Kaan **Akşit**

Associate Professor of Computational Light

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Summary

Kaan Akşit is an Associate Professor in Computer Science department at University College London, where he leads the **Computational Light Laboratory**. Kaan invents novel optics, hardware, and software for next-generation computational display and imaging technologies. Kaan has more than ten years of experience and specialization in various novel computational display technologies, including auto-stereoscopic displays, holographic displays and imagers, and near-eye displays for virtual and augmented reality applications.

Education

Koc University — *Istanbul, Türkiye*

Ph.D. in Electrical and Electronics Engineering — *2010 - 2014*

RWTH Aachen University — *Aachen, Germany*

M.Sc in Electrical Power Engineering — *2007 - 2010*

Istanbul Technical University — *Istanbul, Türkiye*

B.S. in Electrical Engineering — *2003 - 2007*

Work Experiences

University College London — *Gower Street London WC1E 6BT United Kingdom*

Associate Professor of Computational Light — *Jan 2021 -...*

- Formed a research group on devices, users and spaces **Computational Light Laboratory**.
- Research focus: Computer-Generated Holography for next-generation display technologies [1, 2, 3, 4, 5, 6, 7].
- Research focus: Next-generation user experiences and interfaces [8, 9, 10, 11].
- Research focus: Next-generation computational imagers [12].
- Research focus: Perceptual Graphics [13, 14].

Nvidia Corporation — *2788 San Tomas Expy, Santa Clara, CA 95051, USA*

Senior Research Scientist — *July 2014 - August 2020*

- Joined as a post-doctoral researcher, promoted to research scientist, and senior research scientist.
- First member of New Experiences Group (NXP) dedicated to Virtual and Augmented Reality research. Helped an entire team grow from ground up.
- Development of novel optical near-eye display designs using machine learning techniques.
- Built an entire set of laboratories from scratch including tools such as analog holography setups, 3D printers, laser cutters, and vacuum formers.
- Patents and publications in top venues (e.g., SIGGRAPH, IEEE VR, Optica) [15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41].

Imagination Studios — *Kungsgatan 30, 753 21 Uppsala, Sweden*

Visiting Researcher — *August 2013 - September 2013*

- Development of an augmented reality system for motion capture actors funded by FP7-PEOPLE-2012-IAPP [42].

Disney Research — *Clausiusstrasse 49, 8092 Zurich, Switzerland*

Research Intern — *February 2013 - May 2013*

- Development of a communication link between smartphones and bidirectional light emitting diodes (LED) [43].
- Development of analog circuitry consisting high power LED for Visible Light Communication (VLC) systems [44].

Optical Microsystems Laboratory (OML) *Rumeli Feneri Yolu, 34450, Sarıyer, Türkiye*

Research Assistant *May 2010 - June 2014*

- High efficiency based multi user multi modal 3D display (HELIUM3D) project of European union commission seventh framework programme (EC-FP7) and Multiview Autostereoscopic Display systems [45, 46, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56].
- Add-on development for Microvision's PicoP [57, 58, 59, 60, 61].
- A biomedical device to alleviate the Parkinson symptoms [62].

Philips Research *HTC34.2 Hightech campus, 5611KM, Eindhoven, Netherlands*

Research Intern *June 2009 - February 2010*

- Development of a remote heart rate monitoring and motion monitoring system [63].
- Development of a multi-actuator control for unit-injector drives and design of a test facility for fragrance injection.

