

# Seongkook Heo

Assistant Professor, University of Virginia

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My vision is to expand the interaction bandwidth between humans and computers by enabling users to manipulate virtual objects in a rich, nuanced, and bi-directional way like they do in the real world. I design and build new sensing techniques and haptic feedback technologies and interaction techniques that carefully matched to human sensing capabilities and motor skills.

## Appointments

2019 – **University of Virginia, Charlottesville, VA, USA**  
Assistant Professor, Department of Computer Science

2017 – 2019 **University of Toronto, Toronto, ON, Canada**  
Postdoctoral Researcher, Department of Computer Science

## Education

Feb 2017 **Korea Advanced Institute of Science and Technology**, Daejeon, South Korea  
Ph.D. Computer Science  
Advisor: Geehyuk Lee

Aug 2009 **Korea Advanced Institute of Science and Technology**, Daejeon, South Korea  
M.S. Digital Media  
Advisor: Geehyuk Lee

Feb 2007 **Sungkyunkwan University**, Suwon, South Korea.  
B. S. Electric and Electronic Engineering

Feb 2007 **Sungkyunkwan University**, Suwon, South Korea.  
B. S. Computer Engineering (Double major)

## Professional Experience

Jan – Apr 2016 **Autodesk Research, Toronto, Canada**  
Research Intern supervised by Dr. Tovi Grossman  
Developing interaction techniques for wearable devices [C.14]

May–Aug 2015 **Microsoft Research, Redmond, USA**  
Research Intern supervised by Dr. Ken Hinckley  
Developing interaction techniques for mobile devices [C.12]

Jun – Aug 2008 **Samsung Advanced Institution of Technology (SAIT), Suwon, South Korea**  
Research Intern at Multi-modal Interaction Lab  
Designing multi-modal interaction techniques for consumer electronics

