Hrvoje Benko

Director of Research
Meta Reality Labs Research

Email: benko@meta.com
Web: www.hrvojebenko.com

RESEARCH INTERESTS

My research is in the field of Human Computer Interaction. My research interests include augmented and virtual reality, haptics, interactive projection mapping, new input form factors and devices, as well as touch and freehand gestural input. I am passionate about creating highly interactive real-time demonstration systems that highlight the core innovations while at the same time surprising and delighting the user. In my work, I try to strike a balance between long horizon research and solutions that are directly applicable to products in the near term.

EDUCATION

Columbia University
Ph.D. in Computer Science   June 2003 – June 2007
Advisor: Prof. Steven Feiner - Thesis: "User Interaction in Hybrid Multi-Display Environments"
Columbia University
Masters of Science (M.S.) in Computer Science   Sept. 2001 – June 2003
Lehigh University
Bachelors of Science (B.S.) in Computer Engineering   Sept. 1997 – June 2001

EMPLOYMENT

Meta Platforms Inc. (formerly Facebook)

Director of Research @ Meta Reality Labs Research – Redmond, WA   Feb. 2020 –

Manager, Research Science – Redmond, WA   Nov. 2017 – Feb. 2020

Responsible for setting the vision and research direction of the HCI research organization at Meta Reality Labs Research as well as driving the R&D on novel wristband input and haptics solutions for AR/VR. Technical stakeholder responsible for due diligence and team integration for two company acquisitions (valued at >$500M). Formed and directed large-scale multi-disciplinary HW+SW+AI+HCI teams that resulted in novel AR interaction wristbands including development of novel sensing solutions from concept stage to TRL 6 product development. Technical contributions in bioimpedance and camera sensing, haptics, adaptive user interfaces (HCI+AI), and gaze+hand motion user interactions. Established the HCI research pillar at Meta Reality Research and established the HCI fellowship within the Meta PhD Fellowship program.

Microsoft Corporation   July 2007 – Oct. 2017

Principal Researcher @ Microsoft Research – Redmond, WA

Researching novel input devices and spatial augmented reality approaches in Adaptive Systems and Interaction group (w/ Dr. Eric Horvitz), and in the Natural Interaction Research group (w/ Dr. Andy Wilson). Responsible for driving an independent research direction to advance haptics, augmented and virtual reality, projector-camera interactive systems, and non-planar multi-touch sensing devices. Engaged with Microsoft Hardware to productize a research project into a novel input device (Microsoft Multitouch Mouse) which enabled the user to use touch gestures on top of the mouse to control their Windows experience.

Microsoft Corporation   Summer 2005
Summer Research Internship – Redmond, WA
Unisys Corporation   Summer 2000
Summer Internship – Malvern, PA
Merrill Lynch   Summer 1999
Summer Internship – New York, NY

RESEARCH HIGHLIGHTS & AWARDS

- ACM UIST 2022 Lasting Impact Award for the paper "OmniTouch: Wearable Multitouch Interaction Everywhere" (awarded for significant impact to the HCI field beyond 10 years from publication)
- 6 Best Paper Awards (ACM UIST, ACM CHI, ACM CSCW, ACM ITS/ISS)
- 6 Best Paper Honorable Mention Awards (ACM UIST & ACM CHI)
- 80+ journal and conference papers
- 70 issued patents

PUBLICATIONS[1]

Books and Book Chapters

B1. Pandžić, I. S., Pejša, T., Matković, K., Benko, H., Čereković, A., Matijašević, M. (2011). "Virtualna Okruženja: Interaktivna 3D grafika i njene primjene". (In Croatian, translated title: Virtual Environments: Interactive 3D graphics and applications). ISBN: 978-953-197-606-0. Element d.o.o., Zagreb, September 2010.

B2. Benko, H. and Wigdor, D. "Imprecision, Inaccuracy, and Frustration: The Tale of Touch Input". In "Tabletops - Horizontal Interactive Displays". Christian Mueller-Tomfelde (ed.). ISBN: 978-1-84996-112-7. Springer HCI Series, Springer-Verlag London Ltd., April 2010.

Journal Articles

J1. Holman, D., Girouard, A., Benko, H., and Vertegaal, R. (2013). "The Design of Organic User Interfaces: Shape, Sketching and Hypercontext". Interacting with Computers, Oxford Journals. 25(2): 133-142.

J2. Steinicke, F., Benko, H., Daiber, F., Keefe, D.F., and de la Rivière, J.-B. (2013) "Foreword to the special section on touching the 3rd dimension". Computers & Graphics. 37(3).

J3. Thorisson, K., Benko, H., Abramov, D., Arnold, A., Maskey, S., and Vaseekaran, A. (2004). "Constructionist Design Methodology for Interactive Intelligences". AI Magazine. Vol. 25, No. 4. p. 77-90.

J4. Benko, H. (2001). "e-Ireland: Europe's New Internet Hub". Perspectives on Business and Economics, Volume 19. Martindale Center for the Study of Private Enterprise, Lehigh University, Bethlehem, PA, USA. p. 39-48.

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[1] A note on publication venues: in my primary area of research, Human Computer Interaction, the ACM Conference on Human Factors in Computing Systems (CHI) and the ACM Symposium on User Interface Software and Technology (UIST) are considered the best forums for dissemination of research results and covers the broad spectrum of research in Human Computer Interaction. Papers in these conferences are rigorously refereed by 4-5 experts, and have an acceptance rate of around 15-25% each year.

Peer Reviewed Conference Papers and Technotes

C1. Zhang, T., Hu, Z., Gupta, A., Wu, C.-H., Benko, H., and Jonker, T.R. (2022). RIDS: Implicit Detection of a Selection Gesture Using Hand Motion Dynamics During Freehand Pointing in Virtual Reality. In Proceedings of ACM User Interface Software and Technology (ACM UIST '22).

C2. Yu, D., Desai, R., Zhang, T., Benko, H., Jonker, T.R., and Gupta, A. (2022). Optimizing the Timing of Intelligent Suggestion in Virtual Reality. In Proceedings of ACM User Interface Systems and Technology (ACM UIST '22).

C3. Peacock, C.E., Lafreniere, B., Zhang, T., Santosa, S., Benko, H., and Jonker, T.R. (2022). Gaze as an Indicator of Input Recognition Errors. In Proceedings of the ACM on Human-Computer Interaction. Volume 6. Issue ETRA.

C4. Parizi, F. S., Kienzle, W., Whitmire, E., Gupta, A., and Benko, H. (2021). RotoWrist: Continuous Infrared Wrist Angle Tracking using a Wristband. In Proceedings of ACM VRST '21.

C5. David-John, B., Peacock, C. E., Zhang, T., Mudison, T. S., Benko, H., and Jonker, T. R. (2021). Towards gaze-based prediction of the intent to interact in virtual reality. In Proceedings of ACM Symposium on Eye Tracking Research & Applications (ACM ETRA '21).

C6. Lafreniere, B., Jonker, T. R., Santosa, S., Parent, M., Glueck, M., Grossman, T., Benko, H., and Wigdor, D. (2021). False Positives vs. False Negatives: The Effects of Recovery Time and Cognitive Costs on Input Error Preference. In Proceedings of ACM UIST '21.

C7. Foy, C. R., Dudley, J. J., Gupta, A., Benko, H., and Kristensson, P.O. (2021). Understanding, Detecting and Mitigating the Effects of Coactivations in Ten-Finger Mid-Air Typing in Virtual Reality. In Proceedings of ACM CHI '21.
ACM CHI 2021 Best Paper Honorable Mention

C8. Kienzle, W., Whitmire, E., Rittaler, C., and Benko, H. (2021). ElectroRing: Subtle Pinch and Touch Detection with a Ring. In Proceedings of ACM CHI '21.

C9. Li, Z., Chan, J., Walton, J., Benko, H., Wigdor, D., and Gluek, M. (2021). Armstrong: An Empirical Examination of Pointing at Non-Dominant Arm-Anchored UIs in Virtual Reality. In Proceedings of ACM CHI '21.

