CAGATAY ISIL

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SUMMARY

PhD candidate (degree expected in Mar 2025) with 7 years of research experience in **computer vision and machine learning**, resulting in multiple research articles published in peer-reviewed journals, including 6 as first author.

EDUCATION

University of California, Los Angeles, USA
Ph.D. in Electrical and Computer Engineering — Sep 2019 – Mar 2025 (expected)
Supervisor: Prof. Aydogan Ozcan

Middle East Technical University, Ankara, Turkey
M.S. in Electrical and Electronics Engineering — 2017 – 2019
B.S. in Physics (**Double Major**) — 2015 – 2018
B.S. in Electrical and Electronics Engineering — 2013 – 2017

SKILLS

Programming Python, MATLAB, R, C/C++
Libraries/Frameworks Jax, Pytorch, Tensorflow, Keras, Numpy, Pillow, Jupiter, Scikit-learn, SciPy, Pandas

ML&CV EXPERIENCE

Graduate Researcher — Sep 2019 – Mar 2025 (expected)
UCLA — *Los Angeles, CA*

- Developed a virtual staining technique for label-free bacteria using a **conditional generative adversarial network (CGAN)**, transforming **darkfield microscopy** images into Gram-stained equivalents without chemical staining. Implemented a **segmentation** algorithm to quantify the technique's accuracy using various metrics including precision (95.5%), recall (96.5%), and F1-score (96%).
- Developed a **super-resolution image display system** using deep learning to overcome space-bandwidth product (SBP) limitations of traditional wavefront modulators. Designed a pair of **CNN-based image encoder** and **all-optical decoder** to project super-resolved images using low-resolution modulators, increasing the SBP by $\sim$ 16-fold.
- Built a novel analog **image denoiser** for non-iterative noise removal at the speed of light, overcoming latency and computational burdens of traditional digital methods. Designed this all-optical denoiser using **deep learning** to scatter noise-related features while preserving desired object features and achieving 30–40% power efficiency.
- Implemented **image registration** pipelines incorporating both rigid and non-rigid transformations, image stitching, and data cleaning for multiple microscopy projects, enabling precise pixel-to-pixel alignment of input and target images from various imaging modalities.
- Implemented an automated system for phenotypic analysis of microalgae populations using an imaging flow cytometer, **deep neural networks**, and **image processing**. Performed **algae identification** using **convolutional neural networks**, enabling rapid assessment of environmental factors and inter-specific interactions on algal growth and ecosystem health.
- Implemented a **Denoising Diffusion Implicit Model (DDIM)** to address the pixel super-resolution problem, achieving approximately 4x super-resolution on images.

Research Engineer — 2017 – 2019
ASELSAN Research Center — *Ankara, Turkey*

- Developed an iterative algorithm combining multiple **U-nets** with the hybrid input-output (HIO) method for the phase retrieval problem, a classical **inverse problem in imaging**. Demonstrated its robustness under various initialization conditions and noise levels.

- Implemented a **coupled deep autoencoder** to enhance resolution in **wide-field interferometric microscopy**. Demonstrated the network's ability to reconstruct **denoised and resolution-enhanced** image patches for previously unseen inputs, potentially increasing the detection and classification accuracy of subdiffraction-limited nanoparticles.
- Combined a **variational autoencoder** model with triplet loss to improve clustering performance in the latent space for **representation learning**.

