

Cheng Zheng

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EDUCATION

- **Massachusetts Institute of Technology** Cambridge
Ph.D. in Mechanical Engineering; Advisor: Peter So Sep. 2018 - Present
- **The Chinese University of Hong Kong** Hong Kong
Research Assistant; Advisor: Renjie Zhou June 2018 - August 2018
- **Zhejiang University** Hangzhou, China
M.S. in Optical Engineering; Advisor: Cuifang Kuang Sep. 2015 - March 2018
- **Zhejiang University** Hangzhou, China
B.S. in Optical Engineering Sep. 2011 - June 2015

RESEARCH INTEREST

Computational imaging and optics. Optical system inverse design. Computational lithography.

RESEARCH EXPERIENCE

- **Massachusetts Institute of Technology** Cambridge
Graduate researcher, Computational lithography and microscopy Sep. 2018 - Present
 - **Neural lithography** We introduce neural lithography to address the 'design-to-manufacturing' gap in computational optics. We, for the first time, propose a fully differentiable design framework that integrates a pre-trained photolithography simulator into the model-based optical design loop. Leveraging a blend of physics-informed modeling and data-driven training using experimentally collected datasets, we demonstrate the effectiveness of our approach through two typical tasks in computational optics.
 - **De-scattering in deep brain** We develop a computational method to remove the scattered photons in two-photon temporal focusing microscopy. By projecting random illumination patterns, seven scattering lengths in brain is achieved in a wide-field detection manner. This method preserve the ability of imaging in deep tissue while being much faster than conventional point-scanning two-photon microscopy.
- **Zhejiang University** Hangzhou
Graduate researcher, Computational Super-resolution imaging Sep. 2015 - March 2018
 - **Point spread function (PSF) engineering for super-resolution imaging** We achieve the first computational imaging method in point scanning regime to gain an image resolution comparable to STED (the method won the 2014 Nobel Prize). By combining the phase-based PSF engineering and multiview reconstruction, we enable our system to be much cheaper in expense, tender to bio-sample, and more flexible in operation than STED.
 - **Polarized multi-angle total internal reflection fluorescence (TIRF) imaging** We utilize the polarization information to gain a lateral super-resolution and TIRF to estimate the depth map. We develop a two-step sparse reconstruction pipeline and enable video-rate 3D super-resolved imaging.
 - **DMD based quantitative phase imaging** We developed novel quantitative phase imaging method to achieve state-of-the-art lateral and temporal resolution without sacrificing phase precision by the flexible use of digital micromirror device (DMD). We demonstrate the applications in real-time material manufacturing monitoring for quality control and biology study.

PUBLICATIONS

- **Cheng Zheng**^{†*}, Guangyuan Zhao^{†*} et al., "Neural Lithography: Close the Design to Manufacturing Gap in Computational Optics with a 'Real2Sim' Learned Photolithography Simulator," **SIGGRAPH Asia 2023**. [†] equal contribution. [ArXiv Link]
- **Cheng Zheng**[†], Jong Kang Park[†] et al., "De-scattering with Excitation Patterning enables rapid wide-field imaging through scattering media," *Science Advances* (2021), EAAY5496. [†] equal contribution. [Link]
- **Cheng Zheng**, Di Jin, Yanping He et al., "High spatial and temporal resolution synthetic aperture phase microscopy", *Advanced Photonics*(2020).[Link]
- Guangyuan Zhao[†], **Cheng Zheng**[†], Cuifang Kuang, et al., "Nonlinear Focal Modulation Microscopy," *Physical review letters* 120.19 (2018): 193901. [†] equal contribution. [On the cover][Link]

- **Cheng Zheng**, Guangyuan Zhao et al., "3D super-resolved multi-angle TIRF via polarization modulation," *Optics Letters*, (2018). [**Editor's pick**] [Link]
- Youhua Chen, Wenjie Liu, Zhimin Zhang, **Cheng Zheng** et al., "Multi-color live-cell super-resolution volume imaging with multi-angle interference microscopy", *Nature Communications*. (2018) [Link]
- Guangyuan Zhao, **Cheng Zheng**, Cuifang Kuang, and Xu Liu, "Resolution-enhanced SOFI via structured illumination," *Optics Letters* 42, 3956-3959 (2017).[Link]
- **Cheng Zheng**, Guangyuan Zhao, Cuifang Kuang, and Xu Liu, "3D point scanning super-resolution microscopy via polarization modulation," *Optics Letters* 42,(2017) 3734-3737. [Link]
- Guangyuan Zhao, **Cheng Zheng**, Yue Fang, Cuifang Kuang. "Progress of point-wise scanning superresolution methods". *Acta Physica Sinica*. (2017), 66(14): 148702-148702. [**Invited review**] [Link]
- **Cheng Zheng**, Renjie Zhou, Cuifang Kuang et al., "Digital micromirror device-based common-path quantitative phase imaging," *Optics Letters*, (2017). [Link]
- Guangyuan Zhao, Mohammad M. Kabir, Kimani C. Toussaint, Cuifang Kuang, **Cheng Zheng** et al. "Saturated absorption competition microscopy," *Optica*, 6(2017) 633-636.[Link]
- **Cheng Zheng**, Renjie Zhou, Cuifang Kuang et al., "Diffraction phase microscopy realized with an automatic digital pinhole," *Optics Communications* (2017).[Link]
- **Cheng Zheng**, Cuifang Kuang, Guangyuan Zhao, Xu Liu, "A comprehensive description of diffraction phase microscopy," Proc. SPIE 10245, *International Conference on Innovative Optical Health Science*, 1024508 (2017).[Link]
- Guangyuan Zhao, Zihao Rong, **Cheng Zheng** et al., "3D fluorescence emission difference microscopy based on spatial light modulator", *Journal of Innovative Optical Health Sciences*. (2016).[Link]

SKILLS

- **Programming Languages and framework:** Python, MATLAB, PyTorch, Julia