C10. Gupta, A., Samad, M., Kin, K., Kristensson, P.O., and Benko, H. (2020). Investigating Remote Tactile Feedback for Mid-Air Text-Entry in Virtual Reality. In Proceedings of IEEE ISMAR '20.

C11. Gong, J., Gupta, A. and Benko, H. (2020). Acustico: Surface Tap Detection and Localization using Wrist-based Acoustic TDOA Sensing. In Proceedings of ACM UIST '20.

C12. Henrikson, R., Grossman, T., Trowbridge, S., Wigdor, D., and Benko, H. (2020). Head-Coupled Kinematic Template Matching: A Prediction Model for Ray Pointing in VR. In Proceedings of ACM CHI '20.

C13. Zhang, Y., Kienzle, W., Ma, Y., Ng, S. S., Harrison, C., and Benko, H. (2019). ActiTouch: Robust Touch Detection for On-Skin AR/VR Interfaces. In Proc. of ACM UIST 2019.

C14. Gebhardt, C., Hecox, B, van Opheusden, B., Wigdor, D., Hillis, J., Hilliges, O., and Benko, H. (2019). Learning Cooperative Personalized Policies from Gaze Data. In Proc. of ACM UIST 2019.

C15. Penzent, E., Israr, A., Samad, M., Robinson, S., Agrawal, P., Benko, H., and Colonnese, N. (2019). Tasbi: Multisensory Squeeze and Vibrotactile Wrist Haptics for Augmented and Virtual Reality. In Proc. of World Haptics Conference (WHC 2019).

C16. Dudley, J., Benko, H., Wigdor, D., and Kristensson, P.O. (2019). Performance Envelopes of Virtual Keyboard Text Input Strategies in Virtual Reality. In Proc. of IEEE ISMAR 2019.

C17. Maiero, J., Eibich, D., Kruijff, E., Hinkenjann, A., Stuerzlinger, W., Benko, H., Ghinea, G. (2019). Back-of-Device Force Feedback Improves Touch Screen Interaction for Mobile Devices. IEEE Transactions on Haptics (TOH). doi: 10.1109/TOH.2019.2911519

C18. Samad, M., Gatti, E., Hermes, A., Benko, H., and Parise, C. (2019). Pseudo-Haptic Weight: Changing the Perceived Weight of Virtual Objects By Manipulating Control-Display Ratio. In Proc. of ACM CHI 2019.

C19. Strasnick, E., Holz, C., Ofek, E., Sinclair, M. and Benko, H. (2018). Haptic Links: Bimanual Haptics for Virtual Reality Using Variable Stiffness Actuation. In Proc. of ACM CHI '18.

C20. Whitmire, E., Benko, H., Holz, C., Ofek, E. and Sinclair, M. (2018). Haptic Revolver: Touch, Shear, Texture, and Shape Rendering on a Reconfigurable Virtual Reality Controller. In Proc. of ACM CHI '18.
ACM CHI 2018 Best Paper Honorable Mention

C21. Zhao, Y., Bennett, C., Benko, H., Cutrell, E., Holz, C., Morris, M. and Sinclair, M. (2018). Enabling People with Visual Impairments to Navigate Virtual Reality with a Haptic and Auditory Cane Simulation. In Proc. of ACM CHI '18.

C22. Choi, I., Ofek, E., Benko, H., Sinclair, M. and Holz, C. (2018). CLAW: A Multifunctional Handheld Haptic Controller for Grasping, Touching, and Triggering in Virtual Reality. In Proc. of ACM CHI '18.

C23. Xiao, R., Schwartz, J., Wilson, A., and Benko, H. (2018). MRTouch: Adding Touch Input to Head-Mounted Mixed Reality. IEEE Transactions on Visualization and Computer Graphics (TVCG), Special Issue (presented at IEEE VR 2018 Conference).

C24. Fender, A. R., Benko, H. and Wilson, A.D. (2017). MeetAlive: Room-Scale Omni-Directional Display System for Multi-User Content and Control Sharing. In Proc. of ACM Interactive Surfaces and Spaces (ISS) 2017.
ACM ISS 2017 Best Paper Award

C25. Lu, J., Benko, H., and Wilson, A. (2017) Hybrid HFR Depth: Fusing Commodity Depth and Color Cameras to Achieve High Frame Rate, Low Latency Depth Camera Interactions. In Proc. of ACM CHI 2017.
ACM CHI 2017 Best Paper Honorable Mention

C26. Cheng, L.-P., Ofek, E., Holz, C., Benko, H., and Wilson, A. (2017) Sparse Haptic Proxy: Touch Feedback in Virtual Environments Using a General Passive Prop. In Proc. of ACM CHI 2017.

C27. Benko, H., Holz, C., Sinclair, M. and Ofek, E. (2016). NormalTouch and TextureTouch: High-fidelity 3D Haptic Shape Rendering on Handheld Virtual Reality Controllers. In Proc. of ACM UIST 2016.
ACM UIST 2016 Best Paper Honorable Mention

Reprise Presentation at ACM SIGGRAPH 2017

C28. Xiao, R. and Benko, H. (2016). Augmenting the Field-of-View of Head-Mounted Displays with Sparse Peripheral Displays. In Proc. of ACM CHI 2016.
ACM CHI 2016 Best Paper Honorable Mention

C29. Azmandian, M., Hancock, M., Benko, H., Ofek, E., and Wilson, A. (2016). Haptic Retargeting: Dynamic Repurposing of Passive Haptics for Enhanced Virtual Reality Experiences. In Proc. of ACM CHI 2016.
ACM CHI 2016 Golden Mouse Award (Best Video)

C30. Nuernberger, B., Ofek, E., Benko, H., and Wilson, A. (2016). SnapToReality: Aligning Augmented Reality to the Real World. In Proc. of ACM CHI 2016.

C31. Hinckley, K., Heo, S., Pahud, M., Holz, C., Benko, H., Sellen, A., Banks, R., O'Hara, K., Smyth, G., and Buxton, W. (2016). Pre-Touch Sensing for Mobile Interaction. In Proc. of ACM CHI 2016.

C32. Pejsa, T., Kantor, J., Benko, H., Ofek, E., and Wilson. A. (2016). Room2Room: Enabling Life-Size Telepresence in a Projected Augmented Reality Environment. In Proc. of ACM Conference on Computer Supported Cooperative Work (CSCW 2016).
ACM CSCW 2016 Best Paper Award

C33. Benko, H., Ofek, E., Zheng, F., and Wilson, A. D. (2015). FoveAR: Combining an Optically See-Through Near-Eye Display with Spatial Augmented Reality Projections. In Proc. of ACM UIST 2015.

C34. Yoon, D., Hinckley, K., Benko, H., Guimbretiere, F., Irani, P., Pahud, M., and Gavriliu, M. (2015). Sensing Tablet Grasp + Micro-mobility for Active Reading. In Proc. of ACM UIST 2015.

C35. Wilson, A. D. and Benko, H. (2014). "CrossMotion: Fusing Device and Image Motion for User Identification, Tracking and Device Association". In Proc. of ACM International Conference on Multimodal Interaction (ICMI 2014).

C36. Benko, H., Wilson, A. D., Zannier, F. (2014). "Dyadic Projected Spatial Augmented Reality". In Proc. of ACM UIST 2014.

C37. Jones, B., Sodhi, R., Murdock, M., Mehra, R., Benko, H., Wilson, A., Ofek, E., MacIntryre, B., Raghuvanshi, N., Shapira, L. (2014). "RoomAlive: Magical Experiences Enabled by Scalable, Adaptive Projector-Camera Units". In Proc. of ACM UIST 2014.

C38. Hinckley, K., Pahud, M., Benko, H., Irani, P., Gavriliu, M., Guimbretiere, F., Chen, X., Matulic, F., Buxton, W., Wilson, A. D. (2014). "Sensing Techniques for Tablet+Stylus Interaction". In Proc. of ACM UIST 2014.
ACM UIST 2014 Best Paper Award

Invited for Reprise Presentation at ACM SIGGRAPH 2015

C39. Sinclair, M., Pahud, M. and Benko, H. (2014). "TouchMover 2.0 - 3D Touchscreen with Haptic Feedback and Haptic Texture". In Proc. of IEEE Haptics Symposium (HAPTICS '14).

