Byungchul Kim – Curriculum Vitae

Distributed Robotics Lab
Computer Science and Artificial Intelligence Lab (CSAIL)
Electrical Engineering and Computer Science
Massachusetts Institute of Technology
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Research Interests

- Soft Robotics
- Computational Co-design Framework
- Prosthetic Hand
- Soft Hand Wearable Robot
- Tendon-driven Actuator

Experience

Jan. 2023 - Present **Postdoctoral Research Associate**
Distributed Robotics Lab, Computer Science and Artificial Intelligence Lab (CSAIL), Massachusetts Institute of Technology
Advisors: Prof. Daniela Rus
Research Project: Soft Manipulation, Computational Co design, CETI Project

Mar. 2023 - Present **Research Affiliate**
Harvard Microrobotics Lab, School of Engineering and Applied Sciences (SEAS), Harvard
Advisors: Prof. Robert Wood
Research Project: CETI Project

Sep. 2020 - Dec. 2022 **Postdoctoral Research Associate**
Biorobotics Lab, Seoul National University Soft Robotics Research Center (SRRC), Seoul National University
Advisors: Prof. Kyu-Jin Cho
Research Project: Soft Wearable Robot, Tendon-driven actuator, Assistive robot, Rehabilitation robot

Education

Mar. 2014 - Aug. 2020 **Ph.D. in Mechanical Engineering**
Seoul National University, Seoul, Korea
Dissertation: Tendon-Driven Hand Wearable Robot using Slider-Tendon Linear Actuator
Advisor: Prof. Kyu-Jin Cho

Mar. 2012 - Feb. 2014 **M.S. in Mechanical and Aerospace Engineering**
Seoul National University, Seoul, Korea
Thesis: A user-friendly assistive glove for SCI people performing natural writing posture
Advisor: Prof. Kyu-Jin Cho

Mar. 2008 - Feb. 2012 **B.S. in Mechanical and Aerospace Engineering**
Seoul National University, Seoul, Korea
Advisor: Prof. Minsu Kim

PUBLICATIONS

International Journals

1. Jaehyun Yi, **Byungchul Kim**, Kyu-Jin Cho, and Yong-Lae Park, “Underactuated Robotic Gripper with Fiber-Optic Force

Sensing Tendons," in **IEEE Robotics & Automation Letters (I.F 5.2, Top 20%),** 14.1 (2023) [pdf]

2. **Byungchul Kim**, Useok Jeong, Brian Byunghyun Kang, and Kyu-Jin Cho, "Slider-Tendon Linear Actuator with Under-actuation and Fast-connection for Soft Wearable Robots ", in ***IEEE/ASME Transactions on Mechatronics*** **(I.F 6.4, Top 10%)**, vol. 26, no. 6, pp. 2932-2943, Dec. 2021. [pdf], [video]
3. **Byungchul Kim**, Jiwon Ryu, and Kyu-Jin Cho, "Joint Angle Estimation of a Tendon-Driven Soft Wearable Robot through a Tension and Stroke Measurement," in ***Sensors*** **(I.F 3.9, Top 25%)**, 20.10 (2020): 2852. [pdf]
4. **Byungchul Kim**, Hyunki In, Daeyoung Lee, and Kyu-Jin Cho, "Development and assessment of a hand assist device: GRIPIT", in ***Journal of NeuroEngineering and Rehabilitation*** **(I.F 5.1, Top 5%)**, 14.1 (2017): 15. [pdf], [video]

Computer Science Conference

5. Tsun-Hsuan Wang, Juntian Zheng, Pingchuan Ma, Yilun Du, **Byungchul Kim**, Andrew Everett Spielberg, Joshua B. Tenenbaum, Chuang Gan, Daniela Rus, "DiffuseBot: Breeding Soft Robots with Physics-Augmented Generative Diffusion Models," in **Neural Information Processing Systems**. [pdf], [site] **** Oral presentation****

Journals in Preparation / Under Review

6. **Byungchul Kim**, Useok Jeong, and Kyu-Jin Cho, " Analysis and Design of Dual Tendon Routing for the Under-actuated Tendon-Driven Robotic Systems ", submitted, in ***IEEE Transactions on Robotics***.
7. **Byungchul Kim**, Kyubum Kim, Sejin Jeong, and Kyu-Jin Cho, " Exo-Glove Shell: A Hybrid Exo-Glove for the Thumb Opposition with an Under-Actuated Tendon-Driven System," submitted, in ***Soft Robotics***. [site]

Refereed Conference Paper

8. **Byungchul Kim,** Useok Jeong, Brian Byunghyun Kang, and Kyu-Jin Cho, "Slider-Tendon Linear Actuator with Under actuation and Fast connection for Soft Wearable Robots", **International Conference on Advanced Intelligent Mechatronics**, 2021.