Honors & Awards

2021	**IEEEVR 2021**, Best paper nominee (Only 11 papers nominated from over 300 submissions	*Lisbon, Portugal*
2020	**The Optical Society**, Outstanding reviewer	*Washinghton, D.C., USA*
2019	**SIGGRAPH 2019**, Emerging Technologies Best in Show award	*Los Angeles, USA*
2019	**IEEEVR 2019**, Best paper nominee (Only 11 papers nominated from over 300 submissions	*Osaka, Japan*
2018	**ISMAR 2018**, Best paper award	*Munich, Germany*
2018	**SIGGRAPH 2018**, Emerging Technologies Best In Show prize	*Vancouver, Canada*
2017	**SIGGRAPH 2017**, Emerging Technologies DC EXPO special prize	*Los Angeles, USA*
2017	**IEEE VR 2017**, Best paper award	*Los Angeles, USA*
2014	**Koç University**, Graduate studies excellence award received from head of institute, Prof. Tekin Dereli and the dean, Prof. Ümran İnan of Koç (Also affiliated as a professor at Stanford University)	*Istanbul, Türkiye*
2014	**SID Display week 2014**, Student travel grant from SEL (Semiconductor Energy Laboratory), Larry & Jane Weber and Larry & Carol Tannas	*San Diego, USA*
2013	**International 3D Society**, New Product award	*Los Angeles, USA*
2012	**Merck KGaA**, Merck Young Scientist Award received from Merck group's president, Mr. Jürgen König.	*Daegu, Korea*
2012	**IMID 2012**, Student travel grant from Korean Display Society	*Daegu, Korea*
2012	**SEIS**, I have supervised a term project of two undergraduate students, which was recognized as the best project award from Turkish Health Industry Society.	*Istanbul, Türkiye*
2012	**YTü IEEE Student branch**, Best project award from YTU's IEEE student branch among 131 projects; award was given by his excellency, Minister of Science and Technology of Türkiye	*Istanbul, Türkiye*
2007	**TÜBİTAK Solar Car Races 2007 at Hipodrom at Ankara**, Solar Car Race-Among the 38 team, Won 4 trophies for 1. & 2.places in Ankara Race Arena, 1. & 3., ANOK Race 1. Place, Best Design Prize, Fastest Run for placement	*Ankara, Türkiye*
2006	**TÜBİTAK Solar Car Races 2006 at Official F1 Istanbul Racetrack and Arena Izmir**, Solar Car Race Among the 38 team, Won 9 trophies for 1. & 2. places in Istanbul Park F1 Race Arena, 1.& 3. Places in Izmir Race Arena, Best Design Prize, 1. & 2. Places in Placing Tours	*Istanbul-Izmir, Türkiye*

Workshops/Tutorials/Talks/Interviews

- Invited talk and course at London Imaging Meeting 2022.
- Invited talk at Gordon Research Conference, 2022.
- Invited seminar at Universidad Zaragoza, 2022.
- Invited talk at SIGCHI panel, 2022.
- Invited talk at 8th Hisar Virtual Coding Summit, 2022.
- Invited talk at Optica's Frontiers in Optics 2021.
- Invited talk at ICCV 2021.
- Invited talk at Artilabs, 2021.
- Invited Presenter at Korean Information Display Society (KIDS) lecture for 3D/AR/VR technology and metaverse, 2021.
- Invited Presenter at Voices of XR: Next generation display technologies for virtual and augmented reality applications, 2021.
- Invited lecture for UCL's Unit 21, 2021.
- Interviewed for Optical Society's Optics and Photonics News April issue, 2021.
- Invited Presenter at International Meeting On Information Display 2020.
- Panelist at OSA Incubator on Visual Perception in AR/VR, 2020.
- OpenEDS at ICCV 2019: Workshops on Eye Tracking for VR and AR

- PerGraVAR and VisAug at IEEEVR 2019: Joint Workshops on Perception-driven Graphics, Displays, Eye Tracking, and Vision Augmentation
- Workshop at SIGGRAPH Asia 2018: Cutting-edge VR/AR display technologies (gaze-, accommodation-, motion-aware and HDR-enabled)
- Tutorial at IEEEVR 2018: Cutting-edge VR/AR display technologies (gaze-, accommodation-, motion-aware and HDR-enabled)
- Invited Presenter at OSA's Frontiers in Optics 2017: Computational displays for virtual reality and augmented reality applications
- SCIEN talk (2017): Near-Eye Varifocal Augmented Reality Displays at Stanford University
- Invited lecture on display technologies at TU Wien, 2017.