C40. Sinclair, M., Pahud, M. and Benko, H. (2013). "TouchMover: Actuated 3D Touchscreen with Haptic Feedback". In Proc. of ACM Interactive Tabletops and Surfaces (ITS 2013).
ACM ITS 2013 Best Paper Award

C41. Hinckley, K., Chen, X., and Benko, H. (2013). "Motion and Context Sensing Techniques for Pen Computing". In Proc. of Graphics Interface 2013.

C42. Bacim, F., Sinclair, M., and Benko, H. (2013). "Understanding Touch Selection Accuracy on Flat and Hemispherical Deformable Surfaces". In Proc. of Graphics Interface 2013.

C43. Jones, B., Benko, H., Ofek, E., and Wilson, A. D. (2013). "IllumiRoom: Peripheral Projected Illusions for Interactive Experiences". In Proc. of ACM CHI 2013.
ACM CHI 2013 Best Paper Award
ACM CHI 2013 Golden Mouse Award (best video)

C44. Wilson, A. D., Benko, H., Izadi, S., and Hilliges, O. (2012). "Steerable Augmented Reality with the Beamatron". In Proc. of ACM UIST 2012. p. 413-422.

C45. Benko, H., Jota, R. and Wilson, A. D. (2012). "MirageTable: Freehand Interaction on a Projected Augmented Reality Tabletop". In Proc. of ACM CHI 2012. p. 199-208.

C46. Sodhi, R., Benko, H., and Wilson, A. D. (2012). "LightGuide: Projected Visualizations for Hand Movement Guidance". In Proc. of ACM CHI 2012. p. 179-188.
ACM CHI 2012 Best Paper Honorable Mention

C47. Sun, M., Cao, X., Song, H., Izadi, S., Benko, H., Guimbretiere, F., Ren, X., and Hinckley, K. (2011). "Enhancing Naturalness of Pen-and-Tablet Drawing through Context Sensing". In Proceedings of ACM Interactive Tabletops and Surfaces (ITS '11). p. 83-86.

C48. Harrison, C., Benko, H., Wilson, A. D. (2011). "OmniTouch: Wearable Multitouch Interaction Everywhere". In Proceedings of ACM UIST 2011. p. 441-450.
ACM UIST Lasting Impact Award 2022

C49. Saponas, T.S., Harrison, C., Benko, H. (2011) "PocketTouch: Through-Fabric Capacitive Touch Input". In Proceedings of ACM UIST 2011. p. 303-308.

C50. Song, H., Benko, H., Guimbretiere, F., Izadi, S., Cao, X., and Hinckley, K. (2011). "Grips and Gestures on a Multi-Touch Pen". In Proceedings of ACM CHI 2011. p. 1323-1332.

C51. Wigdor, D., Benko, H., Pella, J., Lombardo, J., and Williams, S. (2011). "Rock & Rails: Extending Multi-touch Interactions with Shape Gestures to Enable Precise Spatial Manipulations". In Proceedings of ACM CHI 2011. p. 1581-1590.

C52. Benko, H. and Wilson, A. D. (2010). "Multi-Point Interactions with Immersive Omnidirectional Visualizations in a Dome". In Proceedings of ACM Interactive Tabletops and Surfaces (ITS '10). p. 19-28.

C53. Hinckley, K., Yatani, K., Pahud, M., Coddington, N., Rodenhouse, J., Wilson, A., Benko, H., and Buxton, B. (2010). "Pen + Touch = New Tools". In Proceedings of ACM UIST '10. pp. 27-36.

C54. Wilson, A. and Benko, H. (2010). "Combining Multiple Depth Cameras and Projectors for Interactions On, Above, and Between Surfaces". In Proceedings of ACM UIST '10. pp. 273-282.

C55. Benko, H., Izadi, S., Wilson, A. D., Cao, X., Rosenfeld, D., and Hinckley, K. (2010). "Design and Evaluation of Interaction Models for Multi-touch Mice". In Proceedings of Graphics Interface 2010. p. 253-260.

C56. Hinckley, K., Yatani, K., Pahud, M., Coddington, N., Rodenhouse, J., Wilson, A., Benko, H., and Buxton, B. (2010). "Manual Deskterity: An Exploration of Simultaneous Pen + Touch Direct Input". ACM CHI 2010 Extended Abstracts (alt.chi).

C57. Hartmann, B., Morris, M., Benko, H., and Wilson, A. D. (2010). "Pictionaire: Supporting Collaborative Design Work by Integrating Physical and Digital Artifacts". In Proceedings of ACM CSCW '10. p. 421-424.

C58. Tang, A., Pahud, M., Inkpen, K., Benko, H., Tang, J., and Buxton, B. (2010). "Three's Company: Understanding Communication Channels in Three-way Distributed Collaboration". In Proceedings of ACM CSCW '10. p. 271-280.

C59. Benko, H. Saponas, T.S., Morris, D., and Tan, D. (2009). "Enhancing Input On and Above the Interactive Surface with Muscle Sensing". In Proceedings of ACM Interactive Tabletops and Surfaces (ITS '09). p. 93-100.

C60. Freeman, D., Benko, H., Morris, M. R., and Wigdor, D. (2009). "ShadowGuides: Visualizations for In-Situ Learning of Multi-Touch and Whole-Hand Gestures". In Proceedings of ACM Interactive Tabletops and Surfaces (ITS '09). p. 165-172.

C61. Benko, H. (2009). "Beyond Flat Surface Computing: Challenges of Depth-Aware and Curved Interfaces". In Proceedings of ACM MultiMedia '09.

C62. Villar, N., Izadi, S., Rosenfeld, D., Benko, H., Helmes, J., Westhues, J., Hodges, S., Butler, A., Ofek, E., Cao, X., and Chen, B. (2009). "Mouse 2.0: Multi-touch Meets the Mouse". In Proceedings of ACM User Interface Software and Technology (UIST '09). p. 33-42.
ACM UIST 2009 Best Paper Award

C63. Hartmann, B., Morris, M. R., Benko, H., and Wilson, A. D. (2009). "Augmenting Interactive Tables with Mice & Keyboards". In Proceedings of ACM User Interface Software and Technology (UIST '09). p. 149-152.

C64. Wigdor, D., Williams, S., Cronin, M., White, K., Levy, R., Mazeev, M., and Benko, H. (2009). "Ripples: Utilizing Per-Contact Visualizations to Improve User Interaction with Touch Displays". In Proceedings of ACM User Interface Software and Technology (UIST '09). p. 3-12.

C65. Nacenta, M., Baudisch, P, Benko, H., and Wilson, A. D. (2009). "Separability of Spatial Manipulations in Multi-touch Interfaces". In Proceedings of Graphics Interface '09. Kelowna, BC, Canada, May 2009. p. 175-182.

C66. Benko, H., Wilson, A. D., and Balakrishnan, R. (2008). "Sphere: Multi-Touch Interactions on a Spherical Display". In Proceedings of ACM User Interface Software and Technology (UIST '08). Monterey, CA. p. 77-86.

C67.   Benko, H. and Feiner, S. (2007). "Pointer Warping in Heterogeneous Multi-Monitor Environments". In Proceedings of Graphics Interface '07. Montreal, Canada. May 28-30. p. 111-117.

C68.   Benko, H. and Feiner, S. (2007). "Balloon Selection: A Multi-Finger Technique for Accurate Low-Fatigue 3D Selections." In Proceedings of IEEE Symposium on 3D User Interfaces. Charlotte, North Carolina, USA. March 10-11. p. 79-86.

C69.   Benko, H., Wilson, A. D., and Baudisch, P. (2006). "Precise Selection Techniques for Multi-Touch Screens." In Proceedings of ACM CHI 2006 (CHI'06: Human Factors in Computing Systems). Montreal, Canada. April 24-27. p. 1263-1272.

