

Vivek Boominathan

Research Scientist
Electrical and Computer Engineering
Rice University, Houston, Texas

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RESEARCH INTERESTS

My research lies at the intersection of **computer vision**, **machine learning**, **applied optics**, and **nano-fabrication**. My current research focuses on building end-to-end systems with novel optics, sensors, and machine learning algorithms to create devices with applications in robotics, autonomous driving, wearables, medical sensing, machine vision, the internet of things (IoT), and virtual/augmented reality. Furthermore, I use custom fabricated optics and chips to overcome the challenges of traditional lenses and image sensors, such as size, weight, and function. Broadly, my research is in **computational imaging** and draws from the foundations of *computer vision*, *computer graphics*, *machine learning*, *optics*, *photonics*, and *materials science*.

ACADEMIC POSITIONS

Research Scientist, <i>Electrical and Computer Engineering Dept.</i> , Rice University	2023 - present
Postdoctoral Research Associate, <i>Electrical and Computer Engineering Dept.</i> , Rice University	2019 - 2023
Research Assistant, <i>Electrical and Computer Engineering Dept.</i> , Rice University with Dr. Ashok Veeraraghavan	2012 - 2019

EDUCATION

RICE UNIVERSITY	2019
Ph.D. in Electrical and Computer Engineering	
RICE UNIVERSITY	2016
M.S. in Electrical and Computer Engineering	
INDIAN INSTITUTE OF TECHNOLOGY HYDERABAD	2012
B.Tech. with Honors in Signal Processing, Electrical Engineering	

HIGHLIGHTED PUBLICATIONS

JOURNAL PAPERS

Vishwanath Saragadam, Zheyi Han, Vivek Boominathan, Luocheng Huang, Shiyu Tan, Johannes E. Fröch, Karl F. Böhringer, Richard G. Baraniuk, Arka Majumdar, Ashok Veeraraghavan, "Foveated thermal computational imaging prototype using all-silicon meta-optics", *Optica*, 2024.

Sean M. Farrell, Vivek Boominathan, Nathaniel Raymondi, Ashutosh Sabharwal, Ashok Veeraraghavan, "CoIR: Compressive Implicit Radar", *IEEE Transactions on Pattern Analysis and Machine Intelligence (IEEE TPAMI)*, 2023.

Jimin Wu, Vivek Boominathan, Ashok Veeraraghavan, Jacob T. Robinson, "Real-time, deep-learning aided lensless microscope", *Biomedical Optics Express*, 2023.

Brandon Y. Feng, Haiyun Guo, Mingyang Xie, Vivek Boominathan, Manoj K. Sharma, Ashok Veeraraghavan, Christopher A. Metzler, "NeuWS: Neural wavefront shaping for guidestar-free imaging through static and dynamic scattering media", *Science Advances*, 2023.

Vivek Boominathan*, Jesse K. Adams*, Dong Yan*, Jimin Wu*, Sibao Gao, Alex Rodriguez, Soonyoung Kim, Jennifer Carns, Rebecca Richards-Kortum, Caleb Kemere, Ashok Veeraraghavan, Jacob T. Robinson, "In vivo lensless microscopy via a phase mask generating diffraction patterns with high-contrast contours", *Nature Biomedical Engineering*, 2022. (* = Equally contributed)

Vivek Boominathan, Jacob T. Robinson, Laura Waller, and Ashok Veeraraghavan, "Recent Advances in Lensless Imaging", *Optica*, 2022.

Shiyu Tan, Frank Yang, Vivek Boominathan, Ashok Veeraraghavan, Gururaj V. Naik, "3D Imaging Using Extreme Dispersion in Optical Metasurfaces", *ACS Photonics*, 2021.

Salman S Khan, Varun Sundar, Vivek Boominathan, Ashok Veeraraghavan, Kaushik Mitra, "FlatNet: Towards Photorealistic Scene Reconstruction from Lensless Measurements", *IEEE Transactions on Pattern Analysis and Machine Intelligence (IEEE TPAMI)*, 2020.

