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My research focuses on novel input and output technologies for freeform 3D interactions in everyday environments.

Natural User Interfaces (NUI) have received a great deal of attention in recent years. Much of this attention has been around depth sensing and gaming in the living room. My research looks at ways of taking NUI out of the living room, into our everyday lives. Through the design, prototyping and evaluation of novel NUI systems, I am exploring how NUI can become truly ubiquitous, allowing such interactions to be incorporated into new user experiences and scenarios, in particular in rethinking traditional mobile and desktop interactions.

A secondary theme within my research is exploring the convergence of NUI with Augmented Reality (AR). Over the years we've seen AR technologies such as glasses, tracking and mapping, and mobile computing maturing. A less researched topic is how to make such AR technologies *interactive*. I'm interested in fusing together ideas from NUI with AR. These areas can be seen as very complimentary; NUI is focused on sensing new forms of input, and AR traditionally focuses on new forms of output. Bringing these two fields together can lead to new user experiences that radically change the way we interact and even think about computing systems.

Professional Experience

06/2016 - present Senior Technology Scientist & Founding Team Member

Perceptive IO
San Francisco, CA, USA

Focus:

- *Research areas: VR, AR, Natural User Interfaces, Sensing, Wearables*
 - *I devise interaction scenarios and develop interactive systems and enable dexterous real-time interactions by developing algorithms and combining novel sensing hardware and Perceptive IO's computer vision and machine learning technologies*
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04/2015 – 06/2016 Researcher

Interactive 3D Technologies Group,
Microsoft Research Redmond, USA

Focus:

- *Research areas: VR, AR, Natural User Interfaces, Sensing, Wearables*
- *I led research and development of novel NUI and AR sensing hardware, algorithms, and interaction techniques, which were published or shipped in a product*

Products shipped: HoloLens

- *developed interaction algorithms for the HoloLens hand tracker*
- *co-developed the original KinectFusion code*

Microsoft Special Project: HoloPortation

- *co-led the architecture and integration of real-time rendering in Augmented Reality*
 - *developed a face-completion technique with wireless cameras inside the HoloLens device*
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02/2013 – 03/2015 Post Doc Researcher

Interactive 3D Technologies Group,
Microsoft Research Cambridge, UK
Microsoft Research Redmond, USA

Focus:

- *Areas: AR, Natural User Interfaces, Sensing, Wearables*
- *I led research and development of novel NUI sensing hardware, algorithms, and interaction techniques*

10/2010 – 10/2012 On-site Microsoft Research PhD Fellow

Interactive 3D Technologies Group,
Microsoft Research Cambridge, UK

Focus:

- *Areas: AR, Natural User Interfaces, Sensing, Wearables*
- *I led research and development of novel NUI sensing hardware, algorithms and interaction techniques*

Product Involvement: KinectFusion

- *co-developed original KinectFusion code*
- *developed interaction algorithms in the KinectFusion project*

07/2012 – 10/2012 Research Internship (3 months):

Applied Sciences Group,
Microsoft Corporation, USA

Focus:

- *Areas: Natural User Interfaces, Sensing*
- *I developed a hardware system and algorithms for very fast and accurate contour-based stereo matching and NUI interactions in-air, on-surface and with objects*

05/2010 – 09/2010 Research Internship (5 months):

Sensors and Devices Group,
Microsoft Research Cambridge, UK

Focus:

- *The main focus of my intership was HoloDesk, a spatial AR system that allows for unencumbered direct interactions with the virtual*
- *I designed the hardware and optical system and developed algorithms for direct appearance and simulated physics based interactions between the real and the virtual*

2009 – 2013 Teaching Assistant

Digital Interaction Group, Newcastle University, Newcastle, UK
Lecturing and project assignments in HCI (Multi-touch and NUI)

2006 – 2008 Student Research Assistant

Fluidum Research Group, Department of Informatics
Ludwig Maximilian University of Munich, Germany

Focus:

