Shiqi Xu

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Expertise

- 7 years of experience in designing and prototyping computational imaging systems with a focus on novel methods in high-throughput light and X-ray microscopy. Experienced in developing machine learning and computer vision algorithms to assist gigapixel-scale medical and scientific image analysis. Contributed to 18 peer-reviewed article publications (7 first-authored), and two issued patents.

Education

Duke University *Durham, NC* *2019–2023*
- Ph.D. in Biomedical Engineering Advisor: Dr. Roarke Horstmeyer
- Thesis: Computational Bio-Optical Imaging with Novel Sensor Arrays

Washington University in St Louis *St. Louis, MO* *2017–2019*
- Degree: M.S. in Electrical Engineering Advisor: Dr. Ulugbek Kamilov
- Thesis: Regularized Fourier ptychographic microscopy

University of Illinois at Urbana-Champaign *Urbana-Champaign, IL* *2013–2016*
- Degree: B.S. in Electrical Engineering Advisor: Dr. Michael Oelze
- Senior Design Project: Light Pipe Organ (Best signal-processing area award)

Industrial Experience

Carl Zeiss, X-ray Microscopy. *Dublin, CA* *2023–*
- Senior Algorithm Scientist in Advanced Research and Development team Supervisor: Dr. Matthew Andrew
  (i) Developed a deep learning-assisted artifact removal pipeline for high cone angle 3D computed tomography (CT), with a focus on applications in laminographic CT for wafer-level advanced packaging inspection (patent provision and conference submission under review).
  (ii) Developed high-resolution wavefront sensing methods that outfit a laboratory X-ray system for the quantitative imaging of low-absorption materials and subpixel density fluctuation.

Meta, Reality Labs Research *Redmond, WA* *2022*
- Optical Scientist Intern in Eye Tracking and Optics & Display Research team Supervisor: Dr. Ehsan Vadiee
  (i) Developed an estimation theory-based method to quantify the achievable performance of eye-tracking systems, and design and prototype a miniaturized FMCW-LiDAR-based eye-tracking system based on theoretical guidance.

Academic Experience

Duke University *Durham, NC* *2019–2023*
- Graduate research assistant in the Computational Optics Lab Advisor: Dr. Roarke Horstmeyer
  (i) Developed computational illumination-based optical microscopy systems to create tomographic phase images of label-free cells and tissue samples. Related publications: [1] [2] [3] [4]
  (ii) Developed SPAD array-based highly sensitive optical imaging systems to non-invasively monitor cerebral blood flow underneath intact adult skull. [1] [2] [3]
  (iii) Developed image processing pipelines for the behavior analysis of microorganisms in gigapixel-per-frame brightfield and fluorescence microscope videos. These tasks include segmentation, object detection, tracking, photogrammetry-based depth estimation, and pose estimation. [1] [2] [3]
  (iv) Supported the development of self-supervised and weakly-supervised machine learning methods for classifying diseases such as Covid-19, malaria, and adenocarcinoma from cytology and histopathology slides. [1] [2]

Washington University in St Louis *St. Louis, MO* *2017–2019*
- Graduate research assistant in the Computational Imaging Group; Advisor: Dr. Ulugbek Kamilov
  (i) Developed compressive sensing algorithms to reconstruct optical phase images of unlabeled living cell cultures from fewer measurements. [1]
- Graduate research assistant in the Optical and Ultrasound Imaging Lab; Advisor: Dr. Quing Zhu
  (i) Developed and deployed an object detection-based computer vision algorithm for an endoscopic optical coherence tomography system for rapid colorectal cancer imaging and diagnosis. [1]
  (ii) Developed a sensor-fusion algorithm for improved ultrasound-guided diffuse optical tomography reconstruction for breast cancer diagnosis. [1]

Technical Skills

- **Scientific programming:** Fluent in Python (Pytorch, Tensorflow, OpenCV, Scikit-Image), Matlab. Comfortable with C/C++.
- **Hardware skills:** Experienced at optical system prototyping. Comfortable with optical design tools such as Zemax.

