

# Alex Olwal

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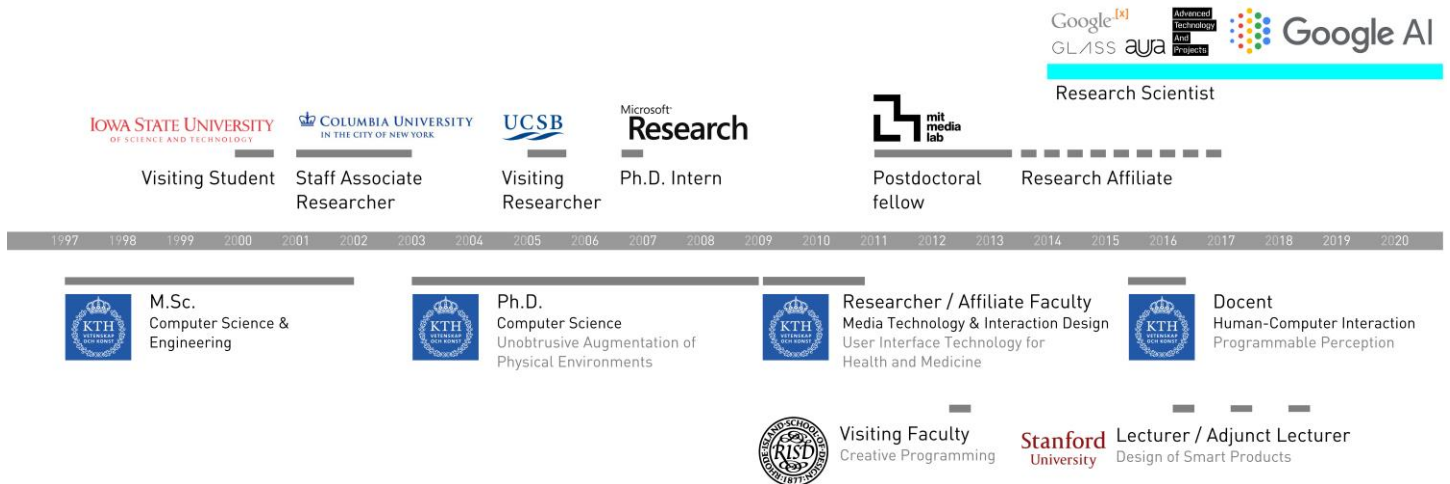
Research Scientist Human-Computer Interaction  
M.Sc. / Ph.D. / Docent Computer Science / Engineering

portfolio olwal.com  
+1 650 276 88 35  
Mountain View, CA  
olwal.com/linkedin

## Research Interests

I lead the Bio Interfaces Team and the Interaction Lab in Google Research, Perception. I direct research and development of interaction technologies based on advancements in display technology, real-time sensing, actuation, soft electronics, interactive textile, wearables, and human-computer interaction. I am passionate about accelerating innovation and disruption.

I am specifically interested in tools, techniques and devices that enable new interaction concepts for the augmentation and empowerment of human abilities. This includes 3D user interfaces, interaction techniques, augmented reality, mixed reality, virtual reality, ubiquitous computing, mobile devices, novel interfaces for medical imaging, multimodal systems, touch-screen interaction, and software/hardware prototyping.



## Employment

Google Research  
2018-Current

Senior Research Scientist / Technical Lead Manager  
Perception

Technical Lead Manager for Bio Interfaces Team (co-founder) and Interaction Lab (10+ research scientists/engineers, PMs, UX researchers/designers)

Leading two funded multi-year programs with VP-support for R&D in wearables, AI and accessibility, leveraging novel sensing and display hardware opportunities.

Google Hardware  
2017-2018

Senior Research Scientist / Technical Lead  
ATAP (Advanced Technology and Projects)

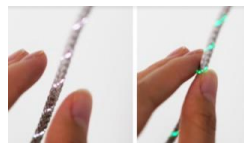
Recruited and led 15-person software/hardware engineering team and ramped up wearable project in 9 months with subsequent successful graduation to Google AI.

