

# XIAOJIAN XU

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Department of Electrical Engineering and Computer Science ◇ University of Michigan

## ABOUT ME

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### Current research

- My current research pursues to combine computational imaging, optimization, and machine learning to enable new intelligent imaging technology for various imaging applications including denoising, deblurring, super-resolution, image segmentation, optical microscopy, magnetic resonance imaging (MRI), radar, and autonomous driving, etc. My research efforts are taking place at two complementary levels: (a) the fundamental and mathematical aspects of imaging; (b) application-oriented projects in collaboration with researchers in medicine, biology, and computer vision.

### Research interests

- Computational Imaging, Optimization, Deep Learning, Inverse Problems, Computer Vision, Signal Processing

## EDUCATION

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**Washington University in St. Louis (WUSTL), USA** 9/2017–7/2022

- Ph.D in Computer Science (GPA: 3.87/4.00), advised by Prof. Ulugbek Kamilov

**University of Electronic Science and Technology of China (UESTC), China** 9/2014–6/2017

- M.S. in Communication & Information Engineering (Graduated with Honors)

**University of Electronic Science and Technology of China (UESTC), China** 9/2010–6/2014

- B.S. in Communication Engineering (GPA: 3.89/4.00)

## WORK EXPERIENCE

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**University of Michigan** 8/2022–present

*Postdoctoral research fellow with Prof. Jeffrey Fessler* Ann Arbor

- Developed time- and memory- efficient 3D image reconstruction methods based on data-driven approaches, especially as applied to applications with limited measurements and/or training data.
- Designed learning-based image feature extraction methods with subpixel level ( $< 125 \text{ um}$ ) accuracy under heavy photon scattering noise.
- Collaborated on the development of diffusion-model-based image prior for solving phase retrieval problems.

**Meta Reality Labs Research** 5/2021–8/2021

*Research intern with Dr. Brian Wheelwright* Seattle (remote)

- Built the ray-tracing model for peripheral display system in Oculus AR/VR devices, solved its display calibration problem, and designed an efficient camera-to-display mapping for its real-time rendering using neural representation.

**Mitsubishi Electric Research Laboratories** 5/2019–8/2019

*Research intern with Dr. Hassan Mansour* Boston

- Worked on the 3D tomographic imaging problem and investigated two distinct methods, model-based optimization and data-driven deep learning, for solving the problem.

## AWARDS & HONORS

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### Honors

- Honored Ph.D student in Computer Science & Engineering department 2021
- Outstanding Graduate Student 2017

### Scholarship

• Graduate Student First-Rank Academic Scholarship	2016
• Graduate Student Second-Rank Academic Scholarship	2015
• Graduate Student First-Rank Academic Scholarship	2014
• National Inspirational Scholarship	2013
• People's First-Rank Scholarship	2012
• National Inspirational Scholarship	2011

## Others

• Third-prize of 'Internet+' Entrepreneurship Competition in Sichuan Province	2016
• Great Award of Intelligent City Technology Competition	2016
• Award of Hackathon Programming Competition	2015
• Second Prize of Electronic Design Competition in UESTC	2011

## SKILLS

- **Languages:** Python, Matlab, C, Java
- **Skills:** Optimization, Inverse problems, Pytorch, Tensorflow, Deep learning, Linux, TCP/IP

## RESEARCH EXPERIENCE

### Model-based deep learning for imaging and vision 8/2020 – Present

- Developed imaging-model-assisted learning methods such as unsupervised learning, self-supervised and deep unrolling framework for different imaging tasks with various noise corruption challenges ([2] [5][3][4] [6][7][8][10] [14][15][17]).

### Learning-based optimization for imaging and vision 8/2020 – Present

- Extensively investigated in variants of Plug-and-Play priors (PnP) and Regularized by denoising (RED) approaches for various imaging tasks by combining the imaging models with the deep-learning priors, in both theory and practice ([7][8][11][12][13]).

### Compressed and stochastic algorithms for large-scale imaging 7/2018 – Present

- Investigated in large-scale imaging problems by developing stochastic variants of optimization- and learning-based algorithms with convergence guarantee ([1][6][14][15][18]).

