Yongyi Zhao

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Introduction: My research interests lie at the intersection of computational imaging and machine learning for end-to-end hardware and algorithm co-design. I have worked on several projects spanning data-driven biomedical optical imaging, neural rendering, polarimetric imaging, metasurface design, and AI mobile processing. My research has been published in top tier journals (e.g. IEEE TPAMI) and conferences (e.g. ECCV, ICCP). I am fluent in scripting languages (e.g. Python, Matlab), machine learning frameworks (e.g. Pytorch), and experienced with system-level languages (e.g. C/C++, Cuda), and rendering/3D design software (e.g. Blender, Solidworks, Mitsuba).

Education

Rice University — **Houston, TX**
Master of Science in Electrical and Computer Engineering — **Mar 2021**
Doctor of Philosophy in Electrical and Computer Engineering — **Jan 2024**
Adviser: Professor Ashok Veeraraghavan

Carnegie Mellon University — **Pittsburgh, PA**
Bachelor of Science in Electrical and Computer Engineering — **Dec 2017**
With University Honors; **GPA: 3.93/4.00**

Professional Experience

Computer Vision Engineer at Metalenz — **Boston, MA (remote)**
- Developing algorithms for PolarID: secure face ID authentication — **Feb 2024 – Present**

Research intern at Samsung Research America — **Plano, TX**
- Worked in Mobile Processor Innovations (MPI) team — **May 2023 – Aug 2023**
- Developed AI algorithm for mobile image processing

Software Development Engineer Intern at Amazon.com — **Seattle, WA**
- Worked on Amazon AWS, Elastic Compute Cloud Team — **May 2017 – Aug 2017**
- Designed and implemented a container service

Research Projects

Metalens Ray Tracer — **Aug 2022 – Jan 2024**
- Implementing a differentiable ray tracer for metalens design in Pytorch
- Implementing a differentiable RCWA module and spline parameterization of Metasurface structures

Metalens for Privacy Preserving Imaging — **Jan 2023 – Jan 2024**
- Designing/implementing a differentiable metalens simulator for end-to-end optimization in privacy-preservation

Optically Asymmetric Plume Design — **Sep 2022 – Jan 2024**
- Developing a differentiable renderer for end-to-end optimization of asymmetric plumes (a plume that selectively degrades image quality based on viewing direction)
- Testing results on both simulated (rendered) and experimental measurements in VIS and IR

Computational Imaging through Dense Scatterers (Links to **JBO** and **TPAMI** papers) — **Aug 2019 – Mar 2023**
- Implemented FISTA/ADMM solvers in Matlab and unrolled network in Pytorch for DOT inverse solver
- Demonstrated high resolution image reconstruction on simulated/experimental CW/ToF-DOT datasets

Physics-based renderer for densely scattering media (Code **link**) — **Aug 2019 – Mar 2023**
- Simulated light propagation and Jacobian matrix for arbitrary scattering media, parallelized in Cuda C++

Neural Renderer for Polarimetric Imaging (Link to ECCV paper) **Oct 2021 – Mar 2022**
- ❖ Designed and implemented polarimetric neural rendering pipeline using implicit neural representations
- ❖ Demonstrated performance on inverse rendering tasks (i.e. diffuse-specular separation) on experimental data

Selected Publications and Patents

Zhao Y., Raghuram A., et al. "Unrolled-DOT: An Interpretable Deep Network for Diffuse Optical Tomography." *Journal of Biomedical Optics*. (2023)

Zhao Y.[*], Raghuram A.[*], et al. "High Resolution, Deep Imaging Using Confocal Time-of-flight Diffuse Optical Tomography." *IEEE Transactions on Pattern Analysis and Machine Intelligence*. (2021).

Zhao Y., Raghuram A., et al. "GDOT: Gated Diffuse Optical Tomography," US20230233085A1. Patent Pending.

Dave A., **Zhao Y.**, Veeraraghavan A. "PANDORA: Polarization-Aided Neural Decomposition Of Radiance." *European Conference on Computer Vision (ECCV)*. (2022).

Kim H. K., **Zhao Y.**, et al. Ultrafast and Ultrahigh-Resolution Diffuse Optical Tomography for Brain Imaging with Sensitivity Equation based Noniterative Sparse Optical Reconstruction (SENSOR). *JQSRT*. (2021).

Raghuram A., **Zhao Y**., et al. "Measuring Physiological Parameters Under the Skin Using Visible/NIR Light." Encyclopedia of Sensors and Biosensors 4, pp. 133-142. (2023) Book Chapter.

[*]Indicates authors contributed equally

Fellowships and Awards

National Library of Medicine Fellowship in Bioinformatics and Data Science **Jan 2021 – Dec 2022**
- ❖ 2-year fellowship with $25,320 stipend and partial tuition support

Best Paper Runner-Up at IEEE ICCP for Confocal ToF-DOT paper **May 2021**

John Clark Jr. Fellowship Award **Aug 2018**
- ❖ Fellowship supporting first-year graduate studies at Rice University

Frank J. Marshall Scholar Award **May 2018**
- ❖ Annual award for one graduating CMU ECE undergraduate for academics and research

Skills

Programming/Computing:
- ❖ **Strong:** Python (including PyTorch, OpenCV, Numpy libraries), Matlab
- ❖ **Proficient:** C/C++, Cuda, Linux, Blender, Rapid prototyping (SLA and FDM 3D printing)
- ❖ **Working understanding:** Version Control (Git), SolidWorks, Mitsuba (physics-based renderer), Laser cutting

Experimental:
- ❖ Optical system design (i.e. constructing scanning and fiber-based time domain diffuse optical imaging system)
- ❖ Imaging on model organisms (e.g. mice, sheep)

Volunteer / Service

Teaching Assistant (TA)
- ❖ Served as an ECE TA for six semesters (e.g. signal processing, computer architecture, and deep learning)
- ❖ Performed TA tasks including grading, office hours, and supplemental lectures

Research Mentor
- ❖ Mentored three Rice University undergraduate students in research on imaging through scattering media
- ❖ Mentored six middle and high school teachers in Houston ISD for PATHS-UP RET program (Summer 2019)