Xiaojian Xu

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

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), St. Louis, MO, USA *9/2017–6/2022 (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

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 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 network software defined netwroks (SDN).

Publications

Preprints

[1] **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

[2] 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

- SIAM Conference on Imaging Science, 07/2020
- UCLouvain, Image and Signal Processing Group Seminar, 09/2020
- Asilomar Conference on Signals, Systems, and Computers, 10/2021

Professional Services

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

Teaching & Supervision Experience

(Head) TA for Optimization *2019–2020*
Assistant Instructor *St. Louis*

- Served as 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.*