

Iksung Kang

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Pronouns: he/his/him

EDUCATION

Massachusetts Institute of Technology

Doctor of Philosophy, Department of Electrical Engineering and Computer Science

Cambridge, MA

2020 – 2022

Massachusetts Institute of Technology

Master of Science, Department of Electrical Engineering and Computer Science

Cambridge, MA

2017 – 2020

Seoul National University

Bachelor of Science, Department of Electrical and Computer Engineering (as class valedictorian)

Seoul, South Korea

2011 – 2017

EXPERIENCE

University of California, Berkeley

Postdoctoral fellow, Department of Neuroscience (Advisor: Na Ji, Stella X. Yu)

Berkeley, CA

Jul 2022 - Present

- **Adaptive optics with machine learning:** Developed a general-purpose adaptive optics framework for widefield and two-photon fluorescence microscopy using neural fields.
- **Fluorescence microscopy for visual neuroscience:** Utilized adaptive optical fluorescence microscopy combined with machine learning for structural and activity imaging, as well as data analysis, in the visual cortex of a live mouse brain.
- **Compressive microscopy:** Collaborated on the design of high-speed optical compressive widefield fluorescence microscopy for sub-millisecond neuronal signal dynamics.

Research Assistant

Massachusetts Institute of Technology (Advisor: George Barbastathis)

Cambridge, MA

Jan 2019 – May 2022

- **Phase retrieval:** Devised a physics-informed machine learning algorithm with random phase modulation for robust phase retrieval under low-photon conditions.
- **Phase tomography:** Designed a dynamical machine learning algorithm for limited-angle phase tomography of multi-layered phase objects.
- **Synchrotron X-ray ptycho-tomography:** Implemented supervised and self-supervised deep learning for three-dimensional nanoscale X-ray imaging of integrated circuits inside semiconductors, under synchrotron X-ray ptycho-tomography and ptycho-laminography geometries.
- **Broadband holography:** Performed simultaneous optical wavelength analysis and holographic reconstruction from a diffraction intensity of a broadband CMOS LED illumination using self-supervised deep learning.

Seoul National University

Undergraduate researcher

Seoul, South Korea

2016

- **Low-cost MRI:** Devised a cost-effective solution for the main magnetic field generation in a small-sized MRI.

Seoul National University

Research intern, Graduate School of Convergence Science and Technology

Seoul, South Korea

2014

- **Neural recording ASIC:** Participated in designing an ASIC for wireless electrical recording of neural signals from a live mouse brain.

RESEARCH INTERESTS

Computational Optical Imaging

- Adaptive optical fluorescence microscopy
- Tomography (optical, X-ray)
- Broadband holography
- Phase retrieval

Machine Learning Algorithm Design

- Neural fields (coordinate-based neural representation)
- Physics-informed supervised, self-supervised deep learning
- Nonlinear inverse problems

PATENTS

1. **Adaptive optical correction in two-photon fluorescence microscopy with neural fields**
U.S. Patent Application No. 63/707,628, filed October 15, 2024
Co-inventors: **Kang I**, Ji N.

PREPRINTS

2. **Adaptive optical correction for in vivo two-photon fluorescence microscopy with neural fields**
Kang I, Kim H, Natan R, Zhang Q, Yu SX, Ji N
bioRxiv (2024) 2024.10.20.619284. <https://doi.org/10.1101/2024.10.20.619284> (under review)
1. **Optical segmentation-based compressed readout of neuronal voltage dynamics**
Kim S, Ko G, **Kang I**, Tian H, Fan LZ, Li Y, Cohen AE, Wu J, Dai Q, Choi MM
bioRxiv (2023) 2023.11.10.566599. <https://doi.org/10.1101/2023.11.10.566599>