C70.   Benko, H., Feiner, S. (2005). "Multi-Monitor Mouse." ACM CHI 2005 (CHI'05: Human Factors in Computing Systems) Extended Abstracts. Portland, Oregon, USA. April 2-7. p. 1208-1211.

C71.   Benko, H., Ishak, E.W., Feiner, S. (2005). "Cross-Dimensional Gestural Interaction Techniques for Hybrid Immersive Environments." In Proceedings of IEEE Virtual Reality (VR '05). Bonn, Germany. March 10-12. p. 209-116.

C72.   Benko, H., Ishak, E.W., Feiner, S. (2004). "Collaborative Mixed Reality Visualization of an Archaeological Excavation." In Proceedings of The International Symposium on Mixed and Augmented Reality (ISMAR '04). November 2-5. p. 132-140.

C73.   Allen, P., Feiner, S. Troccoli, A., Benko, H., Ishak, E., Smith, B. (2004). "Seeing into the Past: Creating a 3D Modeling Pipeline for Archaeological Visualization." In Proceedings of International Symposium on 3D Data Processing Visualization and Transmission (3DPVT '04). p. 751-758.

C74.   Kaiser, E., Olwal, A., McGee, D., Benko, H., Corradini, A., Li, X., Cohen, P., Feiner, S. (2003). "Mutual Disambiguation of 3D Multimodal Interaction in Augmented and Virtual Reality." In Proceedings of The Fifth International Conference on Multimodal Interfaces (ICMI '03). Vancouver, BC. Canada. November 5-7. p. 12-19.

C75.   Olwal, A., Benko, H., Feiner, S. (2003). "SenseShapes: Using Statistical Geometry for Object Selection in a Multimodal Augmented Reality System". In Proceedings of The Second International Symposium on Mixed and Augmented Reality (ISMAR '03). Tokyo, Japan. October 7-10. p. 300-301.

Technical Reports

TR1.   Aigner, R., Wigdor, D., Benko, H., Haller, M., Lindbauer, D., Ion, A., Zhao, S., and Koh, J.T.K.V. (2012). "Understanding Mid-Air Hand Gestures: A Study of Human Preferences in Usage of Gesture Types for HCI". Microsoft Research Technical Report MSR-TR-2012-111. November, 2012.

TR2.   Benko, H., Wilson, A. (2009). "DepthTouch: Using Depth-Sensing Camera to Enable Freehand Interactions On and Above the Interactive Surface". Microsoft Research Technical Report MSR-TR-2009-23. March, 2009.

TR3.   Benko, H., Morris, M. R., Brush, A.J.B., Wilson, A.D. (2009). "Insights on Interactive Tabletops: A Survey of Researchers and Developers". Microsoft Research Technical Report MSR-TR-2009-22. March, 2009.

TR4.   Benko, H., Ishak, E.W., Feiner, S. (2004). "Cross-Dimensional Gestural Interaction Techniques for Hybrid Immersive Environments". Columbia University, New York. Technical Report. CUCS-029-04, August 2004.

Peer-Reviewed Demos & Posters

D1.   Azmandian, M., Hancock, M., Benko, H., Ofek, E., and Wilson, A. (2016). A Demonstration of Haptic Retargeting: Dynamic Repurposing of Passive Haptics for Enhanced Virtual Reality Experiences. ACM ISS 2016.

D2.   Azmandian, M., Hancock, M., Benko, H., Ofek, E., and Wilson, A. (2016). A Demonstration of Haptic Retargeting: Dynamic Repurposing of Passive Haptics for Enhanced Virtual Reality Experiences. ACM CHI 2016.

D3.   Jones, B., Benko, H., Ofek, E., and Wilson, A. D. (2013). "IllumiRoom: Peripheral Projected Illusions for Interactive Experiences". SIGGRAPH 2013 Emerging Technologies. Anaheim, CA. **Best Demo & Invitation to Laval Virtual 2014.**

D4.   Holman, D. and Benko, H. (2011). "SketchSpace: Designing Interactive Behaviors with Passive Materials". CHI 2011 Extended Abstracts, May, 2011.

D5.   Jota, R. and Benko, H. (2011). "Constructing Virtual 3D Models with Physical Building Blocks". CHI 2011 Extended Abstracts, May, 2011.

D6.   Benko, H., Wilson, A. (2010). "Pinch-the-Sky Dome: Freehand Multi-Point Interactions with Immersive Omni-Directional Data". CHI 2010 Extended Abstracts, April, 2010.

D7.   Benko, H., Wilson, A. (2008). "DepthTouch: Using Depth-Sensing Camera to Enable Freehand Interactions On and Above the Interactive Surface". IEEE Workshop on Tabletops and Interactive Surfaces '08. Amsterdam, the Netherlands, October 1-3, 2008.

D8.   Benko, H., Ishak, E.W., Feiner, S. (2004). "VITA: Visual Interaction Tool for Archaeology". The International Symposium on Mixed and Augmented Reality (ISMAR 2004). November 2-5, 2004.

D9.   Benko, H., Ishak, E.W., Feiner, S. (2004). "VITA: Visual Interaction Tool for Archaeology (Demo)". In Proc. The ACM SIGMM Effective Telepresence Workshop (ACM SIGMM ETP 2004), October 15, 2004. p. 48-49.

D10.   Allen, P., Feiner, S., Meskell, L., Ross, K., Troccoli, A., Smith, B., Benko, H., Ishak, E., and Conlon, J. (2004). "Digitally Modeling, Visualizing and Preserving Archaeological Sites". In Proc. Joint Conference on Digital Libraries 2004 (JCDL 2004). Tuscon, AZ. June 7-11. pp. 389.

D11.   Feiner, S. Bell, B., Benko, H., Blasko, G., Güven, S., Hallaway, D., Höllerer, T., and Lok, S. (2002). "Mobile Augmented Reality Systems." Living with the Genie: Governing Scientific and Technological Transformation in the 21st Century. New York, NY. March 5-7.

Workshops

W1. Wilson, A., and Benko, H. (2017) Projected Augmented Reality with the RoomAlive Toolkit. Tutorial at ACM ISS 2016.

W2. Steimle, J., Benko, H., Cassinelli, A., Ishii, H., Leithinger, D., Maes, P., and Poupyrev, I. (2013) "Displays take new shape: an agenda for future interactive surfaces". (workshop) CHI Extended Abstracts 2013. p. 3283-3286.

W3. Bacim, F., Sinclair, M., and Benko, H. (2012) "Challenges of Multitouch Interaction on Deformable Surfaces". Beyond Flat Displays Workshop at ACM ITS 2012.

W4. Steinicke, F., Benko, H., Krüger, A., Keefe, D.F., de la Rivière, J.-B., Anderson, K., Häkkilä, J., Arhippainen, L., and Pakanen, M. (2012) "The 3rd dimension of CHI (3DCHI): touching and designing 3D user interfaces". CHI Extended Abstracts 2012: p. 2695-2698.

W5. Steinicke, F., Benko, H., Daiber, F., Keefe, D.F., and de la Rivière, J.-B. (2011) "Touching the 3rd dimension (T3D workshop)". CHI Extended Abstracts 2011. p. 161-164.

W6. Benko, H. and Wilson, A. (2009). "Design Challenges of Interactive Spherical User Interfaces". Programming Reality Workshop at CHI'09. April, 2009.

W7. Ishak, E., Benko, H., and Feiner, S. (2005). "Development and Evaluation of Mixed Reality Interaction Techniques". Workshop on 3D User Interfaces (3DUI at IEEE VR'05). Bonn, Germany. March 10-12, 2005.

W8. Benko, H., Ishak, E., and Feiner, S. (2003). "Collaborative Visualization of an Archaeological Excavation". Workshop on Collaborative Virtual Reality and Visualization (CVRV 2003). Lake Tahoe, CA. October 26-28, 2003.

Thesis

T1. Benko, H. (2007). "User Interaction in Hybrid Multi-Display Environments". Ph.D. Dissertation. Department of Computer Science, Columbia University, New York, NY. May 2007.

