Yuji Takubo

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Education

Stanford University *Stanford, CA*
Ph.D. Student - Aeronautics and Astronautics *2023.9 -*
- M.S. in Aeronautics and Astronautics (expected in June 2025)
- Space Rendezvous Laboratory (SLAB). GPA: 4.09 / 4.0

Georgia Institute of Technology *Atlanta, GA*
B.S. in Aerospace Engineering *2019.9 - 2023.5*
- GPA: 3.97 / 4.0

Publications and Talks

Journal Papers

(J6) **Takubo, Y.**, Manuel, W., Foss, E., and D'Amico S. "Safe and Optimal N-Spacecraft Swarm Reconfiguration in Non-Keplerian Cislunar Orbits," Journal of Guidance, Control and Dynamics (submitted).

(J5) **Takubo, Y.**, Landau, D., and Brian, A. "Automated Tour Design in the Saturnian System," Celestial Mechanics and Dynamical Astronomy, Celestial Mechanics and Dynamical Astronomy, Vol. 136, article 8, 2024.

(J4) **Takubo, Y.**, and Masahiro, K., "Robust Constrained Multi-objective Optimal Control based on Evolutionary Algorithm and Polynomial Chaos with Application to Supersonic Transport Landing," MDPI Aerospace, 10(11), pp.929, 2023.

(J3) Woodall, B., Borowitz, M., Watkins, K., Costa, M., Howard, A., Kemerait, P., Lee, M., Rolls, G., **Takubo, Y.**, Titshaw, R. and Winstead, M., "The megaregion–forms, functions, and potential? A literature review and proposal for advancing research," International Journal of Urban Sciences, 2023.

(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

(C9) **Takubo, Y.**, Guffanti, T., Gammelli, D., Pavone, M., and D'Amico S. "Towards Robust Spacecraft Trajectory Optimization via Transformers," 2025 IEEE Aerospace Conference, Mar. 2025.

(C8) **Takubo, Y.**, Manuel, W., and D'Amico S. "Passively-Safe Optimal Cislunar Relative Motion using Relative Toroidal Elements," 2025 AAS/AIAA Space Flight Mechanics Conference, Kaua'i, HI, Jan. 2025.

(C7) **Takubo, Y.**, and D'Amico S. "Multiplicative Approach to Constrained Stochastic Attitude Control with Application to Rendezvous and Proximity Operations," 2024 AAS/AIAA Aerodynamics Specialist Conference, Bloomfield, CO, Aug. 2024.

(C6) **Takubo, Y.**, Shimane, Y., and Ho, K. "Optimization of Earth-Moon Low-Thrust-Enhanced Low-Energy Transfer," 2023 AAS/AIAA Aerodynamics Specialist Conference, Big Sky, MT, Aug. 2023

(C5) **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. **Breakwell Student Paper Award**.

(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, Padua, Italy, Jul. 2022.

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

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

Invited Talks

(T3) "Astrodynamics in the Jovian and Saturnian moon system," Stanford University (AA279A Space Mechanics, Guest Lecture), Feb. 24, 2024.

(T2) "Towards Icy Moons: Astrodynamics in Jovian and Saturnian moon system," Stanford University Planetary Science and Exploration Seminar, Nov. 13, 2024.

(T1) "Automated Tour Design in the Saturnian System," Celestial Mechanics and Dynamical Astronomy Seminar Series, May 31, 2024 (Online).

Experiences

Transformer-aided Non-convex Optimization for Robust Spacecraft Rendezvous *Stanford, CA*
Stanford University, Space Rendezvous Laboratory (Advisor: Prof. Simone D'Amico) *2023.9-Present*
- Integrated a chance-constrained optimization into a Transformer-based trajectory generation scheme to initialize the following sequential convex programming. Applied to a fault-tolerant rendezvous in Low Earth Orbit. Related Publication: (C9)

Passively-Safe Optimal Relative Motion Control in Cislunar Orbits *Stanford, CA*
Stanford University, Space Rendezvous Laboratory (Advisor: Prof. Simone D'Amico) *2024.10-Present*
- Established a safe formation reconfiguration in cislunar periodic orbits, leveraging the eigenstructure of the linearized relative dynamics of the circular restricted three-body problem. Related Publications: (C8)(J6)

