

# Kento Kawaharazuka

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## Personal

Date of Birth: 18/07/1994

Research Interests: Humanoid, Biomimetics, Machine Learning

## Education

Ph.D. Candidate in Dept. of Mechano-Informatics, The University of University, Japan, with Prof. Masayuki Inaba (JSK Robotics Laboratory), 2019-current

M.S. in Dept. of Mechano-Informatics, Graduate School of Information Science and Technology, The University of Tokyo, Japan, 2017-2019

B.S. in Dept. of Mechano-Informatics, Faculty of Engineering, The University of Tokyo, Japan, 2013-2017

## Experience

Internship at Preferred Networks, Robotics Engineer, Japan, 2018-2020

Internship at Works Applications Co. Ltd., Software Engineer, Japan, 2016

Internship at Future Standard, Software Engineer, Japan, 2016

Internship at HIOKI, E.E. CORPORATION, Software Engineer, Japan, 2015

## Skills

### *Software Skills*

Basic: Java, JavaScript, Android, Haskell

Intermediate: Ruby, Lisp, Statistics

Advanced: C, C++, Python, Machine Learning, Algorithms

### *Hardware Skills*

Basic: Electorinics, Machining

Intermediate: 3D CAD, 3D Printer

## Publications

### *Journal Articles (Peer Reviewed)*

1. **K. Kawaharazuka**, M. Nishiura, Y. Koga, Y. Omura, Y. Toshimitsu, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Automatic Grouping of Redundant Sensors and Actuators Using Functional and Spatial Connections: Application to Muscle Grouping for Musculoskeletal Humanoids", *IEEE Robotics and Automation Letters (RAL)*, vol. 6, no. 2, pp. 1981-1988, 2021, (**presented at ICRA2021**)
2. **K. Kawaharazuka**, K. Tsuzuki, Y. Koga, Y. Omura, T. Makabe, K. Shinjo, M. Onitsuka, Y. Nagamatsu, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Toward Autonomous Driving by Musculoskeletal Humanoids: Study of Developed Hardware and Learning-Based Software", *IEEE Robotics and Automation Magazine (RAM)*, vol. 27, no. 3, pp. 84-96, 2020, (**presented at ICRA2021**)
3. **K. Kawaharazuka**, K. Tsuzuki, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Object Recognition, Dynamic Contact Simulation, Detection, and Control of the Flexible Musculoskeletal Hand Using a Recurrent Neural Network With Parametric Bias", *IEEE Robotics and Automation Letters (RAL)*, vol. 5, no. 3, pp. 4580-4587, 2020, (**presented at IROS2020**)
4. **K. Kawaharazuka**, N. Hiraoka, K. Tsuzuki, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Estimation and Control of Motor Core Temperature with Online Learning of Thermal Model Parameters: Application to Musculoskeletal Humanoids", *IEEE Robotics and Automation Letters (RAL)*, vol. 5, no. 3, pp. 4273-4280, 2020, (**presented at IROS2020**)
5. **K. Kawaharazuka**, K. Tsuzuki, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Musculoskeletal AutoEncoder: A Unified Online Acquisition Method of Intersensory Networks for State Estimation, Control, and Simulation of Musculoskeletal Humanoids", *IEEE Robotics and Automation Letters (RAL)*, vol. 5, no. 2, pp. 2411-2418, 2020, (**presented at ICRA2020**)
6. **K. Kawaharazuka**, S. Makino, M. Kawamura, S. Nakashima, Y. Asano, K. Okada, M. Inaba: "Human Mimetic Forearm and Hand Design with a Radioulnar Joint and Flexible Machined Spring Finger for Human Skillful Motions", *Journal of Robotics and Mechatronics (JRM)*, vol. 32, no. 2, pp. 445-458, 2020, (**The first two authors contributed equally to this work**)
7. **K. Kawaharazuka**, K. Tsuzuki, S. Makino, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Long-time Self-body Image Acquisition and its Application to the Control of Musculoskeletal Structures", *IEEE Robotics and Automation Letters (RAL)*, vol. 4, no. 3, pp. 2965-2972, 2019, (**presented at IROS2019**)
8. **K. Kawaharazuka**, S. Makino, M. Kawamura, Y. Asano, K. Okada, M. Inaba: "Online Learning of Joint-Muscle Mapping using Vision in Tendon-driven Musculoskeletal Humanoids", *IEEE Robotics and Automation Letters (RAL)*, vol. 3, no. 2, pp. 772-779, 2018, (**presented at ICRA2018**)
9. **K. Kawaharazuka**, M. Kawamura, S. Makino, Y. Asano, K. Okada, M. Inaba: "Antagonist Inhibition Control in Redundant Tendon-driven Structures Based on Human Reciprocal Innervation for Wide Range Limb Motion of Musculoskeletal Humanoids", *IEEE Robotics and Automation Letters (RAL)*, vol. 2, no. 4, pp. 2119-2126, 2017, (**presented at IROS2017**)