KEYNOTES / INVITED TALKS

IT1. Benko, H. (2022). "The Future of Mixed Reality Interactions". HCI Lecture Series. Massachusetts Institute of Technology. Nov. 2022.

IT2. Benko, H. Invited panelist on the panel: "Fabricate It or Render It? Digital Fabrication vs. Virtual Reality for Creating Objects Instantly". At ACM CHI 2022. New Orleans, LA.

IT3. Benko, H. (2021). "The Future of Mixed Reality Interactions". **Keynote** at International XR Workshop, February 12, 2021. Auckland, New Zealand.

IT4. Benko, H. (2020). "The Future of Mixed Reality Interactions". HCI Lecture Series. Stanford University. Oct. 16, 2020.

IT5. Benko, H. (2020). "The Future of Mixed Reality Interactions". **Keynote** at ACM Interactive Surfaces and Spaces (ISS). Lisbon, Portugal 2020.

IT6.   Benko, H. (2019). "The Future of Mixed Reality Interactions". **Keynote** at IEEE AIVR 2019. San Diego, California.

IT7.   Benko, H. (2018). "The ABC of MR Interactions". **Keynote** presentation at IEEE International Symposium on Mixed and Augmented Reality (ISMAR) 2018. Munich, Germany.

IT8.   Benko, H. (2018). "VR Haptic Controllers: Multi-Purpose Handheld Haptics Beyond Vibro-Tactors". **Keynote** presentation at IEEE Haptics Symposium 2018, San Francisco, CA.

IT9.   Benko, H. (2017). "Perception Equals Reality". Invited lecture. Virtual Reality World Congress 2017. Bristol, UK.

IT10.   Benko, H. (2017). "Perception Equals Reality". Lecture series. Simon Fraser University, BC, Canada.

IT11.   Benko, H. (2017). "Perception Equals Reality". Lecture series. University of British Columbia, BC, Canada.

IT12.   Benko, H. (2017). "Perception Equals Reality". Panelist at ACM Spatial User Interfaces (SUI).

IT13.   Benko, H. (2015). "Interacting with Photons: Creating Interactive Projected Augmented Reality Experiences". **TUX Sander's Distinguished Speaker Series** in Toronto, ON. October 13. 2015.

IT14.   Benko, H. (2015). "Interacting with Photons: Creating Interactive Projected Augmented Reality Experiences". Columbia University. October 14. 2015.

IT15.   Benko, H. (2015). "Interacting with Photons: Creating Interactive Projected Augmented Reality Experiences". New York University. October 15. 2015.

IT16.   Benko, H. (2013). "Beyond Flat Displays: Interactivity on Any Surface". Stanford University. HCI Seminar. October 17, 2013.

IT17.   Benko, H. (2013). "Beyond Flat Displays: Interactivity on Any Surface". University of California Berkeley. SWARM Lab Seminar. October 16, 2013.

IT18.   Benko, H. (2013). "Istraživanja iz Microsoft Research-a na području proširene stvarnosti". (in Croatian). WinDays Conference. Umag, Croatia, April 24, 2013.

IT19.   Benko, H. (2013). "Beyond Flat Displays". ACM CHI '13 Workshop on Displays Take New Shape. April 28, 2013.

IT20.   Benko, H. (2012). "Rich Augmented Reality Interactions without Goggles, Gloves or 3D Trackers ". DUB Research Talk. University of Washington. January 4, 2012.

IT21.   Benko, H. (2011). "High-fidelity Augmented Reality Interactions". Microsoft Research Latin American Faculty Summit. May 19, 2011.

IT22.   Benko, H. (2011). "Multi-touch Interactions on Small Input Devices". DUB Research Talk. University of Washington. February 2, 2011.

IT23.   Benko, H. (2009). "Alternative Form Factors of Surface Computing". Microsoft Research Faculty Summit. July 15, 2009.

IT24.   Wilson, A. D. and Benko, H. (2009). "Riffing on Surface". Department of Computer Science, University of California Santa Barbara. March 6, 2009.

IT25.   Benko, H. (2008). "Non-Flat Surface Computing". Microsoft Research Cambridge Lab. September 15, 2008.

IT26.   Benko, H. (2005). "Collaborative Mixed Reality Visualization of an Archaeological Excavation". MIT Media Lab. January 12, 2005.

IT27.   Benko, H., Troccoli, A. (2004). "Creating Telepresence: 3D Modeling and Visualization of an Archaeological Excavation". Ph.D. Seminar, Computer Science, Columbia University. November 23, 2004.

ISSUED PATENTS

P1.   US-10203836-B2. Precise selection techniques for multi-touch screens. Hrvoje Benko, Andrew D. Wilson, Patrick M. Baudisch. Grant date: 2/12/2019

P2.   US-9244545-B2. Touch and stylus discrimination and rejection for contact sensitive computing devices. Kenneth Paul Hinckley, Hrvoje Benko, Steven Bathiche, Paul Henry Dietz, Anoop Gupta. Grant date: 1/26/2016

P3.   US-10168827-B2. Sensor correlation for pen and touch-sensitive computing device interaction. Ken Hinckley, Hrvoje Benko, Michel Pahud, Andrew D. Wilson, Pourang Polad Irani, Francois Guimbretiere. Grant date: 1/1/2019

P4.   US-10044982-B2. Providing a tele-immersive experience using a mirror metaphor. Andrew D. Wilson, Zhengyou Zhang, Philip A. Chou, Neil S. Fishman, Donald M. Gillett, Hrvoje Benko. Grant date: 8/7/2018

P5.   EP-2245528-B1. Projection of graphical objects on interactive irregular displays. Hrvoje Benko, Andrew Wilson. Grant date: 7/29/2015

P6.   US-8622742-B2. Teaching gestures with offset contact silhouettes. Hrvoje Benko, Daniel J. Wigdor, Dustin Freeman. Grant date: 1/7/2014

P7.   US-8982051-B2. Detecting touch on a surface. Daniel Rosenfeld, Jonathan Westhues, Shahram Izadi, Nicolas Villar, Hrvoje Benko, John Helmes, Kurt Allen Jenkins. Grant date: 3/17/2015

P8.   US-10290152-B2. Virtual object user interface display. Julia Schwarz, Bo Robert Xiao, Hrvoje Benko, Andrew Wilson. Grant date: 5/14/2019

P9.   US-11042221-B2. Methods, devices, and systems for displaying a user interface on a user and detecting touch gestures. Sean Jason Keller, Tristan Thomas Trutna, Hrvoje Benko. Grant date: 6/22/2021

P10.   US-10409381-B2. Gestures, interactions, and common ground in a surface computing environment. Meredith June Morris, Eric J. Horvitz, Andrew David Wilson, F. David Jones, Stephen E. Hodges, Kenneth P. Hinckley, David Alexander Butler, Ian M. Sands, V. Kevin Russ, Hrvoje Benko, Shawn R. LeProwse, Shahram Izadi, William Ben Kunz. Grant date: 9/10/2019

P11.   EP-2676450-B1. Providing an interactive experience using a 3d depth camera and a 3d projector. Hrvoje Benko, Ricardo Jorge Jota COSTA, Andrew D. Wilson. Grant date: 8/1/2018

P12. US-10297082-B2. Driving a projector to generate a shared spatial augmented reality experience. Andrew D. Wilson, Hrvoje Benko. Grant date: 5/21/2019

P13. US-9509981-B2. Projectors and depth cameras for deviceless augmented reality and interaction. Andrew David Wilson, Hrvoje Benko. Grant date: 11/29/2016

P14. US-10013143-B2. Interfacing with a computing application using a multi-digit sensor. Hrvoje Benko, Daniel Wigdor. Grant date: 7/3/2018

P15. US-10175487-B2. Peripheral display for head mounted display device. Hrvoje Benko, Bo Robert Xiao. Grant date: 1/8/2019

P16. EP-2929424-B1. Multi-touch interactions on eyewear. Hrvoje Benko, Timothy Scott Saponas. Grant date: 2/17/2021

