Kandai Watanabe

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Portfolio: https://watakandai.github.io/

EDUCATION

University of Colorado Boulder   **Boulder, CO**
5th-year Ph.D. in Computer Science   Aug 2019 – Expected to graduate in May 2024

Keio University   **Tokyo, Japan**
Master of Engineering | Concentration in Robotics & Aerospace Eng.   April 2017 - March 2019
- **GPA**: 3.73/4.0

University of Illinois at Urbana-Champaign   **Champaign, IL**
Aerospace Engineering Program | Concentration in Aerospace Eng. & Computer Science   Aug 2015 - May 2016
- **GPA**: 3.67/4.0 for CS

RESEARCH EXPERIENCE

Assured Reliable Interactive Autonomous (ARIA) Group, University of Colorado Boulder   **Boulder, CO**
Research Assistant (Advisors: S. Sankaranarayanan, and M. Lahijanian)   Oct 2020 – Present
- Derived a **multi-agent optimal planning algorithm** under timed-constrained specification models, formulated a General Traveling Salesman Problem. Currently, extending it to uncertain scenario where travel time is stochastic.
- Solved a **Hybrid System Identification Problem** (NP-Hard, exponential in the # data) linear in the #data but exponential in #mode and the dimensionality of state-space by reformulating the problem with a "gap" (NeurIPS)
- Derived a polynomial algorithm to compute for optimal trade-offs and **strategies for multi-objective two-player game** graph and proved its completeness and complexity (Under review of IEEE Transaction on Robotics)
- Derived a safety-guaranteed **specification learning algorithm** from **human demonstrations** using formal methods and automaton theory. (Accepted for IROS 2021) (Python, C++)

Human Interaction and Robotics (HIRO) Group, University of Colorado Boulder   **Boulder, CO**
Research Assistant   Aug 2019 – Oct 2020
- Enhanced "Task Learning" by stacking **Deep RL** as a hierarchical system to learn atomic actions in the lower controller and learn task planning in the higher controller to achieve a long-term complex task (Python, PyTorch)
- Manufactured a flexible whole-body **artificial skin** (IMU+Proximity) for a manipulator (Python, C++, EAGLE)
- Derived a calibration algorithm to locate each sensor unit by forming it as a global optimization problem, which outperforms the previous method by 10 times in the estimation accuracy.
- Deriving a safety-guaranteed motion planning of a manipulator with the flexible skin for human-robot interaction

Takahashi Laboratory, Keio University   **Tokyo, Japan**
Research Assistant   June 2016 - March 2019
- Derived an easy-to-teach motion learning algorithm for robotic arm which can learn an action in a small number of iterations (e.g. Throwing a dart: 30 iterations in average) leveraging the power of **Bayesian Optimization**
- Developed an **object recognition** (YOLO-v3) for a harvest robot for Prof. Jan Peters (TU Darmstadt) research
- Proposed a drone **controller** that suppresses movement that induces & Implemented an end-to-end system that maps a drone's camera input to **Oculus Rift** and user's motion to drone's controller input via **ROS**

EXTRACURRICULAR EXPERIENCE

Toyota Research Institute North America   **Ann Arbor, MI**
Intern (Extended to Joint Research)   June 2022 – Present
- Proposed the model of *Timed Partial Orders* for specifying workflows for modeling manufacturing processes and a **mining algorithm** to mine TPOs from the data log. Showed the relation between the graph-coloring problem.

Amazon.com, Inc.   **Sunnyvale, CA**
Applied Scientist   June 2020 – Aug 2020
- Surveyed, designed and developed a **novel prediction algorithm** to locate humans inhouse from scratch (Python)

PKSHA Technology Inc.   **Tokyo, Japan**
Machine Learning Intern   March 2019 – Aug 2019
- Developed a model to predict nonlinear pedestrian motion for 0.5s in the future with accuracy of about 80% using PCA + Random Forest (Python).

