

Inrak Choi

✉ irchoi@stanford.edu • 🌐 www.inrakchoi.com

EDUCATION

Stanford University

Ph.D. in Mechanical Engineering

Advisor: Sean Follmer, Ph.D.

Thesis title: Handheld Haptic Feedback for Grasping in Virtual Reality

Cumulative GPA: 3.96 / 4.0

Stanford, CA, USA

2016 – 2019

Stanford University

M.S. in Mechanical Engineering

Quals: Dynamics, Robotics, & Research (Haptics)

Stanford, CA, USA

2013 – 2016

Korea University

B.S. in Mechanical Engineering

Seoul, Korea

2009 – 2013

EMPLOYMENT

Seoul National University

Postdoctoral Research Fellow at Soft Robotics Research Center, Advisor: Yong-Lae Park, Ph.D. Nov. 2019 – present

○ 1) Soft / thin film actuators and 2) Tunable soft materials and structures for wearable and haptic applications.

○ This position is for compulsory **military service** in South Korea.

Seoul, Korea

Stanford SHAPE Lab

Research Assistant, Advisor: Sean Follmer, Ph.D.

○ Developed handheld haptic devices using voice coil actuators to create variable perceived stiffness and pseudo force for VR interaction.

○ Developed wearable haptic interfaces for grasping, named Wolverine and Grabity, to enable users to get kinesthetic feedback from virtual objects, such as rigid stiffness or weight, in VR/AR environments.

○ Investigated passive & energy-dissipative mechanisms, such as jamming, braking, and clutching, for light weight, power-efficient wearable haptic interfaces.

○ Collaborated with researchers at MIT Media Lab, Facebook Reality Labs, and Google Research, and Hyundai Motor Company.

Stanford, CA

June 2015 – September 2019

Microsoft Research

Research Intern for a haptic project

○ Mentor: Mike Sinclair, Hrvoje Benko, Ph.D., Eyal Ofek, Ph.D., Christian Holz, Ph.D.

○ Published a CHI paper about CLAW, a VR haptic controller, and filed a patent.

Redmond, WA

June 2017 – Sept. 2017

Hansen Medical, Inc,

Research Intern in Robotics Group, Supervisor: June Park, Ph.D.

○ Proposed new active guidewire manipulation mechanisms.

○ Wrote two invention disclosures in three months then applied to a patent.

Mountain View, CA

June 2015 – Sept. 2015

Stanford Artificial Intelligence Laboratory

Research Assistant, Advisor: Oussama Khatib, Ph.D.

○ Human-friendly robotic arm project. Designed and assembled a wrist and a gripper.

○ Implemented a hybrid actuation system with pneumatic artificial muscles and electrical dc motors.

Stanford, CA

Jan. 2014 – May 2015

HONORS AND AWARDS

Best Paper Award, UIST 2017 (top 1%) <i>Author, "Gravity: A Wearable Haptic Interface for Simulating Weight and Grasping in Virtual Reality"</i>	2017
Best Paper Award, UIST 2016 (top 1%) <i>Co-author, "Rovables: Miniature On-Body Robots as Mobile Wearables"</i>	2016
Best Demo Award, UIST 2016 <i>Author, "Wolverine: A Wearable Haptic Interface for Grasping in VR"</i>	2016
Distinguished Paper Award, IMWUT 2018 Vol. 2 (top 4%) <i>Co-author, "Epidermal Robots: Wearable Sensors That Climb on the Skin"</i>	2018
Honorable Mention, Fast Company Innovation by Design 2017 <i>"Wolverine: A Wearable Haptic Interface for Grasping in VR"</i>	2017
Young Engineers Honor Society (YEHS) <i>The National Academy of Engineering of Korea (NAEK)</i>	2011 – present
Presidential Science Scholarship <i>Awarded by President of South Korea</i>	2009 – 2013
Great Honor Student for Academic Achievement <i>Korea University</i>	2009 – 2013