Patents

9. Kyu-Jin Cho, **Byungchul Kim**, and Daeyoung Lee, "PEN HOLDER", US 9522562, US.
10. Kyu-Jin Cho, Hyunki In, Kyuhan Cho, and **Byungchul Kim**, "PASSIVE VARIABLE TRANSMISSION FOR WIRE DRIVEN JOINT MECHANISM", 10-11600270-0000, KR. **** Technology transfer****
11. Kyu-Jin Cho, **Byungchul Kim**, and Hyungmin Choi, "SLIDER TYPE TENDON DRIVEN ACTUATOR FOR UNDER-ACTUATION AND GLOVE TYPE WEARABLE ROBOT HAVING THE SAME ACTUATOR", 2020/005275, Patent pending (PCT/KR).

Books

12. Myungjoon Lim, Jiyoung Park, Kuem Ju Lee, Hyosun Kweon, **Byungchul Kim**, Kyu-Jin Cho, and Hyun Choi, "Usability of a New Writing Assistive Device for Persons with Cervical Spinal Cord Injury," in ***Studies in health technology and informatics****, 217 (2015): 710-717.*

Other Conferences and Workshop Papers

13. Cedric Honnet, Yunyi Zhu, Martin Nisser, Chao Liu, **Byungchul Kim**, Jae Hun Seol, Jongho Lee, Daniela Rus, and Stefanie Mueller, "Laser-Etching Flexible Sensors for Robotic Touch Recognition," IEEE International Conference on Robotics and Automation, Late Braking Results, London, United Kingdom, May 2023. [video]
14. **Byungchul Kim** and Kyu-Jin Cho, "Building Simple Yet Competent Soft-Rigid Hybrid Hand Wearable Robots," IEEE RAS/EMBS International Conference on Biomedical Robotics & Biomechanics, Workshop (Advancing Hand Wearable Robotics through novel design, actuation, sensing, and control algorithm), Seoul, Korea, August 2022.
15. **Byungchul Kim** and Kyu-Jin Cho, "Slider-Tendon Linear Actuator to Simplify the Soft Wearable Robots", IEEE International Conference on Robotics and Automation, Workshop (Challenges and Opportunities of Bio-inspired Design, Actuation, and Locomotion), Philadelphia, USA, May 2022.
16. Kyubum Kim, **Byungchul Kim,** and Kyu-Jin Cho, "Data-driven Inverse Kinematics for Human Hand", International Conference on Control Automation and Systems, Korea, October 2021.
17. **Byungchul Kim**, and Kyu-Jin Cho, "Wrist Anchor for Soft Hand Wearable Robot", The Korean society of Mechanical Engineers, on-line, April 2021.
18. **Byungchul Kim**, Hyungmin Choi, and Kyu-Jin Cho, "Wrist tendon anchor for soft wearable robot", The Korean society of Mechanical Engineers, on-line, December 2020.
19. Sanghee Cheon, Brian Byunghyun Kang, **Byungchul Kim**, Hyungmin Choi, Kyubum Kim, and Kyu-Jin Cho, "Exo-Glove Power: A Soft Wearable Hand Robot for Power Grasp Enhancement,", International Conference of Control Automation and Systems, Jeju Island, Korea, July 2019.
20. **Byungchul Kim**, Brian Byunghyun Kang, Sanghee Cheon, Hyungmin Choi, Kyubum Kim, and Kyu-Jin Cho, "Wrist tendon anchor for soft wearable robot," International Conference of Control Automation and Systems, Jeju Island,

Korea, July 2019.

