

# Yasunori Toshimitsu

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## Education

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- Apr 2020 – Mar 2022 | **University of Tokyo, Tokyo, Japan**  
*M.Sc. Department of Creative Informatics, Graduate School of Information Science and Technology*
- Apr 2015 – Mar 2020 | **University of Tokyo, Tokyo, Japan**  
*B.Sc. Department of Mechano-Informatics, Faculty of Engineering*
- Aug 2018 – Jan 2019 | **Massachusetts Institute of Technology, Massachusetts, USA**  
*Exchange Student, fall term. Department of Mechanical Engineering*

## Research Experience

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- Mar 2019 – Mar 2022 | **University of Tokyo, JSK Robotics Lab**  
*Advisor: Masayuki Inaba*  
Research into the control of tendon-driven musculoskeletal humanoid robots taking advantage of its muscle and joint redundancy. By using its dynamic joint structure model and the joint-muscle model, and combining it with a muscle activation model seen in biological muscles, succeeded to apply biomimetic operational space control on a physical musculoskeletal robotic arm. By applying the controller, the robot can reject disturbances while still achieving the given operational space task.  
Also involved in the maintenance of the tendon-driven robot system including soldering, mechanical repair, purchasing management of mechanical and PCB components, and development of the ROS-based codebase.
- Dec 2020 – May 2021 | **ETH Zurich, Soft Robotics Lab**  
*Advisor: Robert Katzschmann*  
Research and development of pneumatically actuated soft continuum robotic arms. Lead the development of SoPrA (Soft continuum Proprioceptive Arm), which contains internal proprioceptive sensors that can sense its pose without the need for external motion capture systems. Developed the dynamic model (and its C++ implementation) for SoPrA which can accurately describe its movement under actuation and external forces, and contributed a method to estimate the force by combining the dynamic model and the internal sensors. Co-designed the CAD model for the pneumatic actuator and developed the silicone casting fabrication procedure to integrate internal structures.  
Built and maintained the C++ software framework used across projects required to communicate with the pneumatic valve array, motion capture system, and serial USB devices. Set up a continuous integration framework to maintain code quality.
- Sep 2018 – Jan 2019 | **MIT, Distributed Robotics Laboratory**  
*Advisor: Daniela Rus, Robert Katzschmann*  
Through UROP (Undergraduate Research Opportunities Program), involved in research for the dynamic control of soft continuum robots in 3D space. Implemented the C++ code based on control methods proposed by coauthors, fabricated some of the soft arms used in experiments.

## Employment

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Feb 2018 – 2020

### **Connected Robotics, Tokyo, Japan**

#### *Internship*

Lead the development of soft serve ice cream robot. Connected Robotics is a cooking robotics startup based in Tokyo. Assigned to be the main developer of a new robotic system that can make soft serve ice cream, in charge of both hardware and software. Based on the Dobot Magician desktop robotic arm, developed a robotic system that can automatically dispense soft serve ice cream, based on realtime feedback from a loadcell at the gripper which measures the ice cream flow. After 5 months of development, the robot was deployed to Huis Ten Bosch, a theme park in Nagasaki, Japan. After the first deployment, continued development to make the system more robust from the software side, and it is now deployed in various ice cream shops around Japan.

## Other Projects

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Sep 2018 – Dec 2018

### **Ionobot, MIT**

#### *design of autonomous oceanic surface vehicle for ionospheric measurements*

The Ionobot was developed in collaboration with the MIT Lincoln Lab, as part of the 2.013 Engineering Systems Design capstone class. Fluctuations in the ionization level of the earth's upper atmosphere lead to inaccuracies in GPS and radio signals. In this project, we have developed "Ionobot", an autonomous surface vehicle that acts as an ocean platform for ionospheric measurement to take measurements not possible by existing ground-based stations. The boat must autonomously navigate to its designated location of measurement, and remain there for up to 6 weeks at a time under its own power.