2016-2017

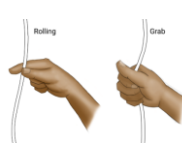
Interaction Lab: Wearables, Augmented and Virtual Reality

2015-2016

Interaction Lab: Project Aura, Glass and Beyond



I/O Braid [olwal.com/iobraid] [Example]  
Interactive textile that senses user's proximity, touch, and twist, while embedded fiber optics enable spiraling light feedback. 6 US patent filings and 1 published research paper (best demo award).

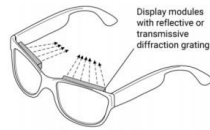


Hybrid Watch [olwal.com/hybridwatch] [Example]  
Electro-mechanical hands with E-ink watch dial enable subtle digital functions while preserving the aesthetics of analog watches. 4 US patent filings and 2 published research demo publications.

Founded Interaction Lab to expand organization's capabilities for rapid hardware prototyping of wearable concepts and interface technology. Presentations and demos to Google Hardware VP-level leadership, incl. Rich Osterloh (SVP Hardware) and Ivy Ross (VP Design).

Google [x]  
2014–2015

Senior Interaction Researcher  
R&D in sensors, display and interaction techniques



1D Eyewear [olwal.com/1d] [Example]  
Arrays of LEDs and computer-generated holograms to enable high-resolution symbols in normal-looking smart-glasses and head-worn displays. Published research paper. 1 granted US patent.

Member of Google Glass Interaction Research team, developing new concepts and innovations to inform Google [x] product roadmaps. Software and hardware prototyping, user interface design and research. Working closely with optics scientists, UX designers and usability researchers. In-person presentations and demos to leadership, incl. Sergey Brin, Larry Page, Sundar Pichai, Ruth Porat.

Stanford University  
2016; 2017; 2018

Lecturer / Adjunct Lecturer  
Teaching: Introduction to the Design of Smart Products

KTH Royal Institute of Technology  
2014–2017

Affiliate Faculty / Researcher  
Virtual Reality for phobia treatment and rehabilitation

Established partnership with clinical partners, co-authored funded grant proposal and mentored junior researchers.

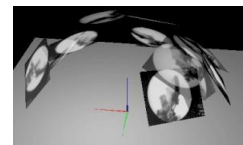
2009–2010

Multi-user surgery planning groupware + 3D visualization of 2D X-rays

Human-Computer Interaction researcher and software developer of cross-platform multi-user, multi-device interaction software for interaction with medical imagery. Co-authored funded grant proposal for 3D interaction with 2D imagery, recruited and mentored junior research students.



Multi-user surgery planning groupware [Example]  
Synchronizes multi-touch and pen interaction across mobile and large-format displays in medical team meetings. Published research paper.



3D visualization of 2D X-Rays [Example]  
Augments 2D X-ray images in image-guided surgery to provide interactive spatiotemporal visualizations. Published research paper.

1997–2002

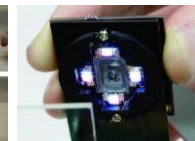
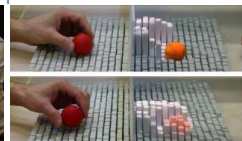
Teaching assistant: Computer science and programming labs

MIT Media Lab  
2014–2017

Research Affiliate  
Tangible Media group



inFORM & Physical Telepresence [Example]  
Shape-Changing hardware that morphs material and form to adapt physical and virtual interface. Shape capture and display enhance interactions with remote people and environments. Multiple research publications.

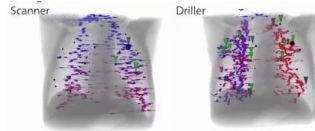


SpecTrans [Example]  
Laser and multi-directional, multispectral illumination for classification of exotic materials such as glass, transparent plastic, and metal. Published research paper and granted US patent.

Worked with postdoctoral researchers, senior Ph.D. students and visiting research to advise on research projects and co-author research publications. We made significant contributions to the emerging user interface paradigm of Shape-Changing User Interfaces through the inFORM, Physical Telepresence, Sublimate, and Shape Displays publications and projects. We explored implicit sensing in furniture, objects and devices through bio-sensing [Zensei] and multi-spectral illumination [SpecTrans].