21. **Byungchul Kim**, Brian Byunghyun Kang, Hyungmin Choi, Kyubum Kim, and Kyu-Jin Cho, "Under-actuated tendon routing for the soft hand wearable robots," 2019 SNU-UT Joint Workshop, Feb 2019.
22. **Byungchul Kim**, and Kyu-Jin Cho, "Modeling of the relationship between wire tension and joint torque for force control of tendon driven hand assist wearable robot", International Conference of Control Automation and Systems, Pyeongchang, Korea, October 2018.
23. **Byungchul Kim**, Haemin Lee, Sanghoon Kim, and Kyu-Jin Cho, "Tendon path design of robotic hand for natural hand motion, The Korean society of Mechanical Engineers, Daejeon, Korea, April 2017.
24. Jiyoung Park, Myungjoon Lim, Keumju Lee, Hyosoon Kweon, **Byungchul Kim**, Kyu-Jin Cho, and Hyeon Choi, Usability assessment of a glove type writing assistive device for people with spinal cord injury, International Convention on Rehabilitation Engineering, and assistive technology, Midview city, Singapore, August 2015.
25. **Byungchul Kim,** Daeyoung Lee, and Kyu-Jin Cho, Development of tendon maintain system for tendon-driven wearable device, The Korean Society of Precision Engineering, Jeju Island, Korea, May 2015.
26. **Byungchul Kim**, Hyunki In, and Kyu-Jin Cho, Strap driven system for hand soft exoskeleton, International Biomedical Engineering Conference, Gwangju, Korea, November 2014.
27. **Byungchul Kim**, Daeyoung Lee, Jisuk Kim, Hyunki In, and Kyu-Jin Cho, Usability assessment of a glove type writing assistive device for people with spinal cord injury, Rehabilitation Engineering and Assistive Technology Society of Korea, Jeonju, Korea, April 2012.

Theses and Dissertations

28. **Byungchul Kim**, "Tendon-Driven Hand Wearable Robot using Slider-Tendon Linear Actuator", Doctoral Dissertation, Seoul National University, Seoul, Korea. [pdf]
29. **Byungchul Kim**, "A user-friendly assistive glove for SCI people performing natural writing posture", master's thesis, Seoul National University, Seoul, Korea.

Invited talks

Jun. 2023	**Under-actuated Tendon-driven Soft Robots for the Human Assistance** UC Berkeley
Jun. 2022	**Under-actuated Tendon-driven Mechanism for the Simple and Competent Robots** MIT

Workshop organization

- Organizing committee, "Advancing Hand Wearable Robotics through novel design, actuation, sensing, and control algorithm", workshop, IEEE RAS/EMBS International Conference on Biomedical Robotics & Biomechanics, August 2022. [pdf] [site]

Research

2023 - Present	**Computational co-design framework [site]** ◆ Generative AI for the robot design Contributed the real-world robot design and fabrication.
2023 - Present	**Project CETI [site]** ◆ Understanding what whales are saying. Contributed wearable tag design.
2023 - Present	**Hybrid rigid-soft hand development** ◆ Designing hybrid rigid-soft hand for kitchen work Contributed the robotic hand design.
2021 - 2023	**Rehabilitation robot system for untact self-training** *Funded by National Research Foundation of Korea, Ministry of Trade, Industry and Energy of Korea* ◆ Upper limb rehabilitation robot system for untact self-training Contributed the actuator design (Slider-Tendon Linear Actuator)

2020 - 2023 **SoFT meta-Human**
Funded by National Research Foundation of Korea, Ministry of Science, ICT and Future Planning
- Soft wearable robots for everyday use.

Contributed the design, prototyping, and experiments.

2020 - 2023 **GUI for the Hand Wearable Robot**
- GUI for the user to manipulate the hand wearable robot.

Contributed the original idea, GUI design, coding.

2020 - 2023 **Soft Hand Wearable Robot for Poliomyelitis**
Funded by National Rehabilitation Center of Korea
- Customized hand wearable robot design for the poliomyelitis

Contributed the design, control for the safety.

2017 - 2023 **Exo-Glove Thumb [Site]**
- Dissertation Topic for Ph. D
- Hand wearable robot that assists the thumb opposition with under-actuation mechanism.

Contributed the original idea, design, prototyping, experiments, and analyzing the data.

2020 - 2023 **POE Grasp**
- Tendon-driven robot simulation toolkit using Matlab

Contributed the original idea, coding, and validation.

2017 - 2023 **Tendon-driven Actuators for the Soft Wearable Robots [site]**
Funded by National Research Foundation of Korea, Ministry of Trade, Industry and Energy of Korea
- Slider-Tendon Linear Actuator (Dissertation Topic for Ph. D)

**** Exhibited in 2020 CES / 2019 RoboSoft / 2022 IROS ****

Contributed the original idea, design, prototyping, experiments, and analyzing the data.
- Slack Enabling Actuator

Stabilized the actuator performance and reduced the actuator size.
- Series/Parallel Elastic Actuator

Designed series/parallel elastic actuator for the tendon-driven soft wearable robot.

2020 - 2021 **Exo-Index**
- Hand wearable robot generating three different postures using machine learning technic.

Contributed the original idea, design, prototyping, experiments, and analyzing the data.

2020 - 2021 **Exo-Glove Poly II ** Exhibited in 2020 CES / 2022 IROS ****
Funded by National Rehabilitation Center of Korea
- Hand wearable robot generating three different postures using machine learning technic.

Contributed the actuator design.