Extracurricular Activity

- Serving as an executive member at the Optical Society of America's display technology group since 2020.
- Recognized as a senior member by the Optical Society of America.
- Served as a part of program committee for ISMAR 2020, ACM SIGGRAPH ASIA 2020, IEEEVR 2021 and ISMAR 2021.
- Served as a reviewer in these publications many times: OSA's Applied Optics, Optics Express, JoDs, ACM SIGGRAPH, ACM SIGGRAPH ASIA, Nature Scientific Reports, IEEEVR, Elsevier Computers and Graphics, SPIE Optical Engineering, Frontiers in Virtual Reality, Frontiers in Photonics and IEEE ISMAR.
- Prepared public demonstrations of a novel foveated near-eye display technique at SIGGRAPH 2019 Emerging technologies floor, and covered by related media. Entire exhibit holds 10k+ visitors).
- Prepared public demonstrations of a novel near-eye display manufacturing technique at SIGGRAPH 2018 Emerging technologies floor, and covered by related media. Entire exhibit holds 10k+ visitors.).
- Prepared public demonstrations of two novel near-eye display techniques at SIGGRAPH 2017 Emerging technologies floor, and covered by related media. Entire exhibit holds 10k+ visitors.
- Helped forming a solar race car team during under graduate studies (2005-2007), helped building two full size solar race cars.

Skills

Languages Turkish, English, German
Musical Instruments Violin

Publications and Patents

[1] Kaan Akşit. Method and apparatus for spatiotemporal enhancement of patch scanning displays, August 24 2021. US Patent 11,100,830.

[2] Kaan Akşit. Towards remote pixelless displays. In *Digital Holography and Three-Dimensional Imaging*, pages DW4B–1. Optical Society of America, 2021.

[3] Koray Kavaklı, Hakan Urey, and Kaan Akşit. Learned holographic light transport. *Applied Optics*, 61(5):B50–B55, 2022.

[4] Yuta Itoh, Takumi Kaminokado, and Kaan Akşit. Beaming displays. *IEEE Transactions on Visualization and Computer Graphics*, 27(5):2659–2668, 2021.

[5] Kaan Akşit, Yuta Itoh, and Takumi Kaminokado. Beaming displays: towards displayless augmented reality near-eye displays. In *AI and Optical Data Sciences III*, volume 12019, pages 34–37. SPIE, 2022.

[6] David R Walton, Koray Kavaklı, Rafael Kuffner Dos Anjos, David Swapp, Tim Weyrich, Hakan Urey, Anthony Steed, Tobias Ritschel, and Kaan Akşit. Metameric varifocal holograms. In *2022 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pages 746–755. IEEE, 2022.

[7] Koray Kavaklı, Yuta Itoh, Hakan Urey, and Kaan Akşit. Realistic defocus blur for multiplane computer-generated holography. *arXiv preprint arXiv:2205.07030*, 2022.

[8] Jason Orlosky, Misha Sra, Kenan Bektaş, Huaishu Peng, Jeeeun Kim, Nataliya Kos'myna, Tobias Höllerer, Anthony Steed, Kiyoshi Kiyokawa, and Kaan Akşit. Telelife: The future of remote living. *Frontiers in Virtual Reality*, 2, 2021.

[9] Kenan Bektaş, Jeeeun Kim, Huaishu Peng, Kiyoshi Kiyokawa, Anthony Steed, Tobias Höllerer, Nataliya Kos'myna, Misha Sra, Jason Orlosky, and Kaan Akşit. Telelife: A vision of remote living in 2035. In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems, CHI*, volume 22, 2022.

[10] Koray Kavaklı, David Robert Walton, Nick Antipa, Rafał Mantiuk, Douglas Lanman, and Kaan Akşit. Optimizing vision and visuals: lectures on cameras, displays and perception. In *ACM SIGGRAPH 2022 Courses*, pages 1–66. 2022.

[11] Mustafa Doga Dogan, Steven Vidal Acevedo Colon, Varnika Sinha, Kaan Akşit, and Stefanie Mueller. Sensicut: Material-aware laser cutting using speckle sensing and deep learning. In *The 34th Annual ACM Symposium on User Interface Software and Technology*, pages 24–38, 2021.