MIT Media Lab  
2011–2013

Postdoctoral Fellow  
Tangible Media Group; Camera Culture Group



**Scanners & Drillers [Example]**  
3D visualization of gaze data from radiologists that search 3D CT scans for lung nodules. Analysis indicate 2 dominant search strategies. Published research paper.



**Jamming User Interfaces [Example]**  
Programmable stiffness, haptic feedback and deformation for new types of flexible and shape-changing interactions. 1 granted US patent and published research paper (Best paper award)



**SpeckleSense [Example]**  
Laser speckle sensing for precise, high-speed, low-latency motion tracking applied to a range of interactive devices. Published research paper.

Conducted research and development of new user interface technology in collaboration with postdoctoral researchers and Ph.D. students, and co-authored research publications. Software development for 3D gaze tracking for radiologists with Harvard Medical School, and software/hardware engineering for high-speed laser speckle sensing (SpeckleSense) and deformable physical interfaces (Jamming User Interfaces). Advisor on wearable eye diagnostics projects (Retinal Imaging) and 3D desktop interfaces (SpaceTop).

Rhode Island School of Design  
2012

Faculty  
Teaching: Introduction to Creative Programming

Microsoft Research  
2006

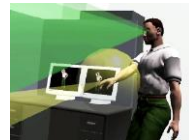
Ph.D. Intern  
SurfaceFusion: Hybrid RFID and Computer Vision for Interactive Surfaces



**SurfaceFusion**  
Sensing for tangible, physical objects on interactive surfaces. Introduction of a hybrid technique that combines RFID and computer vision, to avoid the need for visual markers. Granted US patent and published research paper.

Columbia University  
2001–2003

Staff Associate Researcher  
Multimodal Augmented Reality: SenseShapes, MAVEN, Unit



**SenseShapes & MAVEN**  
MAVEN interprets user intention in AR/VR by fusing speech, gesture, viewpoint, pointing, and SenseShapes statistics, to improve recognition through multimodal disambiguation. Published research papers.



**Unit**  
The Unit framework is a visual dataflow programming language for highly interactive 3D. Interaction techniques are abstracted from devices and application, to separate application logic from behavior. Published research paper.

Tactam / Space + Time  
1999–

Founder, Principal Scientist  
Public installations, interactive exhibit and museum technology  
[Example] Concept and interaction design for MegaMind Science Center (2015)

Rule Communication  
2005–2014

Co-founder, Head of R&D  
Electronic marketing platform: e-mail, mobile, social media

Doera Service Provider  
1999–2000

Software Engineer  
Multi-channel communications platform

Digital Communication Media  
1998–1999

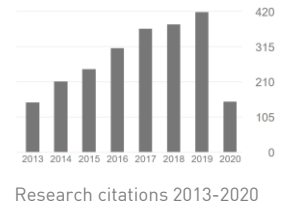
Computer Technician  
Computer installation and network administration

Universum Communications  
1997–2000

Software Developer  
Automated data processing and graphics generation for surveys

## Academic

Docent Human—Computer Interaction 2016	KTH Royal Institute of Technology [Docent Lecture] Programmable Perception: Augmented Reality through matter, tele-robotics and electronic tattoos
Ph.D. Computer Science 2009	KTH Royal Institute of Technology [Ph.D. Thesis] Unobtrusive Augmentation of Physical Environments: Interaction Techniques, Spatial Displays and Ubiquitous Sensing
M.Sc. Computer Science & Engineering 2002	KTH Royal Institute of Technology [M.Sc. Thesis] Unit—A Modular Framework for Interaction Technique Design, Development and Implementation
Visiting Researcher 2005	University of California – Santa Barbara Augmented Reality: Immaterial Displays, Interactive FogScreen, POLAR
Exchange Student 2000	Iowa State University Virtual Reality Applications Center



## Publications, patents and grants

30 first-tier publications      2946 Citations      h-index 31      i10-index 49  
Complete list [olwal.com/publications](http://olwal.com/publications)      Google Scholar [olwal.com/scholar](http://olwal.com/scholar)      May 2020

