

# David Kim | RESUME | August 2022

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My research interests lie in creating AR experiences and new forms of natural interaction with hands and objects in 3D, particularly in everyday environments with augmented reality (AR). My strength lies in the ability to understand and combine complex technologies across the full stack, from sensors and optical systems to GPU-accelerated ML and vision processing, 3D graphics, and gesture recognition to the user interface. I lead cross-functional teams for rapid prototyping of vertically integrated real-time systems that help proof out novel technical contributions or use case scenarios, unblock prototyping on the user-facing side, and identify issues in the backend early on. My background in human-computer interaction allows me to carefully consider human factors, user needs, and usability issues while designing new user interaction techniques or defining technical specifications (e.g. latency, ergonomics).

I started a sabbatical year to focus on family, traveling, and creativity and resigned from my role as Staff Software Engineer at Google on September 30, 2021.

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## Employment

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### Google • Staff Software Engineer (resigned to take a sabbatical year)

June 2017 - September 2021, San Francisco, CA, USA, and then Zurich, Switzerland

Technical Lead for R&D projects in the area of AR systems and input devices. Rapid prototyping of immersive mixed reality experiences with 3D graphics, GPGPU, ML, vision, and hardware. Led and publicly shipped ARCore Depth Lab. Led and internally shipped AR prototyping systems. Drove evaluation of the human perception of passthrough AR optics and explored the solution space. Initiated and co-led a new input device workstream for AR.

### Perceptive IO (acquired by Google) • Senior Technology Scientist (founding team member)

June 2016 - June 2017, San Francisco, CA, USA

Technical Lead for immersive mixed reality experiences and prototyping. Enabled real-time rendering and interaction in mixed reality experiences using proprietary technology: 1000fps depth and hand tracker, real-time dynamic reconstruction volume, co-presence.

### Microsoft Research • Researcher

February 2013 - June 2016, Cambridge, UK, and then Redmond, WA, USA

Led research and development of depth-based AR systems by prototyping with sensing hardware, 3D graphics, vision, and real-time algorithms. Co-developed Holoportation (demonstrated at a TED talk) and original KinectFusion code used for shipping KinectFusion SDK and HoloLens. Published 23 patents and 15 top-tier peer-reviewed academic papers.

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## Education

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### Newcastle University • Ph.D. in Computing Science

2009 - 2014, Newcastle upon Tyne, UK

Supervisors: Prof. Patrick Olivier (internal), Prof. Shahram Izadi (external)

My Ph.D. research within the field of human-computer interaction focused on enabling 3D spatial interaction and natural user interfaces. Sensing hardware and software algorithms were created to capture high degrees of freedom input from hands and everyday objects in everyday environments with depth sensing.

### Ludwig Maximilian University • Diplom in Media Informatics (magna cum laude)

2003 - 2008, Munich, Germany

Minor: Communication Science and Media Research Supervisor: Prof. Andreas Butz

Focus on software engineering, human-computer interaction, and natural user interfaces.

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## Internships and academic employment

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### Microsoft Research • On-site Microsoft Research Ph.D. Fellow

October 2010 - October 2012, Cambridge, UK

Executed Ph.D. research within the Interactive 3D Technologies Group at Microsoft Research. Contributed to research and development of interactive 3D AR systems.

### Microsoft Corporation • Research Intern (3 months)

July 2012 - October 2012, Redmond, WA, USA

Interned with Stevie Bathiche, the head of the Applied Sciences Group. Initiated and developed RetroDepth, a hardware system and algorithms for fast and accurate contour-based stereo matching and NUI interactions in-air, on-surface, and with objects.

### Microsoft Research • Research Intern (5 months)

May 2010 - September 2010, Cambridge, UK

Interned in the Sensors and Devices Group. Led the development of HoloDesk, a spatial AR system that allows for unencumbered direct interactions with the virtual. Designed the hardware and optical system and developed algorithms for direct appearance and simulated physics-based interactions between the real and the virtual.

