Jonghyun Kim

Email: eluardkim@gmail.com
Website: https://research.nvidia.com/person/jonghyun-kim/
Mobile: +1-650-304-5710
Google Scholar: Link

Education and Experience

- **NVIDIA** — Santa Clara, USA
  Sr. Research Scientist — *Aug 2017 - Present*
- **Stanford University** — Stanford, USA
  Visiting Scholar at Computational Imaging lab (Prof. Gordon Wetzstein) — *Nov 2019 - Nov 2022*
- **Seoul National University** — Seoul, Korea
  Doctor of Philosophy - Electrical and Computer Engineering (Prof. Byoungho Lee) — *Mar 2011 - Feb 2017*
  Bachelor of Science - Electrical Engineering — *Mar 2007 - Feb 2011*

Research Interests

- **Near-eye Displays**: Lightweight AR/VR, Foveated Displays, Virtual Retinal Displays, Varifocal Displays
- **Holographic Displays**: Neural Holography, Camera-in-the-loop Training, Holographic Glasses
- **Light Field Displays**: Integral Imaging, Multi-view Displays, Volumetric Displays
- **Computational Displays**: Tensor Displays, Mixed Primary Displays

Featured Projects

- **Holographic AR Glasses with Metasurface Waveguides**: A near-eye display design that pairs inverse-designed metasurface waveguides with AI-driven holographic displays to enable full-colour 3D augmented reality from a compact glasses-like form factor. (Nature 2024)
- **Holographic Glasses for Virtual Reality - 2.5 mm-thick, 3D holographic VR display**: Holographic Glasses is a holographic near-eye display system with an eyeglasses-like form factor for virtual reality. It is composed of a pupil-replicating waveguide, a spatial light modulator, and a geometric phase lens to create holographic images in a lightweight and thin form factor. The proposed design can deliver full-color 3D holographic images using an optical stack of 2.5 mm thickness. A novel Pupil-high-order gradient descent algorithm is presented for the correct phase calculation with the user's varying pupil size. (SIGGRAPH 2022, Optics Letters 2021)
- **Neural Holography and Camera-in-the-loop Training - Unprecedented holographic image quality with better computation**: Neural Holography is an algorithmic CGH framework that uses camera-in-the-loop training to achieve unprecedented image fidelity and real-time frame rates. A precise light propagation function of any holographic displays can be trained with data pairs of displayed phase image and captured amplitude image. This project includes improving image quality, contrast and speckle and supervising 2D, RGBD, focal stack and light field target images. (SIGGRAPH 2020, SIGGRAPH 2022, SIGGRAPH ASIA 2021, Science Advances, Optica)
- **Prescription AR and ModulAR - A fully-customized prescription-embedded AR display**: This project presents a fully-customized AR display design that considers the user's prescription, interpupillary distance, and taste of fashion. A free-form image combiner embedded inside the prescription lens provides augmented images onto the vision-corrected real world. The optics was optimized for each prescription level, which can reduce the mass production cost while satisfying the user's taste. Our design can cover myopia, hyperopia, astigmatism, and presbyopia, and allows the eye-contact interaction with privacy protection. A 169 g dynamic prototype showed a $40^\circ \times 20^\circ$ virtual image with a 23 cpd resolution at center field and 6 mm $\times$ 4 mm eye-box, with the vision-correction and varifocal (0.5-3 m) capability.(SIGGRAPH 2019, Optics Express 2020)
- **Foveated AR - Dynamically-Foveated AR Display**: AR display system that advances the state of the art for simultaneous wide FOV (100° diagonal), compact form factor, high foveal resolution (60 cpd), variable focus display and rendering, and large eyebox (12 mm $\times$ 8 mm). A key innovation is the use of an HOE image combiner with dynamic position driven by gaze tracking, sidestepping the optical invariant for a static element. Integrated low-latency gaze tracking, motors, and rendering enable the dynamic position and varifocal system. (SIGGRAPH 2019)
- **Retinal 3D - A large FOV 3D Virtual Retinal Display for AR**: Retinal 3D provides virtual images with focus cues by generating a localized light field around the pupil position with real-time eye-tracking. A reflective HOE lens was used as a transparent image combiner. This pupil-tracked light field provides a large dynamic eye-box and 3D capability while preserving large FOV of virtual retinal display. (SIGGRAPH ASIA 2017)

Honors and Awards

- **Best in Show Award**: Emerging Technologies in SIGGRAPH 2019 "Matching Prescription & Visual Acuity: Towards AR for Humans" (August 2019)
- **Best Paper Award**: The 23rd Conference on Optoelectronics and Optical Communications, Optical Society of Korea "Light field microscope system with a stretchable lens array" (June 2016)
- **KIDS Award**: The 14th International Meeting on Information Display, The Korean Information Display Society "Analysis of integral floating microscopy" (August 2014)

Featured Invited Talks

- **GTC 2022**: “Holographic Near-eye Display: The Future of XR — Speckle and Form Factor” *Link*
- **SPIE AR|VR|MR 2022**: “Learning-Based Approaches in Holographic Near-Eye Displays” *Link*
- **GTC 2021**: “Holographic Near-eye Display: The Future of XR” *Link*
- **IMID 2021**: “Neural 3D Holography and Michelson Holography” *Link*
- **SPIE AR|VR|MR 2020**: “Modular: AR-convertible prescription glasses” *Link*
- **Stanford SCIEN talk 2020**: “Matching Visual Acuity and Prescription: Towards AR for Humans” *Link*
- **FIO 2019**: “Towards Customized Augmented Reality Displays”
- **SIGGRAPH 2019**: “Matching Visual Acuity and Prescription: Towards AR for Humans”
- **FIO 2024**: “Cloud-Native AI-mediated 3D telepresence”