[12] Oliver Kingshott, Nick Antipa, Emrah Bostan, and Kaan Akşit. Unrolled primal-dual networks for lensless cameras. *arXiv preprint arXiv:2203.04353*, 2022.

[13] David R Walton, Rafael Kuffner Dos Anjos, Sebastian Friston, David Swapp, Kaan Akşit, Anthony Steed, and Tobias Ritschel. Beyond blur: Real-time ventral metamers for foveated rendering. *ACM Transactions on Graphics*, 40(4):1–14, 2021.

[14] Kaan Akşit, Koray Kavaklı, David Walton, Anthony Steed, Hakan Urey, Rafael Kuffner Dos Anjos, Sebastian Friston, Tim Weyrich, and Tobias Ritschel. Perceptually guided computer-generated holography. In *Advances in Display Technologies XII*, volume 12024, pages 11–14. SPIE, 2022.

[15] Eric Whitmire, Kaan Akşit, Michael Stengel, Jan Kautz, David Luebke, and Ben Boudaoud. Gaze tracking system for use in head mounted displays, November 17 2020. US Patent 10,838,492.

[16] Richard Li, Eric Whitmire, Michael Stengel, Ben Boudaoud, Jan Kautz, David Luebke, Shwetak Patel, and Kaan Akşit. Optical gaze tracking with spatially-sparse single-pixel detectors. In *2020 IEEE international symposium on mixed and augmented reality (ISMAR)*, pages 117–126. IEEE, 2020.

[17] Morgan McGuire, Kaan Akşit, Pete Shirley, and David Luebke. Computational blur for varifocal displays, June 30 2020. US Patent 10,699,383.

[18] Kaan Akşit, Jan Kautz, and David Luebke. Gaze-sensing leds for head mounted displays. *arXiv preprint arXiv:2003.08499*, 2020.

[19] Josef Spjut, Ben Boudaoud, Jonghyun Kim, Trey Greer, Rachel Albert, Michael Stengel, Kaan Akşit, and David Luebke. Toward standardized classification of foveated displays. *IEEE transactions on visualization and computer graphics*, 26(5):2126–2134, 2020.

[20] Kaan Akşit. Patch scanning displays: spatiotemporal enhancement for displays. *Optics express*, 28(2):2107–2121, 2020.

[21] Ward Lopes and Kaan Akşit. System and method for foveated image generation using an optical combiner, November 19 2019. US Patent 10,481,684.

[22] Jonghyun Kim, Kaan Akşit, Ward Lopes, and David Patrick Luebke. Holographic reflective slim virtual/augmented reality display system and method, September 3 2019. US Patent 10,401,623.

[23] Jonghyun Kim, Michael Stengel, Jui-Yi Wu, Ben Boudaoud, Josef Spjut, Kaan Akşit, Rachel Albert, Trey Greer, Youngmo Jeong, Ward Lopes, et al. Matching prescription & visual acuity: Towards ar for humans. In *ACM SIGGRAPH 2019 Emerging Technologies*, pages 1–2. 2019.

[24] Jonghyun Kim, Youngmo Jeong, Michael Stengel, Kaan Akşit, Rachel A Albert, Ben Boudaoud, Trey Greer, Joohwan Kim, Ward Lopes, Zander Majercik, et al. Foveated ar: dynamically-foveated augmented reality display. *ACM Trans. Graph.*, 38(4):99–1, 2019.

[25] Kaan Akşit and David Patrick Luebke. Catadioptric on-axis virtual/augmented reality glasses system and method, June 11 2019. US Patent 10,317,678.

[26] George Alex Koulieris, Kaan Akşit, Michael Stengel, Rafał K Mantiuk, Katerina Mania, and Christian Richardt. Near-eye display and tracking technologies for virtual and augmented reality. In *Computer Graphics Forum*, volume 38, pages 493–519. Wiley Online Library, 2019.

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[28] Kaan Akşit, Praneeth Chakravarthula, Kishore Rathinavel, Youngmo Jeong, Rachel Albert, Henry Fuchs, and David Luebke. Manufacturing application-driven foveated near-eye displays. *IEEE transactions on visualization and computer graphics*, 25(5):1928–1939, 2019.