Computer Science and Human—Computer Interaction prioritize first-tier peer-reviewed conferences over journals.  
Highlights:

ACM UIST — 9 papers ACM Symposium on User Interface Software and Technology	3 Best Paper Awards (Top 1%) + 1 Best Demo Average acceptance rate 21%
ACM CHI — 11 papers SIGCHI Conference on Human Factors in Computing Systems	3 Honorable Mention Awards (Top 5%) Average acceptance rate 23%
ACM & IEEE ISMAR — 4 papers IEEE and ACM International Symposium on Mixed and Augmented Reality	Average acceptance rate 22%
ACM ICMI — 2 papers ACM International Conference on Multimodal Interaction	Average acceptance rate 37%

Research grants: Co-authored 14 funded proposals ~4.5 million USD

US Patent 10180769	Symbol display	Granted Jan 2019
US Patent 9482622	Methods and Apparatus for Surface Classification	Granted Nov 2016
US Patent 9448066	Methods and Apparatus for Jammable HCI Interfaces	Granted Sep 2016
US Patent 8847739	Fusing RFID and Vision for Surface Object Tracking	Granted Sep 2014

## Languages

Swedish (fluent), English (fluent), Russian (good), French (beginner), Spanish (beginner)

## Technical skills

I currently mainly direct technical research & development. However, this is a selection of trusted tools:

Graphics / Computer Vision	C++, OpenGL, OpenCV	Prototyping	Java / Processing & C++ / OpenFrameworks JavaScript / P5.js
Cross-platform / Android	Java		C++ / Arduino
Microcontrollers	C / C++	Presentation	Premiere, Illustrator, PhotoShop, LaTeX, InkScape, GSuite / MS Office
Machine Learning	Python / scikit-learn		

