

Nick Antipa

Assistant Professor

*Electrical and Computer Engineering
University of California San Diego*

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Education

2014-2020 **PhD, University of California Berkeley**, *Electrical Engineering and Computer Sciences*, Advisors: **Laura Waller** and **Ren Ng**.

Research Area: **Computational Imaging**

2009 **MS, University of Rochester**, *Optics*, Advisor: **Julie Bentley**.

Thesis: *Effective Utilization of Off-the-Shelf Optics*

2008 **BS, University of California Davis**, *Optical Science and Engineering*.

Positions

2020- **Assistant Professor**, *UC San Diego ECE*, San Diego, California.

2020 **Postdoctoral Researcher**, *UC Berkeley EECS*, Berkeley, California, Advisor: Laura Waller.

2014-2020 **Graduate Student Researcher**, *UC Berkeley EECS*, Berkeley, California.

2009-2014 **Optics Engineer**, **Lawrence Livermore National Lab**, *National Ignition Facility (NIF)*, Livermore, California.

Research Overview

My research aims to understand how optical physics and signal processing mutually inform the design of imaging systems. By jointly designing both the physical and software domains, I develop novel imaging architectures that capture more information than conventional 2D RGB imagers.

Lensless imaging with DiffuserCam

Lensless cameras encode image information using a thin phase- or amplitude-masks in lieu of a traditional lens assembly. Algorithms are used to decode the image from the coded sensor measurements. The DiffuserCam uses a pseudorandom phase optic, called a diffuser, as the mask. We have shown that, under certain conditions, diffusers project rich information onto the sensor, enabling computational recovery of extra scene parameters such as depth, spectrum, or high-speed information. Lensless imagers offer an exciting design space with potential to reduce camera size while capturing information that is invisible to lenses.

Data-driven imaging system design

We are developing tools to enable data-driven methods of optimizing imaging systems. The overall concept is to combine differentiable imaging system models with differentiable algorithms (e.g., neural networks), thereby enabling optimization of system performance over a large set of training images. This allows the simultaneous refinement of optical and image processing algorithms in a task-specific manner.

Computational imaging for miniature neural imaging devices

Miniature imaging devices have become a standard tool for studying *in-vivo* neural circuits

in freely behaving animals. The main thrust of this research area is utilizing computational imaging design principles to enhance the capability of miniature fluorescence imagers with the goal of improving performance for optical neuroimaging. By jointly optimizing the optics and algorithms we aim to reduce device weight while adding information such as depth, extended field-of-view, and high-speed sampling (useful for imaging voltage indicators).

■ Honors and Awards

- 2019 **Best Paper**, *Video from Stills: Lensless Imaging with Rolling Shutter*, IEEE International Conference on Computational Photography (ICCP).
- 2017 **Best Demo**, *DiffuserCam: A Diffuser-Based Lensless Camera*, IEEE International Conference on Computational Photography (ICCP).
- 2016 **Best Paper**, *Single-Shot Diffuser-Encoded Light Field Imaging*, IEEE International Conference on Computational Photography (ICCP).
- 2015 **Outstanding Graduate Student Instructor**, *Electrical Engineering 118/218a: Introduction to Optical Engineering*, UC Berkeley.
- 2012 **Engineering Division Award**, *Outstanding contribution to the National Ignition Facility Capsule Mapping System*, Lawrence Livermore National Laboratory.
- 2011 **NIF and Photon Science Award**, *Outstanding Contributions in Ignition Capsule Metrology*.
- 2010 **NIF and Photon Science Award**, *Development of Prototype Capsule Surface Inspection*.
- 2008 **Graduate with Highest Honors**, *UC Davis*.
- 2008 **Applied Science Departmental Citation**, *UC Davis*.

■ Journal or Journal Equivalent¹ Publications

- 2022 Cem Yalcin, Nathan Tessema Ersaro, Mohammad Meraj Ghanbari, George Bocchetti, Sina Faraji Alamouti, **Nick Antipa**, Daniel Lopez, Nicolas C Pégard, Laura Waller, and Rikky Muller. A mems-based optical scanning system for precise, high-speed neural interfacing. *IEEE Journal of Solid-State Circuits*, 2022.
- 2020 Kyrollos Yanny*, **Nick Antipa***, William Liberti, Sam Dehaeck, Kristina Monakhova, Fanglin Linda Liu, Konlin Shen, Ren Ng, and Laura Waller. Miniscope3d: optimized single-shot miniature 3d fluorescence microscopy. *Light: Science & Applications*, 9(1):1–13, 2020.
- 2020 Fanglin Linda Liu, Grace Kuo, **Nick Antipa**, Kyrollos Yanny, and Laura Waller. Fourier diffuserscope: single-shot 3d fourier light field microscopy with a diffuser. *Optics Express*, 28(20):28969–28986, 2020.
- 2020 Nathan Tessema Ersumo, Cem Yalcin, **Nick Antipa**, Nicolas Pégard, Laura Waller, Daniel Lopez, and Rikky Muller. A micromirror array with annular partitioning for high-speed random-access axial focusing. *Light: Science & Applications*, 9(1):1–15, 2020.
- 2019 Kristina Monakhova, Joshua Yurtsever, Grace Kuo, **Nick Antipa**, Kyrollos Yanny, and Laura Waller. Learned reconstructions for practical mask-based lensless imaging. *Optics Express*, 27(20):28075–28090, 2019.