JOURNAL PUBLICATION

11. **Coordinate-based neural representations for computational adaptive optics in widefield microscopy**
Kang I*, Zhang Q*, Yu SX, Ji N
Nature Machine Intelligence (2024) 6, 714–725. <https://doi.org/10.1038/s42256-024-00853-3>
*Contributed equally and co-correspondence authors.
10. **Accelerated deep self-supervised ptycho-laminography for three-dimensional nanoscale imaging of integrated circuits**
Kang I, Jiang Y, Holler M, Guizar-Sicairos M, Levi AFJ, Klug J, Vogt S, Barbastathis G
Optica (2023) 8, 1000-1008. <https://doi.org/10.1364/OPTICA.492666>
9. **Attentional Ptycho-Tomography (APT) for three-dimensional nanoscale X-ray imaging with minimal data acquisition and computation time**
Kang I*, Wu Z*, Jiang Y, Yao Y, Klug J, Vogt S, Barbastathis G
Light: Science & Applications (2023) 12(131). <https://www.nature.com/articles/s41377-023-01181-8>
*Contributed equally.
8. **Three-dimensional nanoscale imaging via deep neural networks and multi-angle ptychography (RAPID)**
Wu Z*, **Kang I***, Yao Y, Jiang Y, Deng J, Klug J, Vogt S, Barbastathis G
eLight (2023) 3(7). <https://doi.org/10.1186/s43593-022-00037-9>
*Contributed equally.
7. **Simultaneous spectral recovery and CMOS micro-LED holography with an untrained deep neural network**
Kang I*, de Cea M*, Xue J, Li Z, Barbastathis G, Ram R
Optica (2022) 9(10), 1149-1155. <https://doi.org/10.1364/OPTICA.470712>
*Contributed equally.
6. **Dynamical machine learning volumetric reconstruction of objects' interiors from limited angular views**
Kang I*, Goy A, Barbastathis G
Light: Science & Applications (2021) 10(74). <https://doi.org/10.1038/s41377-021-00512-x>
*Correspondence author.
5. **Recurrent neural network reveals transparent objects through scattering media**
Kang I*, Pang S, Zhang Q, Fang N, Barbastathis G
Optics Express (2020) 29(4), 5316-5326. <https://doi.org/10.1364/OE.412890>
*Correspondence author.

4. **Deep residual learning for low-order wavefront sensing in high-contrast imaging systems**
Allan G*, **Kang I***, Douglas E, Barbastathis G, Cahoy K
Optics Express (2020) 28(18), 26267-26283. <https://doi.org/10.1364/OE.397790>
*Contributed equally.
3. **On the interplay between physical and content priors in deep learning for computational imaging**
Deng M*, Li S*, Zhang Z, **Kang I**, Fang N, Barbastathis G
Optics Express (2020) 28(16), 24152-24170. <https://doi.org/10.1364/OE.395204>
2. **Phase Extraction Neural Network (PhENN) with Coherent Modulation Imaging (CMI) for phase retrieval at low photon counts**
Kang I*, Zhang F, Barbastathis G
Optics Express (2020) 28(15), 21578-21600. <https://doi.org/10.1364/OE.397430>
*Correspondence author.
1. **Learning to synthesize: Robust phase retrieval at low photon counts**
Deng M, Li S, Goy A, **Kang I**, Barbastathis G
Light: Science & Applications (2020) 9(36). <https://doi.org/10.1038/s41377-020-0267-2>

CONFERENCE PROCEEDINGS & PRESENTATIONS

11. **Aberration measurement and correction for ultrafast two-photon fluorescence imaging**
Zhu J, Natan R, Zhong J, **Kang I**, Ji N
SPIE Photonics West (2025).
10. **Computational adaptive optics for in vivo two-photon fluorescence microscopy using coordinate-based neural representations**
Kang I*, Zhang Q, Yaeger C, Pham T, Yu SX, Harnett M, Ji N
SPIE Photonics West (2024) 12851-9. <https://doi.org/10.1117/12.3008468>
*Speaker, oral presentation.
9. **On the use of deep learning for three-dimensional computational imaging**
Barbastathis G, Pang S, **Kang I**, Wu Z, Liu Z, Guo Z, Zhang F
SPIE Photonics West (2023) 12445. <https://doi.org/10.1117/12.2655261>
8. **Deep self-supervised learning for computational adaptive optics in widefield microscopy**
Kang I*, Zhang Q, Ji N
SPIE Photonics West (2023) 12388-34. <https://doi.org/10.1117/12.2658934>
*Speaker, oral presentation.
7. **Optical segmentation for compressed readout on sub-millisecond neuronal circuit dynamics – Diffractive Multisite Optical Segmentation Assisted Image Compression: DeMOSAIC)**
Kim S, Wu J, **Kang I**, Ko G, Tian H, Fan LZ, Li Y, Cohen AE, Dai Q, Choi MM
Frontiers in Neurophotonics (FiNs) (2022).
6. **Photon-starved X-ray Ptychographic Imaging using Spatial Pyramid Atrous Convolution End-to-end Reconstruction (PtychoSPACER)**
Wu Z, **Kang I**, Zhou T, Coykendall V, Ge B, Cherukara MJ, Barbastathis G
Computational Optical Sensing and Imaging (2022) CF1D.6. <https://doi.org/10.1364/COSI.2022.CF1D.6>
5. **Adaptive image segmentation for crosstalk-free high-speed compressive imaging**
Kim S, Wu J, **Kang I**, Li Y, Tian H, Fan LZ, Cohen AE, Dai Q, Choi MM
Focus on Microscopy (FOM) (2022).
4. **Three-dimensional reconstruction of integrated circuits by single-angle X-ray ptychography with machine learning**
Kang I*, Yao Y, Deng J, Klug J, Vogt S, Honig S, Barbastathis G
Computational Optical Sensing and Imaging (2021) CTu6A.4. <https://doi.org/10.1364/COSI.2021.CTu6A.4>
*Speaker, oral presentation.