JOURNAL PUBLICATIONS (SELECTED)

- **Ç. Işıl**, H. C. Koydemir, M. Eryilmaz, K. de Haan, N. Pillar, K. Mentesoglu, A. F. Unal, Y. Rivenson, S. Chandrasekaran, O. B. Garner, and A. Ozcan, **'Virtual Gram staining of label-free bacteria using darkfield microscopy and deep learning,'** Science Advances, 2025
- G. Ma, X. Yang, B. Bai, J. Li, Y. Li, T. Gan, C. Shen, Y. Zhang, Y. Li, **Ç. Işıl**, M. Jarrahi, and A. Ozcan, **'Multiplexed All-Optical Permutation Operations Using a Reconfigurable Diffractive Optical Network,'** Laser & Photonics Reviews, 2024
- M. J. Fanous, P. C. Costa, **Ç. Işıl**, L. Huang and A. Ozcan, **'Neural Network-Based Processing and Reconstruction of Compromised Biophotonic Image Data,'** Light:science & applications, 2024
- J. Hu, K. Liao, N. U. Dinc, C. Gigli, B. Bai, T. Gan, X. Li, H. Chen, X. Yang, Y. Li, **Ç. Işıl**, M. S. S. Rahman, J. Li, X. Hu, M. Jarrahi, D. Psaltis, and A. Ozcan, **'Subwavelength imaging using a Solid-Immersion Diffractive Optical Processor,'** eLight, 2024
- **Ç. Işıl**, T. Gan, F. O. Ardic, K. Mentesoglu, J. Digani, H. Karaca, H. Chen, J. Li, D. Mengu, M. Jarrahi, K. Akşit, and A. Ozcan, **'All-optical image denoising using a diffractive visual processor,'** Light:science & applications, 2024
- M. S. S. Rahman, T. Gan, E. A. Deger, **Ç. Işıl**, M. Jarrahi, and A. Ozcan, **'Learning Diffractive Optical Communication Around Arbitrary Opaque Occlusions,'** Nature Communications, 2023
- Y. Li, T. Gan, B. Bai, **Ç. Işıl**, M. Jarrahi, and A. Ozcan, **'Optical information transfer through random unknown diffusers using electronic encoding and diffractive decoding,'** Advanced Photonics, 2023
- **Ç. Işıl**, D. Mengu, Y. Zhao, A. Tabassum, J. Li, Y. Luo, M. Jarrahi, and A. Ozcan, **'Super-resolution image display using diffractive decoders,'** Science Advances, 2022
- **Ç. Işıl**, K. de Haan, Z. Göröcs, H. Ceylan Koydemir, S. Peterman, D. Baum, F. Song, T. Skandakumar, E. Gumustekin, and A. Ozcan, **'Phenotypic Analysis of Microalgae Populations Using Label-Free Imaging Flow Cytometry and Deep Learning,'** ACS Photonics, 2021.
- **Ç. Işıl**, F. S. Oktem, and A. Koç,**'Deep Iterative Reconstruction for Phase Retrieval,'** Applied Optics, 2019
- **Ç. Işıl**, M. Yorulmaz, B. Solmaz, A. B. Turhan, C. Yurdakul, S. Ünlü, E. Ozbay, and A. Koç, **'Resolution enhancement of wide-field interferometric microscopy by coupled deep autoencoders,'** Applied Optics, 2018

CONFERENCE TALKS (SELECTED)

- **Ç. Işıl***, D. Mengu, Y. Zhao, A. Tabassum, J. Li, Y. Luo, M. Jarrahi, and A. Ozcan, **'Diffractive super-resolution image display,'** SPIE: Emerging Topics in Artificial Intelligence, 2024
- **Ç. Işıl***, T. Gan, F. O. Ardic, K. Mentesoglu, J. Digani, H. Karaca, H. Chen, J. Li, D. Mengu, M. Jarrahi, K. Akşit, and A. Ozcan, **'Diffractive processors enable all-optical image denoising,'** SPIE: Emerging Topics in Artificial Intelligence, 2024
- **Ç. Işıl***, T. Gan, F. O. Ardic, K. Mentesoglu, J. Digani, H. Karaca, H. Chen, J. Li, D. Mengu, M. Jarrahi, K. Akşit, and A. Ozcan, **'Image denoising using diffractive optical processors,'** CLEO: Fundamental Science, 2024
- Y. Li*, T. Gan, B. Bai, **Ç. Işıl**, M. Jarrahi, and A. Ozcan, **'Transferring optical information through random unknown diffusers using a diffractive decoder with electronic encoding,'** SPIE AI and Optical Data Sciences, 2024

