Shiqi Xu

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Expertise

- 7 years of research and development experience in computational imaging, with 20+ peer-reviewed publications, 700+ citations, and three issued patents.
- Specializing in designing imaging algorithms and systems for high-resolution light and X-ray 3D tomography.
- Expertise in developing image processing and analysis algorithms and solving inverse problems.
- Hands-on skills in prototyping optical setups and verifying performance.

Education

Duke University *Durham, NC* *2019–2023*
- Ph.D. in Biomedical Engineering; Advisor: Dr. Roarke Horstmeyer

Washington University in St Louis *St. Louis, MO* *2017–2019*
- M.S. in Electrical Engineering Advisor: Dr. Ulugbek Kamilov

University of Illinois at Urbana-Champaign *Urbana-Champaign, IL* *2013–2016*
- B.S. in Electrical Engineering Advisor: Dr. Michael Oelze

Industrial Experience

Carl Zeiss, X-ray Microscopy. *Dublin, CA* *2023–*
- Senior Algorithm Scientist in Advanced Design and Development team
  (i) Led the technical development of reconstruction workflows for high-throughput laminographic computed tomography. Developed a self-supervised learning-based image restoration method to reduce noise and cone-beam artifacts. Presentation
  (ii) Led the technical and application developments of a lab-based hard X-ray plenoptic imaging system for tomographic phase and scattering imaging of low-absorption materials.

Meta, Reality Labs Research *Redmond, WA* *2022*
- Optical Scientist Intern in Eye Tracking and Optics & Display Research team
  (i) Developed an estimation theory-based method to quantify the achievable performance of eye-tracking systems. Design and prototype a miniaturized FMCW-LiDAR-based eye-tracking system based on the 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 optical microscopy systems to create polarization-sensitive tomographic phase images of unlabeled cells and tissue samples. Related publications: [5][12]
  (ii) Developed image processing pipelines for analyzing microorganism behavior in gigapixel-per-frame brightfield and fluorescence microscope videos. Downstream image analysis tasks included segmentation, object detection, and pose estimation. [9][7]
  (iii) Developed SPAD array-based high-sensitivity, high-frame-rate optical systems for non-invasive monitoring of cerebral blood flow. [14][18]
  (iv) Supported the development of weakly-supervised machine learning methods to classify diseases such as COVID-19, malaria, and adenocarcinoma using cytology and histopathology imaging slides. [11][16]

Washington University in St Louis *St. Louis, MO* *2017–2019*
- Graduate research assistant in the Computational Imaging Group; Advisor: Dr. Ulugbek Kamilov
  (i) Developed a reconstruction algorithm for compressive imaging of unlabeled living cell cultures. [22]
- Graduate research assistant in the Optical and Ultrasound Imaging Lab; Advisor: Dr. Quing Zhu
  (i) Developed an object detection-based algorithm for rapid colorectal cancer diagnosis using endoscopic microscopy. [20]
  (ii) Developed a sensor fusion algorithm to improve the optical tomographic reconstruction of breast tumors. [21]

Technical Skills

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

Issued Patents

1. Tensorial tomographic Fourier Ptychography. US18/677,131
2. Method and System of polarization microscope imaging. US18/073,759
3. 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

Preprints

1. Kreiss, L., Wu, M., Wayne, M., **Xu, S.**, McKee, P., Dwamena, D., Kim, K., Lee, K.C., Liu, W., Ulku, A. and Harfouche, M., 2024. Beneath the Surface: Revealing Deep-Tissue Blood Flow in Human Subjects with Massively Parallelized Diffuse Correlation Spectroscopy. arXiv:2403.03968.
2. Zhou, K.C., Cook, C., Chakraborty, A., Bagwell, J., Jönsson, J., Lee, K.C., Yang, X., **Xu, S.**, Balla, R., Harfouche, M. and Fox, D.T., 2024. High-speed 4D fluorescence light field tomography of whole freely moving organisms. bioRxiv, pp.2024-09.