PUBLICATIONS

- Conference & Journal Papers.....
1. J. Kwon*, I. Choi*, J. Moon, M. Park, B. Jeong, P. Pathak, J. Ahn, and Y.L. Park. Sandwich Jamming Structures with Cellular Cores and Rubber-Laminated Face Sheets for Assistive and Protective Wearables. *: **equally contributed** (In review)
 2. B. Do, I. Choi, and S. Follmer. An All-Soft Variable Impedance Actuator Enabled by Embedded Layer Jamming. IEEE/ASME Transactions on Mechatronics (TMECH) (In review)
 3. I. Choi, E. J. Gonzalez, and S. Follmer. Hybrid Actuation with Unidirectional Clutches for Handheld Haptic Controllers. IEEE Robotics and Automation Letters (RA-L), 2021.
<https://doi.org/10.1109/LRA.2021.3068700>
 4. I. Choi, Y. Zhao, E. J. Gonzalez, and S. Follmer. Augmenting Perceived Softness of Haptic Proxy Objects through Transient Vibration and Visuo-Haptic Illusion in Virtual Reality. IEEE Transactions on Visualization and Computer Graphics (TVCG), 2020.
<https://doi.org/10.1109/TVCG.2020.3002245>
 5. I. Choi, E. Ofek, H. Benko, M. Sinclair, and C. Holz. CLAW: A Multifunctional Handheld Haptic Controller for Grasping, Touching, and Triggering in Virtual Reality. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montreal, QC, Canada (CHI 2018)
<https://doi.org/10.1145/3173574.3174228>
 6. A. Dementyev, J. Hernandez, I. Choi, S. Follmer, and J. Paradiso. 2018. Epidermal Robots: Wearable Sensors That Climb on the Skin. Proc. ACM Interact. Mob. Wearable Ubiquitous Technol (IMWUT). 2, 3, Article 102, 2018. **Distinguished Paper Award (among the top 8 awarded papers)**
<https://doi.org/10.1145/3264912>

7. **I. Choi**, N. Corson, L. Peiros, E. W. Hawkes, S. Keller, and S. Follmer. A Soft, Comtrollable, High Force Density Linear Brake Utilizing Layer Jamming. *IEEE Robotics and Automation Letters (RA-L)*, 2018. <https://doi.org/10.1109/LRA.2017.2761938>
8. **I. Choi**, H. Culbertson, M. R. Miller, A. Olwal, and S. Follmer. Grability: A Wearable Haptic Interface for Simulating Weight and Grasping in Virtual Reality. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software & Technology (UIST 2017)* **Best Paper Award (Top 1%)** <https://doi.org/10.1145/3126594.3126599>
9. H.-L. C. Kao, D. Ajilo, O. Anilionyte, A. Dementyev, **I. Choi**, S. Follmer, and C. Schmandt. Exploring interactions and perceptions of kinetic wearables. In *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS 2017)* <https://doi.org/10.1145/3064663.3064686>
10. A. Dementyev, H.-L. C. Kao, **I. Choi**, D. Ajilo, M. Xu, J. A. Paradiso, C. Schmandt, and S. Follmer. Rovables: Miniature On-Body Robots as Mobile Wearables. In *Proceedings of the 29th Annual ACM Symposium on User Interface Software & Technology (UIST 2016)* **Best Paper Award (Top 1%)** <https://doi.org/10.1145/2984511.2984531>
11. **I. Choi**, E. W. Hawkes, D. L. Christensen, C. J. Ploch, and S. Follmer. Wolverine: A Wearable Haptic Interface for Grasping in Virtual Reality. In *Proceedings of the 2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2016)* <https://doi.org/10.1109/IROS.2016.7759169>

Demos & Posters.....

1. **I. Choi**, E. Ofek, H. Benko, M. Sinclair, and C. Holz. Demonstration of CLAW: A Multifunctional Handheld VR Haptic Controller. In *Adjunct proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montreal, QC, Canada (CHI 2018)*
2. M. Sinclair, E. Ofek, C. Holz, **I. Choi**, E. Whitmire, E. Strasnick, H. Benko. Three Haptic Shape-Feedback Controllers for Virtual Reality. *IEEE Virtual Reality 2018*
3. A. Dementyev, J. Hernandez, S. Follmer, **I. Choi**, and J. Paradiso. SkinBot: A Wearable Skin Climbing Robot. In *Adjunct proceedings of the 30th Annual ACM Symposium on User Interface Software & Technology (UIST 2017)*
4. **I. Choi** and S. Follmer. Wolverine: A Wearable Haptic Interface for Grasping in Virtual Reality. In *Adjunct proceedings of the 29th Annual ACM Symposium on User Interface Software & Technology (UIST 2016)* **Best Demo Award (among the top 3 awarded demos)**
5. **I. Choi** and S. Follmer. "Wolverine", *ACM Interactions, Demo Hour, Jan/Feb 2017*.

