# IKSUNG KANG

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Google Scholar: https://scholar.google.com/citations?user=WbDsUMcAAAAJ&hl=en

## EDUCATION

**Massachusetts Institute of Technology**, Ph.D. in Electrical Engineering and Computer Science 2022
- Thesis: Multi-dimensional computational imaging from diffraction intensity using deep neural networks.
- Minor: Machine learning

**Massachusetts Institute of Technology**, M.Sc. in Electrical Engineering and Computer Science 2020
- Thesis: High-fidelity inversion at low photon counts using deep learning and random phase modulation.

**Seoul National University**, B.S. in Electrical and Computer Engineering 2017
- Thesis: Configuring main field for low-cost and portable MRI.

## RESEARCH EXPERIENCE

**Massachusetts Institute of Technology** Cambridge, MA
**Research Assistant**, Dept. of Mechanical Engineering; Advisor: G. Barbastathis 2018 – 2022
- Devised a physics-informed machine learning approach with random phase modulation for robust low-photon phase retrieval.
- Designed a dynamical machine learning framework for limited-angle phase tomography of multi-layered objects.
- Implemented non-invasive three-dimensional nanoscale imaging of integrated circuits with X-ray ptycho-tomography and ptycho-laminography geometries for rapid semiconductor manufacturing inspection process using deep neural networks.
- Performed optical wavelength analysis from an experimental diffraction intensity under a novel CMOS LED illumination with narrow numerical aperture using deep learning.

**Seoul National University** Seoul, Republic of Korea
**Undergraduate Researcher**, Dept. of Electrical and Computer Engineering; Advisor: Jong-Ho Lee 2016

**Seoul National University** Seoul, Republic of Korea
**Research Intern**, Graduate School of Convergence Science and Technology Winter 2014

**Visiting Student, University of California, Berkeley** Summer 2012

## TEACHING EXPERIENCE

**Massachusetts Institute of Technology** Cambridge, MA
**Kaufman Teaching Certificate Program (KTCP)**, Teaching & Learning Laboratory Spring 2022
- 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.
- 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**, Dept. of Mechanical Engineering Spring 2020

- Mentored to 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.

## MENTORING EXPERIENCE

**End-Term Project Mentor,** Massachusetts Institute of Technology Spring 2022

- Mentored a graduate student group in the Physical Systems Modeling and Design Using Machine Learning course for their end-term project on the image segmentation of noisy ultrasonic images.

**End-Term Project Mentor,** Massachusetts Institute of Technology Spring 2020

- Mentored two graduate student groups in the Learning Machines course for their end-term projects on the reaction modeling to facilitate pharmaceutical process development using machine learning & the control of autonomous ocean vehicles using reinforcement learning.

**Volunteer**, Korea Foundation for Advanced Studies Overseas Program February 2018

- Participated as a volunteer in the Kingdom of Cambodia for a week, teaching children math and building houses.

## CERTIFICATIONS

**Kaufman Teaching Certificate Program (KTCP)**, Massachusetts Institute of Technology 2022
**Biophysics Program Certificate,** Massachusetts Institute of Technology 2018

## FELLOWSHIPS & AWARDS

**Ph.D. Study-Abroad Scholarship**, Korea Foundation of Advanced Studies 2017 – 2022
**Hewlett-Packard Fellowship**, Massachusetts Institute of Technology Fall 2017
**Summa Cum Laude Award** for class valedictorian, Seoul National University 2017
**Eminence Scholarship**, Seoul National University 2015, 2016
**Merit-Based Scholarship**, Seoul National University 2012, 2015
**Superior Academic Performance Scholarship**, Seoul National University 2011

## PEER-REVIEWED JOURNAL PUBLICATIONS

J6. **I. Kang**, A. Goy, G. Barbastathis, "Dynamical machine learning volumetric reconstruction of objects' interiors from limited angular views," *Light Sci. Appl.* 10(47) (2021), doi: https://doi.org/10.1038/s41377-021-00512-x.