- *Areas: Ubiquitous Computing, Instrumented Environments, Natural User Interfaces*
 - *I developed novel sensing hardware for on-surface interactions and NUI interaction techniques*
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Education

2009-2014 Digital Interaction Group, Newcastle University, Newcastle upon Tyne, UK
PhD in Computing Science
Supervision: Prof. Patrick Olivier, Prof. Shahram Izadi
Research Fields: HCI, NUI, AR, 3D Spatial Interaction
Research Topic: "Freeform 3D Interactions in Everyday Environments"

2003-2008 Ludwig Maximilian University of Munich, Germany
Diplom in Media Informatics (Magna Cum Laude),
(equivalent to MSc with Honors – 1st Class)
Minor: Communication Science and Media Research
Diploma Thesis (Supervision: Prof. Andreas Butz):
"Compensating Missing Hover-Information on Interactive Surfaces"

Selected Projects and Publications

Holoportation **Full Paper:**
S. Orts-Escolano, C. Rhemann, S. Fanello, W. Chang, A. Kowdle, Y. Degtyarev, **D. Kim**, P. L. Davidson, S. Khamis, M. Dou, V. Tankovich, C. Loop, Q. Cai, P. A. Chou, S. Mennicken, J. Valentin, V. Pradeep, S. Wang, S. B. Kang, P. Kohli, Y. Lutchyn, C. Keskin, S. Izadi. 2016.
Holoportation: Virtual 3D Teleportation in Real-time. *ACM UIST*, Oct 2016.

Fusion4D **Full Paper:**
M. Dou, S. Khamis, Y. Degtyarev, P. Davidson, S. Fanello, A. Kowdle, S. Orts Escolano, C. Rhemann, **D. Kim**, J. Taylor, P. Kohli, V. Tankovich, S. Izadi, Fusion4D: Real-time Performance Capture of Challenging Scenes, *ACM SIGGRAPH*, July 2016.

HyperDepth **Full Paper:**
S. Fanello, C. Rhemann, V. Tankovich, A. Kowdle, S. Orts Escolano, **D. Kim**, and S. Izadi, HyperDepth: Learning Depth from Structured Light Without Matching, *IEEE CVPR*, June 2016.
(Oral)

FlexCase **Full Paper:**
C. Rendl, **D. Kim**, P. Parzer, S. Fanello, M. Haller, S. Izadi, FlexCase: Enhancing Mobile Interaction with a Flexible Sensing and Display Cover. *ACM CHI*, San Jose, CA, USA, May 2016.
(Best Paper Award)

Casalendar **Full Paper:**
S. Mennicken, **D. Kim**, E. Huang, Integrating the Smart Home into the Digital Calendar. *ACM CHI*, San Jose, CA, USA, May 2016.

SemanticPaint **Full Paper:**
J. Valentin, V. Vineet, M.-M. Cheng, **D. Kim**, J. Shotton, P. Kohli, M. Niessner, A. Criminisi, S. Izadi, and P. Torr, SemanticPaint: Interactive 3D Labeling and Learning at your Fingertips, in *ACM Trans. on Graphics (TOG)*, ACM – Association for Computing Machinery, August 2015.

