

# XIAOJIAN XU

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Department of Computer Science and Engineering ♦ Washington University in St. Louis

## 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)**, St. Louis, MO, USA 9/2017–7/2022 (*expected*)

- 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)**, Chengdu, China 9/2014–6/2017

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

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

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

## WORKING EXPERIENCE

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**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

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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

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

## RESEARCH EXPERIENCE

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

- Developed imaging-model-assisted learning methods such as unsupervised learning, self-supervised and unrolling framework for different imaging tasks with various noise corruption challenges ([1, 2, 6, 7, 9]).

### 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 ([3, 4, 5]).

### 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 ([6, 7, 10]).

### 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

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### Preprints

- [1] Y. Hu, J. Liu, **X. Xu\***, and Kamilov, U. S. "Monotonically Convergent Regularization by Denoising." arXiv preprint arXiv:2202.04961 (2022).
- [2] **X. Xu\*** et al., "Bregman Plug-and-Play Priors." arXiv preprint arXiv:2202.02388 (2022).
- [3] **X. Xu** et al., "Learning-based Motion Artifact Removal Networks (LEARN) for Quantitative  $R_2^*$  Mapping," arXiv:2109.01622 [eess], Sep. 2021, [Online]. Available: <http://arxiv.org/abs/2109.01622>
- [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.

### Published

(\* indicates equal contribution)

- [3] **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.
- [4] **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.
- [5] **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.
- [6] 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.
- [7] 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.
- [8] **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.
- [9] 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.

- [10] **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.

## INVITED TALKS

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- SIAM Conference on Imaging Science, 7/2020
- UCLouvain, Image and Signal Processing Group Seminar, 9/2020
- Asilomar Conference on Signals, Systems, and Computers, 10/2021

## PROFESSIONAL SERVICES

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- **Conferences reviewer:** ISBI, ICASSP
- **Journals reviewer:** IEEE Transactions on Image Processing (TIP), IEEE Transactions on Computational Imaging (TCI), Optics Communications, Scientific Reports, Signal Processing

## TEACHING & SUPERVISION EXPERIENCE

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### (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–Present

*Research Supervisor*

*St. Louis*

#### Current students

- 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*

#### Previous students

- Zhixin Sun, "Neural representation for MRI 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 MRI 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 at Baidu Inc.*
- Fa Long, "Dictionary learning for image restoration", *now at Tencent Inc.*