Yuji Takubo

Undergraduate Student · Georgia Tech, School of Aerospace Engineering

yujitakubo@gatech.edu | Japanese citizen

Education

Georgia Institute of Technology *Atlanta, GA*

Undergraduate Student - Aerospace Engineering *2019.9 - 2023.5 (expected)*

- GPA: 3.96 / Sigma Gamma Tau Aerospace Honor's Society
- Study Abroad Program: Universidad Carlos III de Madrid (UC3M), Spain - Spring 2022

Interests

Space Systems (Astrodynamics, Space Logistics), Optimization (Stochastic/Robust, Multi-objective, MINLP/MILP), Operations Research, Sequential decision making (Optimal Control, Reinforcement Learning, Dynamic Programming).

Publications

Papers in preparation

2023

(C*2) **Takubo, Y.**, Landau, D., and Brian, A. "Automated Tour Design in the Saturnian System," 33rd AAS/AIAA Space Flight Mechanics Meeting, Austin, TX, Jan. 2023 (Full paper Accepted, available at *arXiv:2210.14996*).

(C*1) Shimane, Y., **Takubo, Y.**, and Ho, K., "Design of Earth-Moon Low-Thrust-Enhanced Low-Energy Transfer," 33rd AAS/AIAA Space Flight Mechanics Meeting, Austin, TX, Jan. 2023 (Extended abstract Accepted).

Journal Papers

2022

(J2) Isaji, M., **Takubo, Y.**, and Ho, K., "Multidisciplinary Design Optimization Approach to Integrated Space Mission Planning and Spacecraft Design," Journal of Spacecraft and Rockets, 59(6), pp.1660-1670, 2022.

(J1) **Takubo, Y.**, Chen, H., and Ho, K., "Hierarchical Reinforcement Learning Framework for Stochastic Spaceflight Campaign Design," Journal of Spacecraft and Rockets, 59(2), pp.421-433, 2022.

Conference Proceedings

2022

(C4) **Takubo, Y.**, and Kanazaki, M., "Robust Constrained Multi-objective Evolutionary Algorithm based on Polynomial Chaos Expansion for Trajectory Optimization," IEEE Congress on Evolutionary Computation, IEEE WCCI 2022, Padua, Italy, Jul. 2022.

2021

(C3) **Takubo, Y.**, and Kanazaki, M., "Robust Multi-objective Optimization of the Control Input of Trajectory Planning," The 20th Japanese Society of Evolutionary Computation Symposium, Online, Sep. 2021. (Japanese).

(C2) Isaji, M., **Takubo, Y.**, and Ho, K., "Multidisciplinary Design Optimization Approach to Integrated Space Mission Planning and Spacecraft Design," AIAA ASCEND, Las Vegas, NV, Oct. 2021.

2020 | (C1) **Takubo, Y.**, Chen, H., and Ho, K., "Performance Analysis of Hierarchical Reinforcement Learning Framework for Stochastic Space Logistics," AIAA ASCEND, Online, Oct. 2020.

Projects

Covariance Steering Control and Optimal Steering of Probability Distribution *Atlanta, GA*

Advisor: Prof.Panagiotis Tsiotras (Georgia Tech, Dynamics and Control Systems Lab.) *2021.9-present*

- Applied Normalizing Flow (generative model) to the optimal steering of (non-)Gaussian distributions.
- Developed the numerical algorithm of covariance steering problem based on coupled Riccati equation, investigating the extension of the generalized control of probability distribution in discrete-time linear dynamical systems.
- Investigating the optimal control of (higher-order) moment-state space.

Low-thrust-enhanced Low-energy Earth-Moon Transfer *Atlanta, GA*

Advisor: Prof.Koki Ho (Georgia Tech, Space Systems Optimization Group) *2022.9-Present*

- Developing a new family of low-energy transfer in the Earth-Moon system with Sun perturbation and low-thrust propulsion, using a bicircular restricted four body problem (BCR4BP).
- Related Publications: (C*1)

Mission Design of Saturn Moon Tour - JPL Visiting Student Research Program *Pasadena, CA (Remote)*

Advisor: Dr. Damon Landau (NASA Jet Propulsion Laboratory, Sec. 312A) *2022.6-2022.8*

- Multi-objective Trade space exploration of the Saturn Moon Tour (i.e., resonance hopping) trajectory optimization based on Dynamic Programming and branch-and-bounds.
- Accelerated the computational time by precomputing the optimal transfers based on V_∞-leveraging transfers (VILT).
- Related Publications: (C*2)

Robust Multi-objective Trajectory Optimization of Supersonic Transport *Tokyo, Japan*

Advisor: Prof. Masahiro Kanazaki (Tokyo Metropolitan University) *2021.5-2021.9*

- Developed the architecture which integrates Polynomial Chaos Expansion to Multi-objective Evolutionary Algorithm to solve a robust multi-objective trajectory optimization under wind uncertainty.
- Related Publications: (C3)(C4)

Co-design of Space Mission Planning and Nonlinear Spacecraft Design *Atlanta, GA*

Advisor: Prof.Koki Ho (Georgia Tech, Space Systems Optimization Group) *2021.5-2022.5*

- Solved a concurrent optimization problem of space transportation planning and spacecraft design (MINLP), by decoupling into MIQP and NLP through Augmented Lagrangian Coordination (ALC).
- Related Publications: (J1), (C2)

Hierarchical Reinforcement Learning for Stochastic Space Mission Design *Atlanta, GA*

Advisor: Prof.Koki Ho (Georgia Tech, Space Systems Optimization Group) *2019.11-2021.12*

- Proposed the architecture for a stochastic spaceflight campaign planning based on Hierarchical Reinforcement Learning and Mixed-integer Linear Programming.
- Related Publications: (J2), (C1)

Awards, Fellowships, & Grants

Awards

2022.06 **International Astronautical Congress (IAC) 2022, International Space Education Board, Japanese Student Delegate (Student Leader)**, Japan Aerospace Exploration Agency (JAXA)

2022.03 **UJA Paper Award, Special Award**, United Japanese researchers Around the world

2019.10 **Satellite Design Contest, Japan Space Forum Award**, DISCERN (Deimos In-Situ Cubesat-based Economical RecoNnaissance)

2018.10 **Satellite Design Contest, Japan Space Forum Award**, Fuel Supplying Satellite for the Lunar Free Return

Fellowships, Grants & Funds

2020.4 -	**Ezoe Memorial Recruit Scholarship**, Full-ride scholarship, potentially until academic year 2027-2028. Currently at renewal process (Final results will be revealed in mid-December).	*– 10M JPY / yr*
2022.7	**Student Government Association, Conference Travel Fund**, Georgia Tech	*$ 250*
2022.6	**President's Undergraduate Research Award (PURA), Travel Award**, Georgia Tech	*$ 1,000*
2021.8 - 2021.12	**President's Undergraduate Research Award (PURA), Salary Award**, Georgia Tech	*$ 1,500*
2021.1 - 2021.5	**President's Undergraduate Research Award (PURA), Salary Award**, Georgia Tech	*$ 1,500*

Miscellaneous

Language

English & Japanese (Bilingual)

Software Skills

Programming Language: Python, MATLAB, Julia, SysML (MagicDraw/Cameo), Fortran

Optimization: Gurobi, Pygmo, Tensorflow

Engineering: SolidWorks

Professional Memberships

AIAA Student Member, IEEE Student Member, AAS Student Member