2005–2006 **AhnLab, Seoul, South Korea**  
Software Engineering Intern

## Peer-reviewed Publications (index starting with C: conference paper, J: Journal paper)

- C.21 **Seongkook Heo**, Jaeyeon Lee, Daniel Wigdor. (2019) PseudoBend: Producing Haptic Illusions of Stretching, Bending, and Twisting Using Grain Vibrations. *UIST '19*. (Acceptance rate: 20.6%)
- C.20 Devamardeep Hayatpur, **Seongkook Heo**, Haijun Xia, Wolfgang Stuerzlinger, Daniel Wigdor. (2019) Plane, Ray, and Point: Enabling Precise Spatial Manipulations with Shape Constraints. *UIST '19*. (Acceptance rate: 20.6%)
- C.19 Sanghwa Hong, Eunseok Jeong, **Seongkook Heo**, Byungjoo Lee. (2018) FDSense: Estimating Young's Modulus and Stiffness of End Effectors to Facilitate Kinetic Interaction on Touch Surfaces. *UIST '18*. (Acceptance rate: 20.6%)
- C.18 Zhicong Lu, **Seongkook Heo**, Daniel Wigdor. (2018) StreamWiki: Enabling Viewers of Knowledge Sharing Live Streams to Collaboratively Generate Archival Documentation for Effective In-Stream and Post-Hoc Learning. *CSCW'18*. (Acceptance rate: 25.6%)
- C.17 **Seongkook Heo**, Christina Chung, Geehyuk Lee, Daniel Wigdor. (2018) Thor's Hammer: An Ungrounded Force Feedback Device Utilizing Propeller-Induced Propulsive Force. *CHI '18*. (Acceptance rate: 25.7%)
- C.16 Zhicong Lu, Haijun Xia, **Seongkook Heo**, Daniel Wigdor. (2018) You Watch, You Give, and You Engage: A Study of Live Streaming Practices in China. *CHI '18*. (Acceptance rate: 25.7%)
- C.15 Sunggeun Ahn, **Seongkook Heo**, Geehyuk Lee. (2017) Typing on a Smartwatch for Smart Glasses. *ISS '17*. (Acceptance rate: 26.9%)
- C.14 **Seongkook Heo**, Michelle Annett, Ben Lafreniere, Tovi Grossman, George Fitzmaurice. (2017) No Need to Stop What You're Doing: Exploring No-Handed Smartwatch Interaction. *GI '17*.
- J.5 **Seongkook Heo** and Geehyuk Lee. (2017) Vibrotactile Compliance Feedback for Tangential Force Interaction. *IEEE Transactions on Haptics*, Vol. 10, Issue 3.
- C.13 **Seongkook Heo**, Jingun Jung, and Geehyuk Lee. (2016) MelodicTap: Fingering Hotkey for Touch Tablets. *OZCHI '16*.
- C.12 Ken Hinckley, **Seongkook Heo**, Christian Holz, Hrvoje Benko, Abigail Sellen, Richard Banks, Kenton O'Hara, Gavin Smyth, and William Buxton. (2016) Pre-Touch Sensing for Mobile Interaction. *CHI '16*. (Acceptance Rate: 23%)
- J.4 Jonggi Hong, **Seongkook Heo**, Poika Isokoski, and Geehyuk Lee. (2016) Comparison of Three QWERTY Keyboards for a Smartwatch. *Interacting with Computers*, Vol. 28, Issue 6.
- C.11 Chang-Min Kim, **Seongkook Heo**, Kyeong Ah Jeong, and Youn-Kyung Lim. (2016) Formula One: Mobile Device Supported Rapid In-the-Wild Design and Evaluation of Interactive Prototypes. *HCI Korea '16 (Best paper award)*.
- C.10 Jonggi Hong, **Seongkook Heo**, Poika Isokoski, and Geehyuk Lee. (2015) SplitBoard: A Simple Split Soft Keyboard for Wristwatch-sized Touch Screens. *CHI '15*. (Acceptance Rate: 23%)
- C.9 **Seongkook Heo**, Jiseong Gu, and Geehyuk Lee. (2014) Expanding Touch Input Vocabulary by Using Consecutive Distant Taps. *CHI '14* (Acceptance Rate: 23%).
- J.3 Jaehyun Han, **Seongkook Heo**, Hyong-Euk Lee, and Geehyuk Lee. (2014) IrPen: A 6-DOF Pen System to Support Over-the-surface Interactions with Tablet Computers. *IEEE Computer Graphics and Applications*, Vol. 34, Issue 3.
- C.8 **Seongkook Heo**, Jaehyun Han, and Geehyuk Lee. (2013) Designing Rich Touch Interaction through Proximity and 2.5D Force Sensing Touchpad, *OZCHI '13*.

- C.7 **Seongkook Heo** and Geehyuk Lee. (2013) Indirect Shear Force Estimation for Multi-Point Shear Force Operations. *CHI '13*. (Acceptance Rate: 20%)
- C.6 Jiseong Gu, **Seongkook Heo**, Jaehyun Han, Sunjun Kim, and Geehyuk Lee. (2013) LongPad: A TouchPad Using the Whole Area below the Keyboard on a Laptop. *CHI '13*. (Acceptance Rate: 20%)
- C.5 Jinhyuk Choi, **Seongkook Heo**, Jaehyun Han, Geehyuk Lee, and Junehwa Song. (2013) Mining Social Relationship Types in an Organization by using Communication Patterns, *CSCW '13*.
- J.2 Jaehyun Han, Sangwon Choi, **Seongkook Heo**, and Geehyuk Lee. (2012) Optical touch sensing based on internal scattering in a touch surface. *Electronics Letters*, Vol. 48, Issue 22.
- C.4 **Seongkook Heo** and Geehyuk Lee. (2012) ForceDrag: Using Pressure as a Touch Input Modifier, *OZCHI '12*.
- C.3 **Seongkook Heo**, Jaehyun Han, Sangwon Choi, Seunghwan Lee, Geehyuk Lee, Hyong-Euk Lee, SangHyun Kim, Won-Chul Bang, DoKyoon Kim, and ChangYeong Kim. (2011) IrCube tracker: an optical 6-DOF tracker based on LED directivity. *UIST '11*. (Acceptance Rate: 26%)
- C.2 **Seongkook Heo** and Geehyuk Lee. (2011) Force gestures: augmenting touch screen gestures with normal and tangential forces. *UIST '11*. (Acceptance Rate: 26%)
- C.1 **Seongkook Heo** and Geehyuk Lee. (2011) Forcetap: extending the input vocabulary of mobile touch screens by adding tap gestures. *MobileHCI '11*. (Acceptance Rate: 23%)
- J.1 Jaehyun Han, **Seongkook Heo**, G Lee, Won-Chul Bang, DoKyoon Kim, and ChangYeong Kim. (2011) 6-DOF tracker using LED directivity. *Electronics Letters*, Vol. 47, Issue 3.