RELEVANT PROJECT EXPERIENCE

Team Wolve'Z CanSat Project   **Tokyo, Japan**
Software Development Manager (https://github.com/watakandai/cansat2017)   March 2017 - Sep 2017
- Awarded 1st Place for Mission Competition at Worldwide CanSat Competition 2017 among 20 teams

- Managed and educated a team of 5, developing all-automated two-wheel rover software in C++ using Arduino
- Implemented a sensor driver, calibration algorithms, Attitude Estimate Decision Making, and Sequence algorithm.

University of Illinois CubeSat Project (Nanosatellite in Aerospace Engineering)   **Champaign, IL**
Attitude Determination & Control Engineer   Aug 2015 - Dec 2015
- Designed and manufactured a Center of Gravity Measurement Device for realizing the precise attitude determination and control, which led in our laboratory to save $22,000

SKILLS & INTERESTS

Languages: Japanese (*Native*), English (*Business*: TOEFL iBT 109), German (*Conversational*)
Skills: ROS, Gazebo, MoveIt, Linux, Digital Signal Processing, Raspberry Pi, EAGLE
Programming Languages: Python, Julia, C++, C, MATLAB, Java, C#, Ruby, Scala, JavaScript, HTTP
Interests: Avid Traveler (Visited 30+ countries), Competitive Skier, Competitive Soccer Player, Modern Gadgets

AWARDS & ACTIVITIES

JASSO (Japan Student Services Organization) Overseas Graduate Fellowship ($40,000/year for 3 years)   July 2019
Keio University Global Fellowship ($50,000/year for 2 years)   December 2018
1st Place at CanSat (Can-sized Satellite) Competition 2017   March 2017 - Sep 2017

PUBLICATIONS

- **K. Watanabe**, N. Renninger, S. Sankaranarayanan, and M. Lahijanian, "Specification Learning for Reactive Synthesis with Safety Constraints," *IEEE Transactions on Robotics* (Under Review).
- **Watanabe, K.**, Fainekos, G., Hoxha, B., Lahijanian, M., Prokhorov, D., Sankaranarayanan, S., & Yamaguchi, T. (2023). Timed Partial Order Inference Algorithm. *Proceedings of the International Conference on Automated Planning and Scheduling*, *33*(1), 639-647.
- Berger, G., Narasimhamurthy, M., **Watanabe, K.**, Lahijanian, M., & Sankaranarayanan, S. (2022). An Algorithm for Learning Switched Linear Dynamics from Data. *Advances in Neural Information Processing Systems*, *35*, 30419-30431.
- **Watanabe, K.**, Renninger, N., Sankaranarayanan, S., & Lahijanian, M. (2021, S). Task Learning with Preferences for Planning with Safety Constraints. *Workshop on Accessibility of Robot Programming and the Work of the Future in Robotics: Science and Systems (RSS)*.
- **Watanabe, K.**, Renninger, N., Sankaranarayanan, S., & Lahijanian, M. (2021, September). Probabilistic Specification Learning for Planning with Safety Constraints. *IEEE/RSJ International Conference on Intelligent Robots and Systems* (IROS) (pp. 6658-6565). IEEE.
- **Watanabe, K.**, Strong, M., West, M., Escobedo, C., Aramburu, A., Kodur, K. C., & Roncone, A. (2021, September). Self-contained kinematic calibration of a novel whole-body artificial skin for human-robot collaboration. In *2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (pp. 1778-1785). IEEE.
- **Watanabe, K.**, & Takahashi, M. (2020). Head-synced drone control for reducing virtual reality sickness. *Journal of Intelligent & Robotic Systems*, *97*(3-4), 733-744.
- **Watanabe, K.**, & Takahashi, M. (2018). Control system design of a quadrotor suppressing the virtual reality sickness. In *2018 AIAA Modeling and Simulation Technologies Conference* (p. 1916).

Teaching

University of Colorado Boulder   **Boulder, CO**
Teaching Assistant   Jan 2023 – May 2023
- Taught and advised 250 sophomore college students in Principle of Programming Language (Scala)

Keio University   **Tokyo, Japan**
Teaching Assistant   Sep 2017 – March 2019
- Taught and advised C++ to 160 sophomore college students as part of a course curriculum for consecutive years