P17. US-9430093-B2. Monitoring interactions between two or more objects within an environment. Chris Harrison, Hrvoje Benko, Andrew David Wilson. Grant date: 8/30/2016

P18. US-9113033-B2. Mobile video conferencing with digital annotation. Sasa Junuzovic, Kori Inkpen Quinn, Anoop Gupta, Aaron Hoff, Gina Venolia, Andreas Nowatzyk, Hrvoje Benko, Gavin Jancke, John Tang. Grant date: 8/18/2015

P19. US-10373381-B2. Virtual object manipulation within physical environment. Benjamin Nuernberger, Hrvoje Benko, Andrew Wilson, Eyal Ofek. Grant date: 8/6/2019

P20. EP-2842303-B1. Proximity and connection based photo sharing. Stephen G. Latta, Kenneth P. Hinckley, Kevin Geisner, Steven Nabil Bathiche, Hrvoje Benko, Vivek Pradeep. Grant date: 9/9/2020

P21. US-8681127-B2. Touch discrimination. Stephen E. Hodges, Hrvoje Benko, Ian M. Sands, David Alexander Butler, Shahram Izadi, William Ben Kunz, Kenneth P. Hinckley. Grant date: 3/25/2014

P22. US-9459784-B2. Touch interaction with a curved display. Hrvoje Benko, Andrew D. Wilson, Billy Chen, Ravin Balakrishnan, Patrick M. Baudisch. Grant date: 10/4/2016

P23. US-10416769-B2. Physical haptic feedback system with spatial warping. Eyal Ofek, Andrew Wilson, Hrvoje Benko, Christian Holz, Lung-Pan Cheng. Grant date: 9/17/2019

P24. US-9317140-B2. Method of making a multi-touch input device for detecting touch on a curved surface. Daniel Rosenfeld, Jonathan Westhues, Shahram Izadi, Nicolas Villar, Hrvoje Benko, John Helmes, Kurt Allen Jenkins. Grant date: 4/19/2016

P25. US-9696427-B2. Wide angle depth detection. Andrew Wilson, Hrvoje Benko, Jay Kapur, Stephen Edward Hodges. Grant date: 7/4/2017

P26. US-9201520-B2. Motion and context sharing for pen-based computing inputs. Hrvoje Benko, Xiang Chen, Kenneth Paul Hinckley. Grant date: 12/1/2015

P27. EP-2805220-B1. Skinnable touch device grip patterns. Kenneth P. Hinckley, Paul Henry Dietz, Hrvoje Benko, Desney S. Tan, Steven Nabil Bathiche. Grant date: 10/10/2018

P28. EP-3077992-B1. Process and system for determining the location of an object by fusing motion features and iamges of the object. Andrew D. Wilson, Hrvoje Benko. Grant date: 11/6/2019

P29.	US-9542092-B2. Prediction-based touch contact tracking. Weidong Zhao, David A. Stevens, Aleksandar Uzelac, Hrvoje Benko, John L. Miller. Grant date: 1/10/2017

P30.	US-10346529-B2. Using physical objects in conjunction with an interactive surface. Bjoern U. Hartmann, Andrew D. Wilson, Hrvoje Benko, Meredith J. Morris. Grant date: 7/9/2019

P31.	US-9423876-B2. Omni-spatial gesture input. Eric Horvitz, Kenneth P Hinckley, Hrvoje Benko, Desney S Tan. Grant date: 8/23/2016

P32.	US-10789760-B2. Focus guidance within a three-dimensional interface. Hrvoje Benko, Daniel Chaim Robbins. Grant date: 9/29/2020

P33.	US-8665479-B2. Three-dimensional printing. Desney S. Tan, Hrvoje Benko, Stephen G. Latta, Steven Nabil Bathiche, Kevin Geisner, Kenneth P. Hinckley. Grant date: 3/4/2014

P34.	US-9513798-B2. Indirect multi-touch interaction. John Helmes, Nicolas Villar, Hrvoje Benko, Shahram Izadi, Daniel Rosenfeld, Stephen Hodges, David Alexander Butler, Xiang Cao, Richard Banks. Grant date: 12/6/2016

P35.	US-8988398-B2. Multi-touch input device with orientation sensing. Xiang Cao, Minghui Sun, Shahram Izadi, Hrvoje Benko, Kenneth P. Hinckley. Grant date: 3/24/2015

P36.	US-10459559-B2. Touch screen interaction using dynamic haptic feedback. Michael J. Sinclair, Michel Pahud, Hrvoje Benko. Grant date: 10/29/2019

P37.	EP-3155502-B1. Multi-user sensor correlation for computing device interaction. Ken Hinckley, Hrvoje Benko, Michel Pahud, Andrew D. Wilson, Pourang Polad Irani, Francois GUIMBRETIERE. Grant date: 11/13/2019

P38.	EP-3117601-B1. Latency reduction in camera-projection systems. Jarrod Knibbe, Hrvoje Benko, Andrew Wilson. Grant date: 1/31/2018

P39.	US-8581856-B2. Touch sensitive display apparatus using sensor input. Hrvoje Benko, Desney S. Tan, Daniel Morris, Timothy Scott Saponas. Grant date: 11/12/2013

P40.	US-9857915-B2. Touch sensing for curved displays. Hrvoje Benko, Andrew Wilson, Ravin Balakrishnan. Grant date: 1/2/2018

P41.	US-9480907-B2. Immersive display with peripheral illusions. Hrvoje Benko, Brett R. Jones, Eyal Ofek, Andrew Wilson, Gritsko Perez. Grant date: 11/1/2016

P42.	EP-2638452-B1. Resolving merged touch contacts. Hrvoje Benko, Andrew Wilson. Grant date: 9/16/2020

P43.	US-9939888-B2. Correlating movement information received from different sources. Andrew D. Wilson, Hrvoje Benko. Grant date: 4/10/2018

P44.	US-9210401-B2. Projected visual cues for guiding physical movement. Andrew Wilson, Hrvoje Benko, Rajinder Sodhi. Grant date: 12/8/2015

P45.	EP-2932362-B1. Reducing latency in ink rendering. Steven Bathiche, Paul Henry Dietz, Hrvoje Benko, Andreas Georg Nowatzyk. Grant date: 3/30/2022

P46.	US-10290153-B2. Dynamic haptic retargeting. Hrvoje Benko, Andrew D. Wilson, Eyal Ofek, Mahdi Azmandian, Mark Hancock. Grant date: 5/14/2019

P47.   US-8928579-B2. Interacting with an omni-directionally projected display. Andrew David Wilson, Hrvoje Benko. Grant date: 1/6/2015

P48.   US-9703398-B2. Pointing device using proximity sensing. David Alexander Butler, Nicolas Villar, John Helmes, Shahram Izadi, Stephen E. Hodges, Daniel Rosenfeld, Hrvoje Benko. Grant date: 7/11/2017

P49.   US-8446367-B2. Camera-based multi-touch mouse. Hrvoje Benko, Daniel Allen Rosenfeld, Eyal Ofek, Billy Chen, Shahram Izadi, Nicolas Villar, John Helmes. Grant date: 5/21/2013

P50.   US-8436789-B2. Surface puck. Steven N. Bathiche, Hrvoje Benko, Stephen E. Hodges, Shahram Izadi, David Alexander Butler, William Ben Kunz, Shawn R. LeProwse. Grant date: 5/7/2013

P51.   US-8514188-B2. Hand posture mode constraints on touch input. Paul Armistead Hoover, Maxim Oustiogov, Daniel J. Wigdor, Hrvoje Benko, Jarrod Lombardo. Grant date: 8/20/2013

P52.   US-9569094-B2. Disambiguating intentional and incidental contact and motion in multi-touch pointing devices. Christopher Stoumbos, John Miller, Robert Young, Hrvoje Benko, David Perek, Peter Ansell, Oyvind HAEHRE. Grant date: 2/14/2017

