

# Seongkook Heo

Assistant Professor, University of Virginia

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I am interested in the design and development of interactive technologies and systems that enrich the human-computer and human-computer-human interactions.

*Keywords: VR/AR, immersive computing, interaction techniques, sensing techniques, haptics, computer-supported communication.*

## Appointments

- 12/8/2019 – **University of Virginia**, Virginia, USA  
Alfred Weaver Assistant Professor, Department of Computer Science
- 1/5/2017 – **University of Toronto**, Ontario, Canada
- 10/8/2019 Postdoctoral Researcher, Department of Computer Science  
Advisor: Dr. Daniel Wigdor

## Education

- 17/2/2017 **Korea Advanced Institute of Science and Technology**, Daejeon, South Korea  
Ph.D. Computer Science  
Advisor: Dr. Geehyuk Lee
- 18/6/2009 **Korea Advanced Institute of Science and Technology**, Daejeon, South Korea  
M.S. Digital Media  
Advisor: Dr. Minsoo Hahn
- 26/2/2007 **Sungkyunkwan University**, Suwon, South Korea  
B. S. Electric and Electronic Engineering  
B. S. Computer Engineering (Double Major)

## Professional Experience

- 4/1/2016 – **Autodesk Research**, Toronto, Canada
- 22/4/2016 Research Intern supervised by Dr. Tovi Grossman  
Developing interaction techniques for wearable devices
- 26/5/2015 – **Microsoft Research**, Redmond, USA
- 21/8/2015 Research Intern supervised by Dr. Ken Hinckley  
Developing interaction techniques for mobile devices

## Selected Honors and Awards

- 2021 **Facebook Research Award**
- 2021 **University of Virginia Engineering Research Innovation Award**
- 2016 **Naver Ph.D. Fellowship**