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- Hand Tracking** **Full Paper:**
T. Sharp, C. Keskin, D. Robertson, J. Taylor, J. Shotton, **D. Kim**, C. Rhemann, I. Leichter, A. Vinnikov, Y. Wei, D. Freedman, P. Kohli, E. Krupka, A. Fitzgibbon, S. Izadi. Accurate, Robust, and Flexible Real-time Hand Tracking. *ACM CHI*, Seoul, South Korea, April 2015.
(Honorable Mention)
-
- FlexSense** **Full Paper:**
C. Rendl, **D. Kim**, S. R. Fanello, P. Parzer, C. Rhemann, J. Taylor, M. Zirkl, M. Haller, S. Izadi. FlexSense: A Transparent Self-Sensing Deformable Surface. *ACM UIST*, Honolulu, HI, USA, Oct 2014
-
- PumpSpark** **Full Paper:**
P. Dietz, G. Reyes, **D. Kim**. The PumpSpark Fountain Development Kit. *ACM DIS*, Vancouver, BC, Canada, June 2014
-
- MixFab** **Full Paper:**
C. Weichel, M. Lau, **D. Kim**, N. Villar, H. Gellersen. MixFab: A Mixed-Reality Environment for Personal Fabrication. *ACM CHI*, Toronto, ON, Canada, April 2014
(Best Paper Award)
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- RetroDepth** **Full Paper:**
D. Kim, S. Izadi, J. Dostal, C. Rhemann, C. Keskin, C. Zach, J. Shotton, T. Large, S. Bathiche, M. Nießner, A. Butler, S. Fanello, V. Pradeep. RetroDepth: 3D Silhouette Sensing for High-Precision Input On and Above Physical Surfaces. *ACM CHI*, Toronto, ON, Canada, April 2014
(Best Paper Award)
-
- Digits** **Full Paper:**
D. Kim, O. Hilliges, S. Izadi, A. Butler, J. Chen, I. Oikonomidis, P. Olivier. Digits: Freehand 3D Interactions Anywhere Using a Wrist-Worn Gloveless Sensor. *ACM UIST*, Cambridge, MA, USA, Oct 2012
(Best Demo Award 2nd place)
-
- Augmented Projectors** **Full Paper:**
D. Molyneaux, S. Izadi, **D. Kim**, O. Hilliges, S. Hodges, X. Cao, A. Butler, and H. Gellersen. Interactive Environment-Aware Handheld Projectors for Pervasive Computing Spaces. *PERVASIVE*, Springer, Newcastle upon Tyne, UK, Jun 2012 **(Best Paper Award)**
-
- HoloDesk** **Full Paper:**
O. Hilliges, **D. Kim**, S. Izadi, M. Weiss, A. Wilson. HoloDesk: Direct 3D Interactions with a Situated See-Through Display. *ACM CHI*, Austin, TX, USA, May 2012
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- KinectFusion** **Full Paper:**
S. Izadi, **D. Kim**, O. Hilliges, D. Molyneaux, R. Newcombe, P. Kohli, J. Shotton, S. Hodges, D. Freeman, A. Davison, and A. Fitzgibbon. KinectFusion: Real-Time 3D Reconstruction and Interaction using a Moving Depth Camera. *ACM UIST*, Santa Barbara, CA, USA, Oct 2011
- Full Paper:**
R. Newcombe, S. Izadi, O. Hilliges, D. Molyneaux, **D. Kim**, A. Davison, P. Kohli, J. Shotton, S. Hodges, A. Fitzgibbon. Real-Time Dense Surface Mapping and Tracking with Kinect. *IEEE ISMAR*. Basel, Switzerland, Oct 2011 **(Best Paper Award)**
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Vermeer	Full Paper: A. Butler, O. Hilliges, S. Izadi, S. Hodges, D. Molyneaux, D. Kim , D. Kong. Vermeer: Direct Interaction with a 360° Viewable 3D Display. <i>ACM UIST</i> , Santa Barbara, CA, USA, Oct 2011
Shake'n'Sense	Short Paper: A. Butler, S. Izadi, O. Hilliges, D. Molyneaux, S. Hodges, D. Kim . Shake'n'Sense: Reducing Interference for Overlapping Structured Light Depth Cameras. <i>ACM CHI</i> , Austin, TX, USA, May 2012 (Honorable Mention)
Multi-Touch Authentication	Full Paper: D. Kim , P. Dunphy, P. Briggs, J. Hook, J. Nicholson, J. Nicholson, P. Olivier. Multi-Touch Authentication on Tabletops. <i>ACM CHI</i> , Atlanta, Georgia, USA, Apr 2010
Liquid Displacement Sensing	Short Paper: O. Hilliges, D. Kim , S. Izadi. Creating Malleable Interactive Surfaces using Liquid Displacement Sensing. <i>IEEE Tabletop and Interactive Surfaces</i> , Amsterdam, Netherlands, Oct 2008
BrainStorm	Full Paper: O. Hilliges, L. Terrenghi, S. Boring, D. Kim , H. Richter, A. Butz. Designing for Collaborative Creative Problem Solving. <i>ACM Creativity & Cognition</i> , Washington D.C., USA, Jun 2007
FLASHED	EU funded 3-year project (start 2013) that explored interactive flexible displays.
EU Seventh Framework Program	In collaboration with Media Interaction Lab Hagenberg, Fraunhofer ISC, Joanneum Research, FlexEnable and Microsoft Research, the project demonstrated new materials for flexible and transparent input sensing, self-contained interactive hardware systems, data-driven sensing algorithms and novel interaction techniques and form factors.
Industry-Academia Partnership	Along with Shahram Izadi, I represented Microsoft Research and led the development of the interaction scenarios and interaction techniques.
Balance @Home	EU funded 4-year project (start 2008) that explored home-based support systems for promotion of food, nutritional knowledge and personal choice.
EU Seventh Framework Program	In collaboration with Philips Electronics and Newcastle University, the project demonstrated embedded sensing and machine learning algorithms and user experiences for promoting healthy food preparation.
Industry-Academia Partnership	I was tasked with the design and user experience of <i>persuasive</i> ambient interfaces in the kitchen.
Lindow Man Table	Designed and built the user interface and fingertip tracking for a multi-user multi-touch table that was part of the Lindow Man Exhibition in the Great North Museum.