Covariance Control of Spacecraft Attitude for Rendezvous and Docking *Stanford, CA*
Stanford University, Space Rendezvous Laboratory (Advisor: Prof. Simone D'Amico) *2023.9-Present*
- Developed a stochastic trajectory optimization in SO(3) via iterative covariance steering, which concurrently optimizes mean quaternion state and error-modified Rodrigues parameter (MRP) covariance matrix. Related Publication: (C7)

Europa Clipper Contingency Trajectory Design *Pasadena, CA*
NASA Jet Propulsion Laboratory, Sec. 392M (Advisor: Stefano Campagnola) *2023.5-2023.8*
- Developed a trajectory optimization method using MONTE for contingency scenarios during Europa Clipper's moon tour phase, providing proof-of-concept trajectories and unveiling the trade space across radiation does vs. ΔV.

Covariance Steering and Optimal Steering of Probability Distribution *Atlanta, GA*
Georgia Tech, Dynamics and Control Systems Lab. (Advisor: Prof. Panagiotis Tsiotras) *2021.9-2023.5*
- 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.

Low-thrust-enhanced Low-energy Transfer in the Earth-Moon System *Atlanta, GA*
Georgia Tech, Space Systems Optimization Group (Advisor: Prof.Koki Ho) *2022.9-2023.8*
- Optimized low-energy transfers in the Sun-Earth-Moon system augmented by low-thrust propulsion, using a bicircular restricted four-body problem and direct method with forward-backward shooting. Related Publications: (C6)

Multi-objective Optimization of the Saturn Moon Tour for Enceladus Missions *Pasadena, CA (Remote)*
NASA Jet Propulsion Laboratory, Sec. 312A (Advisor: Damon Landau) *2022.6-2022.8*
- Developed a dynamic programming framework to solve a multi-objective trade space exploration of the Saturn Moon Tour (i.e., resonance hopping) trajectory optimization. Accelerated the computational time via the database generation of optimal V_∞-leveraging transfers (VILT). Related Publications: (C5),(J5)

Robust Multi-objective Trajectory Optimization with Polynomial Chaos Expansion *Tokyo, Japan*
Tokyo Metropolitan University (Advisor: Prof. Masahiro Kanazaki) *2021.5-2021.9*
- Developed an evolutionary algorithm that integrates Polynomial Chaos Expansion to solve a robust multi-objective trajectory design of supersonic aircraft landing under epistemic wind uncertainty. Related Publications: (C3),(C4),(J4)

Co-design of Space Logistics and Nonlinear Spacecraft Design *Atlanta, GA*
Georgia Tech, Space Systems Optimization Group (Advisor: Prof.Koki Ho) *2021.5-2022.5*
- Solved a concurrent optimization problem of space transportation scheduling and spacecraft design (MINLP) by decoupling into MIQP and NLP through Augmented Lagrangian Coordination (ALC). Related Publications: (J2), (C2)

Hierarchical Reinforcement Learning for Stochastic Space Logistics Mission Design *Atlanta, GA*
Georgia Tech, Space Systems Optimization Group (Advisor: Prof.Koki Ho) *2019.11-2021.12*
- Proposed an architecture for a stochastic spaceflight campaign planning (multi-commodity network flow optimization) based on Hierarchical Reinforcement Learning and Mixed-integer Linear Programming. Related Publications: (J1), (C1)

Awards, Grants, & Funds

2023.05 **Jet Propulsion Laboratory Graduate Fellowship (JPLGF)**, NASA JPL

2023.07 **Global Trajectory Optimization Competition (GTOC) 12**, 1st place (NASA JPL)

2023.01 **Breakwell Student Paper Award**, 33rd AAS/AIAA Space Flight Mechanics Meeting, 2023

Miscellaneous

SKILLS: **Programming:** Python, MATLAB, C++, Julia, Fortran,

Optimization: Gurobi, CVXPY, YALMIP, Pygmo, PyTorch, JAX **Astrodynamics:** MONTE (COSMIC), FreeFlyer

REVIEWER: AIAA Journal of Guidance, Control, and Dynamics (JGCD). AIAA Journal of Spacecraft and Rockets (JSR). Springer Celestial Mechanics and Dynamical Astronomy (CMDA). IEEE American Control Conference (ACC). Elsevier Advances in Space Research.