## Peer-Reviewed Publications

- 2022 E. Pakdamanian, E. Hu, S. Sheng, S. Kraus, S. Heo, and L. Feng, “Enjoy the ride consciously with cawa: Context-aware advisory warnings for automated driving,” in *Proceedings of the ACM AutomotiveUI '22*, 2022 (to appear)
- 2022 E. Hu, M. A. R. Azim, and S. Heo, “Fluidmeet: Enabling frictionless transitions between in-group, between-group, and private conversations during virtual breakout meetings,” in *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI)*, 2022
- 2021 E. Pakdamanian, S. Sheng, S. Baee, S. Heo, S. Kraus, and L. Feng, “Deeptake: Prediction of driver takeover behavior using multimodal data,” in *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI)*, 2021, pp. 1–14
- 2021 H. Kim, S. Hong, J. Kim, T. Jang, W. Woo, S. Heo, and B. Lee, “Realitybrush: An ar authoring system that captures and utilizes kinetic properties of everyday objects,” *Multimedia Tools and Applications*, vol. 80, no. 20, pp. 31 135–31 158, 2021
- 2020 K. Park, D. Kim, S. Heo, and G. Lee, “Magtouch: Robust finger identification for a smartwatch using a magnet ring and a built-in magnetometer,” in *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI)*, 2020, pp. 1–13
- 2019 S. Heo, J. Lee, and D. Wigdor, “Pseudobend: Producing haptic illusions of stretching, bending, and twisting using grain vibrations,” in *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (UIST)*, 2019, pp. 803–813
- 2019 D. Hayatpur, S. Heo, H. Xia, W. Stuerzlinger, and D. Wigdor, “Plane, ray, and point: Enabling precise spatial manipulations with shape constraints,” in *Proceedings of the 32nd annual ACM symposium on user interface software and technology (UIST)*, 2019, pp. 1185–1195
- 2018 S. Hong, E. Jeong, S. Heo, and B. Lee, “Fdsense: Estimating young’s modulus and stiffness of end effectors to facilitate kinetic interaction on touch surfaces,” in *Proceedings of the 31st Annual ACM Symposium on User Interface Software and Technology (UIST)*, 2018, pp. 809–823
- 2018 Z. Lu, S. Heo, and D. J. Wigdor, “Streamwiki: Enabling viewers of knowledge sharing live streams to collaboratively generate archival documentation for effective in-stream and post hoc learning,” *Proceedings of the ACM on Human-Computer Interaction*, vol. 2, no. CSCW, pp. 1–26, 2018
- 2018 S. Heo, C. Chung, G. Lee, and D. Wigdor, “Thor’s hammer: An ungrounded force feedback device utilizing propeller-induced propulsive force,” in *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI)*, 2018, pp. 1–11
- 2018 Z. Lu, H. Xia, S. Heo, and D. Wigdor, “You watch, you give, and you engage: A study of live streaming practices in china,” in *Proceedings of the 2018 CHI conference on human factors in computing systems (CHI)*, 2018, pp. 1–13
- 2017 S. Ahn, S. Heo, and G. Lee, “Typing on a smartwatch for smart glasses,” in *Proceedings of the 2017 ACM International Conference on Interactive Surfaces and Spaces*, 2017, pp. 201–209
- 2017 S. Heo, M. Annett, B. Lafreniere, T. Grossman, and G. Fitzmaurice, “No need to stop what you’re doing: Exploring no-handed smartwatch interaction,” in *Graphics Interface*, 2017
- 2017 S. Heo and G. Lee, “Vibrotactile compliance feedback for tangential force interaction,” *IEEE Transactions on Haptics*, vol. 10, no. 3, pp. 444–455, 2017
- 2016 S. Heo, J. Jung, and G. Lee, “Melodictap: Fingering hotkey for touch tablets,” in *Proceedings of the 28th Australian Conference on Computer-Human Interaction*, 2016, pp. 396–400
- 2016 K. Hinckley, S. Heo, M. Pahud, C. Holz, H. Benko, A. Sellen, R. Banks, K. O’Hara, G. Smyth, and B. Buxton, “Pre-touch sensing for mobile interaction,” in *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI)*, 2016, pp. 69–2881
- 2016 J. Hong, S. Heo, P. Isokoski, and G. Lee, “Comparison of three qwerty keyboards for a smart-

- watch,” *Interacting with Computers*, vol. 28, no. 6, pp. 811–825, 2016
- 2016 C.-M. Kim, S. Heo, K. A. Jeong, and Y.-K. Lim, “Formula one: Mobile device supported rapid in-the-wild design and evaluation of interactive prototypes,” in *Proceedings of HCI Korea*, 2016, pp. 333–338 (**Best paper award**)
- 2015 J. Hong, S. Heo, P. Isokoski, and G. Lee, “Splitboard: A simple split soft keyboard for wristwatch-sized touch screens,” in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI)*, 2015, pp. 1233–1236
- 2014 S. Heo, J. Gu, and G. Lee, “Expanding touch input vocabulary by using consecutive distant taps,” in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI)*, 2014, pp. 2597–2606
- 2014 J. Han, S. Heo, H.-E. Lee, and G. Lee, “The irpen: A 6-dof pen for interaction with tablet computers,” *IEEE Computer Graphics and Applications*, vol. 34, no. 3, pp. 22–29, 2014
- 2013 S. Heo, J. Han, and G. Lee, “Designing rich touch interaction through proximity and 2.5 d force sensing touchpad,” in *Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration*, 2013, pp. 401–404
- 2013 S. Heo and G. Lee, “Indirect shear force estimation for multi-point shear force operations,” in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI)*, 2013, pp. 281–284
- 2013 J. Gu, S. Heo, J. Han, S. Kim, and G. Lee, “Longpad: A touchpad using the entire area below the keyboard of a laptop computer,” in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI)*, 2013, pp. 1421–1430
- 2013 J. Choi, S. Heo, J. Han, G. Lee, and J. Song, “Mining social relationship types in an organization using communication patterns,” in *Proceedings of the 2013 conference on Computer supported cooperative work*, 2013, pp. 295–302
- 2012 J. Han, S. Choi, S. Heo, and G. Lee, “Optical touch sensing based on internal scattering in touch surface,” *Electronics letters*, vol. 48, no. 22, pp. 1420–1422, 2012
- 2012 S. Heo and G. Lee, “Forcedrag: Using pressure as a touch input modifier,” in *OzCHI '12 Proceedings of the 24th Australian Computer-Human Interaction Conference*, ACM, 2012, pp. 204–207
- 2011 S. Heo, J. Han, S. Choi, S. Lee, G. Lee, H.-E. Lee, S. Kim, W.-C. Bang, D. Kim, and C. Kim, “Ircube tracker: An optical 6-dof tracker based on led directivity,” in *Proceedings of the 24th annual ACM symposium on User interface software and technology (UIST)*, 2011, pp. 577–586
- 2011 S. Heo and G. Lee, “Force gestures: Augmenting touch screen gestures with normal and tangential forces,” in *Proceedings of the 24th annual ACM symposium on User interface software and technology (UIST)*, 2011, pp. 621–626
- 2011 S. Heo and G. Lee, “Forcetap: Extending the input vocabulary of mobile touch screens by adding tap gestures,” in *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, ACM, 2011, pp. 113–122
- 2011 J. Han, S. Heo, G. Lee, W.-C. Bang, D. Kim, and C. Kim, “6-dof tracker using led directivity,” *Electronics letters*, vol. 47, no. 3, pp. 177–178, 2011

