SHUNTARO TAKEKUMA

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RESEARCH INTERESTS

My principal research interests lie in the field of control theory, specifically control of stochastic systems. I am currently investigating the control of systems composed of *hopping rovers* to explore low-gravity planets autonomously, which include large uncertainties.

My future research plans are to build on the foundations of my PhD research to further investigate the control of stochastic autonomous distributed systems from the perspective of control theory.

In addition, to increase their feasibility, I'm planning to tackle the issue mentioned above from the perspective of robotics, too.

RESEARCH EXPERIENCE

PhD Research, Dept. Mechanical Systems Engineering, Nagoya University, Nagoya, Japan (2020–present)

- Modeled a multi-hopping-rover system, which is a kind of autonomous distributed systems composed of hopping rovers
- Developed consensus controller for the multi-hopping-rover system to achieve convergence in the mean of the mean-square stability
- Modeled an autonomous system for the rover to conduct SLAM
- Derived a controller for the system mentioned above which optimizes the movement of the rover for its SLAM

PhD Research, Dept. Systems Science, Kyoto University, Kyoto, Japan (2022–present)

- As a special research student, supervised by Prof. Shun-ichi Azuma at Kyoto University
- Publishing of scientific papers in peer-reviewed journals to support the research program mentioned above
- Modeling a system for the rover to search resources, e.g. water, on the planets
- Developing a controller that makes the rover converge to where the resource concentrations are maximized

RELEVANT RESEARCH SKILLS

- Design model-based controllers of dynamical systems
- Analysis of stability of dynamical systems
- Optimal control
- Control of multi-agent systems
- Control of stochastic systems
- Numerical simulation of dynamical systems on Matlab

AWARDS

- Nagoya University Interdisciplinary Frontier Fellowship (2022, 180,000 JPY/month and a research grant of 25,000 JPY/year)
- Outstanding Fellow of Nagoya University Interdisciplinary Frontier Fellowship (2023, 200,000 JPY/month and a research grant of 50,000 JPY/year)
- Best Presentation Award, SICE Chubu Branch Young Researchers Presentation (2022)
- Second Prize, Nagoya University School of Engineering International Exchange Cup, English Speech Contest (2022)

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- IEEE Control Systems Society (2022-present)
- The Japan Society for Aeronautical and Space Science (2022-present)
- The Institute of Systems, Control and Information Engineers (2019-present)

SUPERVISORS

- Prof. Shun-ichi Azuma, Dept. Systems Science, Kyoto University, Kyoto, Japan, sazuma@i.kyoto-u.ac.jp
- Prof. Toru Asai, Dept. Mechanical Systems Engineering, Nagoya University, Nagoya, Japan, asai@nuem.nagoya-u.ac.jp

ADDITIONAL RELEVANT EXPERIENCE

Internship, Japan Aerospace Exploration Agency, Tsukuba, Japan (2019)
- Implementing several types of path planning on the hopping rover on a physical simulator, Gazebo

Laboratory Assistant, Photo Electron Soul, Nagoya, Japan (2018)
- Developed a PID feedback controller to stabilize the output of a Photocathode-type electron beam generator
- Conducted performance tests of a new electron beam generator

PUBLICATIONS

International Journal (Peer Reviewed)
- S. Takekuma, S. Azuma, R. Ariizumi, and T. Asai, "Consensus Control of Multi-Hopping-Rover Systems: Convergence Analysis," *IEEE Access*, vol. 11, pp. 36176-36183, 2023
- S. Takekuma, S. Azuma, R. Ariizumi, and T. Asai, "Optimal Movement for SLAM by Hopping Rover," *IEICE Trans. Fundamentals of Electronics, Communications and Computer Sciences*, vol. E106-A, pp. 715-720, 2023

International Conference (Peer Reviewed)
- S. Takekuma, S. Azuma, R. Ariizumi, and T. Asai, "Consensus Control of Multi-Hopping-Rover Systems," *proc. The 4th International Symp. on Swarm Behavior and Bio-Inspired Robotics*, vol. 4, pp. 610-619, 2021

Domestic Conference (Without Reviewed, In Japanese)
- S. Takekuma and S. Azuma, "Consensus Control of Multi-Hopping Rover Systems," *Proc. 63rd Conf. The Institute of Systems, Control and Information Engineers*, pp. 1463-1465, vol. 63, 2019
- S. Takekuma, S. Azuma, R. Ariizumi, and T. Asai, "Gain Design for Consensus Control of Multi-hopping Rover Systems," *Proc. 64th Conf. The Institute of Systems, Control and Information Engineers*, pp. 901-904, vol. 64, 2020
- S. Takekuma, S. Azuma, R. Ariizumi, and T. Asai, "Optimal Movement for SLAM by Hopping Rover: MultipleLandmark Case," *Proc. 66th Space Sciences and Technology Conf.*, pp. 4I06, vol. 66, 2022
- S. Takekuma, S. Azuma, R. Ariizumi, and T. Asai, "Optimal Movement for SLAM by Hopping Rover," *SICE Chubu Branch Young Researchers Presentation*, 2022