## Book Chapters

- B.1 **Seongkook Heo**, Jaehyun Han, and Geehyuk Lee.  
Designing for Hover-and Force-Enriched Touch Interaction. *Computer-Human Interaction. Cognitive Effects of Spatial Interaction, Learning, and Ability*, Springer, 2015. 68-87.

## Peer-reviewed Posters and Demonstrations (index starting with p: posters, d: demonstrations)

- d.3 **Seongkook Heo**, Christina Chung, Geehyuk Lee, Daniel Wigdor. (2018) Thor's Hammer: An Ungrounded Force Feedback Device Utilizing Propeller-Induced Propulsive Force. *CHI '18 Demo*.
- d.2 **Seongkook Heo** and Geehyuk Lee.  
Creating Haptic Illusion of Compliance for Tangential Force Input using Vibrotactile Actuator. *UIST '17 Demo*.
- p.7 Jaehyun Han, **Seongkook Heo**, and Geehyuk Lee.  
Trampoline: A Double-sided Elastic Touch Device for Repousse and Chasing Techniques. *CHI '14 Works-in-progress*.
- p.6 **Seongkook Heo** and Geehyuk Lee.  
Ta-tap: Consecutive Distant Tap Operations for One-handed Touch Screen Use. *UIST '13 Poster*.
- p.5 **Seongkook Heo**, Yongki-Lee, Jiho Yeom, and Geehyuk Lee.  
Design of a Shape Dependent Snapping Algorithm. *CHI '12 Works-in-progress*.
- d.1 Sangwon Choi, Jaehyun Han, Sunjun Kim, **Seongkook Heo**, and Geehyuk Lee.  
ThickPad: A Hover-tracking Touchpad for a Laptop, *UIST '11 Demo*.

- p.4 **Seongkook Heo** and Geehyuk Lee.  
Force gestures: Augmented Touch Screen Gestures using Normal and Tangential Force, *CHI '11 Works-in-progress*.
- p.3 **Seongkook Heo**, Dongwook Lee, and Minsoo Hahn.  
FloatingPad: A Touchpad based 3D Input Device, *ICAT '08 Poster*.
- p.2 Seungwoo Lee, **Seongkook Heo**, Youmin Kim, Youngjae Kim, Soojin Lee, and Minsoo Hahn.  
An Interactive Knocking Floor, *UbiComp 2008 Poster*.
- p.1 Seungsoon Park, Seungwoo Lee, **Seongkook Heo**, Kyoungsin Park, and Minsoo Hahn.  
Escape!: An Indoor Location-based Horror Game using Indirect Ambient Cues, *UCS 2007 Poster*.

## Patents

- P.24 Pre-interaction context associated with gestures and touch interactions, US Patent Pending, Application #US20180239509A1, 2/20/2017
- P.23 Pre-touch sensing for mobile interaction, US Patent Pending, Application #US20180004386A1, 6/30/2016
- P.22 Method and apparatus of playing haptic feedback for shear movement, KR Patent Pending, Application #2014-0026719, 3/6/2014
- P.21 Touch screen controlling method in mobile device, and mobile device thereof, KR Patent #1496017, 2/16/2015
- P.20 Method and apparatus for one-handed application of multi-touch gesture using continuous touch, KR Patent Pending, Application #2013-0083986, 7/17/2013
- P.19 Optical touchpad apparatus with proximity and force sensing capabilities and method of sensing touch in apparatus, KR Patent #1449833, 10/2/2014
- P.18 User interface method and apparatus using successive touches, US Patent Pending, Application #US20150026619, 1/22/2015
- P.17 Device and method of video playback control using force and contact position information, KR Patent #1393261, 4/30/2014
- P.16 Device and method for identifying multi-touch points using internal scattering, PCT/KR2012/006624, 8/21/2012
- P.15 Method and system for body tracking for spatial gesture recognition, PCT/KR2012/006372, 8/10/2012
- P.14 Apparatus and method for multi-touch sensing using total internal reflection, KR Patent #1356835, 1/22/2014
- P.13 Method and system for body tracking for spatial gesture recognition, KR Patent #1256046, 4/12/2013
- P.12 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
- P.11 Method for controlling touch screen in portable device, and portable device of the same, KR Patent #1177650, 8/21/2012
- P.10 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
- P.9 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