## Book Chapters

- 2013 S. Heo, J. Han, and G. Lee, “Designing for hover-and force-enriched touch interaction,” in *Australian Computer-Human Interaction Conference*, Springer, Cham, 2013, pp. 68–87

## Workshop papers, Posters, Demonstrations

- 2022 A. Narayanan, E. Hu, and S. Heo, “Enabling remote hand guidance in video calls using directional force illusion,” in *CSCW ’22 Poster*, 2022 (to appear)
- 2022 Z. Su, F. H. Shezan, Y. Tian, D. Evans, and S. Heo, “Perception hacking for 2d cursorjacking in virtual reality,” in *ACM CHI’22, Workshop on Novel Challenges of Safety, Security and Privacy in Extended Reality*, 2022
- 2020 A. Lalamentik and S. Heo, “Tactile glance: Encoding notifications using illusive movement constraints for eyes- and ears-free interaction,” in *IEEE Haptics Symposium 2020 Works-in-progress*, 2020
- 2018 S. Heo, C. Chung, G. Lee, and D. Wigdor, “Thor’s hammer: An ungrounded force feedback device utilizing propeller-induced propulsive force,” in *ACM CHI 2018 Demo*, 2018
- 2017 S. Heo and G. Lee, “Creating haptic illusion of compliance for tangential force input using vibrotactile actuator,” in *ACM UIST ’17 Demo*, 2017
- 2014 J. Han, S. Heo, J. Gu, and G. Lee, “Trampoline: A double-sided elastic touch device for repoussé and chasing techniques,” in *ACM CHI’14 Works-in-progress*, 2014
- 2013 S. Heo and G. Lee, “Ta-tap: Consecutive distant tap operations for one-handed touch screen use,” in *ACM UIST ’13 Poster*, 2013
- 2012 S. Heo, Y.-K. Lee, J. Yeom, and G. Lee, “Design of a shape dependent snapping algorithm,” in *ACM CHI’12 Works-in-progress*, 2012
- 2011 S. Choi, J. Han, S. Kim, S. Heo, and G. Lee, “Thickpad: A hover-tracking touchpad for a laptop,” in *UIST ’11 Demo*, 2011
- 2011 S. Heo and G. Lee, “Force gestures: Augmented touch screen gestures using normal and tangential force,” in *CHI’11 Works-in-progress*, 2011, pp. 1909–1914
- 2008 S. Heo, D. Lee, and M. Hahn, “Floatingpad: A touchpad based 3d input device,” in *ICAT ’08 Poster*, 2008
- 2008 S. Lee, S. Heo, Y. Kim, Y. Kim, S. Lee, and M. Hahn, “An interactive knocking floor,” in *ubiquitous Computing*, p. 20, 2008
- 2007 S. Park, S. Lee, S. Heo, K. S. Park, and M. Hahn, “Escape!: An indoor location-based horror game using indirect ambient cues,” 2007