J5. **I. Kang**, S. Pang, Q. Zhang, G. Barbastathis, "Recurrent neural network reveals transparent objects through scattering media," *Opt. Express* 29(4), pp. 5316-5326 (2020), doi: https://doi.org/10.1364/OE.412890.

J4. **I. Kang***, G. Allan*, E. Douglas, G. Barbastathis, K. Cahoy, "Deep residual learning for low-order wavefront sensing in high-contrast imaging systems", *Opt. Express* 28(18), pp. 26267-26283 (2020), doi:

https://doi.org/10.1364/OE.397790. (* equal contribution)

J3. M. Deng*, S. Li*, Z. Zhang, **I. Kang**, N. X. Fang, G. Barbastathis, "On the interplay between physical and content priors in deep learning for computational imaging", *Opt. Express* 28(16), pp. 24152-24170 (2020), doi: https://doi.org/10.1364/OE.395204.

J2. **I. Kang**, F. Zhang, G. Barbastathis, "Phase Extraction Neural Network (PhENN) with Coherent Modulation Imaging (CMI) for phase retrieval at low photon counts", *Opt. Express* 28(15), pp. 21578-21600 (2020), doi: https://doi.org/10.1364/OE.397430.

J1. M. Deng, S. Li, A. Goy, **I. Kang**, G. Barbastathis, "Learning to synthesize: Robust phase retrieval at low photon counts", *Light Sci. Appl*. 9(36) (2020), doi: https://doi.org/10.1038/s41377-020-0267-2.

**Manuscripts in review:**

M4. **I. Kang**, Y. Jiang, Y. Yao, J. Klug, S. Vogt, G. Barbastathis, "Three-dimensional ptycho-laminographic reconstruction of integrated circuits using deep image prior." (Target journal: *Nature Communications*)

M3. **I. Kang***, Z. Wu*, Y. Jiang, Y. Yao, J. Klug, N. Weisse-Bernstein, S. Vogt, G. Barbastathis, "Attentional Ptycho-Tomography (APT) for three-dimensional nanoscale X-ray imaging with minimal data acquisition and computation time." (Target journal: *Nature Photonics*) (* equal contribution)

M2. **I. Kang***, Z. Wu*, Y. Yao, Y. Jiang, J. Deng, J. Klug, N. Weisse-Bernstein, S. Vogt, G. Barbastathis, "Rapid three-dimensional nanoscale imaging via deep neural networks and multi-angle ptychography." (Target journal: *Proc. Natl. Acad. Sci.*) (* equal contribution)

M1. **I. Kang***, M. de Cea*, G. Barbastathis, R. Ram, "DeepOSA: Deep image prior optical spectrum analysis for lensless CMOS LED holography." (Target journal: *Optica*) (* equal contribution)

**CONFERENCE PROCEEDINGS**

C4. **I. Kang**, Y. Yao, J. Deng, J. Klug, S. Vogt, S. Honig, G. Barbastathis, "Three-dimensional reconstruction of integrated circuits by single-angle X-ray ptychography with machine learning," in *Imaging and Applied Optics Congress*, OSA Technical Digest (Optical Society of America 2021), paper CTu6A.4, doi: https://doi.org/10.1364/COSI.2021.CTu6A.4.

C3. **I. Kang**, G. Barbastathis, "Probability of error as an image metric for the assessment of tomographic reconstruction of dense-layered binary-phase objects," *Proc. SPIE* 11653, Quantitative Phase Imaging VII, 116530T (5 March 2021), doi: https://doi.org/10.1117/12.2577264.

C2. **I. Kang***, G. Allan*, E. Douglas, M. N'Diaye, G. Barbastathis, K. Cahoy, "Deep neural networks to improve the dynamic range of Zernike phase-contrast wavefront sensing in high-contrast imaging systems," *Proc. SPIE* 11443, Space Telescopes and Instrumentation 2020: Optical, Infrared, and Millimeter Wave, 1144349 (13 December 2020), doi: https://doi.org/10.1117/12.2562927. (* equal contribution)

C1. **I. Kang**, "A portable, low-cost, 3D-printed main magnetic field system for magnetic imaging", *2017 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2017, pp. 3533-3536, doi: 10.1109/EMBC.2017.8037619.

