Yasunori Toshimitsu

yasu313nori@gmail.com | ETH Zürich | Zürich, SWITZERLAND
0000-0003-4896-8742 | https://github.com/Yasu31 | https://yasunori.xyz

Education

Jan 2024 – present | **The Max Planck Institute for Intelligent Systems** *Stuttgart, Germany*

Jul 2022 – Jan 2024 | **ETH Zürich** *Zürich, Switzerland*
Ph.D. in the Department of Mechanical and Process Engineering (D-MAVT)
Doctoral Fellow at the Max Planck ETH Center for Learning Systems (CLS)
Recipient of the doctoral research scholarship from the Swiss Government Excellence Scholarship
Recipient of the overseas study scholarship from the Takenaka Scholarship Foundation

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

Jan 2024 – present | **Robotic Materials Department, The Max Planck Institute for Intelligent Systems** *Stuttgart, Germany*
Advisors: Robert Katzschmann, Christoph Keplinger
One-year exchange to the Max Planck Institute as part of the doctoral fellowship program for the Max Planck ETH Center for Learning Systems (CLS)

Jul 2022 – Jan 2024 | **ETH Zürich, Soft Robotics Lab** *Zürich, Switzerland*
Advisors: Robert Katzschmann, Christoph Keplinger
Research the co-optimization of robotic hands for dexterous manipulation to find the optimal configuration with different number of fingers and joints to improve performance and design simplicity
Led the development of a GPU-based simulation and reinforcement learning framework for the dexterous robotic hands such as the Faive Hand, a biomimetic robot hand developed at the Soft Robotics Lab. By training thousands of simulated robot hands in parallel, a policy to rotate a sphere in-hand could be learned in about one hour. It was developed based on IsaacGymEnvs and was released as the faive_gym[1] open source library.

[1] https://github.com/srl-ethz/faive_gym_oss

Mar 2019 – Mar 2022 **University of Tokyo, JSK Robotics Lab** *Tokyo, Japan*

Advisor: Masayuki Inaba, Kei Okada

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** *Zürich, Switzerland*

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** *Boston, USA*

Advisor: Daniela Rus, Robert Katzschmann

Through UROP (Undergratuate 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

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

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.

Scholarships and Fellowships

Sep 2022 – present

Swiss Government Excellence Scholarship

Recipient of the 2022 doctoral research scholarship

Jul 2022 – present

Takenaka Scholarship Foundation

Recipient of the 2022 overseas study scholarship

Jul 2022 – present

Max Planck ETH Center for Learning Systems (CLS)

Doctoral Fellow

Publications

2023

1. **Toshimitsu, Y.**, Forrai, B., Cangan, B. G., Steger, U., Knecht, M., Weirich, S. & Katzschmann, R. K. *Getting the Ball Rolling: Learning a Dexterous Policy for a Biomimetic Tendon-Driven Hand with Rolling Contact Joints* in *2023 IEEE-RAS 22nd International Conference on Humanoid Robots (Humanoids)* (2023), 1–7.
2. Fischer, O., **Toshimitsu, Y.**, Kazemipour, A. & Katzschmann, R. K. Dynamic Task Space Control Enables Soft Manipulators to Perform Real-World Tasks. *Advanced Intelligent Systems* **5**, 2200024. eprint: `https://onlinelibrary.wiley.com/doi/pdf/10.1002/aisy.202200024` (2023).
4. Yasa, O., **Toshimitsu, Y.**, Michelis, M. Y., Jones, L. S., Filippi, M., Buchner, T. & Katzschmann, R. K. An Overview of Soft Robotics. *Annual Review of Control, Robotics, and Autonomous Systems* **6**. eprint: `https://doi.org/10.1146/annurev-control-062322-100607` (2023).

2022

3. Gürtler, N., Widmaier, F., Sancaktar, C., Blaes, S., Kolev, P., Bauer, S., Wüthrich, M., Wulfmeier, M., Riedmiller, M., Allshire, A., Wang, Q., McCarthy, R., Kim, H., Baek, J., Kwon, W., Qian, S., **Toshimitsu, Y.**, Michelis, M. Y., Kazemipour, A., Raayatsanati, A., Zheng, H., Cangan, B. G., Schölkopf, B. & Martius, G. *Real Robot Challenge 2022: Learning Dexterous Manipulation from Offline Data in the Real World* in *Proceedings of the NeurIPS 2022 Competitions Track* (eds Ciccone, M., Stolovitzky, G. & Albrecht, J.) **220** (PMLR, 28 Nov–09 Dec 2022), 133–150.
5. **Toshimitsu, Y.**, Kawaharazuka, K., Miki, A., Okada, K. & Inaba, M. *DIJE: Dense Image Jacobian Estimation for Robust Robotic Self-Recognition and Visual Servoing* in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2022), 2219–2226.
6. Suzuki, T., **Toshimitsu, Y.**, Nagamatsu, Y., Kawaharazuka, K., Miki, A., Ribayashi, Y., Bando, M., Kojima, K., Kakiuchi, Y., Okada, K. & Inaba, M. *RAMIEL: A Parallel-Wire Driven Monopedal Robot for High and Continuous Jumping* in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2022), 5017–5024.
7. Ribayashi, Y., Kawaharazuka, K., **Toshimitsu, Y.**, Kusuyama, D., Miki, A., Shinjo, K., Baudo, M., Suzuki, T., Kojio, Y., Okada, K. & Inaba, M. *Imitation Behavior of the Outer Edge of the Foot by Humanoids Using a Simplified Contact State Representation* in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2022), 4243–4249.
8. Kawaharazuka, K., Ribayashi, Y., Miki, A., **Toshimitsu, Y.**, Suzuki, T., Okada, K. & Inaba, M. *Learning of Balance Controller Considering Changes in Body State for Musculoskeletal Humanoids* in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (2022), 5809–5816.
10. Omura, Y., Kawaharazuka, K., Nagamatsu, Y., Koga, Y., Nishiura, M., **Toshimitsu, Y.**, Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. Human-mimetic binaural ear design and sound source direction estimation for task realization of musculoskeletal humanoids. *ROBOMECH Journal* **9,** 17 (June 2022).
11. Kawaharazuka, K., Miki, A., **Toshimitsu, Y.**, Okada, K. & Inaba, M. Adaptive Body Schema Learning System Considering Additional Muscles for Musculoskeletal Humanoids. *IEEE Robotics and Automation Letters* **7,** 3459–3466 (2022).
12. Kawaharazuka, K., Nishiura, M., **Toshimitsu, Y.**, Omura, Y., Koga, Y., Asano, Y., Okada, K., Kawasaki, K. & Inaba, M. Robust continuous motion strategy against muscle rupture using online learning of redundant intersensory networks for musculoskeletal humanoids. *Robotics and Autonomous Systems* **152,** 104067 (2022).
13. Kazemipour, A., Fischer, O., **Toshimitsu, Y.**, Wong, K. W. & Katzschmann, R. K. *Adaptive Dynamic Sliding Mode Control of Soft Continuum Manipulators* in *2022 International Conference on Robotics and Automation (ICRA)* (2022), 3259–3265.

2021
14. **Toshimitsu, Y.**, Wong, K. W., Buchner, T. & Katzschmann, R. *SoPrA: Fabrication & 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.
15. **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.
16. 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).
17. 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).
18. 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).
19. 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.
20. 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
21. **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
22. 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.
23. 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.