## Peer-reviewed Conference Publications (43)

• = selected publications \* = awards

- **E-Textile Microinteractions: Augmenting Twist with Flick, Slide and Grasp Gestures for Soft Electronics.**  
Olwal, A., Starner, T., and Mainini, G.  
Proceedings of CHI 2020 (ACM CHI Conference on Human Factors in Computing Systems)  
Honolulu, HI, Apr 25–30, 2020, pp. 1–13.
- **SensorSnaps: Integrating Wireless Sensor Nodes into Fabric Snap Fasteners for Textile Interfaces.**  
Dementyev, A., Gálvez, T. V., and Olwal, A.  
Proceedings of UIST 2019 (ACM Symposium on User Interface Software and Technology),  
New Orleans, LA, Oct 20–23, 2019, pp. 17–28.
- **I/O Braid: Scalable Touch-Sensitive Lighted Cords using Spiraling, Repeating Sensing Textiles and Fiber Optics.**  
Olwal, A., Moeller, J., Priest-Dorman, G., Starner, T., and Carroll, B.  
Proceedings of UIST 2018 (ACM Symposium on User Interface Software and Technology),  
Berlin, Germany, Oct 14–17, 2018, pp. 485–497.
- \* **Best Demo Award (Voted by conference participants).**  
**1D Eyewear: Peripheral, Hidden LEDs and Near-Eye Holographic Displays for Unobtrusive Augmentation.**  
Olwal, A., and Kress, B.  
Proceedings of ISWC 2018 (ACM International Symposium on Wearable Computers),  
Singapore, Singapore, Oct 8–12, 2018, pp. 184–187.
- **Grability: A Wearable Haptic Interface for Simulating Weight and Grasping in Virtual Reality.**  
Choi, I., Culbertson, H., Miller, M.R., Olwal, A., and Follmer, S.  
Proceedings of UIST 2017 (ACM Symposium on User Interface Software and Technology),  
Quebec City, CA, Oct 22–25, 2017, pp. 119–130.
- \* **Best Paper Award (Top 1% of papers).**  
**SmartSleeve: Real-time Sensing of Surface and Deformation Gestures on Flexible, Interactive Textiles, using a Hybrid Gesture Detection Pipeline.**  
Parzer, P., Sharma, A., Vogl, A., Steimle, J., Olwal, A., and Haller, M.  
Proceedings of UIST 2017 (ACM Symposium on User Interface Software and Technology),  
Quebec City, CA, Oct 22–25, 2017, pp. 119–130.
- **shiftIO: Reconfigurable Tactile Elements for Dynamic Affordances and Mobile Interaction**  
Strasnick, E., Yang, J., Tanner, K., Olwal, A., and Follmer, S.  
Proceedings of CHI 2017 (SIGCHI Conference on Human Factors in Computing Systems),  
Denver, CO, May 6–11, 2017, pp. 5075–5086.
- \* **Best paper honorable mention award (Top 5% of papers).**
- **Zensei: Embedded, Multi-electrode Bioimpedance Sensing for Implicit, Ubiquitous User Recognition**  
Sato, M., Puri, R., Olwal, A., Ushigome, Y., Franciszkiewicz, L., Chandra, D., Poupyrev, I., and Raskar, R.  
Proceedings of CHI 2017 (SIGCHI Conference on Human Factors in Computing Systems),  
Denver, CO, May 6–11, 2017, pp. 3972–3985.
- WatchThru: Expanding Smartwatch Displays with Mid-air Visuals and Wrist-worn Augmented Reality**  
Wenig, D., Schöning, J., Olwal, A., Oben, M., and Malaka, R.  
Proceedings of CHI 2017 (SIGCHI Conference on Human Factors in Computing Systems),  
Denver, CO, May 6–11, 2017, pp. 716–721.
- StretchEBand: Enabling fabric-based interactions through Rapid Fabrication of Textile Stretch Sensors**  
Vogl, A., Parzer, P., Babic, T., Leong, J., Olwal, A., and Haller, M.  
Proceedings of CHI 2017 (SIGCHI Conference on Human Factors in Computing Systems),  
Denver, CO, May 6–11, 2017, pp. 2617–2627.
- **SkinMarks: Enabling Interactions on Body Landmarks Using Conformal Skin Electronics**  
Weigel, M., Nittala, A., Olwal, A., and Steimle, J.  
Proceedings of CHI 2017 (SIGCHI Conference on Human Factors in Computing Systems),  
Denver, CO, May 6–11, 2017, pp. 3095–3105.
- **proCover: Sensory Augmentation of Prosthetic Limbs Using Smart Textile Covers**  
Leong, J., Parzer, P., Perteneder, F., Babic, T., Rendl, C., Vogl, A., Egger, H., Olwal, A., Haller, M.  
Proceedings of UIST 2014 (ACM Symposium on User Interface Software and Technology),  
Tokyo, Japan, Oct 16–19, pp. 335–346.
- \* **Best Paper Award (Top 1% of papers).**

### **SpecTrans: Versatile Material Classification for Interaction with Textureless, Specular and Transparent Surfaces**

Sato, M., Yoshida, S., Olwal, A., Shi, B., Hiyama, A., Tanikawa, T., Hirose, M., Raskar, R..  
Proceedings of CHI 2015 (SIGCHI Conference on Human Factors in Computing Systems),  
Seoul, South Korea, Apr 18-23, 2015, pp. 2191–2200.

- **Physical Telepresence: Shape Capture and Display for Embodied, Computer-mediated Remote Collaboration**

Leithinger, D., Follmer, S., Olwal, A., and Ishii, H.  
Proceedings of UIST 2014 (ACM Symposium on User Interface Software and Technology),  
Honolulu, HI, Oct 5-8, 2014, pp. 461–470.

### **T(ether): Spatially-Aware Handhelds, Gestures and Proprioception for Multi-User 3D Modeling and Animation**

Lakatos, D., Blackshaw, M., Olwal, A., Barryte, Z., Perlin, K., and Ishii, H.  
Proceedings of SUI 2014 (ACM Symposium on Spatial User Interaction),  
Honolulu, HI, Oct 4-5, 2014, pp. 90–93.

- **inFORM: Dynamic Physical Affordances and Constraints through Shape and Object Actuation**

Follmer, S., Leithinger, D., Olwal, A., Hogge, A., and Ishii, H.  
Proceedings of UIST 2013 (ACM Symposium on User Interface Software and Technology),  
St Andrews, UK, Oct 8-11, 2013, pp. 417–426.