### Some earlier research experience 3/2014 – 6/2017

- Intelligent home system design and development.
- Routing and resource scheduling algorithms for large-scale software defined networks (SDN).

## PUBLICATIONS

### Preprints (\* indicates equal contribution)

- [1] **X. Xu**, M. Klasky, M. McCann, J. A. Fessler, "Swap-Net: A Memory-Efficient 2.5D Cascade Network for 3D Image Reconstruction", arXiv preprint. (Coming online soon)
- [2] Z. Li, J. Hu, **X. Xu**, L. Shen, and J. A. Fessler (2023). "AWFSD: Accelerated Wirtinger Flow with Score-based Diffusion Image Prior for Poisson-Gaussian Holographic Phase Retrieval." arXiv preprint arXiv:2305.07712. [\[Paper\]](#)
- [3] **X. Xu**, W. Gan, S.V.V.N. Kothapalli, D.A. Yablonskiy, and U.S. Kamilov, 2022. "CoRECT: A Deep Unfolding Framework for Motion-Corrected Quantitative R2\* Mapping." arXiv preprint arXiv:2210.06330. [\[Paper\]](#)

### Published (\* indicates equal contribution)

- [4] **X. Xu**, J. Fessler, M. Klasky, S. GS; J. Schei, M. McCann, "An End-to-End Learning Approach for Subpixel Feature Extraction." Optica Imaging Congress 2023. (Coming online soon)
- [5] Z. Li, **X. Xu**, J. Hu, J. A. Fessler, Y. Dewaraja, "Reducing SPECT acquisition time by predicting missing projections with single-scan self-supervised coordinate-based learning", Journal of Nuclear Medicine, June 2023, 64 (supplement 1) P1014.

- [6] **X. Xu\***, J. Liu\*, W. Gan, S. Shoushtari, and U. S. Kamilov, "Online Deep Equilibrium Learning for Regularization by Denoising." Advances in Neural Information Processing Systems 35 (NeurIPS 2022): 25363-25376. [\[Paper\]](#)
- [7] Y. Hu, J. Liu, **X. Xu**, and U. S. Kamilov, "Monotonically Convergent Regularization by Denoising." 2022 IEEE International Conf. on Image Processing (ICIP), Bordeaux, France, 2022, pp. 426-430. [\[Paper\]](#)
- [8] **X. Xu\***, A. H. Al-Shabili\*, I. Selesnick, and U. S. Kamilov, "Bregman Plug-and-Play Priors." 2022 IEEE International Conf. on Image Processing (ICIP), Bordeaux, France, 2022, pp. 241-245. [\[Paper\]](#)
- [9] S. Kahali, S.V.V.N. Kothapalli, **X. Xu**, U. S. Kamilov, and D. A. Yablonskiy, "Deep-Learning-Based Accelerated and Noise-Suppressed Estimation (DANSE) of quantitative Gradient Recalled Echo (qGRE) MRI metrics associated with Human Brain Neuronal Structure and Hemodynamic Properties," NMR in Biomedicine. 2022;e4883. [\[Paper\]](#)
- [10] **X. Xu**, S. V. V. N. Kothapalli, S. Kahali and U. S. Kamilov, and D. A. Yablonskiy, "Learning-based motion artifact removal networks for quantitative R2\* mapping," Magnetic Resonance in Medicine (MRM), vol. 88, no. 1, pp. 106–119, 2022. [\[Paper\]](#)
- [11] **X. Xu**, Y. Sun, J. Liu, B. Wohlberg, and U. S. Kamilov, "Provable Convergence of Plug-and-Play Priors with MMSE Denoisers," IEEE Signal Process. Lett. (SPL), vol. 27, pp. 1280–1284, 2020. [\[Paper\]](#)
- [12] **X. Xu**, J. Liu, Y. Sun, B. Wohlberg, and U. S. Kamilov, "Boosting the Performance of Plug-and-Play Priors via Denoiser Scaling," in 54th Asilomar Conf. on Signals, Systems, and Computers (ACSSC), 2020, pp. 1305–1312. [\[Paper\]](#)
- [13] **X. Xu\***, Y. Sun\*, Z. Wu\*, B. Wohlberg, and U. S. Kamilov, "Scalable Plug-and-Play ADMM With Convergence Guarantees," IEEE Trans. on Comp. Imag. (TCI), vol. 7, pp. 849–863, 2021. [\[Paper\]](#)
- [14] J. Liu, Y. Sun, W. Gan, **X. Xu**, B. Wohlberg, and U. S. Kamilov, "SGD-Net: Efficient Model-Based Deep Learning with Theoretical Guarantees," IEEE Trans. on Comp. Imag. (TCI), vol. 7, pp. 598–610, 2021. [\[Paper\]](#)
- [15] J. Liu, Y. Sun, W. Gan, **X. Xu**, B. Wohlberg, and U. S. Kamilov, "Stochastic Deep Unfolding for Imaging Inverse Problems," in IEEE Int. Conf. Acoustics, speech and signal process (ICASSP), 2021, pp. 1395–1399. [\[Paper\]](#)
- [16] **X. Xu**, O. Dhifallah, H. Mansour, P. T. Boufounos, and P. V. Orlik, "Robust 3D Tomographic Imaging of the Ionospheric Electron Density," in 2020 IEEE Int. Geoscience and Remote Sensing Symposium (IGARSS), 2020, pp. 437–440. [\[Paper\]](#)
- [17] J. Liu, Y. Sun, **X. Xu**, and U. S. Kamilov, "Image Restoration Using Total Variation Regularized Deep Image Prior," in 2019 IEEE Int. Conf. Acoustics, speech and signal process (ICASSP), 2019, pp. 7715–7719. [\[Paper\]](#)
- [18] **X. Xu** and U. S. Kamilov, "SignProx: One-bit Proximal Algorithm for Nonconvex Stochastic Optimization," in IEEE Int. Conf. Acoustics, speech and signal process (ICASSP), Brighton, UK, May 2019, pp. 7800–7804. [\[Paper\]](#)

