem for safe planetary landing and solved with deep reinforcement learning.
- Hazard Detection Algorithm for Safe Planetary Landing
 - Developing a novel real-time uncertainty quantification algorithm for landing safety probability under topographic uncertainty via Gaussian random field/2D Gaussian process model.
 - Developed and demonstrated uncertainty-aware hazard detection algorithm for LiDAR point cloud data and optical imagery with deep semantic segmentation.
 - Developed terrain and safety map data generation pipeline with **Georgia Tech high performance computing (HPC) infrastructure**.
- Sensor Tasking for Space Domain Awareness
 - Proposed a novel and efficient mixed integer linear programming formulation for optimal sensor tasking in cislunar space via extended information filter.
 - Analyzed and related the Fisher information of optical measurements with the uncertainty deformation caused by cislunar dynamics
 - Developed space-borne sensor tasking simulator in Python
- Research Initiatives
 - Helped writing the selected proposal for **NASA Early Career Faculty Award, 2019**.
 - Planned, completed, and documented 4 years of the funded research project as a student lead.
 - Mentored total of 4 graduate and 4 undergraduate students, resulting in 1 journal, 2 proceedings, and 1 Master thesis with them being first authors.

ADCS Engineer / Graduate Research Assistant

MAR 2019 | [Intelligent Space Systems Laboratory](#), Tokyo, Japan

APR 2018

- Worked as an Attitude, Dynamics, and Control System Engineer of a 6U deep space CubeSat, [EQUULEUS](#), which is one of the only two fully successful CubeSats missions out of 10 launched CubeSats as NASA Artemis 1 secondary payloads.
 - Designed, integrated, and tested ADCS hardware modules.
 - Developed onboard flight software in C.
 - Developed flight simulator in C++ for software-in-the-loop testing.
 - Conducted risk analysis of the deep space Delta-V operations for lunar flyby

PUBLICATIONS

Journal Papers

- [J1] **K. Tomita**, K. Skinner, and K. Ho, "[Bayesian Deep Learning for Segmentation for Autonomous Safe Planetary Landing](#)," *Journal of Spacecraft and Rockets*, Vol. 59, No. 6, pp. 1800-1808, 2022.
- [J2] T. Claudet, **K. Tomita**, and K. Ho, "[Benchmark Analysis of Semantic Segmentation Algorithms for Safe Planetary Landing Site Selection](#)," *IEEE Access*, Vol. 10, No. 6, pp. 41766-41775, 2022.
- [J3] K. Ho, R. Beeson, **K. Tomita**, O. Gunasekara, and A. J. Sinclair, "[Analysis of Information-Theoretic Initial Sensor Search Method for Space Situation Awareness](#)," *Journal of Guidance, Control, and Dynamics*, Vol. 44, No. 3, pp. 641-645, 2021.
- [J4] R. Funase, **K. Tomita**, et.al., "[Mission to Earth-Moon Lagrange Point by a 6U CubeSat: EQUULEUS](#)," *IEEE Aerospace and Electronic Systems Magazine*, Vol. 35, No. 3, pp. 30-44, 2020.