### **Cloud Rhymer: Prototype Demo and Intervention Proposal**

Robert, D., Schmitt, P., and Olwal, A.  
Proceedings of IDC 2013 (ACM SIGCHI International Conference on Interaction Design and Children),  
New York, NY, Jun 24–27, 2013, pp. 507–510.

- **Sublimate: State-Changing Virtual and Physical Rendering to Augment Interaction with Shape Displays**

Leithinger, D., Follmer, S., Olwal, A., Luescher, S., Hogge, A., Lee, J., and Ishii, H.  
Proceedings of CHI 2013 (SIGCHI Conference on Human Factors in Computing Systems),  
Paris, France, April 27–May 2, 2013, pp. 1441–1450.

- \* **Best paper honorable mention award (Top 5% of papers).**

### **SpaceTop: Integrating 2D and Spatial 3D Interactions in a See-through Desktop**

Lee, J., Olwal, A., Ishii, H., and Boulanger, C.  
Proceedings of CHI 2013 (SIGCHI Conference on Human Factors in Computing Systems),  
Paris, France, April 27–May 2, 2013, pp. 189–192.

### **Multimodal Motion Guidance: Techniques for Adaptive Dynamic Feedback**

Schönauer, C., Fukushi, K., Olwal, A., Kaufmann, H., and Raskar, R.  
Proceedings of ICMI 2012 (ACM International Conference on Multimodal Interaction),  
Santa Monica, CA, Oct 22–26, 2012, pp. 133–140.

- **Jamming User Interfaces: Programmable Particle Stiffness and Sensing for Malleable and Shape-Changing Devices**

Follmer, S., Leithinger, D., Olwal, A., Cheng, N., and Ishii, H.  
Proceedings of UIST 2012 (ACM Symposium on User Interface Software and Technology),  
Cambridge, MA, Oct 7–10, 2012, pp. 519–528.

- \* **Best paper award (Top 3 papers).**

- **SpeckleSense: Fast, Precise, Low-cost and Compact Motion Sensing using Laser Speckle**

Zizka, J., Olwal, A., and Raskar, R.  
Proceedings of UIST 2011 (ACM Symposium on User Interface Software and Technology),  
Santa Barbara, CA, Oct 16–19, 2011, pp. 489–498.

### **Design and Evaluation of Interaction Technology for Medical Team Meetings**

Olwal, A., Frykholm, O., Groth, K., and Moll, J.  
Proceedings of INTERACT 2011 (IFIP TC13 Conference on Human–Computer Interaction),  
Lisbon, Portugal, Sep 5–9, 2011, pp. 505–522.

### **3D Visualization and Interaction with Spatiotemporal X-ray Data to Minimize Radiation in Image-guided Surgery**

Ioakeimidou, F., Olwal, A., Nordberg, A., and Von Holst, H.  
Proceedings of CBMS 2011 (IEEE International Symposium on Computer-based Medical Systems),  
Bristol, UK, Jun 27–30, 2011.

### **OldGen: Mobile Phone Personalization for Older Adults**

Olwal, A., Lachanas, D., and Zacharouli, E.  
Proceedings of CHI 2011 (SIGCHI Conference on Human Factors in Computing Systems),  
Vancouver, BC, May 7–12, 2011, pp. 3393–3396.

### **Augmenting Surface Interaction through Context-sensitive Mobile Devices**

Olwal, A.  
Proceedings of INTERACT 2009 (IFIP TC13 Conference on Human–Computer Interaction),  
Uppsala, Sweden, August 26–28, 2009, pp. 336–339.

- **Spatially Aware Handhelds for High-Precision Tangible Interaction with Large Displays**

Olwal, A. and Feiner, S.

Proceedings of TEI 2009 (International Conference on Tangible and Embedded Interaction),  
Cambridge, UK, Feb 16–18, 2009, pp. 181–188.

#### **Unencumbered 3D Interaction with See-through Displays**

Olwal, A.

Proceedings of NordiCHI 2008 (Nordic Conference on Human Computer Interaction),  
Lund, Sweden, Oct 18–22, 2008, pp. 527–530.