P53.   US-10551940-B2. Apparatus for use in a virtual reality system. Edward Cutrell, Christian Holz, Hrvoje Benko, Michael J. Sinclair, Meredith June Morris, Yuhang Zhao, Cynthia Lynn BENNETT. Grant date: 2/4/2020

P54.   US-10928889-B1. Apparatus, system, and method for directional acoustic sensing via wearables donned by users of artificial reality systems. Eric Michael Whitmire, Wolf Kienzle, David R. Perek, Hrvoje Benko. Grant date: 2/23/2021

P55.   US-10824247-B1. Head-coupled kinematic template matching for predicting 3D ray cursors. Rorik Henrikson, Tovi Grossman, Sean Trowbridge, Hrvoje Benko, Daniel Wigdor. Grant date: 11/3/2020

P56.   US-11256342-B2. Multimodal kinematic template matching and regression modeling for ray pointing prediction in virtual reality. Rorik Henrikson, Tovi Samuel Grossman, Sean Edwin Trowbridge, Hrvoje Benko, Daniel John Wigdor, Marcello Giordano, Michael Glueck, Tanya Renee Jonker, Aakar Gupta, Stephanie Santosa, Carolina Brum Medeiros, Daniel CLARKE. Grant date: 2/22/2022

P57.   US-11366522-B1. Systems and methods for providing substantially orthogonal movement of a device about a user's body part. Evan Matthew Pezent, Priyanshu Agarwal, Hrvoje Benko, Nicholas Colonnese, Ali Israr, Shea Jonathan Robinson. Grant date: 6/21/2022

P58.   US-10617942-B2. Controller with haptic feedback. Christian Holz, Eyal Ofek, Michael Jack Sinclair, Hrvoje Benko, Inrak Choi, Eric Whitmire. Grant date: 4/14/2020

P59.   US-8805010-B2. Gesture identification using an ad-hoc multidevice network. Eric Horvitz, Kenneth P. Hinckley, Hrvoje Benko. Grant date: 8/12/2014

P60.   US-10216982-B2. Projecting a virtual copy of a remote object. Tomislav Pejsa, Andrew Wilson, Hrvoje Benko, Eyal Ofek, Julian Kantor. Grant date: 2/26/2019

P61. US-11467670-B2. Methods, devices, and systems for displaying a user interface on a user and detecting touch gestures. Sean Jason Keller, Tristan Thomas Trutna, Hrvoje Benko. Grant date: 10/11/2022

P62. US-10788897-B1. Systems and methods for sensing gestures via vibration-sensitive wearables donned by users of artificial reality systems. Hrvoje Benko, Wolf Kienzle, Neil Weiss, Yu-Te Wang, Yanjun Ma, David R. Perek. Grant date: 9/29/2020

P63. US-10948976-B1. Systems and methods for electric discharge-based sensing via wearables donned by users of artificial reality systems. Eric Michael Whitmire, Wolf Kienzle, David R. Perek, Hrvoje Benko. Grant date: 3/16/2021

P64. US-9916003-B1. 3D haptics for interactive computer systems. Michael Jack Sinclair, Eyal Ofek, Hrvoje Benko, Christian Holz. Grant date: 3/13/2018

P65. US-11132058-B1. Spatially offset haptic feedback. Aakar Gupta, Majed Jamal Samad, Hrvoje Benko. Grant date: 9/28/2021

P66. US-11416075-B1. Wearable device and user input system for computing devices and artificial reality environments. Jun Gong, Aakar Gupta, Hrvoje Benko. Grant date: 8/16/2022

P67. US-11334157-B1. Wearable device and user input system with active sensing for computing devices and artificial reality environments. Jun Gong, Aakar Gupta, Hrvoje Benko. Grant date: 5/17/2022

P68. US-11488361-B1. Systems and methods for calibrating wearables based on impedance levels of users' skin surfaces. Shiu Sang Ng, Yanjun Ma, Wolf Kienzle, Hrvoje Benko. Grant date: 11/1/2022

P69. US-11093035-B1. Finger pinch detection. Shiu Sang Ng, Yanjun Ma, Wolf Kienzle, Hrvoje Benko. Grant date: 8/17/2021

P70. US-11287885-B1. Apparatus, system, and method for determining the position of wearables donned by users of artificial reality systems. Wolf Kienzle, Hrvoje Benko, Joseph Davis Greer, Tristan Thomas Trutna, Raymond King, Yanjun Ma. Grant date: 3/29/2022

MENTORSHIP OF PHD GRADUATES

PHD1. *Rachel Franz* – Modeling Abilities in VR. University of Washington. Primary advisor: Jacob Wobbrock. Expected graduation date: 2024.

PHD2. *Dr. Robert Xiao* – On-World Computing: Enabling Interaction on Everyday Surfaces. Carnegie Mellon University. Primary advisor: Chris Harrison. Graduation date: 2018.

PHD3. *Dr. Tomislav Pejsa* – Effective Directed Gaze for Character Animation. University of Wisconsin-Madison. Primary advisor: Michael Gleicher. Graduation date: 2016.

PHD4. *Dr. Brett Jones* – Content Creation for Seamless Augmented Experiences with Projection Mapping. University of Illinois at Urbana-Champaign. Primary advisors: David Forsyth and Brian Bailey. Graduation date: 2014.

INTERN SUPERVISION[2]

M1. *Jun Gong,* Dartmouth College (Summer 2019) - Surface Tap Detection and Localization using Wrist-based Acoustic TDOA Sensing.

M2. *Christoph Gebhardt,* ETH Zurich (Summer 2018) – Reinforcement learning agent for adaptive label presentation in AR.

M3. *Peter Hamilton,* University of Toronto (Summer 2018) – Occlusion management techniques for AR/VR/MR

M4. *Eric Whitmire,* University of Washington (Spring 2018) – Touch sensing on un-instrumented surfaces.

M5. *Eric Whitmire,* University of Washington (Summer 2017) – Novel Haptic VR controller.

M6. *Inrak Choi,* Stanford University (Summer 2017) – Novel Haptic VR controller.

M7. *Evan Strasnick,* Stanford University (Summer 2017) – Novel Haptic VR controller.

M8. *Yuhang Zhao,* Cornell Tech (Summer 2017) – Haptic solutions for blind people to experience VR.

M9. *Jan Gugenheimer,* University of Ulm, Germany (Summer 2017) – Large-scale VR solutions.

M10. *Robert Xiao* (Spring 2017) – Interactions with Hololens

M11. *Jiajun Lu* (Summer 2016) – Hybrid high speed depth camera from fusion of RGB and depth images

M12. *Andreas Fender* (Summer 2016) – Room-scale omnidirectional projection system for meetings

M13. *Robert Xiao* (Summer 2016) – Interactions with Hololens

M14. *Benjamin Nuernberger* (Summer 2015) – Snapping to real world constraints

M15. *Mahdi Azmandian* (Summer 2015) – Haptic retargeting of passive haptic sensations for virtual reality experiences

M16. *Robert Xiao* (Summer 2015) – Sparse peripheral displays for augmented and virtual reality HMDs

M17. *Tomislav Pejsa* (Summer 2014) – Life-sized projection mapped augmented reality teleconferencing

M18. *Feng Zhang* (Summer 2014) – Combination of head-mounted displays with projection-based augmented reality

M19. *Julian Kantor* (Summer 2014) – Experiences for room-sized augmented reality

M20. *Jarrod Knibbe* (Summer 2013) – Software techniques for addressing projector camera latency

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[2] I have frequently co-advised interns with my colleagues.