### *International Conference Proceedings (Peer Reviewed)*

1. Y. Toshimitsu, **K. Kawaharazuka**, M. Nishiura, Y. Koga, Y. Omura, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Biomimetic Operational Space Control for Musculoskeletal Humanoid Optimizing across Muscle Activation and Joint Nullspace", *Proceedings of the 2021 IEEE International Conference on Robotics and Automation (ICRA2021)*, 2021

2. S. Nakashima, **K. Kawaharazuka**, M. Nishiura, Y. Asano, Y. Kakiuchi, K. Okada, K. Kawasaki, M. Inaba: "Restoring Force Design of Active Self-Healing Tension Transmission System and Application to Tendon-Driven Legged Robot", *Proceedings of the 2021 IEEE International Conference on Robotics and Automation (ICRA2021)*, 2021
3. **K. Kawaharazuka**, M. Nishiura, S. Nakashima, Y. Toshimitsu, Y. Omura, Y. Koga, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Stability Recognition with Active Vibration for Bracing Behaviors and Motion Extensions Using Environment in Musculoskeletal Humanoids", *Proceedings of the 2021 IEEE International Conference on Soft Robotics (ROBOSOFT2021)*, pp. 126-133, 2021
4. **K. Kawaharazuka**, Y. Koga, K. Tsuzuki, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Exceeding the Maximum Speed Limit of the Joint Angle for the Redundant Tendon-driven Structures of Musculoskeletal Humanoids", *Proceedings of the 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2020)*, pp. 3585-3590, 2020
5. **K. Kawaharazuka**, Y. Koga, K. Tsuzuki, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Applications of Stretch Reflex for the Upper Limb of Musculoskeletal Humanoids: Protective Behavior, Postural Stability, and Active Induction", *Proceedings of the 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2020)*, pp. 3598-3603, 2020
6. **K. Kawaharazuka**, T. Ogawa, C. Nabeshima: "Tool Shape Optimization through Backpropagation of Neural Network", *Proceedings of the 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2020)*, pp. 8387-8393, 2020
7. Y. Toshimitsu, **K. Kawaharazuka**, K. Tsuzuki, M. Onitsuka, M. Nishiura, Y. Koga, Y. Omura, M. Tomita, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Biomimetic Control Scheme for Musculoskeletal Humanoids Based on Motor Directional Tuning in the Brain", *Proceedings of the 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2020)*, pp. 7784-7791, 2020
8. **K. Kawaharazuka**, K. Tsuzuki, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Stable Tool-Use with Flexible Musculoskeletal Hands by Learning the Predictive Model of Sensor State Transition", *Proceedings of the 2020 IEEE International Conference on Robotics and Automation (ICRA2020)*, pp. 4572-4578, 2020
9. T. Nishio, M. Zhao, F. Shi, T. Anzai, **K. Kawaharazuka**, K. Okada, M. Inaba: "Stable Control in Climbing and Descending Flight under Upper Walls using Ceiling Effect Model based on Aerodynamics", *Proceedings of the 2020 IEEE International Conference on Robotics and Automation (ICRA2020)*, pp. 172-178, 2020
10. **K. Kawaharazuka**, S. Makino, K. Tsuzuki, M. Onitsuka, Y. Nagamatsu, K. Shinjo, T. Makabe, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Component Modularized Design of Musculoskeletal Humanoid Platform Musashi to Investigate Learning Control Systems", *Proceedings of the 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2019)*, pp. 7294-7301, 2019
11. **K. Kawaharazuka**, K. Tsuzuki, S. Makino, M. Onitsuka, K. Shinjo, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Task-specific Self-body Controller Acquisition by Musculoskeletal Humanoids: Application to Pedal Control in Autonomous Driving", *Proceedings of the 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2019)*, pp. 813-818, 2019
12. **K. Kawaharazuka**, T. Ogawa, C. Nabeshima: "Dynamic Task Control Method of a Flexible Manipulator Using a Deep Recurrent Neural Network", *Proceedings of the 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2019)*, pp. 7689-7695, 2019