Peer-reviewed publications

1. Kim, K., Chaware, A., Cook, C. B., **Xu, S.**, Abdelmalak, M., Cooke, C., ... & Horstmeyer, R. (2024). Rapid 3D imaging at cellular resolution for digital cytopathology with a multi-camera array scanner (MCAS). npj Imaging 2.1 (2024): 39. Link
2. **Xu, S.**, Candell, S., Case, T., Goehnermeier, A., Irwin, J., Majlan, K., Preil, M., Ruoff, J., Xu, M., Yang, F. and Andrew, M., 2024, October. Self-supervised deep image restoration for x-ray computed laminographic tomography. In Developments in X-Ray Tomography XV (Vol. 13152, p. 131520T). SPIE. Link
3. Andrew, M., Andreyev, A., Yang, F., Xu, M. and **Xu, S.**, 2024, October. X-ray reconstruction using synthetic prior image restoration, with application to noise and artefact removal. In Developments in X-Ray Tomography XV (Vol. 13152, p. 131520E). SPIE. Link
4. Lee, K.C., Chae, H., **Xu, S.**, Lee, K., Horstmeyer, R., Lee, S.A. and Hong, B.W., 2024. Anisotropic regularization for sparsely sampled and noise-robust Fourier ptychography. Optics Express, 32(14), pp.25343-25361. Link
5. **Xu, S.**, Dai, X., Ritter, P., Kreiss, L., ... & Horstmeyer, R., 2023. Tensorial tomographic Fourier Ptychography with applications to muscle tissue imaging. Advanced Photonics. Link
6. 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
7. Harfouche, M., Kim, K., ... & Horstmeyer, R., 2022. Multi-scale gigapixel microscopy using a multi-camera array microscope. *Optica* 10(4), 471-480 (2023) . Link
8. 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
9. 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
10. 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
11. 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
12. **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
13. **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
14. **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
15. **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__
16. 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
17. 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
18. 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__
19. 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

20. **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
21. **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.
22. 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

Conference presentations

1. SPIE Optics and Photonics, 2023: Self-supervised deep image restoration for X-ray computed laminographic tomography [Oral]
2. Optica Computational Optical Sensing and Imaging, 2023: Multi-Scale Speckle-Plethysmography With a Multi-Camera Array Microscope [Oral]
3. Optica Computational Optical Sensing and Imaging, 2023: Anisotropic Intensity Diffraction Tomography [Oral]
4. SPIE Photonics West, 2023: Unsupervised deep image restoration for gigapixel microscopy [Oral]
5. IEEE International Conference on Computational Photography, 2022: Tensorial tomographic differential phase contrast microscopy [Oral]
6. OSA Biophotonics congress, 2022: Speckle contrast diffuse correlation spectroscopy with parallelized single photon detection [Oral]
7. SPIE Optical Systems Design, 2021: Imaging anisotropy with vectorial Fourier ptychography. [Oral]
8. IEEE International Conference on Computational Photography, 2021: Imaging deep within dynamic scattering media via SPAD array detection. [Oral]
9. OSA Biophotonics congress, 2021: Rapid imaging of deep-tissue motion with parallelized diffuse correlation spectroscopy. [Oral]
10. SPIE Photonics West, 2021: Imaging decorrelation via deep learning and SPAD array detection. [Oral]
11. OSA Computational Optical Sensing and Imaging, 2020: Classifying decorrelation events hidden beneath scattering media via SPAD array detection. [Oral]
12. SPIE Photonics West, 2019: Ultrasound-guided diffuse optical tomography using iterative Born approximation with sparse regularization. [Oral]

Book chapters

1. Kreiss, L., Zhou, K.C., Cook, C.B., Xu, S., Chaware, A. and Horstmeyer, R., 2024. Innovations in signal/image processing and data analysis in optical microscopy. In Biophotonics and Biosensing (pp. 349-389). Elsevier.

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.

Honors and Award

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

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

- Zijing Guo: Previous summer intern at Zeiss; currently pursuing Ph.D. in nano-neurotechnology at Rice University.
- Xiang Dai: Previous M.S. student in Computational Optics Lab at Duke University; currently pursuing Ph.D. in computer vision at the University of California, San Diego.
- Xing Yao: Previous M.S. student in Computational Optics Lab at Duke University; currently pursuing Ph.D. in medical imaging analysis at Vanderbilt University.