PATENTS

1. S. Lee, S. Follmer, and **I. Choi**, "Vehicle and Method of Controlling the same," 2020. (U.S. Appl. No.: 16/991,559)
2. S. Lee, S. Follmer, and **I. Choi**, "Input Device and Vehicle Including the same, and Method of Controlling Input Device," 2020. (U.S. Appl. No.: 16/991,539)
3. C. Holz, E. Ofek, M. J. Sinclair, H. Benko, **I. Choi**, and E. Whitmire, "Controller with haptic feedback," 2020. (U.S. Patent: 10,617,942)
4. **I. Choi**, H. Culbertson, and S. Follmer, "Grability: A Wearable Haptic Interface for Simulating Weight and Grasping in Virtual Reality," 2017. (U.S. Patent: 10,852,872)

5. E. W. Hawkes, **I. Choi**, and S. Follmer, "Wolverine: A Wearable Haptic Interface for Grasping in Virtual Reality," 2019. (U.S. Patent: 10,248,201)
6. **I. Choi**, J. Park, and A. Kokish, "Active Drive for Guidewire Manipulation," 2016. (U.S. Appl. No.: 15/250,232).
7. **I. Choi**, "A Device for Removing the Snow of Vinyl House," 2008. (Korea Utility Model Appl. No. 20-2008-0000167)

TEACHING EXPERIENCE

ME 161 / 261: Dynamic Systems, Vibrations and Control <i>Course Assistant, Instructor: Paul Mitiguy, Ph.D.</i>	Stanford 2014, 2015, and 2016
ME 331 A: Advanced Dynamics & Computation <i>Course Assistant, Instructor: Paul Mitiguy, Ph.D.</i>	Stanford 2014 and 2015
ME 331 B: Advanced Dynamics, Simulation & Control <i>Course Assistant, Instructor: Paul Mitiguy, Ph.D.</i>	Stanford 2014 and 2015
CS 225A: Experimental Robotics <i>Course Assistant, Instructor: Oussama Khatib, Ph.D.</i>	Stanford 2015
CS 223A: Introduction to Robotics <i>Course Assistant, Instructor: Oussama Khatib, Ph.D.</i>	Stanford 2015

PROFESSIONAL ACTIVITIES

Reviewer.....
 More than 40 papers in HCI/Haptics/Robotics such as ToH, SoRo, TMECH, Actuators, IEEE VR, UIST, CHI, ICRA, IROS, RA-L, IJHCI, Haptics Symposium, Eurohaptics, TOMM, BioRob, ISMAR

SELECTED MEDIA COVERAGE

BBC Click "Robot seeks out skin cancer with suction" October 15, 2018
Digital Trends "MIT's Creepy-crawly Robot can Help Monitor Your Health" October 1, 2018
New Scientist "Robot seeks out skin cancer with suction" September 28, 2018

Gizmodo "Microsoft Wants You to Touch the VR World With a Giant CLAW." March 12, 2018
The Register "Microsoft floats feelers for fake worlds." March 8, 2018
Engadget "Microsoft's mad scientists are making AR more tactile." March 12, 2018
Co.Design Fast Company "Crazy Microsoft Is The Best Microsoft." March 9, 2018
Road to VR "Microsoft Shows New Research in Haptics With 'CLAW' VR Controller Prototype." March 13, 2018

Recode "These tiny, wearable robots can cling to your clothes and drive around your body." October 19, 2016
The Verge "These robots will crawl over your clothes for some reason." October 21, 2016
Engadget "Tiny body-roaming robots could be the future of wearables." October 19, 2016

Digital Trends "Get a grip, bub: Wolverine haptic device lets you grasp objects in VR." October 27, 2016
Futurism "Meet Wolverine, the Tech That Lets You Grab Objects in Virtual Reality." October 26, 2016
Motherboard "Haptic Feedback Prototype Lets You Grasp Objects in VR" October 23, 2016
IEEE Spectrum "Video Friday: Robot Toes, Wolverine Haptic Hand, and More From IROS 2016" October 21, 2016

References

Available upon request