¹ In fields such as graphics, conference papers are subject to a fully rigorous peer review process

* Indicates co-first authorship

- 2019 **Nick Antipa***, Patrick Oare*, Emrah Bostan, Ren Ng, and Laura Waller. Video from stills: Lensless imaging with rolling shutter. In *2019 IEEE International Conference on Computational Photography (ICCP)*, pages 1–8. IEEE, 2019.
- 2018 **Nick Antipa***, Grace Kuo*, Reinhard Heckel, Ben Mildenhall, Emrah Bostan, Ren Ng, and Laura Waller. Diffusercam: lensless single-exposure 3d imaging. *Optica*, 5(1):1–9, 2018.
- 2016 Nicolas C Pégard, Hsiou-Yuan Liu, **Nick Antipa**, Maximilian Gerlock, Hillel Adesnik, and Laura Waller. Compressive light-field microscopy for 3d neural activity recording. *Optica*, 3(5):517–524, 2016.
- 2016 **Nick Antipa**, Sylvia Necula, Ren Ng, and Laura Waller. Single-shot diffuser-encoded light field imaging. In *Computational Photography (ICCP), 2016 IEEE International Conference on*, pages 1–11. IEEE, 2016.
- 2013 **Nick Antipa**, SH Baxamusa, ES Buice, AD Conder, MN Emerich, MS Flegel, CL Heinbockel, JB Horner, JE Fair, LM Kegelmeyer, and others. Automated ICF capsule characterization using confocal surface profilometry. *Fusion Science and Technology*, 63(2):151–159, 2013.

Conferences and Technical Reports

- 2022 Koray Kavakli, David Robert Walton, **Nick Antipa**, Rafał Mantiuk, Douglas Lanman, and Kaan Akşit. Optimizing vision and visuals: lectures on cameras, displays and perception. In *ACM SIGGRAPH 2022 Courses*, pages 1–66. 2022.
- 2021 Cem Yalcin, Nathan Tessema Ersumo, George Bocchetti, Mohammad Meraj Ghanbari, **Nick Antipa**, Sina Faraji Alamouti, Laura Waller, Daniel Lopez, and Rikky Muller. 19.3 a mems-based dynamic light focusing system for single-cell precision in optogenetics. In *2021 IEEE International Solid-State Circuits Conference (ISSCC)*, volume 64, pages 290–292. IEEE, 2021.
- 2021 Eric Markley, Fanglin Linda Liu, Michael Kellman, **Nick Antipa**, and Laura Waller. Physics-based learned design for fourier diffuserscope. In *Computational Optical Sensing and Imaging*, pages CM6B–3. Optica Publishing Group, 2021.
- 2019 Thomas Zimmerman, **Nick Antipa**, Daniel Elnatan, Alessio Murru, Sujoy Biswas, Vito Pastore, Mayara Bonani, Laura Waller, Jennifer Fung, Gianni Fenu, and others. Stereo in-line holographic digital microscope. In *Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVI*, volume 10883, page 1088315. International Society for Optics and Photonics, 2019.
- 2019 Kyrollos Yanny, **Nick Antipa**, Ren Ng, and Laura Waller. Miniature 3d fluorescence microscope using random microlenses. In *Optics and the Brain*, pages BT3A–4. Optical Society of America, 2019.
- 2019 Kristina Monakhova, **Nick Antipa**, and Laura Waller. Learning for lensless mask-based imaging. In *Computational Optical Sensing and Imaging*, pages CTu3A–2. Optical Society of America, 2019.
- 2019 Fanglin Linda Liu, Vaishnavi Madhavan, **Nick Antipa**, Grace Kuo, Saul Kato, and Laura Waller. Single-shot 3d fluorescence microscopy with fourier diffusercam. In *Novel Techniques in Microscopy*, pages NS2B–3. Optical Society of America, 2019.