Vivek Boominathan, Jesse K. Adams, Jacob T. Robinson, Ashok Veeraraghavan, "PhlatCam: Designed phase-mask based thin lensless camera", *IEEE Transactions on Pattern Analysis and Machine Intelligence (IEEE TPAMI)*, 2020.

Jasper Tan, Li Niu, Jesse K. Adams, Vivek Boominathan, Jacob T. Robinson, Richard G. Baraniuk, Ashok Veeraraghavan, "Face Detection and Verification Using Lensless Cameras", *IEEE Transactions on Computational Imaging (IEEE TCI)*, 2018.

Jesse K. Adams*, Vivek Boominathan*, Benjamin W. Avants, Daniel G. Vercosa, Fan Ye, Richard G. Baraniuk, Jacob T. Robinson, Ashok Veeraraghavan, "Single-Frame 3D Fluorescence Microscopy with Ultra-Miniature Lensless FlatScope", *Science Advances*, 2017.

Vivek Boominathan, Jesse K. Adams, Salman Asif, Benjamin W. Avants, Jacob T. Robinson, Richard G. Baraniuk, Aswin C. Sankaranarayanan, Ashok Veeraraghavan, "Lensless Imaging: A Computational Renaissance", *Computational Photography and Displays Special Issue in the IEEE Signal Processing Magazine*, 2016.

CONFERENCE PAPERS

Yang Zhao, Ziyun Li, Yonggan Fu, Yonggan Zhang, Chaojian Li, Cheng Wan, Haoran You, Shang Wu, Xu Ouyang, Vivek Boominathan, Ashok Veeraraghavan, Yingyan Lin, "i-FlatCam: A 253 FPS, 91.49 μ J/Frame Ultra-Compact Intelligent Lensless Camera for Real-Time and Efficient Eye Tracking in VR/AR". *IEEE Symposium on VLSI Technology and Circuits (VLSI)*, 2022.

Haoran You, Cheng Wan, Yang Zhao, Zhongzhi Yu, Yonggan Fu, Jiayi Yuan, Shang Wu, Shun Yao Zhang, Yingyan Zhang, Chaojian Li, Vivek Boominathan, Ashok Veeraraghavan, Ziyun Li, Yingyan Lin, "EyeCoD: eye tracking system acceleration via flatcam-based algorithm & accelerator co-design", *International Symposium on Computer Architecture (ISCA)*, 2022.

Yonggan Fu, Yang Zhang, Yue Wang, Zhihan Lu, Vivek Boominathan, Ashok Veeraraghavan, Yingyan Lin, "SACoD: Sensor Algorithm Co-Design Towards Efficient CNN-powered Intelligent PhlatCam", *IEEE International Conference on Computer Vision (ICCV)*. 2021.

Sajjad Moazeni, Eric H. Pollmann, Vivek Boominathan, Filipe A. Cardoso, Jacob T. Robinson, Ashok Veeraraghavan, Kenneth L. Shepard, "A Mechanically Flexible Implantable Neural Interface for Computational Imaging and Optogenetic Stimulation over $5.4 \times 5.4 \text{ mm}^2$ FoV", *IEEE International Solid-State Circuits Conference*

(ISSCC), 2021.

Yicheng Wu, Vivek Boominathan, Xuan Zhao, Jacob T. Robinson, Hiroshi Kawasaki, Aswin Sankaranarayanan, Ashok Veeraraghavan, “FreeCam3D: Snapshot Structured Light 3D with Freely-Moving Cameras”, *European Conference on Computer Vision (ECCV)*, 2020.

Salman S. Khan, Adarsh V. R., Vivek Boominathan, Jasper Tan, Ashok Veeraraghavan, Kaushik Mitra, “Towards Photorealistic Reconstruction of Highly Multiplexed Lensless Images”, *IEEE/CVF International Conference on Computer Vision (ICCV)*, 2019.