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## INVITED TALKS

- UCLouvain, Image and Signal Processing Group Seminar, 9/2020
- MSU, The Department of Computational Mathematics, Science, and Engineering, expected 11/2023

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## PROFESSIONAL SERVICE

- **Conference reviewer:** ISBI, ICASSP
- **Journal reviewer:** IEEE Transactions on Image Processing (TIP), IEEE Transactions on Computational Imaging (TCI), IEEE Transactions on Medical Imaging (TMI), IEEE Signal Processing Letters (SPL), Signal, Image and Video Processing, Nuclear Inst. and Methods in Physics Research-A (NIM-A), Applied Mathematical Modelling, Optics Communications, Scientific Reports, Signal Processing

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## TEACHING & SUPERVISION EXPERIENCE

### (Head) TA for optimization

2019–2020

Assistant Instructor

St. Louis

- Served as the head assistant instructor and guest lecturer for course "Optimization" and "Large-Scale Optimization for Data Science" and obtained high evaluation from students.

*Research Mentor*

- Ziyun Li, "Coordinate-based Internal Learning for medical imaging", *now M.S. student at UMich*
- Eddie Chandler, "Inhomogeneity correction for MRI", *now Ph.D student at WUSTL*
- Yixuan Luo, "Deep-learning-based image segmentation", *now M.S. student at WUSTL*
- Michael Kincheloe, "Reinforcement learning for MRI artifacts correction". *now B.S. student at WUSTL*
- Zhixin Sun, "Neural representation for image reconstruction", *coming Ph.D student at WUSTL*
- Weijie Gan, "Fast MRI reconstruction and artifacts correction", *now Ph.D student at WUSTL*
- Jiarui Xing, "Deep-learning-based image artifacts correction", *now Ph.D student at University of Virginia*
- Shiqi Xu, "Sparse Fourier ptychographic microscopy", *now Ph.D student at Duke University*
- Hao Tang, "Adversarially robust classifiers for image reconstruction", *now M.S. student at WUSTL*
- Ryogo Suzuki, "Unfolding networks for image restoration", *now at Rakuten Group, Inc.*
- Yukun Li, "Single image denoising", *now Ph.D student at Tufts University.*
- Fa Long, "Dictionary learning for image restoration", *now at Tencent Inc.*