- M. S. S. Rahman*, T. Gan, E. A. Deger, **Ç. Işıl**, M. Jarrahi, and A. Ozcan, **'Information transfer around arbitrary opaque occlusions using programmed diffraction,'** SPIE AI and Optical Data Sciences, 2024
- **Ç. Işıl***, D. Mengu, Y. Zhao, A. Tabassum, J. Li, Y. Luo, M. Jarrahi, and A. Ozcan, **'Diffractive decoders project super-resolved images,'** SPIE: AI and Optical Data Sciences, 2023
- **Ç. Işıl***, D. Mengu, Y. Zhao, A. Tabassum, J. Li, Y. Luo, M. Jarrahi, and A. Ozcan, **'Super-resolution image projection using a diffractive optical decoder,'** CLEO: Fundamental Science, 2023
- **Ç. Işıl***, K. de Haan, Z. Göröcs, H. Ceylan Koydemir, S. Peterman, D. Baum, F. Song, T. Skandakumar, E. Gumustekin, and A. Ozcan, **'Label-free imaging flow cytometry for phenotypic analysis of microalgae populations using deep learning,'** OSA Frontiers in Optics + Laser Science, 2021
- **Ç. Işıl***, K. De Haan, H. Ceylan Koydemir, Z. Göröcs, D. Baum, F. Song, T. Skandakumar, E. Gumustekin, and A. Ozcan, **'Label-free analysis of micro-algae populations using a high-throughput holographic imaging flow cytometer and deep learning,'** SPIE Label-free Biomedical Imaging and Sensing, 2021,
- **Ç. Işıl*** and F. S. Oktem, **'Model-based Phase Retrieval with Deep Denoiser Prior,'** OSA Imaging and Applied Optics Congress, 2020
- **Ç. Işıl***, F. S. Oktem, and A. Koç, **'Deep Learning-Based Hybrid Approach for Phase Retrieval,'** OSA Imaging and Applied Optics Congress, 2019
- **Ç. Işıl** and F. S. Oktem*, **'A phase-space approach to diffraction-limited resolution,'** OSA Adaptive Optics: Analysis, Methods ,& Systems, 2018
- **Ç. Işıl***, B. Solmaz, and A. Koç, **'Variational autoencoders with triplet loss for representation learning,'** IEEE Signal Processing and Communications Applications Conference, 2018
- M. Yorulmaz*, **Ç. Işıl**, E. Seymour, C. Yurdakul, B. Solmaz, A. Koc, and M. S. Ünlü, **'Single-particle imaging for biosensor applications,'** SPIE Emerging Imaging and Sensing Technologies for Security and Defence II, 2017

*Speakers of the conferences

PATENTS

- A. Ozcan, **Ç. Işıl**, D. Mengu, and M. S. S. Rahman, **'Super-resolution image display and free space communication using diffractive decoders,'** WO2023244949A1, 2023

PROFESSIONAL SERVICES

Reviewer
Optica Publishing Group Journals (more than 10 articles)

- Optics Letters (3 reviews), Optics Express (6 reviews), Applied Optics (2 reviews), Journal of the Optical Society of America A (1 review)

Mentor Sep 2019 – Mar 2025 (expected)
Bio- and Nano- Photonics Laboratory, UCLA *Los Angeles, CA*

- mentored and supervised more than 5 undergraduate researchers

ACHIEVEMENTS, CERTIFICATES & HONORS

- TUBITAK (The Scientific and Technological Research Council of Turkey) Scholarship for the M.S. degree
- TUBITAK Scholarship for the double major
- Dean's High Honor List, Middle East Technical University (All semesters, except for one)
- LabVIEW Certified Associate Developer (2017-2019)
- Honor Certificate in High School
- Ranked 2115^{th} in the national university entrance examination among two million students, 2012
- Information & Communication Technologies Certificate by Ericsson