- P.8 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
- P.7 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
- P.6 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
- P.5 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
- P.4 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
- P.3 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
- P.2 Method for controlling touch screen on portable device using built-in accelerometer, and portable device of the same, KR Patent #1173400, 8/6/2011
- P.1 Apparatus for sensing if a driver drives a car safely, KR Patent #1054062, 7/28/2011

## Awards and Honors

- 2016 Naver Ph.D. Fellowship Award
- 2016 HCI Korea Best Paper Award
- 2013 ACM UIST Student Innovation Contest, 2<sup>nd</sup> Place in Most Creative
- 2012 ACM UIST Student Innovation Contest, 2<sup>nd</sup> Place in People's Choice
- 2011 ACM UIST Student Innovation Contest, 2<sup>nd</sup> Place in People's Choice

## Academic Service

- Organizing Committee ACM ISS 2019 Demos Co-Chair
- Program Committee MobileHCI 2015, CHI 2019, CHI 2020, UIST 2020
- Session Chair CHI 2019
- Reviewer CHI, UIST, DIS, TEI, MobileHCI, SIGGRAPH ASIA, ICMI, IEEE VR, IEEE Transactions on Haptics
- Student Volunteer World Haptics Conference '15, UIST '16

## Teaching

- Spring 2020 Instructor, **CS4501: Engineering Interactive Technologies**, University of Virginia
- Fall 2019 Instructor, **CS6501: Topics in Human Computer Interaction**, University of Virginia
- Fall 2018 Guest Lecturer, **CSC318: Design of Interactive Computational Media**, University of Toronto
- Winter 2018 Guest Lecturer, **CSC2514: Human-Computer Interaction**, University of Toronto
- Spring 2010-11 Teaching Assistant, **CS472: Human-Computer Interaction**, KAIST
- 2012 Spring Teaching Assistant, **CS420: Compiler Design**, KAIST

## Invited Talks

- Oct 2019 User Interface for Future Computers  
*Korean-American Scientists and Engineers Association (KSEA) Central VA Chapter*
- Apr 2019 Towards Man-Computer Symbiosis  
*University of Virginia*
- Nov 2018 Expanding Touch Interaction Bandwidth by Making Computers to Feel Our Touch and to be Felt  
*TUX: Toronto User Experience Speaker Series*
- Aug 2018 As We May Touch—toward richer and more natural touch interaction  
*Oculus Research*
- Jul 2018 As We May Touch—toward richer and more natural touch interaction  
*EPIC Group, Microsoft Research*
- Feb 2018 Let it move—Creating force and movement feedback on the surface and in the air  
*Future Reality Lab, New York University*
- Dec 2017 Let it move—Creating force and movement feedback on the surface and in the air  
*HCI Group, Saarland University*
- Nov 2016 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*

## Media and Press Coverage

- Microsoft’s hover gestures for Windows phones are magnificent, *The Verge*, May 2016
- Smartphones next big thing: ‘Pre-Touch’, *SlashGear*, May 2016
- Apple should definitely copy Microsoft’s incredible finger-sensing smartphone technology, *Business Insider*, May 2016
- Microsoft Research anticipates the future with pre-sensing touchscreen prototype, *gizmag*, May 2016
- Microsoft Research's New Touchscreen Can (Almost) Read Your Mind, *Co.Design*, May 2016
- Infrared laptop trackpad ignores accidental touches, *New Scientist*, Jan 2013
- Intelligent Keyboard-Wide Touchpad Is Smart Enough to Ignore Your Palms, *Gizmodo*, Feb 2013