Honors and Award

- 2020 Duke Theo Pilkington Fellowship in Biomedical Engineering
- 2019 Duke Biomedical Engineering Scholar Award

Peer-reviewed article publications

1. **Xu, S.**, Dai, X., Ritter, P., Kreiss, L., ... & Horstmeyer, R., 2023. Tensorial tomographic Fourier Ptychography with applications to muscle tissue imaging. Advanced Photonics. Link
2. Kreiss, L., Jiang, S., Li, X., **Xu, S.**, Zhou, K.C., Mühlberg, A., Lee, K.C., Kim, K., Chaware, A., Ando, M. and Barisoni, L., Digital staining in optical microscopy using deep learning - a review. PhotoniX 4, 34 (2023). Link
3. Harfouche, M., Kim, K., ... & Horstmeyer, R., 2022. Multi-scale gigapixel microscopy using a multi-camera array microscope. *Optica* 10(4), 471-480 (2023) . Link
4. Yang, X., Harfouche, M., Zhou, K.C., Kreiss, L., **Xu, S.**, Kim, K., Horstmeyer, R., 2022. Multi-modal imaging using a cascaded microscope design. *Optics Letter*,48 (7), 1658-1661. Link
5. Thomson, E., Harfouche, M., Konda, P., Seitz, C.W., Kim, K., Cooke, C., **Xu, S.**, Blazing, R., Chen, Y., Jacobs, W.S. and Park, J., 2022. Gigapixel imaging with a novel multi-camera array microscope. *eLife*,11,e74988. Link
6. Ayaz, H., Baker, W. B., Blaney, G., Boas, D. A., Bortfeld, H., Brady, K., ... & Zhou, W., 2022. Optical imaging and spectroscopy for the study of the human brain: status report. *Neurophotonics*. Link
7. Cooke, C.L., Kim, K., **Xu, S.**, Chaware, A., Yao, X., Yang, X., Neff, J., Pittman, P., McCall, C., Glass, C. and Jiang, X.S., 2021. A multiple instance learning approach for detecting COVID-19 in peripheral blood smears. *PLOS Digital Health*. Link
8. **Xu, S.**, Dai, X., Yang, X., Zhou, K.C., Kim, K., Pathak, V., Glass, C., Horstmeyer, R., 2022. Tensorial tomographic differential phase-contrast microscopy. *2022 International conference on computational photography (ICCP)*. Link
9. **Xu, S.**, Liu, W., Yang, X., Jonsson, J., Qian, R., McKee P, Kim, K., Konda, P.C., Zhou, K.C., KreiSS, K., Wang, H., Huettel, S., Berrocal, E. and Horstmeyer, R., 2022. Transient motion classification through turbid volumes via parallelized single-photon detection and deep contrastive embedding. *Front. Neurosci*, 908770. Link
10. **Xu, S.**, Yang, X., Liu, W., Jonsson, J., Qian, R., Konda, P.C., Zhou, K.C., Dai, Q., Wang, H., Berrocal, E. and Horstmeyer, R., 2022. Imaging dynamics beneath turbid media via parallelized single-photon detection. *Advanced Science*, 10.1002. Link
11. **Xu, S.**, Dai, X., Yang, X., Zhou, K.C., Glass, C., Konda, P.C. and Horstmeyer, R., 2021. Quantitative Jones matrix imaging using vectorial Fourier ptychography. *Biomedical optics express*, 13(3), pp.1457-1470. Link. *Editor's pick
12. Yao, X., Pathak, V., Xi, H., Chaware, A., Cooke, C., Kim, K., **Xu, S.**, Li, Y., Dunn, T., Konda, P.C. and Zhou, K.C., 2021. Increasing a microscope's effective field of view via overlapped imaging and machine learning. Optics express, 30(2), pp. 1745-1761. *Biomedical optics express*, 13(3), pp.1457-1470. Link
13. Yang, X., Konda, P.C., **Xu, S.**, Bian, Liheng, and Horstmeyer, R., 2021. Quantized Fourier ptychography with binary images from SPAD cameras. *Photonics research*, 9.10 (2021): 1958-1969.. Link
14. Liu, W., Qian, R., **Xu, S.**, Konda, P.C., Harfouche, M., Borycki, D., Jonsson, J., Berrocal, E., Cooke, C., Sinclair, A. and Wang, H., 2020. Fast and sensitive diffuse correlation spectroscopy with highly parallelized single photon detection. *APL Photonics*, 6(2), 026106. Link. *2021 APL Photonics best paper
15. Konda, P.C., Loetgering, L., Zhou, K.C., **Xu, S.**, Harvey, A.R. and Horstmeyer, R., 2020. Fourier ptychography: current applications and future promises. *Optics Express*, 28(7), pp.9603-9630. Link
16. **Xu, S.**, Zeng, Y., Chapman Jr, W.C., Li, S., Alipour, Z., Abdelal, H., Chatterjee, D., Mutch, M. and Zhu, Q., 2020. Real-time colorectal cancer diagnosis using PR-OCT with deep learning. *Theranostics*, 10(6), p.2587. Link
    *Featured in *Biophotonics* magazine, Nov/Dec 2020
17. **Xu, S.**, Uddin, K.S. and Zhu, Q., 2019. Improving DOT reconstruction with a Born iterative method and US-guided sparse regularization. *Biomedical optics express*, 10(5), pp.2528-2541. Link. *Top download.
18. Sun, Y., **Xu, S.**, Li, Y., Tian, L., Wohlberg, B. and Kamilov, U.S., 2019, May. Regularized Fourier ptychography using an online plug-and-play algorithm. In 2019 *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)* (pp. 7665-7669). IEEE. Link