[29] Jonghyun Kim, Kaan Akşit, Ward Lopes, and David Patrick Luebke. Holographic reflective slim virtual/augmented reality display system and method, December 11 2018. US Patent 10,151,924.

[30] Praneeth Chakravarthula, David Dunn, Kaan Akşit, and Henry Fuchs. Focusar: Auto-focus augmented reality eyeglasses for both real world and virtual imagery. *IEEE transactions on visualization and computer graphics*, 24(11):2906–2916, 2018.

[31] Kishore Rathinavel, Praneeth Chakravarthula, Kaan Akşit, Josef Spjut, Ben Boudaoud, Turner Whitted, David Luebke, and Henry Fuchs. Steerable application-adaptive near eye displays. In *ACM SIGGRAPH 2018 Emerging Technologies*, pages 1–2. 2018.

[32] David Dunn, Praneeth Chakravarthula, Qian Dong, Kaan Akşit, and Henry Fuchs. 10-1: Towards varifocal augmented reality displays using deformable beamsplitter membranes. In *SID Symposium Digest of Technical Papers*, volume 49, pages 92–95. Wiley Online Library, 2018.

[33] George-Alex Koulieris, Kaan Akşit, Christian Richardt, and Rafał Mantiuk. Cutting-edge vr/ar display technologies (gaze-, accommodation-, motion-aware and hdr-enabled). In *SIGGRAPH Asia 2018 Courses*, pages 1–341. 2018.

[34] George-Alex Koulieris, Kaan Akşit, Christian Richardt, Rafał Mantiuk, and Katerina Mania. Cutting-edge vr/ar display technologies (gaze-, accommodation-, motion-aware and hdr-enabled). In *IEEE VR 2018-25th IEEE Conference on Virtual Reality and 3D User Interfaces*, 2018.

[35] Kaan Akşit, Ward Lopes, Jonghyun Kim, Peter Shirley, and David Luebke. Near-eye varifocal augmented reality display using see-through screens. *ACM Transactions on Graphics (TOG)*, 36(6):1–13, 2017.

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[37] Kaan Akşit, Ward Lopes, Jonghyun Kim, Josef Spjut, Anjul Patney, Peter Shirley, David Luebke, Steven A Cholewiak, Pratul Srinivasan, Ren Ng, et al. Varifocal virtuality: a novel optical layout for near-eye display. In *ACM SIGGRAPH 2017 Emerging Technologies*, pages 1–2. 2017.

[38] Kaan Akşit. Computational displays for virtual reality and augmented reality applications. In *3D Image Acquisition and Display: Technology, Perception and Applications*, pages DTu4F–1. Optica Publishing Group, 2017.

[39] David Dunn, Cary Tippets, Kent Torell, Petr Kellnhofer, Kaan Akşit, Piotr Didyk, Karol Myszkowski, David Luebke, and Henry Fuchs. Wide field of view varifocal near-eye display using see-through deformable membrane mirrors. *IEEE transactions on visualization and computer graphics*, 23(4):1322–1331, 2017.

[40] Daniel Kade, Kaan Akşit, Hakan Urey, and Oğuzhan Özcan. Head-mounted mixed reality projection display for games production and entertainment. *Personal and Ubiquitous Computing*, 19(3):509–521, 2015.

[41] Kaan Akşit, Jan Kautz, and David Luebke. Slim near-eye display using pinhole aperture arrays. *Applied optics*, 54(11):3422–3427, 2015.

[42] Kaan Akşit, Daniel Kade, Oğuzhan Özcan, and Hakan Urey. Head-worn mixed reality projection display application. In *Proceedings of the 11th Conference on Advances in Computer Entertainment Technology*, pages 1–9, 2014.

[43] Giorgio Corbellini, Kaan Akşit, Stefan Schmid, Stefan Mangold, and Thomas R Gross. Connecting networks of toys and smartphones with visible light communication. *IEEE communications magazine*, 52(7):72–78, 2014.