- **SurfaceFusion: Unobtrusive Tracking of Everyday Objects in Tangible User Interfaces**

Olwal, A. and Wilson, A.

Proceedings of GI 2008 (Graphics Interface),  
Windsor, Ontario, May 28–30, 2008, pp. 235–242.

- **Rubbing and Tapping for Precise and Rapid Selection on Touch-Screen Displays**

Olwal, A., Feiner, S. and Heyman, S.

Proceedings of CHI 2008 (SIGCHI Conference on Human Factors in Computing Systems),  
Florence, Italy, April 5–10, 2008, pp. 295–304.

- \* **Best paper honorable mention (Top 5% of papers).**

#### **Spatial Augmented Reality on Industrial CNC-Machines**

Olwal, A., Gustafsson, J., and Lindfors, C.

Proceedings of SPIE 2008 Electronic Imaging, Vol. 6804 (The Engineering Reality of Virtual Reality 2008),  
San Jose, CA, January 27–31, 2008.

#### **Consigalo: Multi-user, Face-to-face Interaction with Adaptive Audio, on an Immaterial Display**

Olwal, A., DiVerdi, S., Rakkolainen, I., and Höllerer, T.

Proceedings of INTETAIN 2008 (International Conference on Intelligent Technologies for Interactive Entertainment),  
Cancun, Mexico, January 8–10, 2008.

#### **LUMAR: A Hybrid Spatial Display System for 2D and 3D Handheld Augmented Reality**

Olwal, A. and Henrysson, A.

Proceedings of ICAT 2007 (International Conference on Artificial Reality and Teleexistence),  
Esbjerg, Denmark, Nov 28–30, 2007, pp. 63–70.

#### **LightSense: Enabling Spatially Aware Handheld Interaction Devices**

Olwal, A.

Proceedings of ISMAR 2006 (IEEE and ACM International Symposium on Mixed and Augmented Reality),  
Santa Barbara, CA, Oct 22–25, 2006, pp. 119–122.

#### **An Immaterial, Dual-sided Display System with 3D Interaction**

Olwal, A., DiVerdi, S., Candussi, N., Rakkolainen, I., and Höllerer, T.

Proceedings of VR 2006 (IEEE Virtual Reality Conference 2006),  
Alexandria, VA, Mar 25–29, 2006, pp. 279–280.

#### **A Novel Walk-through 3D Display**

DiVerdi, S., Rakkolainen, I., Höllerer, T., and Olwal, A.

Proceedings of SPIE 2006 Electronic Imaging, Vol. 6055 (Stereoscopic Displays and Virtual Reality Systems XIII),  
San Jose, CA, January 15–18, 2006, pp. 428–437.

#### **ASTOR: An Autostereoscopic Optical See-through Augmented Reality System**

Olwal, A., Lindfors, C., Gustafsson, J., Kjellberg, T., and Mattson, L.

Proceedings of ISMAR 2005 (IEEE and ACM International Symposium on Mixed and Augmented Reality),  
Vienna, Austria, Oct 5–8, 2005, pp. 24–27.

#### **Immersive Mixed-Reality Configuration of Hybrid User Interfaces**

Sandor, C., Olwal, A., Bell, B., and Feiner, S.

Proceedings of ISMAR 2005 (IEEE and ACM International Symposium on Mixed and Augmented Reality),  
Vienna, Austria, Oct 5–8, 2005, pp. 110–113.

#### **POLAR: Portable, Optical see-through, Low-cost Augmented Reality**

Olwal, A. and Hollerer, T.

Proceedings of VRST 2005 (ACM Symposium on Virtual Reality and Software Technology),  
Monterey, CA, Nov 7–9, 2005, pp. 227–230.

#### **Interaction Techniques Using Prosodic Features of Speech and Audio Localization**

Olwal, A. and Feiner, S.

Proceedings of IUI 2005 (ACM International Conference on Intelligent User Interfaces),  
San Diego, CA, Jan 9–12, 2005, pp. 284–286.

## Unit: Modular Development of Distributed Interaction Techniques for Highly Interactive User Interfaces

Olwal, A. and Feiner, S.