Granted Patents

Stereo image processing using contours (US 9269018 B2). **David Kim**, Shahram Izadi, Christoph Rhemann, Christopher Zach. 05 May 2016

Generating computer models of 3d objects (US 9053571 B2). Jamie Daniel Joseph Shotton, Shahram Izadi, Otmar Hilliges, **David Kim**, David Molyneaux, Pushmeet Kohli, Andrew Fitzgibbon, Stephen Edward Hodges. 9 Jun 2015.

Moving object segmentation using depth images (US 8401225 B2). Richard Newcombe, Shahram Izadi, Otmar Hilliges, **David Kim**, David Molyneaux, Jamie Daniel Joseph Shotton, Pushmeet Kohli, Andrew Fitzgibbon, Stephen Edward Hodges, David Alexander Butler.

Real-time camera tracking using depth maps (US8401242 B2). Richard Newcombe, Shahram Izadi, David Molyneaux, Otmar Hilliges, **David Kim**, Jamie Daniel Joseph Shotton, Pushmeet Kohli, Andrew Fitzgibbon, Stephen Edward Hodges, David Alexander Butler.

Gesture Recognition Techniques (US 20120306734 A1). **David Kim**, Otmar D Hilliges, Shahram Izadi, Patrick L Olivier, Jamie Daniel Joseph Shotton, Pushmeet Kohli, David G Molyneaux, Stephen E Hodges, Andrew W Fitzgibbon.

Mobile Camera Localization Using Depth Maps (US 20120194644 A1). Richard Newcombe, Shahram Izadi, David Molyneaux, Otmar Hilliges, **David Kim**, Jamie Daniel Joseph Shotton, Pushmeet Kohli, Andrew Fitzgibbon, Stephen Edward Hodges, David Alexander Butler.

Using a three-dimensional environment model in gameplay (US 8570320 B2). Shahram Izadi, David Molyneaux, Otmar Hilliges, **David Kim**, Jamie Daniel Joseph Shotton, Pushmeet Kohli, Andrew Fitzgibbon, Stephen Edward Hodges, David Alexander Butler.