13. K. Shinjo, **K. Kawaharazuka**, Y. Asano, S. Nakashima, S. Makino, M. Onitsuka, K. Tsuzuki, K. Okada, K. Kawasaki, M. Inaba: "Foot with a Core-shell Structural Six-axis Force Sensor for Pedal Depressing and Recovering from Foot Slipping during Pedal Pushing Toward Autonomous Driving by Humanoids", *Proceedings of the 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2019)*, pp. 3049-3054, 2019
14. S. Nakashima, T. Shirai, **K. Kawaharazuka**, Y. Asano Y. Kakiuchi, K. Okada, M. Inaba: "An Approach of Facilitated Investigation of Active Self-healing Tension Transmission System Oriented for Legged Robots", *Proceedings of the 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2019)*, pp. 2567-2572, 2019, **SICE International Young Authors Award (2019)**
15. T. Makabe, T. Shirai, Y. Nagamatsu, **K. Kawaharazuka**, S. Fumihito, K. Okada, M. Inaba: "Development of Joint Module with Two-Speed Gear Transmission and Joint Lock Mechanism during Driving for Task Adaptable Robot", *Proceedings of the 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2019)*, pp. 5123-5130, 2019
16. **K. Kawaharazuka**, K. Tsuzuki, M. Onitsuka, Y. Koga, Y. Omura, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Reflex-based Motion Strategy of Musculoskeletal Humanoids under Environmental Contact Using Muscle Relaxation Control", *Proceedings of the 2019 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2019)*, pp. 114-119, 2019
17. Y. Koga, **K. Kawaharazuka**, M. Onitsuka, T. Makabe, K. Tsuzuki, Y. Omura, Y. Asano, K. Okada, M. Inaba: "Modification of Muscle Antagonistic Relations and Hand Trajectory on the Dynamic Motion of Musculoskeletal Humanoid", *Proceedings of the 2019 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2019)*, pp. 632-637, 2019
18. Y. Asano, S. Nakashima, I. Yanokura, M. Onitsuka, **K. Kawaharazuka**, K. Tsuzuki, Y. Koga, Y. Omura, K. Okada, M. Inaba: "Ankle-Hip-Stepping Stabilizer on Tendon-Driven Humanoid Kengoro by Integration of Muscle-Joint-Work Space Controllers for Knee-Stretched Humanoid Balance", *Proceedings of the 2019 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2019)*, pp. 397-402, 2019
19. **K. Kawaharazuka**, K. Tsuzuki, S. Makino, Y. Asano, K. Okada, M. Inaba: "Modeling and On-line Learning of Musculoskeletal Intersensory Networks for Static Controls of Tendon-driven Humanoids", *Proceedings of 9th International Symposium on Adaptive Motion of Animals and Machines (AMAM2019)*, 2019, **Company of Biologists Early Career Researcher Grant (500 GBP)**
20. **K. Kawaharazuka**, T. Ogawa, J. Tamura, C. Nabeshima: "Dynamic Manipulation of Flexible Objects with Torque Sequence Using a Deep Neural Network", *Proceedings of the 2019 IEEE International Conference on Robotics and Automation (ICRA2019)*, pp. 2139-2145, 2019
21. **K. Kawaharazuka**, T. Makabe, S. Makino, K. Tsuzuki, Y. Nagamatsu, Y. Asano, T. Shirai, F. Sugai, K. Okada, K. Kawasaki, M. Inaba: "TWIMP: Two-Wheel Inverted Musculoskeletal Pendulum as a Learning Control Platform in the Real World with Environmental Physical Contact", *Proceedings of the 2018 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2018)*, pp. 784-790, 2018, **(The first two authors contributed equally to this work)**
22. **K. Kawaharazuka**, S. Makino, M. Kawamura, Y. Asano, K. Okada, M. Inaba: "A Method of Joint Angle Estimation Using Only Relative Changes in Muscle Lengths for Tendon-driven Humanoids with Complex Musculoskeletal Structures", *Proceedings of the 2018 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2018)*, pp. 1128-1135, 2018
23. T. Makabe, **K. Kawaharazuka**, K. Tsuzuki, K. Wada, S. Makino, M. Kawamura, A. Fujii, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: "Development of Movable Binocular High-Resolution