Proceedings of GRAPHITE 2004 (International Conference on Computer Graphics and Interactive Techniques in Australasia and Southeast Asia),

Singapore, Singapore, Jun 15–18, 2004, pp. 131–138.

- **Mutual Disambiguation of 3D Multimodal Interaction in Augmented and Virtual Reality**

Kaiser, E., Olwal, A., McGee, D., Benko, H., Corradini, A., Li, X., Feiner, S., and Cohen, P.

Proceedings of ICMI 2003 (ACM International Conference on Multimodal Interfaces),

Vancouver, BC, Nov 5–7, 2003, pp. 12–19.

## SenseShapes: Using Statistical Geometry for Object Selection in a Multimodal Augmented Reality System

Olwal, A., Benko, H., and Feiner, S.

Proceedings of ISMAR 2003 (IEEE and ACM International Symposium on Mixed and Augmented Reality),

Tokyo, Japan, Oct 7–10, 2003, pp. 300–301.

## Journal Publications (3)

- **On-Skin Interaction Using Body Landmarks**

Steimle, J., Bergstrom-Lehtovirta, J., Weigel, M., Nittala, A.S., Boring, S., Olwal, A., Hornbæk, K.

Computer 2017 (IEEE Computer, Cover Feature, Vol. 50, no 10), Oct, 2017, pp. 19-27.

- **Shape Displays: Spatial Interaction with Dynamic Physical Form**

Leithinger, D., Follmer, S., Olwal, and Ishii, H.

IEEE Computer Graphics and Applications,

Vol. 35, no 5, Sept-Oct. 2015.

- **Scanners and Drillers: Characterizing Expert Visual Search through Volumetric Images**

Drew, T., Vo, M., Olwal, A., Jacobson, F., Seltzer, S., and Wolfe, J.

Journal of Vision,

Vol. 13, no 10, Aug 6, 2013.

## Peer-reviewed Book Chapters

### An Immaterial Pseudo-3D Display System with 3D Interaction

DiVerdi, S., Olwal, A., Rakkolainen, I., and Höllerer, T.

Three-Dimensional Television: Capture, Transmission, and Display.

ISBN 978-3-540-72531-2. Editors: Haldun M. Ozaktas and Levent Onural. Springer, 2008, pp. 505–528.

## Ph.D. Thesis

### Unobtrusive Augmentation of Physical Environments: Interaction Techniques, Spatial Displays and Ubiquitous Sensing

Olwal, A.

Doctoral Thesis, KTH, Department of Numerical Analysis and Computer Science,

Trita-CSC-A, ISSN 1653-5723; 2009:09. <http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-10439>

## Peer-reviewed Extended Abstracts (10)

### Hybrid Watch User Interfaces: Collaboration between Electro-Mechanical Components and Analog Materials

Olwal, A.

UIST '18 Adjunct Proceedings (ACM Symposium on User Interface Software and Technology), Oct 14-17, 2018, pp. 200–202.

### Hybrid Watch User Interfaces: Collaboration between Electro-Mechanical Components and Analog Materials

Olwal, A.

Ubicomp '18 Adjunct Proceedings (ACM International Joint Conference on Pervasive and Ubiquitous Computing), Oct 9-11, 2018.

### FlexTiles: A Flexible, Stretchable, Formable, Pressure-Sensitive, Tactile Input Sensor.

Parzer, P., Probst, K., Babic, T., Rendl, C., Vogl, A., Olwal, A., and Haller, M.

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### **Rubbing the Fisheye: Precise Touch-Screen Interaction with Gestures and Fisheye Views**

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## **Peer-reviewed Publications in National Conferences / Workshops (2)**

### **Gestural 3D Interaction with a Beating Heart: Simulation, Visualization and Interaction.**

Ioakeimidou, F., Ericson, E., Spühler, J., Olwal, A., Forsslund, J., Jansson, J., Sallnäs Pysander, E.-L., and Hoffman, J.  
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### **Methods and apparatus for surface classification**

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### **Methods and Apparatus for Jammable HCI Interfaces**

Follmer, S., Leithinger, D., Ishii, H, and Olwal, A.  
Massachusetts Institute of Technology, Cambridge, MA, USA  
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