## Patents

- 2017 No-handed smartwatch interaction techniques, US Patent Pending, Application #US20180024642A1, 7/14/2017
- 2017 Pre-interaction context associated with gestures and touch interactions, US Patent Pending, Application #US20180239509A1, 2/20/2017
- 2016 Pre-touch sensing for mobile interaction, US Patent Pending, Application #US20180004386A1, 6/30/2016
- 2015 Touch screen controlling method in mobile device, and mobile device thereof, KR Patent #1496017, 2/16/2015
- 2015 User interface method and apparatus using successive touches, US Patent Pending, Application #US20150026619, 1/22/2015
- 2014 Optical touchpad apparatus with proximity and force sensing capabilities and method of sensing touch in apparatus, KR Patent #1449833, 10/2/2014

- 2014 Method and apparatus of playing haptic feedback for shear movement, KR Patent Pending, Application #2014-0026719, 3/6/2014
- 2014 Device and method of video playback control using force and contact position information, KR Patent #1393261, 4/30/2014
- 2014 Apparatus and method for multi-touch sensing using total internal reflection, KR Patent #1356835, 1/22/2014
- 2013 Method and apparatus for one-handed application of multi-touch gesture using continuous touch, KR Patent Pending, Application #2013-0083986, 7/17/2013
- 2013 Method and system for body tracking for spatial gesture recognition, KR Patent #1256046, 4/12/2013
- 2012 Device and method for identifying multi-touch points using internal scattering, PCT/KR2012/006624, 8/21/2012
- 2012 Method and system for body tracking for spatial gesture recognition, PCT/KR2012/006372, 8/10/2012
- 2012 Method for controlling touch screen in portable device, and portable device of the same, KR Patent #1177650, 8/21/2012
- 2011 System and method for estimating position and direction, EU Patent #EP2385390, 21/8/2013, China Patent #CN102279380, 21/10/2015 US Patent Pending, Application #US20110261270, 4/18/2011
- 2011 Apparatus and method for sensing a moving object and a virtual golf simulation device using the same capable of accurately implementing the center point coordinate about an extracted object, KR Patent #1019801, 2/25/2011
- 2011 Apparatus and method for sensing a moving object and a virtual golf simulation device using the same capable of obtaining a multiple exposure image about a moving object, KR Patent #1019823, 2/25/2011
- 2011 Apparatus and method for sensing a moving object and a virtual golf simulation device using the same capable of accurately extracting an image of an object, KR Patent #1019798, 2/25/2011
- 2011 Apparatus and method for sensing a moving object and a virtual golf simulation device using the same capable of exactly extracting the center point coordinate of a moving object using a low speed camera, KR Patent #1019824, 2/25/2011
- 2011 Apparatus and method for sensing a moving ball and a virtual golf simulation device using the same capable of obtaining the center point coordinate about an image of a ball, KR Patent #1019829, 2/25/2011
- 2011 Sensing processing device for a moving object and a method thereof, and a virtual golf simulation device using the same capable of accurately extracting center point coordinate of an overlapped object, KR Patent #1019782, 2/25/2011
- 2011 Apparatus and method for sensing a moving ball and a virtual golf simulation device using the same capable of obtaining an image of a moving ball, KR Patent #1019847, 2/25/2011
- 2011 Device and method for sensing processing of a moving object, and a virtual golf simulation device using the same capable of achieving accuracy of sensing, KR Patent #1019902, 2/25/2011
- 2011 Method for controlling touch screen on portable device using built-in accelerometer, and portable device of the same, KR Patent #1173400, 8/6/2011
- 2011 Apparatus for sensing if a driver drives a car safely, KR Patent #1054062, 7/28/2011