- Eye-Camera Unit for Humanoid and the Evaluation of Looking Around Fixation Control and Object Recognition”, *Proceedings of the 2018 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2018)*, pp. 840-845, 2018
24. **K. Kawaharazuka**, S. Makino, M. Kawamura, A. Fujii, Y. Asano, K. Okada, M. Inaba: “Online Self-body Image Acquisition Considering Changes in Muscle Routes Caused by Softness of Body Tissue for Tendon-driven Musculoskeletal Humanoids”, *Proceedings of the 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2018)*, pp. 1711-1717, 2018
  25. S. Makino, **K. Kawaharazuka**, M. Kawamura, A. Fujii, T. Makabe, M. Onitsuka, Y. Asano, K. Okada, K. Kawasaki, M. Inaba: “Five-Fingered Hand with Wide Range of Thumb Using Combination of Machined Springs and Variable Stiffness Joints”, *Proceedings of the 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2018)*, pp. 4562-4567, 2018, **IEEE RAS Japan Joint Chapter Young Award (2018), IROS ICROS Best Application Paper Award 2018 Finalists**
  26. A. Fujii, S. Nakashima, M. Kawamura, **K. Kawaharazuka**, S. Makino, Y. Asano, K. Okada, M. Inaba: “Development and Functional Evaluation of a Deformable Membrane Capsule for an Open Ball Glenohumeral Joint”, *Proceedings of The 2018 IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechanics (BIOROB2018)*, pp. 853-858, 2018
  27. **K. Kawaharazuka**, S. Makino, M. Kawamura, Y. Asano, Y. Kakiuchi, K. Okada, M. Inaba: “Human Mimetic Forearm Design with Radioulnar Joint using Miniature Bone-muscle Modules and its Applications”, *Proceedings of the 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2017)*, pp. 4956-4962, 2017, **IEEE RAS Japan Joint Chapter Young Award (2017)**
  28. S. Makino, **K. Kawaharazuka**, M. Kawamura, Y. Asano, K. Okada, M. Inaba: “High-power, flexible, robust hand: Development of musculoskeletal hand using machined springs and realization of self-weight supporting motion with humanoid”, *Proceedings of the 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2017)*, pp. 1187-1192, 2017
  29. Y. Asano, T. Kozuki, S. Ookubo, M. Kawamura, S. Nakashima, T. Katayama, Y. Iori, H. Toshinori, **K. Kawaharazuka**, S. Makino, Y. Kakiuchi, K. Okada, M. Inaba: “Human Mimetic Musculoskeletal Humanoid Kengoro toward Real World Physically Interactive Actions”, *Proceedings of the 2016 IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS2016)*, pp. 876-883, 2016, **Best Interactive Paper Award Finalist**

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