Issued Patents

- Method and System of polarization microscope imaging. US18/073,759
- Ultrasound-target-shape-guided sparse regularization to improve accuracy of diffused optical tomography and target depth-regularized reconstruction in diffuse optical tomography using ultrasound segmentation as prior information. US16/948,261

Conference presentations

- Optica Computational Optical Sensing and Imaging, 2023: Multi-Scale Speckle-Plethysmography With a Multi-Camera Array Microscope [Oral]
- Optica Computational Optical Sensing and Imaging, 2023: Anisotropic Intensity Diffraction Tomography [Oral]
- SPIE Photonics West, 2023: Unsupervised deep image restoration for gigapixel microscopy [Oral]
- IEEE International Conference on Computational Photography, 2022: Tensorial tomographic differential phase contrast microscopy [Oral]

- OSA Biophotonics congress, 2022: Speckle contrast diffuse correlation spectroscopy with parallelized single photon detection [Oral]
- SPIE Optical Systems Design, 2021: Imaging anisotropy with vectorial Fourier ptychography. [Oral]
- IEEE International Conference on Computational Photography, 2021: Imaging deep within dynamic scattering media via SPAD array detection. [Oral]
- OSA Biophotonics congress, 2021: Rapid imaging of deep-tissue motion with parallelized diffuse correlation spectroscopy. [Oral]
- SPIE Photonics West, 2021: Imaging decorrelation via deep learning and SPAD array detection. [Oral]
- OSA Computational Optical Sensing and Imaging, 2020: Classifying decorrelation events hidden beneath scattering media via SPAD array detection. [Oral]
- SPIE Photonics West, 2019: Ultrasound-guided diffuse optical tomography using iterative Born approximation with sparse regularization. [Oral]

Professional services

- Reviewers of Advanced Science, Advanced Photonics Nexus, Light Science & Applications, Optics Communications, Optics Express, Optics Letters, Photonics Research, Transactions on Computational Imaging, and Journal of OSA-A, and Journal on Imaging Sciences.

Teaching

- Spring 2022: Teaching assistant of BME548 Machine Learning and Imaging at Duke University
- Fall 2022: Teaching assistant of BME671 Signal Processing and Applied Mathematics at Duke University

Supervised students

- Xiang Dai: Previously earned an M.S. in Biomedical Engineering at Duke University; now a Ph.D. student in Electrical and Computer Engineering at the University of California, San Diego.
- Xing Yao: Previously earned an M.S. in Biomedical Engineering at Duke University; now a Ph.D. student in Computer Science at Vanderbilt University.