3. **Probability of error as an image metric for the assessment of tomographic reconstruction of dense-layered binary-phase objects**
Kang I*, Barbastathis G
SPIE Photonics West (2021) 116530T. <https://doi.org/10.1117/12.2577264>
 *Speaker, oral presentation.
2. **Deep neural networks to improve the dynamic range of Zernike phase-contrast wavefront sensing in high-contrast imaging systems**
 Allan G, **Kang I**, Douglas E, N'Diaye M, Barbastathis G, Cahoy K
SPIE Astronomical Telescopes + Instrumentation (2020) 1144349. <https://doi.org/10.1117/12.2562927>
1. **A portable, low-cost, 3D-printed main magnetic field system for magnetic imaging**
Kang I*
IEEE Engineering in Medicine and Biology Society (2017). <https://doi.org/10.1109/EMBC.2017.8037619>
 *Speaker, oral presentation.

AWARDS, HONORS & CERTIFICATIONS

Ph.D. Study-Abroad Scholarship	2017–2022
<i>Korea Foundation for Advanced Studies (KFAS)</i>	<i>South Korea</i>
Kaufman Teaching Certificate Program (KTCP)	2022
<i>Massachusetts Institute of Technology</i>	<i>Cambridge, MA</i>
Biophysics Program Certificate	2018
<i>Massachusetts Institute of Technology</i>	<i>Cambridge, MA</i>
Summa Cum Laude Award	2017
<i>Seoul National University</i>	<i>Seoul, South Korea</i>
Eminence Scholarship	2015, 2016
<i>Seoul National University</i>	<i>Seoul, South Korea</i>
Merit-Based Scholarship	2012, 2015
<i>Seoul National University</i>	<i>Seoul, South Korea</i>
Superior Academic Performance Scholarship	2011
<i>Seoul National University</i>	<i>Seoul, South Korea</i>

INVITED TALKS & SEMINARS

Guest Lecture	Mar 2025 (scheduled)
<i>PHYSICS H190 - AI for Optical Microscopy</i>	<i>University of California, Berkeley, USA</i>
Invited Talk	Nov 2024
<i>Center for Adaptive Optics Fall Science Retreat</i>	<i>University of California, Los Angeles, USA</i>
Invited Talk	Apr 2024
<i>Graduate School of Data Science, Seoul National University</i>	<i>Seoul, South Korea</i>
Guest Speaker in Mini-symposium – Computational Imaging in Neurophotonics	Jan 2023
<i>Seoul National University</i>	<i>Seoul, South Korea</i>
Speaker in Photobears Lightning talk series	Sep 2022
<i>University of California, Berkeley</i>	<i>Berkeley, CA</i>
Invited Talk	Apr 2022
<i>Aerospace Controls Laboratory (ACL), Massachusetts Institute of Technology</i>	<i>Cambridge, MA</i>
Research seminar	Oct 2021
<i>Computational Imaging Lab, Princeton University</i>	<i>Online</i>
Invited Talk	Oct 2021
<i>CRISP (Computation, Representation, and Inference in Signal Processing) Group, Harvard University</i>	<i>Cambridge, MA</i>

Research seminar <i>University of California, Los Angeles</i>	Sep 2021 Online
Research seminar <i>Ji Lab, University of California, Berkeley</i>	Sep 2021 Online
Invited Talk <i>Neurophotonics Lab, Seoul National University</i>	Feb 2021 Seoul, South Korea