## TECHNICAL REPORTS

T3. G. Barbastathis, J. Song, Z. Wu, **I. Kang**, S. Pang, Z. Guo, "LION: Learning to Invert 3D Objects by Neural Networks," *Microsystems Annual Research Report* (2021)

T2. **I. Kang**, S. Pang, Q. Zhang, N. Fang, G. Barbastathis, "Imaging Transparent Objects through Dynamic Scattering Media Using Recurrent Neural Networks," *Microsystems Annual Research Report* (2021)

T1. **I. Kang**, F. Zhang, G. Barbastathis, "On the Use of Deep Learning for Retrieving Phase from Noisy Inputs in the Coherent Modulation Imaging Scheme," *Microsystems Annual Research Report* (2020)

## INVITED TALK & SEMINAR

6. Invited talk @ Aerospace Controls Laboratory (ACL), Massachusetts Institute of Technology (04.29.2022)
5. Research seminar @ Computational Imaging Lab, Princeton University (10.22.2021)
4. Invited talk @ CRISP (Computation, Representation, and Inference in Signal Processing) Group, Harvard University (10.12.2021)
3. Research seminar @ University of California, Los Angeles (09.30.2021)
2. Research seminar @ Ji Lab, University of California, Berkeley (09.20.2021)
1. Invited talk @ Neurophotonics Lab, Seoul National University (02.22.2021)

## LEADERSHIP & SERVICE

**Massachusetts Institute of Technology** Cambridge, MA

**Founder & Group Leader**, MIT Korean Graduate Students Swimming Club 2019 – 2021

- Organized a swimming session twice a week and held social events among swimming club members.

**Group Leader**, EECS Korean Graduate Students Society 2019 – 2020

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

**Event Officer**, Korean Graduate Students Association 2018 – 2019

- Planned and organized social events to facilitate networking among Korean graduate students.

**Group Leader,** Sidney-Pacific Inter-Cultural Exchange Program (SPICE) 2018

- Organized social gatherings for networking among group members from diverse backgrounds living in Sidney-Pacific graduate residence.

**Event Chair**, EECS Graduate Students Association Summer 2018

- Organized and led weekly coffee hours to facilitate social gathering and networking among international EECS students.

**Student Ambassador, Kakao Ventures** 2018

- Contributed to the creation of a startup ecosystem on/off campus in Cambridge and worked as a liaison to Kakao Ventures in Republic of Korea.

**Sergeant**, Korean Augmentation to the U.S. Army (KATUSA), Republic of Korea 2013 – 2014

- 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

Optica, Optics Letter, Optics Express, Applied Optics from *Optica Publishing*, USA

## MEDIA COVERAGE

2. Phys.org. https://phys.org/news/2021-04-dynamical-machine-accurately-reconstructs-volume.html, April 2021.

1. EurekaAlert!, AAAS (American Association for the Advancement of Science). https://www.eurekalert.org/news-releases/777818, April 2021.

## REFERENCE

**Prof. George Barbastathis** (Ph.D advisor, he/his/him)
Professor of Mechanical Engineering at Massachusetts Institute of Technology
Singapore Professor of Optics, Singapore-MIT Alliance for Research and Technology (SMART)
Email: gbarb@mit.edu

**Dr. Stefan Vogt** (Thesis committee member & Collaborator, he/his/him)
Associate Division Director, Argonne National Laboratory
Adjunct Associate Professor at the Feinberg School of Medicine at Northwestern University
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**Prof. Karl Berggren** (Thesis committee member, he/his/him)
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**Prof. Sixian You** (Thesis committee member, she/her/hers)
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