Iksung Kang

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Education

Massachusetts Institute of Technology — Cambridge, MA
Doctor of Philosophy, Department of Electrical Engineering and Computer Science — *2020 – 2022*

Massachusetts Institute of Technology — Cambridge, MA
Master of Science, Department of Electrical Engineering and Computer Science — *2017 – 2020*

Seoul National University — Seoul, South Korea
Bachelor of Science, Department of Electrical and Computer Engineering (as class valedictorian) — *2011 – 2017*

Experience

Postdoctoral Fellow — Berkeley, CA
University of California - Berkeley, Department of Neuroscience (Advisors: Na Ji, Stella X. Yu) — *Jul 2022 - Present*

- **Computational Microscopy**: Adaptive optical control of high-resolution microscopy systems using self-supervised machine learning.
- **Application - living samples: neuroscience**: *In vivo* structural and functional activity imaging of the mouse brain, biological signal processing, and data analysis.
- **Software methods**: Differentiable rendering (e.g., neural fields) for linear inverse problems.
- **Hardware methods**: Widefield and two-photon fluorescence microscopy, adaptive optics.

Graduate Research Assistant — Cambridge, MA
Massachusetts Institute of Technology, Mechanical Engineering (Advisor: George Barbastathis) — *Jan 2019 – May 2022*

- **Computational Micro/Nanoscale Imaging**: Optimizing high-resolution non-invasive imaging workflows to maximize speed using supervised and self-supervised deep learning.
- **Application - non-living samples: manufacturing inspection**: Rapid analysis and inspection of manufacturing defects in 16-nm process semiconductors achieving speeds up to 100 times faster than conventional techniques.
- **Software methods**: Supervised and self-supervised deep learning (e.g., convolutional/recurrent neural networks, transformers) for non-linear inverse problems.
- **Hardware methods**: Phase retrieval, X-ray ptycho-tomography, digital holography.
- **Collaboration**: Argonne National Laboratory (U.S.), Paul Scherrer Institute (Switzerland), MIT Department of Aeronautics and Astronautics.

Undergraduate Researcher — Seoul, South Korea
Seoul National University, Electrical and Computer Engineering (Advisor: Jongho Lee) — *2016*

Undergraduate Research Intern — Seoul, South Korea
Seoul National University, Graduate School of Convergence Science and Technology — *2014*

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 at *Nature Methods*)
   Co-corresponding author.

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 (under review at *Nature Methods*)
   Co-author.

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. (IF: 18.8 (2023), Springer Nature)
Co-Corresponding author.

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. (IF: 8.4 (2023), Optica Publishing Group)
First author.

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). (IF: 20.6 (2023), Springer Nature)
Co-first author.

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). (IF: 27.2 (2023), Springer Nature)
Co-first author.

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. (IF: 8.4 (2023), Optica Publishing Group)
Co-first author.

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). (IF: 20.6 (2023), Springer Nature)
Corresponding 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. (IF: 3.2 (2023), Optica Publishing Group)
Corresponding 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. (IF: 3.2 (2023), Optica Publishing Group)
Co-first author.

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. (IF: 3.2 (2023), Optica Publishing Group)
Co-author.

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. (IF: 3.2 (2023), Optica Publishing Group)
Corresponding 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). (IF: 20.6 (2023), Springer Nature)
Co-author.

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)**. https://bit.ly/40taADQ

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
Speaker, oral presentation.

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
Korea Foundation for Advanced Studies (KFAS) *South Korea*

Kaufman Teaching Certificate Program (KTCP) 2022
Massachusetts Institute of Technology *Cambridge, MA*

Biophysics Program Certificate 2019
Massachusetts Institute of Technology *Cambridge, MA*

Summa Cum Laude Award 2017
Seoul National University *Seoul, South Korea*

Eminence Scholarship 2015, 2016
Seoul National University *Seoul, South Korea*

Merit-Based Scholarship 2012, 2015
Seoul National University *Seoul, South Korea*

Superior Academic Performance Scholarship 2011
Seoul National University *Seoul, South Korea*

Invited Talks & Seminars

Guest Lecture Mar 2025 (scheduled)
PHYSICS H190 - AI for Optical Microscopy *University of California, Berkeley, USA*

Invited Talk Nov 2024
Center for Adaptive Optics Fall Science Retreat *University of California, Los Angeles, USA*

Invited Talk Apr 2024
Graduate School of Data Science, Seoul National University *Seoul, South Korea*

Guest Speaker in Mini-symposium – Computational Imaging in Neurophotonics Jan 2023
Seoul National University *Seoul, South Korea*

Speaker in Photobears Lightning talk series Sep 2022
University of California, Berkeley *Berkeley, CA*

Invited Talk Apr 2022
Aerospace Controls Laboratory (ACL), Massachusetts Institute of Technology *Cambridge, MA*

Research seminar Oct 2021
Computational Imaging Lab, Princeton University *Online*

Invited Talk Oct 2021
CRISP (Computation, Representation, and Inference in Signal Processing) Group, Harvard University *Cambridge, MA*

Research seminar Sep 2021
University of California, Los Angeles *Online*

Research seminar Sep 2021
Ji Lab, University of California, Berkeley *Online*

Invited Talk Feb 2021
Neurophotonics Lab, Seoul National University *Seoul, South Korea*

Mentoring Experience

Course Project Mentor Spring 2022
Massachusetts Institute of Technology *Cambridge, MA*

- **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 Spring 2020
Massachusetts Institute of Technology *Cambridge, MA*

- **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 Feb 2018
Korea Foundation for Advanced Studies Overseas Program *Kingdom of Cambodia*

- 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) Spring 2022
Teaching & Learning Laboratory, Massachusetts Institute of Technology *Cambridge, MA*

- **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 Spring 2020
Massachusetts Institute of Technology *Cambridge, MA*

- 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 2019 – 2020
EECS Korean Graduate Students Society, Massachusetts Institute of Technology *Cambridge, MA*

- Organized social gatherings and networking to foster cohesion among EECS Korean graduate students.

Founder & Group Leader 2019 – 2021
Korean Graduate Students Swimming Club, Massachusetts Institute of Technology *Cambridge, MA*

- 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, Scientific Reports
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
Professor of Mechanical Engineering at Massachusetts Institute of Technology
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Na Ji
Postdoc advisor
Professor of Physics and Neurobiology at University of California, Berkeley
Email: jina@berkeley.edu (admin: georgelu@berkeley.edu)

Stella X. Yu
Postdoc advisor
Professor of Electrical and Computer Engineering at University of Michigan, Ann Arbor
Email: stellayu@umich.edu

Stefan Vogt
Collaborator & Thesis committee member, he/his/him
Associate Division Director at Argonne National Laboratory
Email: svogt@anl.gov