### Newcastle University • Teaching Assistant

2009 - 2013, Newcastle, UK

Lecturing and project assignments in human-computer interaction.

### Ludwig Maximilian University • Student Research Assistant

2006 - 2008, Munich, Germany

Developed BrainStorm, a multi-touch collaboration tool, and Liquid Displacement Display, novel sensing hardware for on-surface interactions and NUI interaction techniques.

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## Skills

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C#, C++, Java, Python, GPU shaders, OpenCV, Unity, Arduino, Adobe CC

All fluent: English, German, Korean

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## Awards, grants

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**Lasting Impact Award (for KinectFusion)** at ACM UIST 2022

**Lasting Impact Award (for KinectFusion)** at IEEE ISMAR 2022

**Best Paper Award (for FlexCase)** at ACM CHI 2016

**Honorable Mention (for Hand Tracking)** at ACM CHI 2015

**Best Paper Award (for RetroDepth)** at ACM CHI 2014

**Best Paper Award (for MixFab)** at ACM CHI 2014

**Runner-up Best Demo Award (for Digits)** at ACM UIST 2012

**Best Paper Award (Augmented Projectors)** at PERVASIVE 2012

**Honorable Mention (for Shake'n'Sense)** at ACM CHI 2012

**Best Paper Award (for KinectFusion)** at IEEE ISMAR 2011

**PhD grant** Microsoft Research PhD Fellowship, 2-year, 2012

**PhD grant** Engineering and Physical Sciences Research Council (EPSRC, UK, 2009)

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## Academic services

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

**Co-Chair** for Posters at ACM ITS 2015

**Co-Chair** for Student Innovation Contest at ACM UIST 2014

**Co-Chair** Student Innovation Contest at ACM UIST 2013

**Program Committee Member:** ITS 2015, UIST 2015, UIST 2016, CHI 2014, CHI 2015

**Paper Peer Reviewer:**

CHI: 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2020

UIST: 2011, 2012, 2013, 2014, 2015, 2016, 2018, 2021, 2022

ITS: 2012, 2013, 2015

SIGGRAPH: 2015, 2016, SIGGRAPH ASIA: 2018, 2022

UbiComp 2012, DIS 2012, TEI 2013, IUI 2013, Mobile HCI 2015, IMWUT 2018

IEEE Pervasive Computing (2014), IEEE Computer Graphics and Applications (2013), International Journal of Human-Computer Studies (2014), The Visual Computer (2014)

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## Papers

**Depth Lab (full paper):** R. Du, E. Turner, M. Dzitsiuk, L. Prasso, I. Duarte, J. Dourgarian, J. Afonso, J. Pascoal, J. Gladstone, N. Cruces, S. Izadi, A. Kowdle, K. Tsotsos, **D. Kim**. DepthLab: Real-time 3D interaction with depth maps for mobile augmented reality. ACM UIST. 10/2020

**Fast Hand Tracking (full paper):** J. Taylor, V. Tankovich, D. Tang, C. Keskin, **D. Kim**, P. Davidson, A. Kowdle, S. Izadi. Articulated distance fields for ultra-fast tracking of hands interacting. ACM TOG. 11/2017

**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. Holoportation: Virtual 3D Teleportation in Real-time. ACM UIST, 10/2016.

**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, 7/2016.

**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, 6/2016. **(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, 5/2016. **(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, 5/2016.

**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), 8/2015.

**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, 4/2015. **(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, 10/2014

**PumpSpark (full paper):** P. Dietz, G. Reyes, **D. Kim**. The PumpSpark Fountain Development Kit. ACM DIS, Vancouver, BC, Canada, 6/2014

**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, 4/2014 **(Best Paper Award)**

**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, 4/2014 **(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, 10/2012 **(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, Newcastle, UK, 6/2012 **(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, 5/2012

**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, 10/2011

**KinectFusion (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, 10/2011 **(Best Paper Award)**

**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. UIST, Santa Barbara 10/2011

**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. ACM CHI, Austin, TX, USA, 5/2012 **(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. ACM CHI, Atlanta, Georgia, USA, 4/2010