Distributed asynchronous localization and mapping for augmented reality (US 8933931 B2). Alexandru Balan, Jason Flaks, Steve Hodges, Michael Isard, Oliver Williams, Paul Barham, Shahram Izadi, Otmar Hilliges, David Molyneaux, **David Kim**. 13 Jan 2015

Three-dimensional environment reconstruction (US 8587583 B2). Richard Newcombe, Shahram Izadi, David Molyneaux, Otmar Hilliges, **David Kim**, Jamie Daniel Joseph Shotton, Stephen Edward Hodges, David Alexander Butler, Andrew Fitzgibbon, Pushmeet Kohli.

Human Body Pose Estimation (US 20110210915 A1). Jamie Daniel Joseph Shotton, Shahram Izadi, Otmar Hilliges, **David Kim**, David Geoffrey Molyneaux, Matthew Darius Cook, Pushmeet Kohli, Antonio Criminisi, Ross Brook Girshick, Andrew William Fitzgibbon.

Learning Image Processing Tasks from Scene Reconstructions (US8971612 B2). Jamie Daniel Joseph Shotton, Pushmeet Kohli, Stefan Johannes Josef Holzer, Shahram Izadi, Carsten Curt Eckard Rother, Sebastian Nowozin, **David Kim**, David Molyneaux, Otmar Hilliges. 03 Mar 2015.

Reducing interference between multiple infra-red depth cameras (US9247238 B2). Shahram Izadi, David Molyneaux, Otmar Hilliges, **David Kim**, Jamie Daniel Joseph Shotton, Stephen Edward Hodges, David Alexander Butler, Andrew Fitzgibbon, Pushmeet Kohli. 26 Jan 2016.

Other Co-Authored Patent Applications

User interaction in augmented reality (US20120113223 A1). Otmar Hilliges, **David Kim**, Shahram Izadi, David Molyneaux, Stephen Edward Hodges, David Alexander Butler. 04 Nov 2010

Augmented reality with direct user interaction (US20120113140 A1). Otmar Hilliges, **David Kim**, Shahram Izadi, David Molyneaux, Stephen Edward Hodges, David Alexander Butler. 04 Nov 2010

Wearable sensor for tracking articulated body-parts (US20140098018 A1). **David Kim**, Shahram Izadi, Otmar Hilliges, David Alexander Butler, Stephen Hodges, Patrick Luke Olivier, Jiawen Chen, Iason Oikonomidis. 04 Oct 2012

Grasping virtual objects in augmented reality (US20140104274 A1). Otmar Hilliges, **David Kim**, Shahram Izadi, Malte Hanno Weiss. 17 Oct 2012

Authentication by multi-level pressure exertion on multi-touch tabletop interfaces (GB 2476822 A). Paul Dunphy, **David Kim**, James Nicholson, John Nicholson, Jonathan Hook Pamela Briggs, Patrick Olivier

Depth sensing using an infrared camera (US 20150248764 A1). Cem Keskin, Sean Ryan Francesco Fanello, Shahram Izadi, Pushmeet Kohli, **David Kim**, David Sweeney, Jamie Daniel Joesph Shotton, Duncan Paul ROBERTSON, Sing Bing Kang. 03 Sep 2015

Contour-based classification of objects (US 20150199592 A1). **David Kim**, Cem Keskin, Jamie Daniel Joseph Shotton, Shahram Izadi. 16 Jul 2015.

3d silhouette sensing system (US 20150199018 A1). **David Kim**, Shahram Izadi, Vivek Pradeep, Steven Bathiche, Timothy Andrew Large, Karlton David Powell. 16 Jul 2015.

Using photometric stereo for 3d environment modeling (US 20140184749 A1). Otmar Hilliges, Malte Hanno Weiss, Shahram Izadi, **David Kim**, Carsten Curt Eckard Rother. 28 Dec 2012.