2015 - 2017 **Development of Biomimetic Bionic Hand Mechanism**
Funded by National Research Foundation of Korea, Ministry of Science, ICT and Future Planning
- Prosthetic hand for the amputee

Contributed the design of tendon-driven actuators, tendon routings, and electric circuits.

2014 - 2015 **Under-actuated bionic arm system ** Technology transfer****
Funded by National Research Foundation of Korea, Ministry of Science, ICT and Future Planning
- Under-actuated Prosthetic hand for the amputee

Contributed the under-actuated tendon routing design.

2013 - 2017 **GRIPIT ** Minister`s Prize, 16th Industrial Technology Award of the Month ****
Funded by National Research Foundation of Korea, Ministry of Industry and Energy
(Co-work with SMT Inc.)
- Active Hand Assist Device for the People with Spinal Cord Injury

Contributed the original idea, design, prototyping, experiments, and analyzing the data.
Received $2,000 investment through social funding (KaKao Story Funding)

2013 - 2014 **Development of an Embedded Control Module for Rehabilitation Devices**
Funded by National Rehabilitation Center of Korea
(Co-work with National Rehabilitation Center of Korea and NT Research Inc.)
- Rehabilitation devices for the stroke people

Participated in clinical trials with muscular disease patients and SCI patients.

2012 - 2015 **Exo-Glove**
Funded by National Rehabilitation Center of Korea
Funded by National Research Foundation of Korea, Ministry of Education and Science Technology
- Hand wearable robot for the spinal cord injury

Participated in clinical trials with muscular disease patients and SCI patients (Co-work with National Rehabilitation Center of Korea)

Technical Skills

Design & Manufacturing, Embedded system, Control, Clinical test

- *Various prototyping experiences* (Exo-Glove, Bionic arm, GRIPIT, embedded control module for rehabilitation devices, experimental setups)
- *Actuator design and control* (Tendon-driven actuators for the soft wearable robots, low-level control, CAN open communication)
- *Clinical test experiences* (Clinical test of Exo-Glove, GRIPIT, Bionic arm, rehabilitation devices for the stroke patient, etc.)
- *Controller design and simulation* (MATLAB, LabVIEW, QT creator, etc.)
- *Control system prototyping* (ROS, Compact RIO, FPGA, STM, Arduino, etc.)
- *Analysis* (MATLAB, Working model 2D, etc.)
- *CAD design* (SOLIDWORKS, CARTIA, etc.)
- *Manufacturing* (CNC milling, laser cutter, 3D printing, etc.)
- *Circuit design, Artworks* (KiCAD)

Scholarship

Jan. 2023 - Jan. 2024 **Biomedical Global Talent Nurturing Program**
Funded by Korea Health Industry Development Institute

Sep. 2016 - Dec. 2016 **Brain Korea 21 Research Scholarship**
Sep. 2012 - Dec. 2012 *Funded by National Research Foundation of Korea*
Mar. 2012 - Jun. 2012

Mar. 2014 - Jun. 2014 **Lecture & Research Scholarship**
Funded by Seoul National University

Sep. 2011 - Dec. 2011 **Superior Academic Performance**
Sep. 2010 - Dec. 2010 *Funded by Seoul National University*
Sep. 2009 - Dec. 2009

Honor and Awards

Dec. 2016 Excellence award, Government 3.0 National Participation and Collaboration Contest, Ministry of Health and Welfare
Nov. 2012 President prize, Creative design competition, Korea Society for Engineering Education
Nov. 2012 Bronze prize, International Co-Creative Design Competition, Seoul National University
Oct. 2012 Gold prize, Creative design competition, Korea University
Oct. 2012 Grand prize, Creative design competition, Seoul National University

Teaching Experience

Mar. 2017 - Jun. 2017 **Teaching Assistant**
Introduction for soft robotics (Prof. Kyu-Jin Cho)
Seoul National University

Mar. 2012 - Jun. 2012 **Teaching Assistant**
Mechanical System Modeling and Control (Prof. Kyu-Jin Cho)
Seoul National University

Mar. 2020 - Dec. 2020 **B.S Thesis/UROP Tutoring**
Mar. 2019 - Jun. 2019 Led the B.S. Thesis of three undergraduate students (Prof. Kyu-Jin Cho)
Mar. 2018 - Dec. 2018 Led four students for the Undergraduate Research Opportunities (Prof. Kyu-Jin Cho)
Mar. 2017 - Dec. 2017 *Seoul National University*
Mar. 2012 - Dec. 2012

Mar. 2020 - Dec. 2020 **High school lecture**
Lecture for Book-il High school students “Careers and Occupations”