MENTORING EXPERIENCE

Course Project Mentor <i>Massachusetts Institute of Technology</i>	Spring 2022 Cambridge, MA
<ul style="list-style-type: none"> ◦ Physical Systems Modeling and Design Using Machine Learning: Mentored a student group of 3 graduate students for their end-term project on the image segmentation of noisy ultrasonic images. ◦ Mentored students: April Marie Anlage, Yiwen Huang, Itay Fayer. 	
Course Project Mentor <i>Massachusetts Institute of Technology</i>	Spring 2020 Cambridge, MA
<ul style="list-style-type: none"> ◦ Learning Machines: Mentored a student group of 7 undergraduate and graduate students in total for their end-term projects on (1) the reaction modeling to facilitate pharmaceutical process development using machine learning; and (2) the control of autonomous ocean vehicles using reinforcement learning. ◦ Mentored students: (1) Natalie Suzanne Eyke, Benjamin David Russell, Robyn Wen-Yi Lee; and (2) Timothy Samuel Fountain, Warner A. McGee, HongSeok Cho, Bouke K. Edskes. 	
Volunteer <i>Korea Foundation for Advanced Studies Overseas Program</i>	Feb 2018 Kingdom of Cambodia
<ul style="list-style-type: none"> ◦ Participated as a volunteer in the Kingdom of Cambodia for a week, teaching children physics and building homes for the residents. 	

TEACHING EXPERIENCE

Kaufman Teaching Certificate Program (KTCP) <i>Teaching & Learning Laboratory, Massachusetts Institute of Technology</i>	Spring 2022 Cambridge, MA
<ul style="list-style-type: none"> ◦ Workshop: Completed seven workshops to develop teaching skills as part of the teaching certificate program. A major part of the program involved introducing students to relevant research in teaching and learning and laying out future teaching models. ◦ Microteaching sessions: Presented two microteaching sessions that were videotaped, where I received feedback on my performance regarding my teaching and provided feedback to other participants. 	
Teaching Assistant <i>Massachusetts Institute of Technology</i>	Spring 2020 Cambridge, MA
<ul style="list-style-type: none"> ◦ Mentored course research projects, contributed to curriculum design, conducted after-hour office hours, and graded assignments. Class taught totaled around 40 students and comprised course research projects on the connection between machine learning and physical systems. 	

LEADERSHIP

Group Leader <i>EECS Korean Graduate Students Society, Massachusetts Institute of Technology</i>	2019 – 2020 Cambridge, MA
<ul style="list-style-type: none"> ◦ Organized social gatherings and networking to foster cohesion among EECS Korean graduate students. 	
Founder & Group Leader <i>Korean Graduate Students Swimming Club, Massachusetts Institute of Technology</i>	2019 – 2021 Cambridge, MA
<ul style="list-style-type: none"> ◦ Organized a swimming session twice a week and held social events among swimming club members. 	

- Event Officer** 2018 – 2019
Korean Graduate Students Association, Massachusetts Institute of Technology Cambridge, MA
- Planned and organized social events to facilitate networking among Korean graduate students.
- Group Leader** 2018
Sidney-Pacific Inter-Cultural Exchange Program (SPICE), Massachusetts Institute of Technology Cambridge, MA
- Organized social gatherings for networking among group members from diverse backgrounds living in Sidney-Pacific graduate residence.
- Event Chair** Summer 2018
EECS Graduate Students Association, Massachusetts Institute of Technology Cambridge, MA
- Organized and led weekly coffee hours to facilitate social gathering and networking among international EECS students.
- Student Ambassador** 2018
Kakao Ventures Seoul, South Korea
- Contributed to the creation of a startup ecosystem on/off campus in Cambridge and worked as a liaison to Kakao Ventures in South Korea.
- Sergeant** Feb 2013 – Nov 2014
Korean Augmentation to the U.S. Army (KATUSA) South Korea
- Worked as the Information Assurance Security Officer and a deputy of Information Assurance Manager (IAM) / Systems Administrator (SA) in accordance with AR 25-2 in Information Management Office, 8th Army NCO Academy and KATUSA Training Academy.

REVIEWER ACTIVITIES

Light: Science & Applications

Nature Portfolio, United Kingdom

Optica, Optics Letter, Optics Express, Applied Optics

Optica Publishing, United States

IEEE Transactions on Medical Imaging

IEEE, United States

REFERENCE

George Barbastathis

Ph.D advisor, he/his/him

Professor of Mechanical Engineering at Massachusetts Institute of Technology

Email: gbarb@mit.edu

Na Ji

Postdoc advisor, she/her/hers

Professor of Physics and Neurobiology at University of California, Berkeley

Email: jina@berkeley.edu

Stella X. Yu

Postdoc advisor, she/her/hers

Professor of Electrical and Computer Engineering at University of Michigan, Ann Arbor

Email: stellayu@umich.edu