Awards and Grants

Best Paper Award at ACM CHI 2016

Honorable Mention at ACM CHI 2015

2x Best Paper Awards at ACM CHI 2014

Runner-up Best Demo Awards at ACM UIST 2012

Best Paper Awards at PERVASIVE 2012

Honorable Mention at ACM CHI 2012

Best Paper Awards at IEEE ISMAR 2011

Engineering and Physical Sciences Research Council (EPSRC, UK) 2-year PhD stipend, 2009

Microsoft Research PhD Fellowship, 2-year PhD stipend, 2012

Services

Organizing Chair First Workshop on Kinect in Pervasive Computing (in conjunction with the International PERVASIVE Conference, 2012), 30+ participants

Co-Chair Posters Co-Chair at ACM ITS 2015

Student Innovation Contest Co-Chair at ACM UIST 2014

Student Innovation Contest Co-Chair at ACM UIST 2013

Program Committee Member ACM ITS 2015
ACM UIST 2015, ACM UIST 2016
ACM CHI 2014, ACM CHI 2015

Reviewer CHI 2011, CHI 2012, CHI 2013, CHI 2014, CHI 2015, CHI 2016, CHI 2017, UIST 2011, UIST 2012, UIST 2013, UIST 2014, UIST 2015, UIST 2016, ITS 2012, ITS 2013, ITS 2015, SIGGRAPH 2015, SIGGRAPH 2016, UbiComp 2012, DIS 2012, TEI 2013, IUI 2013, Mobile HCI 2015, IEEE Pervasive Computing (2014), IEEE Computer Graphics and Applications (2013), International Journal of Human-Computer Studies (2014), The Visual Computer (2014)

**Invited Talks,
Presentations,
Lectures,
Demonstrations**

- FlexSense: A Transparent Self-Sensing Deformable Surface. ACM UIST conference talk. Honolulu, Oct 2014
 - RetroDepth: 3D Silhouette Sensing for High-Precision Input On and Above Physical Surfaces. ACM CHI conference talk. Toronto, Apr 2014
 - Digits & RetroDepth, invited talk, Stream WPP at Cannes, June 2014
 - Digits, invited talk, MediaCom at Cannes, June 2014
 - Digits: Hands-Free-3-D, IEEE Spectrum Video Interview, Oct 2012
 - Digits. Microsoft's UK research lab. BBC News (TV interview), Jan 2013
 - Digits: Freehand 3D Interactions Anywhere Using a Wrist-Worn Gloveless Sensor. ACM UIST conference talk, Cambridge, Oct 2012
 - HoloDesk: Direct 3D Interactions. ACM CHI conference talk, Austin, May 2012
 - Multi-Touch authentication on Tabletops, ACM CHI conference, Atlanta, April 2010
 - 3D Interactions in AR, invited talk, Uni. of Hagenberg, Hagenberg, March 2015
 - 3D Interactions in AR, invited talk, University of Zurich, Zurich, May 2014
 - Spatial Interaction, Designing and Interacting with Spatial Information in the Wild Workshop, invited talk, Edinburgh, Mar 2014
 - KinectFusion, invited talk, Rainbow Group, Cambridge University, Nov 2011
 - KinectFusion, invited talk, Chaos Communication Congress, Berlin, Dec 2011
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- KinectFusion, CES Microsoft Exhibition, Main Hall, Las Vegas, Jan 2012
- AR Interaction, invited talk, Research Seminar, Newcastle University, Apr 2012
- Tabletop Interaction, Lecture, Newcastle University, Dec 2010
- Spatial Natural Interaction, Lecture, Newcastle University, Dec 2011

Student Volunteer *IEEE Tabletop and Interactive Surface*, Amsterdam, Netherlands, Oct 2008

Exhibition Coordination and development of a multi-touch table at Lindow Man exhibition, Great North Museum, Newcastle, UK, August 2009

Skills

Programming Languages: C#, C++, Java
2D/3D/Image Processing APIs: XNA, WPF, Direct3D, OpenCV, Unity

Languages English, German, Korean (all fluent)

Reference

Shahram Izadi, CTO / Co-Founder
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Human-Machine-Interaction
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Ludwig Maximilian University of Munich
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80333 Muenchen, Germany
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