* indicates co-first authorship

- 2018 Grace Kuo, **Nick Antipa**, Ren Ng, and Laura Waller. 3d fluorescence microscopy with diffusercam. In *Computational Optical Sensing and Imaging*, pages CM3E–3. Optical Society of America, 2018.
- 2017 Grace Kuo, **Nick Antipa**, Ren Ng, and Laura Waller. Diffusercam: diffuser-based lensless cameras. In *Computational Optical Sensing and Imaging*, pages CTu3B–2. Optical Society of America, 2017.
- 2017 **Nick Antipa**, Grace Kuo, Ren Ng, and Laura Waller. 3d diffusercam: Single-shot compressive lensless imaging. In *Computational Optical Sensing and Imaging*, pages CM2B–2. Optical Society of America, 2017.
- 2016 AV Hamza, A Nikroo, E Alger, **N Antipa**, LJ Atherton, D Barker, S Baxamusa, S Bhandarkar, T Biesiada, E Buice, and others. Target development for the national ignition campaign. *Fusion Science and Technology*, 69(1):395–406, 2016.
- 2016 Gautam Gunjala, Aamod Shanker, Volker Jaedicke, **Nick Antipa**, and Laura Waller. Optical transfer function characterization using a weak diffuser. In *Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXIII*, volume 9713, page 971315. International Society for Optics and Photonics, 2016.
- 2015 Nicolas C Pegard, Evan Lyall, Alan Mardinly, **Nick Antipa**, Laura Waller, and Hillel Adesnik. High-speed 3d brain activity quantification with compressive light-field microscopy. In *Novel Techniques in Microscopy*, pages NW2C–3. Optical Society of America, 2015.
- 2015 Nicolas Pégard, Hsiou-Yuan Liu, **Nick Antipa**, Laura Waller, and Hillel Adesnik. Functional brain imaging at cellular resolution with compressive light-field microscopy. In *Imaging Systems and Applications*, pages JTh4A–3. Optical Society of America, 2015.
- 2015 LC Carlson, EL Alfonso, H Huang, A Nikroo, ME Schoff, MN Emerich, T Bunn, **Nick Antipa**, and JB Horner. Automation of NIF target characterization and laser ablation of domes using the 4pi system. *Fusion Science and Technology*, 67(4):762–770, 2015.
- 2014 JD Lindl, OL Landen, J Edwards, El Moses, and others. Erratum to physics of plasmas 21, 020501 (2014). *Phys. Plasmas*, 21:129902, 2014.
- 2013 DM Haas, H Huang, AQL Nguyen, K Sequoia, RB Stephens, A Nikroo, and **Nick Antipa**. Advancements in capsule surface defect characterization. *Fusion Science and Technology*, 63(2):160–168, 2013.
- 2013 Eric Buice, Richard C Montesanti, **Nicholas Antipa**, Alan D Conder, Michael A Johnson, and John S Taylor. Method and system for inspecting surfaces of miniature components, May 16 2013. US Patent App. 13/662,434.
- 2013 SH Baxamusa, SD Bhandarkar, JL Reynolds, B Maranville, J Horner, DC Mason, CL Heinbockel, **Nick Antipa**, and AD Conder. A solvent cleaning process for the outer surface of plastic ICF capsules. *Fusion Science and Technology*, 63(2):169–176, 2013.
- 2012 Daniel Potter and **Nick Antipa**. Visualization of target inspection data at the national ignition facility. *Fusion Engineering and Design*, 87(12):2136–2139, 2012.
- 2012 **Nick Antipa**. The capsule-fill-tube-assembly mapping system. *Proc. 20th Target Fabrication Mtg*, pages 20–24, 2012.

- 2011 ES Buice, ET Alger, **Nick Antipa**, SD Bhandarkar, TA Biesiada, AD Conder, EG Dzenitis, MS Flegel, AV Hamza, CL Heinbockel, and others. Development of a 3d surface mapping system to inspect capsule fill-tube assemblies used in laser-driven fusion targets. Technical report, Lawrence Livermore National Lab.(LLNL), Livermore, CA (United States), 2011.
- 2011 ES Buice, ET Alger, **Nick Antipa**, SD Bhandarkar, TA Biesiada, AD Conder, EG Dzenitis, MS Flegel, AV Hamza, CL Heinbockel, and others. 3d surface mapping of capsule fill-tube assemblies used in laser-driven fusion targets. Technical report, Lawrence Livermore National Lab.(LLNL), Livermore, CA (United States), 2011.

— Students Mentored

- Ugrad **Sylvia Necula**, *Georgia Tech*, Summer 2015.
Jon Silberstein, *UC Berkeley*, Fall 2015.
Camille Biscarrat, *UC Berkeley*, Spring 2017 - Summer 2018.
Shreyas Parthasarathy, *UC Berkeley*, Spring 2017 - Summer 2018.
Essence Hansberry, *UC Berkeley*, Summer 2017.
Patrick Oare, *UC Berkeley*, Summer 2018 - 2019.
Jonathan Fung, *UC Berkeley*, 2018 - present.
- Grad **Kyrollos Yanny**, *UC Berkeley*, Spring 2017 - present.

— Teaching

- 2020- **ECE 45: Circuits and Systems**, *Instructor*, UC San Diego.
Present
- 2018 **EE123: Digital Signal Processing**, *Graduate Student Instructor*, Fall, UC Berkeley.
- 2015 **EE118/218a: Introduction to Optical Engineering**, *Graduate Student Instructor*, Fall, UC Berkeley.

— Invited Talks

- 2021 **UC San Diego Pixel Cafe**, *Computational Imaging with Random Optics*.
- 2021 **Purdue Imaging Seminar**, *Computational Imaging with Random Optics*.
- 2020 **UC San Diego Pixel Cafe**, *Computational Imaging with Random Optics*.
- 2020 **Stanford SCIEN Seminar**, *DiffuserCam: a lensless camera*.
- 2019 **Apple**, *Compressive High Dimensional Imaging*.
- 2019 **IEEE Photonics Society Silicon Valley Chapter**, *Imaging Without Lenses*.
- 2018 **Rice University**, *Diffuser-based Computational Imaging*.