M21.   *Ravish Mehra* (Summer 2013) – Spatial audio propagation techniques for Augmented reality scenarios

M22.   *Brett Jones* (Summer 2013) – Multi camera & projector calibration

M23.   *Rajinder Sodhi* (Summer 2013) – Interactivity for room-sized augmented reality experiences

M24.   *Michael Murdock* (Summer 2013) – Special effects for augmented reality scenarios

M25.   *Felipe Bacim de Araujo e Silva* (Intern Summer 2012) – Deformable Haptics

M26.   *Brett Jones* (Summer 2012) – IllumiRoom project

M27.   *Rajinder Sodhi* (Summer 2011) – Projected visual guides for movement guidance

M28.   *Chris Harrison* (Spring 2011) – Touch interactions on any surface

M29.   *Roland Aigner* (Fall 2010) co-advised with Daniel Wigdor – Freehand selection and manipulations

M30.   *Ricardo Costa Jota* (Summer 2010) – Fluid 3D capture of tabletop interactions

M31.   *David Holman* (Summer 2010) – Mockup design of physical user interfaces

M32.   *Dustin Freeman* (Spring 2009) – On-screen tools for multitouch gesture learning

M33.   *Miguel Nacenta* (Summer 2008) – Tabletop interactions

M34.   *Bjoern Hartmann* (Summer 2008) – Large tabletop prototyping and interactions

M35.   *Bhashinee Garg* (Spring 2007) - Exploration of dual-sided multi-touch interactions on a handheld device

M36.   *Ivor Baksa* (Spring 2006) - Development of AR conversational agent

M37.   *Shezan Baig* (Spring 2004) - Tablet AR system for archeological visualization

M38.   *Erik Peterson* (Spring 2004) - Interface development for situated AR multimedia

M39.   *Shezan Baig* (Fall 2003) - Adaptive meshing algorithm for large meshes

M40.   *Sajid Sadi* (Spring 2003) - P5 Glove gesture recognizer

M41.   *Zachariah Munoz* (Fall 2002, Spring 2003) – 3D modeling of the Cathedral of St. John the Divine

M42.   *Sajid Sadi* (Fall 2002) – Design of control interfaces

PRODUCT TRANSFER[3]

2016-17. RoomAlive Toolkit https://github.com/Microsoft/RoomAliveToolkit .

2010 . Mouse 2.0 project shipped as *Microsoft Touch Mouse*

2009 . Ripples project shipped in Microsoft Surface SDK and ultimately incorporating in Windows OS (starting with Windows 7).

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[3] Research projects that shipped as (part of) a commercial product or were open sourced.

CONFERENCE & JOURNAL ORGANIZATION

CO1. **Associate Editor for *Transactions of Human-Computer Interaction (TOCHI) Journal 2016-now***

CO2. Program Committee member for IEEE Virtual Reality Conference 2018

CO3. Program Committee member for ACM CHI 2018

CO4. Program Committee member for World Haptics Conference 2017

CO5. Program Committee member for ACM CHI 2017

CO6. **Information Director for *Transactions of Human-Computer Interaction (TOCHI) Journal 2016-2018***

CO7. Program Committee member for ACM ISS 2016

CO8. Program Committee member for ACM UIST 2016

CO9. Program Committee member for *ACM SIGGRAPH 2015*

CO10. Program Committee member for *ACM CHI 2015*

CO11. **Steering Committee member for ACM UIST 2015 – ongoing**

CO12. **General Chair of *ACM UIST 2014***

CO13. **Associate Editor of the *IEEE Computer Graphics and Applications***

CO14. Guest Co-Editor of the Special Issue of *IEEE Computer Graphics and Applications* (May/June 2014): Interacting Beyond the Screen

CO15. Program Committee member for *ACM CHI 2014*

CO16. Program Committee member for *ACM ISMAR 2013*

CO17. **Program Committee Co-Chair for *ACM UIST 2012***

CO18. Guest Co-Editor of the Special Issue of *Computers and Graphics* on Touching the 3rd Dimension. Published by Elsevier in Dec. 2012.

CO19. Program Committee member for *ACM ISMAR 2012*

CO20. Program Committee member for *ACM CHI 2012*

CO21. Program Committee member for *ACM ITS 2011*

CO22. Program Committee member for Video Showcase at *ACM CHI 2011*

CO23. Program Committee member for *ACM UIST 2010*

CO24. Program Committee member and Doctoral Symposium Co-Chair for *ACM ITS 2010*

CO25. Program Committee member for *ACM ICMI/MLMI 2010*

CO26. Program Committee member for *IEEE 3DUI 2010*

CO27. Webmaster for *ACM UIST 2009*

CO28. Program Committee Member for *IEEE 3DUI 2009*

CO29. Demo Co-Chair for *ACM UIST 2008*

CO30. Program Committee member and Publicity Chair for 2nd International Conference on Intelligent Technologies for Interactive Entertainment (*INTETAIN '08*)

CO31. Publicity Co-Chair for *IEEE ISMAR 2007*, Nara, Japan.

CO32. Co-Chair for the First Annual Columbia Computer Science Student Research Symposium, December 8th 2006, Davis Auditorium, Columbia University, NY.

CO33. Student Volunteer Organizing Committee, *IEEE and ACM ISAR 2001* (International Symposium on Augmented Reality).

REVIEWING

ACM CHI: 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2021, 2022

ACM User Interface Software and Technology (UIST): 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2022

ACM SIGGRAPH: 2003, 2008, 2009, 2010, 2011, 2012, 2013, 2015, 2016, 2017, 2018

ACM SIGGRAPH ASIA: 2012, 2013

ACM Interactive Tabletops and Surfaces (ITS): 2009, 2010, 2011, 2012, 2013, 2016, 2017

IEEE/ACM International Symposium on Mixed and Augmented Reality (ISMAR): 2003, 2004, 2005, 2010, 2012, 2013

ACM ToCHI Journal: 2009, 2012, 2015, 2016, 2017, 2018

IEEE Transactions on Visualization and Computer Graphics (TVGC): 2008, 2009, 2011, 2018

International Conference on Multimodal Interfaces (ICMI): 2010

IEEE Virtual Reality (VR): 2004, 2005, 2007, 2016, 2018

IEEE Symposium on 3D User Interfaces: 2007, 2008, 2009, 2010, 2011

IEEE International Symposium on Wearable Computing (ISWC): 2007

IEEE Visualization: 2003, 2006

IEEE Haptic Symposium: 2018

World Haptics Conferences: 2017

Pervasive: 2005

SmartGraphics: 2004

PROFESSIONAL MEMBERSHIP

ACM (Association for Computing Machinery) Senior Member - http://www.acm.org

ACM SIGCHI (ACM Special Interest Group on Human Computer Interaction) http://www.sigchi.org

IEEE (Institute of Electrical and Electronics Engineers) http://www.ieee.org

SELECTED POPULAR PRESS[4]

PP1. New York Times – "Here's Looking at You (but I'm Still Texting)" – Anne Eisenberg (Feb. 11, 2012) – Sunday Times press edition

PP2. MIT Technology Review – "Stealth Texting"(December 20, 2011)

PP3. Forbes – "Turn Any Surface Into a Touch Screen" (October 19, 2011)

PP4. MIT Technology Review – "Kinect Turns Any Surface Into a TouchScreen" – Duncan Graham-Rowe (October, 18, 2011)

PP5. Seattle Times – "Microsoft shows first multitouch touch mouse" - Sharon Chan (January 6, 2011)

PP6. Seattle Post-Inteligencer – "Microsoft finally shows off its own multi-touch mouse" - Nick Eaton (January 7, 2011)

PP7. Seattle Post-Inteligencer – "LightSpace: Microsoft Research's room-size computer environment" (October 5, 2010)

PP8. Seattle Times – "Wild mice of the future in Microsoft labs" – Brier Dudley (October 5, 2009)

PP9. New York Times – "Microsoft Mapping Course to a Jetsons-Style Future" - Ashlee Vance (March, 1, 2009) – business page cover story

PP10. Seattle Times – "Microsoft TechFest: A pinch of your fingers and images, videos move" - Brier Dudley (February 25, 2009)

PP11. Seattle Times – "Microsoft shows off search product, but Sphere gets the attention" – Benjamin Romano (July 30, 2008) – business page cover story

Technology Blogs

My work has also appeared numerous times on Gizmodo, Engadget, cNet, Ars Technica, Slash Gear, PC World, TechFlash, ComputerWorld, ZD Net, VentureBeat, and Guardian Tech Blog.

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[4] Mainstream press & magazines featuring my research. Incomplete list.