Selected Publications

79 Publications in total, 1949 Citations *Link to Google Scholar*

- M. Gopakumar, G.-Y. Lee, S. Choi, B. Chao, Y. Peng, **J. Kim**, G. Wetzstein, “Full-colour 3D holographic augmented-reality displays with metasurface waveguides,” Nature, vol. 629, pp. 791–797, 2024.
- **J. Kim**, M. Gopakumar, S. Choi, Y. Peng, W. Lopes, G. Wetzstein, “Holographic Glasses for Virtual Reality,” SIGGRAPH 2022 Conference Proceedings, 2022.
- S. Choi, M. Gopakumar, Y. Peng, **J. Kim**, M. O’Toole, G. Wetzstein, “Time-multiplexed Neural Holography: A Flexible Framework for Holographic Near-eye Displays with Fast Heavily-quantized Spatial Light Modulators,” SIGGRAPH 2022 Conference Proceedings, 2022.
- M. Gopakumar, **J. Kim**, S. Choi, Y. Peng, G. Wetzstein, “Unfiltered holography: optimizing high diffraction orders without optical filtering for compact holographic displays,” Optics Letters, vol. 46, no. 23, 5822, 2021.
- Y. Peng, S. Choi, **J. Kim**, and G. Wetzstein, “Speckle-free holography with partially coherent light sources and camera-in-the-loop calibration,” Science Advances, vol. 7, no. 46, eabg5040, 2021.
- S. Choi, M. Gopakumar, Y. Peng, **J. Kim**, G. Wetzstein, “Neural 3D Holography: Learning Accurate Wave Propagation Models for 3D Holographic Virtual and Augmented Reality Displays,” ACM Transactions on Graph. (TOG) in SIGGRAPH Asia, vol. 40, no. 6, article 240, 2021.
- S. Choi, **J. Kim**, Y. Peng, and G. Wetzstein, “Optimizing image quality for holographic near-eye displays with Michelson Holography,” Optica, vol. 8, no. 2, pp. 143-146, 2021.
- J.-Y. Wu and **J. Kim**, “Prescription AR: a fully-customized prescription-embedded augmented reality display,” Optics Express, vol. 28, no. 5, pp. 6225-6241, 2020.
- **J. Kim**, Y. Jeong, M. Stengel, K. Akşit, R. Albert, B. Boudaoud, T. Greer, J. Kim, W. Lopes, Z. Majercik, P. Shirley, J. Spjut, M. McGuire, and D. Luebke, “Foveated AR: Dynamically-Foveated Augmented Reality Display,” ACM Transactions on Graphics (TOG) in SIGGRAPH 2019, vol. 38, no. 4, article 99, 2019.
- K. Akşit, W. Lopes, **J. Kim**, P. Shirley, D. Luebke, “Near-eye varifocal augmented reality display using see-through screens,” ACM Transactions on Graphics (TOG) in SIGGRAPH ASIA 2017, vol. 36, no. 6, article 189, 2017.
- C. Jang, K. Bang, S. Moon, **J. Kim**, S. Lee, and B. Lee, “Retinal 3D: augmented reality near-eye display via pupil-tracked light field projection on retina,” ACM Transactions on Graphics (TOG) in SIGGRAPH ASIA 2017, vol. 36, no. 6, article 190, 2017.
- F.-C. Huang, D. Pająk, **J. Kim**, J. Kautz, and D. Luebke. “Mixed-primary factorization for dual-frame computational displays,” ACM Transactions on Graphics (TOG) in SIGGRAPH 2017, vol. 36, no. 4, article 149, 2017
- J.-Y. Hong, C.-K. Lee, S. Lee, B. Lee, D. Yoo, C. Jang, **J. Kim**, J. Jeong, and B. Lee, “See-through optical combiner for augmented reality head-mounted display: index-matched anisotropic crystal lens,” Scientific Reports, vol. 7, 2753, 2017.
- **J. Kim**, J.-Y. Hong, K. Hong, H. K. Yang, S. B. Han, J.-M. Hwang, and B. Lee, “Glasses-free randot stereotest,” Journal of Biomedical Optics, vol. 20, no. 6, article 065004, 2015.
- **J. Kim**, C.-K. Lee, Y. Jeong, C. Jang, J.-Y. Hong, W. Lee, Y.-C. Shin, J.-H. Yoon, and B. Lee, “Crosstalk-reduced dual-mode mobile 3D display,” Journal of Display Technology, vol. 11, no. 1, pp. 97-103, 2015.
- **J. Kim**, J.-H. Jung, Y. Jeong, K. Hong, and B. Lee, “Real-time integral imaging system for light field microscopy,” Optics Express, vol. 22, no. 9, pp. 10210-10220, 2014.
- **J. Kim**, J.-H. Jung, C. Jang, and B. Lee, “Real-time capturing and 3D visualization method based on integral imaging,” Optics Express, vol. 21, no. 16, pp. 18742-18753, 2013.
- **J. Kim**, Y. Kim, J. Hong, G. Park, K. Hong, S.-W. Min, and B. Lee, “A full-color anaglyph three-dimensional display system using active color filter glasses,” Journal of Information Display, vol. 12, no. 1, pp. 37-41, 2011.