Conference Papers

- [C1] **K. Tomita**, Y. Shimane, and K. Ho, "[Optimal Predictive Guidance for Autonomous Hazard Detection and Avoidance](#)," *AIAA SciTech 2024 Forum*, Orlando FL, January 2024.
- [C2] **K. Tomita**, Y. Shimane, and K. Ho, "[Multi-Spacecraft Predictive Sensor Tasking for Cislunar Space Situational Awareness](#)," *AMOS Conference*, Maui, Hawaii, September 2023.
- [C3] Y. Shimane, **K. Tomita**, and K. Ho, "Strategic Regions for Monitoring Incoming Low-Energy Transfers to Low-Lunar Orbits," *AMOS Conference*, Maui, Hawaii, September 2023.
- [C4] **K. Tomita** and K. Ho, "[Learning Reachability for Hazard Detection and Avoidance in Planetary Landing](#)," *AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, MT, August 2023.
- [C5] I. Noltan, **K. Tomita**, Y. Shimane, and K. Ho, "Sensitivity Analysis of Separation Time along Weak Stability Boundary Transfers," *AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, MT, August 2023.
- [C6] **K. Tomita** and K. Ho, "[Stochastic Hazard Detection for Landing Under Topographic Uncertainty](#)," *AAS/AIAA Space Flight Mechanics Meeting*, Austin, TX, January 2023.
- [C7] **K. Tomita***, T. Driver*, and K. Ho, "[Deep Monocular Hazard Detection for Safe Small Body Landing](#)," *AAS/AIAA Space Flight Mechanics Meeting*, Austin, TX, January 2023. * These authors contributed equally to this work.
- [C8] **K. Tomita**, Y. Shimane, and K. Ho, "Small body reconnaissance by multiple spacecraft via deep reinforcement learning," *AAS/AIAA Astrodynamics Specialist Conference*, Charlotte, NC, August 2022.
- [C9] **K. Tomita** and K. Ho, "Adaptive Hazard Detection and Avoidance for Planetary Landing via Bayesian Semantic Segmentation," *AIAA SciTech 2022 Forum*, San Diego, CA, January 2022.
- [C10] **K. Tomita**, K. A. Skinner, K. Iiyama, B. A. Jagatia, T. Nakagawa, and K. Ho, "Hazard Detection Algorithm for Planetary Landing Using Semantic Segmentation," *ASCEND*, Las Vegas, NV, November 2020.
- [C11] K. Iiyama, **K. Tomita**, B. A. Jagatia, T. Nakagawa, and K. Ho, "Deep Reinforcement Learning for Safe Landing Site Selection with Concurrent Consideration of Divert Maneuvers," *AAS/AIAA Astrodynamics Specialist Conference*, Lake Tahoe, CA, August 2020.

SKILLS

Programming Languages: Python, C++/C, MATLAB, Fortran

Libraries and Tools: Pytorch, TensorFlow, Scikit-learn, Trimesh, Blender, OpenCV, CUDA, Gurobi

Languages: ENGLISH (business), JAPANESE (native)

AWARDS AND SCHOLARSHIPS

NOV 2022	Excellent Reviewer for the Journal of Guidance, Control, and Dynamics (Oct. 1 2021-Sep. 30, 2022)
SEP 2019 - AUG 2022	Murata Overseas Foundation Scholarship
JAN 2019 - DEC 2023	Japan Student Services Organization Scholarship
MAR 2018	Outstanding Student Award of Japan Society for Aeronautical and Space Sciences
MAR 2015	Kyushu University President's Award and Scholarship

TECHNICAL JOURNAL OR CONFERENCE REFEREE ACTIVITIES

- Delegate reviewer, IEEE Conference on Decision and Control, 2023
- Reviewer, AIAA Journal of Guidance, Control, and Dynamics, 2022
- Reviewer, AIAA ASCEND, 2024
- Reviewer, AIAA SciTech, 2021

SELECTED COURSEWORK

Control and Robotics

Linear Control, Nonlinear Control, Optimal Control, Nonlinear Stochastic Optimal Control, Planning and Decision-Making for Autonomy, Intelligent Cyber-Physical Systems, Optimization-Based Learning Control and Games

Math

Real Analysis, Optimization, Statistics

Artificial Intelligence

Artificial Intelligence, Machine Learning

Astrodynamics and Space Systems

Orbital Mechanics, Space Exploration Robotics Engineering, Spacecraft Attitude Determination and Control, Spacecraft Design, Optical Navigation (Audit), Space Logistics

REFERENCES

Koki Ho, Ph.D.

(Advisor/PhD committee member)

Dutton-Ducoffee Endowed Professor, Associate Professor
Guggenheim School of Aerospace Engineering
Georgia Institute of Technology
Chair, AIAA Space Logistics Technical Committee
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Panagiotis Tsiotras, Ph.D.

(Collaborator/PhD committee member)

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John Christian, Ph.D.

(PhD committee member)

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Kyriakos G. Vamvoudakis, Ph.D.

(Final Project Advisor for Cyber-Physical Systems)

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