**Liquid Displacement Sensing (short paper):** O. Hilliges, **D. Kim**, S. Izadi. Creating Malleable Interactive Surfaces using Liquid Displacement Sensing. IEEE ITS, Amsterdam, NL, 10/2008

**BrainStorm (full paper):** O. Hilliges, L. Terrenghi, S. Boring, **D. Kim**, H. Richter, A. Butz. Designing for Collaborative Creative Problem Solving. ACM Creativity & Cognition, Washington D.C., USA, 6/2007

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## Patents

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**Gesture calibration for devices (US 11347320 B1).** Dongeek Shin, **David Kim**, Sofien Bouaziz. 31 May 2022

**Hand tracking based on articulated distance field (US 11030773 B2).** Jonathan James Taylor, Vladimir Tankovich, Danhang Tang, Cem Keskin, Adarsh Prakash Murthy Kowdle, Philip L Davidson, Shahram Izadi, David Kim. 8 Jun 2021

**System and method for active stereo depth sensing (US 10839539 B2).** Adarsh Prakash Murthy Kowdle, Vladimir Tankovich, Danhang Tang, Cem Keskin, Jonathan James Taylor, Philip L Davidson, Shahram Izadi, Sean Ryan Fanello, Julien Pascal Christophe Valentin, Christoph Rhemann, Mingsong Dou, Sameh Khamis, David Kim. 17 November 2020

**Changing an application state using neurological data (US 9864431 B2).** Cem Keskin, **David Kim**, Bill Chau, Jaeyoun Kim, Kazuhito Koishida, Khuram Shahid. 9 Jan 2018

**Augmented reality with direct user interaction (US 9891704B2 B2).** Otmar Hilliges, **David Kim**, Shahram Izadi, David Molyneaux, Stephen Hodges, Alexander Butler. 13 Feb 2018

**3d silhouette sensing system (US 9720506 B2).** **David Kim**, Shahram Izadi, Vivek Pradeep, Steven Bathiche, Timothy Andrew Large, Karlton David Powell. 01 Aug 2017.

**Grasping virtual objects in augmented reality (US 9552673 B2).** Otmar Hilliges, **David Kim**, Shahram Izadi, Malte Hanno Weiss. 24 Jan 2017

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

**Depth sensing using an infrared camera (US 9380224 B2).** Cem Keskin, Sean Ryan Francesco Fanello, Shahram Izadi, Pushmeet Kohli, **David Kim**, David Sweeney, Jamie Daniel Joesph Shotton, Duncan Paul Robertson, Sing Bing Kang. 28 Jun 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 10761612 B2).** **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. 1 Sep 2020

**Mobile Camera Localization Using Depth Maps** (US 8711206 B6). 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 8638985 B2). 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.

**Determining Depth from Structured Light Using Trained Classifiers** (US 9916524 B2 A1). Sean Ryan Francesco Fanello, Christoph Rhemann, Adarsh Prakash Murthy Kowdle, Vladimir Tankovich, David Kim, Shahram Izadi. 13 Mar 20218

**User interaction in augmented reality** (US20120113223 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** (US 10234941B2). **David Kim**, Shahram Izadi, Otmar Hilliges, David Alexander Butler, Stephen Hodges, Patrick Luke Olivier, Jiawen Chen, Iason Oikonomidis. 19 Mar 2019

**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

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

**Using photometric stereo for 3d environment modeling** (US 11215711 B2). Otmar Hilliges, Malte Hanno Weiss, Shahram Izadi, **David Kim**, Carsten Curt Eckard Rother. 4 Jan 2022

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**Invited talks,  
presentations,  
lectures,  
demos**

Digital AR. "UltraFast 3D Sensing, Reconstruction, and Understanding of People, Objects and Environments" tutorial at IEEE CVPR 2018

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 and radio 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, University 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

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

Multi-touch Lindow Man exhibition, Great North Museum, Newcastle, UK, August 2009