## Teaching

Spring 2020 - 22	<b>CS4501/6501: Engineering Interactive Technologies</b> , <i>University of Virginia</i> Instructor
Fall 2019 - 22	<b>CS6501: Human-Computer Interaction</b> , <i>University of Virginia</i> Instructor
Fall 2018	<b>CSC318: Design of Interactive Computational Media</b> , <i>University of Toronto</i> Guest Lecturer
Winter 2018	<b>CSC2514: Human-Computer Interaction</b> , <i>University of Toronto</i> Guest Lecturer
Spring 2012	<b>CS420: Compiler Design</b> , <i>KAIST</i> Teaching Assistant
Spring 2011	<b>CS684: Human-Computer Interaction</b> , <i>KAIST</i> Teaching Assistant
Spring 2010, 11	<b>CS472: Human-Computer Interaction</b> , <i>KAIST</i> Teaching Assistant

## Invited Talks

May 2022	As we may chat: virtualizing proxemic cues for fluid transitions in virtual meetings <i>UNIST</i>
Dec 2021	Why I Chose Academia <i>KAIST</i>
Nov 2021	Physicalizing Virtual and Augmented Reality <i>Virginia Tech</i>
Nov 2021	Physicalizing Virtual and Augmented Reality <i>George Mason University</i>
Sep 2021	Physicalizing Virtual and Augmented Reality <i>Yonsei University</i>
May 2020	High-bandwidth Human-Computer Interaction: Possibilities and Challenges <i>University of Copenhagen</i>
Oct 2019	User Interface for Future Computers <i>Korean-American Scientists and Engineers Association (KSEA) Central VA Chapter</i>
Apr 2019	Towards Man-Computer Symbiosis <i>Pohang University of Science and Technology (POSTECH)</i>
Apr 2019	Towards Man-Computer Symbiosis <i>University of Virginia</i>
Nov 2018	Expanding Touch Interaction Bandwidth by Making Computers to Feel Our Touch and to be Felt <i>TUX: Toronto User Experience Speaker Series</i>
Aug 2018	As We May Touch—toward richer and more natural touch interaction <i>Oculus Research</i>
Jul 2018	As We May Touch—toward richer and more natural touch interaction <i>EPIC Group, Microsoft Research</i>
Feb 2018	Let it move—Creating force and movement feedback on the surface and in the air <i>Future Reality Lab, New York University</i>
Feb 2018	Let it move—Creating force and movement feedback on the surface and in the air

*HCI Group, Saarland University*  
 Dec 2017 As We May Touch—toward richer and more natural touch interaction  
*HCI Group, KAIST*  
 Jan 2016 Enriching Touch – with force, hover, and manual dexterity  
*DGP Lab, University of Toronto*  
 Jan 2016 Enriching Touch – with force, hover, and manual dexterity  
*Autodesk Research*  
 Oct 2014 Enriching Touch  
*Hideep Co.*  
 Mar 2014 Enriching interaction on and over the surface  
*Korea Electronics Technology Institute*  
 Feb 2014 Completing Touch  
*TEDxKAIST Salon: Beyond Now*

## Academic Service

**Organizing Committee**, ACM ISS 2019 Demos Co-Chair, IEEE SIEDS 2021 Workshop Organizer  
**Program Committee**, CHI 2019, 2020, 2022, UIST 2020, MobileHCI 2015, VRST 2021, 2022, TEI 2022  
**Reviewer**, CHI, UIST, DIS, TEI, MobileHCI, SIGGRAPH ASIA, ICMI, IEEE VR, IMWUT,  
 IEEE Trans. Haptics, ACM TOCHI, IJHCS, Frontiers in Virtual Reality  
**Volunteering**, Workshop Instructor for Girls Who Code@UVA,  
 Student Volunteer at World Haptics Conference 2015, Student Volunteer at UIST 2016