Yicheng Wu, Vivek Boominathan, Huaijin Chen, Aswin Sankaranarayanan, Ashok Veeraraghavan, “PhaseCam3D – Learning Phase Masks for Passive Single ViewDepth Estimation”, *IEEE International Conference on Computational Photography (ICCP)*, 2019.

Vivek Boominathan, Kaushik Mitra and Ashok Veeraraghavan, “Improving Resolution and Depth-of-Field of Light Field Cameras Using a Hybrid Imaging System”, *IEEE International Conference on Computational Photography (ICCP)*, 2014.

TALKS

“Lensless Imaging: A Miniaturizing Perspective”, Optica Imaging Congress, Optica, Boston	Aug 2023
“Computational Imaging:Mavericks of Next-gen imaging”, Computational Optics Summer Seminar, Northwestern Univ.	July 2023
“Designing Computational Imaging Systems with End-to-End learning”, Tutorial, Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP)	Dec 2022
“Optics, Sensors & AI: Synergic Computational Imaging”, Faculty Candidate Seminar, ESE Dept., Washington University in St. Louis	June 2022
“Optics, Sensors & AI: Next-Generation Computational Imaging”, Faculty Candidate Seminar, ECE Dept., Boston University	March 2022
“Optics, Sensors & AI: Next-Generation Computational Imaging”, Faculty Candidate Seminar, ECE Dept., University of Southern California	March 2022
“Tackling Real-World Constraints with End-to-End Computational Vision Systems”, Faculty Candidate Seminar, CS Dept., Dartmouth College	February 2022
“Recent Advances in Lensless Imaging”, IEEE Conference on Computer Vision and Pattern Recognition (CVPR) CCD Workshop	June 2021
“Imaging Without Focusing: A Computational Approach to Miniaturizing Cameras”, VASC Seminar, Carnegie Mellon University	December 2019
“Designing Flat Cameras by Replacing Lenses with Computation”, Image Analysis Seminar, University of Houston	October 2019
“Machine Learning & Computational Vision Sensors”, ML Seminar, Rice University	October 2019
“Data-Driven Computational Imaging: Visual Sensing Using Machine Learning”, Tutorial, IEEE Conference on Computer Vision and Pattern Recognition (CVPR)	June 2019

TEACHING EXPERIENCE

INTRODUCTION TO COMPUTER VISION (ELEC & COMP 345/447/546)	SPRING 2016, 2018
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Teaching Assistant, Rice University

SIGNAL AND SYSTEMS (ELEC 301)	FALL 2014
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Teaching Fellow, Rice University

ACHIEVEMENTS AND AWARDS

Best University Demo Award at 59 th Design Automation Conference	July 2022
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Finalist - top 13 PhD theses at ACM SIGGRAPH	July 2019
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Best poster award at IEEE ICCP	May 2019
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Insitute of Biosciences and Bioengineering Travel award	March 2018
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Best demo award at Rice ECE Corporate Affiliates Day	Jan 2016
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2 nd place at Johnson Space Center Health Innovation Challenge	Feb 2014
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The University of Tokyo (Todai) - IIT Undergraduate Students Scholarship	2009, 2010, 2011
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PROFESSIONAL SERVICE

PUBLICATION CHAIR for IEEE ICCP 2020, 2021, 2022, 2023, 2024**REVIEWER (JOURNAL)**

IEEE Signal Processing Magazine

IEEE Transactions on Image Processing

IEEE Journal of Selected Topics in Signal Processing

Springer International Journal of Computer Vision

Optica

REVIEWER (CONFERENCE)

IEEE ICCP 2017-2022

AAAI 2020-2021

Pacific Graphics 2017

ICVGIP 2018

CVPR 2022-2024

ECCV 2022-2024

Siggraph 2024