# Xiaojian Xu

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## About me

**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

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

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

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

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

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

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

## Work Experience

**University of Michigan-Department of EECS** *8/2022–present*

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

- Investigation of the development, implementation, and evaluation of image reconstruction methods based on data-driven approaches, especially as applied to applications with limited measurements and/or training data.

**Facebook Reality Labs Research (FRLR)** *5/2021–8/2021*

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

- Built the ray-tracing model for peripheral display system in Oculus, 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 (MERL)** *5/2019–8/2019*

*Research intern with Dr. Hassan Mansour* *Boston*

- Investigated in 3D tomographic imaging problems and solved the problem by proposing two distinct methods, model-based optimization and data-driven deep learning.

## Awards & Honors

**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, Tensorflow, Pytorch, 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 ([1][2][3][5][9][10][12]).

**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 ([2][3][6][7][8]).

**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][9][10][13]).

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

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

## Publications

**Preprints** *(* indicates equal contribution)*

[1] J. Liu*, **X. Xu***, W. Gan, S. Shoushtari, and U. S. Kamilov, "Online Deep Equilibrium Learning for Regularization by Denoising." arXiv, May 25, 2022. Accessed: Jul. 12, 2022.Available: http://arxiv.org/abs/2205.13051 [Paper]

[2] Y. Hu, J. Liu, **X. Xu**, and U. S.Kamilov, "Monotonically Convergent Regularization by Denoising." arXiv preprint arXiv:2202.04961 (2022, accepted to ICIP). [Paper]

[3] **X. Xu***, A. H. Al-Shabili*, I. Selesnick, and U. S. Kamilov, "Bregman Plug-and-Play Priors." arXiv, Feb. 04, 2022. doi: 10.48550/arXiv.2202.02388 (2022, accepted to ICIP).[Paper]

[4] 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," bioRxiv, 2021, doi: 10.1101/2021.09.10.459810. [Paper]

**Published** *(* indicates equal contribution)*

[5] **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, vol. 88, no. 1, pp. 106–119, 2022, doi: 10.1002/mrm.29188. [Paper]

[6] **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., vol. 27, pp. 1280–1284, 2020. [Paper]

[7] **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, 2020, pp. 1305–1312. [Paper]

[8] **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., vol. 7, pp. 849–863, 2021. [Paper]

[9] 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., vol. 7, pp. 598–610, 2021. [Paper]

[10] 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]

[11] **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]

[12] 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]

[13] **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]

## Invited talks

- UCLouvain, Image and Signal Processing Group Seminar, 9/2020

## 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), Optics Communications, Scientific Reports, Signal Processing

## 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.

**Students supervision** *7/2018–07/2022*
*Research Supervisor* *St. Louis*

- Eddie Chandler, "Inhomogeneity correction for MRI", *now B.S. 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.*