[44] Stefan Schmid, Daniel Schwyn, Kaan Akşit, Giorgio Corbellini, Thomas R Gross, and Stefan Mangold. From sound to sight: Using audio processing to enable visible light communication. In *2014 IEEE Globecom Workshops (GC Wkshps)*, pages 518–523. IEEE, 2014.

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[46] Kaan Akşit, Amir Hossein Ghanbari Niaki, Osman Eldes, and Hakan Urey. Super stereoscopy 3d glasses for more realistic 3d vision. In *2014 3DTV-Conference: The True Vision-Capture, Transmission and Display of 3D Video (3DTV-CON)*, pages 1–3. IEEE, 2014.

[47] Kaan Akşit. Next generation 3d display applications using laser scanning pico projectors. *Available at SSRN 3698405*, 2014.

[48] Kaan Akşit, Amir Hossein Ghanbari Niaki, and Hakan Urey. P-187l: Late-news poster: Improved 3d with super stereoscopy technique. In *SID Symposium Digest of Technical Papers*, volume 45, pages 1067–1069. Wiley Online Library, 2014.

[49] Kaan Akşit, Selim Ölçer, and Hakan Urey. 56.6 l: Late-news paper: Modular multi-projection multi-view autostereoscopic display using mems laser projectors. In *SID Symposium Digest of Technical Papers*, volume 45, pages 828–831. Wiley Online Library, 2014.

[50] Osman Eldes, Kaan Akşit, and Hakan Urey. Multi-view autostereoscopic projection display using rotating screen. *Optics Express*, 21(23):29043–29054, 2013.

[51] Phil Surman, Sally Day, Kaan Akşit, Hakan Urey, Joshua Benjamin, Kuber Jain, and Hao Chen. Single and multi-user head tracked glasses-free 3d displays. In *2013 3DTV Vision Beyond Depth (3DTV-CON)*, pages 1–4. IEEE, 2013.

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[54] Kaan Akşit, Osman Eldes, M Kivanc Hedili, and Hakan Urey. Paper no 15.1: Augmented reality and 3d displays using pico-projectors. In *SID Symposium Digest of Technical Papers*, volume 44, pages 243–246. Wiley Online Library, 2013.

[55] Kaan Akşit, Hadi Baghsiahi, Phil Surman, Selim Ölçer, Eero Willman, David R Selviah, Sally Day, and Hakan Urey. Dynamic exit pupil trackers for autostereoscopic displays. *Optics express*, 21(12):14331–14341, 2013.

[56] H. Baghsiahi, D.R. Selviah, E. Willman, A. Fernández, S.E. Day, Kaan Akşit, S. Ölçer, A. Mostafazadeh, E. Erden, V.C. Kishore, et al. 48.4: Beam Forming for a Laser Based Auto-stereoscopic Multi-Viewer Display. SID, 2011.

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[60] H. Urey, Kaan Akşit, and O. Eldes. Novel 3d displays using micro-optics and mems. In *International Conference on Fibre Optics and Photonics*. Optical Society of America, 2012.

[61] Kaan Akşit, S. Ölçer, E. Erden, VC Kishore, H. Urey, E. Willman, H. Baghsiahi, S.E. Day, D.R. Selviah, F. Aníbal Fernández, et al. Light engine and optics for HELIUM3D auto-stereoscopic laser scanning display. In *3DTV Conference: The True Vision-Capture, Transmission and Display of 3D Video (3DTV-CON), Turkey, 2011*, pages 1–4. IEEE, 2011.

[62] Yusuf Ozgur Cakmak, Hakan Urey, Selim Ölçer, and Kaan Akşit. Electro-stimulation device, December 2 2018. US Patent 9855426B2.

[63] Giovanni Cennini, Jeremie Arguel, Kaan Akşit, and Arno van Leest. Heart rate monitoring via remote photoplethysmography with motion artifacts reduction. *Optics Express*, 18(5):4867–4875, 2010.

[64] Eric Whitmire, Kaan Akşit, Michael Stengel, Jan Kautz, David Luebke, and Ben Boudaoud. Driver gaze tracking system for use in vehicles, March 25 2021. US Patent App. 16/578,077.