In this project I have worked as the manager of the power supply system team. We created the required specifications through repeated discussions and negotiations with other teams (especially for solar panel size and battery weight), designed a system that met the needs for the required power output and oceanic / climate conditions, and evaluated the performance of the solar panels through experiments.

## Publications

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- 2022 | 1. **Toshimitsu, Y.**, Kawaharazuka, K., Akihiro, M., Okada, K. & Inaba, M. *DIJE: Dense Image Jacobian Estimation for Robust Robotic Self-Recognition and Visual Servoing* (submitted, under review) in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2022).
- 2021 | 2. **Toshimitsu, Y.**, Wong, K. W., Buchner, T. & Katzschmann, R. *SoPrA: Fabrication and Dynamical Modeling of a Scalable Soft Continuum Robotic Arm with Integrated Proprioceptive Sensing* in *2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2021), 653–660.
3. **Toshimitsu, Y.**, Kawaharazuka, K., Nishiura, M., Koga, Y., Omura, Y., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Biomimetic Operational Space Control for Musculoskeletal Humanoid Optimizing Across Muscle Activation and Joint Nullspace* in *2021 IEEE International Conference on Robotics and Automation (ICRA)* (May 2021), 1184–1190.
4. Kawaharazuka, K., **Toshimitsu, Y.**, Nishiura, M., Koga, Y., Omura, Y., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Design Optimization of Musculoskeletal Humanoids with Maximization of Redundancy to Compensate for Muscle Rupture* in *2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2021).
5. Koga, Y., Kawaharazuka, K., **Toshimitsu, Y.**, Nishiura, M., Omura, Y., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Self-Body Image Acquisition and Posture Generation With Redundancy Using Musculoskeletal Humanoid Shoulder Complex for Object Manipulation*. *IEEE Robotics and Automation Letters* **6**, 6686–6692 (2021).
6. Kawaharazuka, K., Nishiura, M., Koga, Y., Omura, Y., **Toshimitsu, Y.**, Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Automatic Grouping of Redundant Sensors and Actuators Using Functional and Spatial Connections: Application to Muscle Grouping for Musculoskeletal Humanoids*. *IEEE Robotics and Automation Letters* **6**, 1981–1988 (2021).
7. Onitsuka, M., Nishiura, M., Kawaharazuka, K., Tsuzuki, K., **Toshimitsu, Y.**, Omura, Y., Koga, Y., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Development of Musculoskeletal Legs with Planar Interskeletal Structures to Realize Human Comparable Moving Function* in *Proceedings of the 2020 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2020)* (July 2021), 17–24.
8. Kawaharazuka, K., Nishiura, M., Nakashima, S., **Toshimitsu, Y.**, Omura, Y., Koga, Y., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Stability Recognition with Active Vibration for Bracing Behaviors and Motion Extensions Using Environment in Musculoskeletal Humanoids* in *2021 IEEE 4th International Conference on Soft Robotics (RoboSoft)* (2021), 126–133.
- 2020 | 9. **Toshimitsu, Y.**, Kawaharazuka, K., Tsuzuki, K., Onitsuka, M., Nishiura, M., Koga, Y., Omura, Y., Tomita, M., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. *Biomimetic Control Scheme for Musculoskeletal Humanoids Based on Motor Directional Tuning in the Brain* in *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2020), 7784–7791.
- 2019 | 10. Katzschmann, R. K., Santina, C. D., **Toshimitsu, Y.**, Bicchi, A. & Rus, D. *Dynamic Motion Control of Multi-Segment Soft Robots Using Piecewise Constant Curvature Matched with an Augmented Rigid Body Model* in *2019 2nd IEEE International Conference on Soft Robotics (RoboSoft)* (2019), 454–461.
11. Hayashi, K. & **Toshimitsu, Y.** *Eyes on you: field study of robot vendor using human-like eye component “Akagachi”* in *2019 28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)* (2019), 1–6.