Xiaojian Xu

[Homepage]   [Google Scholar]   [Github]   [Twitter]

✉ xiaojianxu@wustl.edu   📞 +1 314-203-8568

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 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, Deep Learning, Inverse Problems, Optimization, Computer Vision

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)

Work Experience

Facebook Reality Labs Research (FRLR)   *5/2021–8/2021*
Research intern   *Seattle (remote)*
- Simulated the end-to-end peripheral display system (lens-lets and display LED array included) in Oculus and implemented a corresponding efficient ray-tracing model for the system, all from scratch.
- Solved the display calibration problem with the simulated display system and ray tracing model by designing various optimization strategies.
- Designed a novel deep-learning-based (neural representation) method for the challenging pupil-movement-based camera-to-display mapping in the virtual reality (VR) system, which achieved real-time rendering capacity (0.3 sec) without losing visual quality.

Mitsubishi Electric Research Laboratories (MERL)   *5/2019–8/2019*
Research intern   *Boston*
- Investigated in 3D tomographic imaging problems and solved them with both model- and learning-based methods on both simulated and experimental data.

Research Experience

Model-based deep learning for imaging   *8/2020 – Present*
- Provable model-based unfolding networks and learning prior assisted methods in medical imaging
- Macroscopic magnetic field inhomogeneities corrected MRI image reconstruction

Plug-and-Play priors (PnP)   *8/2018 – Present*
- Conducted the first mathematical analysis of plug-and-play priors (PnP) framework for minimum mean squared error (MMSE) denoisers. This result provides new insights into usage of deep-learning denoisers in PnP.
- Designed a practically efficient denoiser scaling technique that can greatly boost the performance of PnP algorithms under deep-learning priors by explicitly adjusting the amount of PnP regularization.

Compressed and stochastic optimization for large-scale imaging *7/2018 – Present*
- Developed compressed proximal algorithms for stochastic optimization problems and was the first to prove the convergence.
- Developed the stochastic variant of the PnP-ADMM algorithm for large-scale optimization and proved its convergence .

Learning-based magnetic resonance imaging (MRI) / quantitative-MRI (qMRI) *7/2018 – Present*
- Developed both supervised and self-supervised deep-learning-based methods for motion artifact removal in qMRI mapping.
- Investigated the application of reinforcement learning, neural representation and sparse representation in fast MRI reconstruction.

Model and learning combined methods for image reconstruction *3/2018 – present*
- Conducted different image reconstruction tasks (e.g. debluring, super-resolution, Poisson/Gaussian denoising, compressive sensing, phase retrieval, MRI, CT, etc.) by combining the physical models together with the deep learning priors, e.g. the model-based unrolling networks and learning-involved optimization.

Some earlier research experience *3/2014 – 6/2017*
- Development of Intelligent Home System.
- Design routing and resource scheduling algorithms for large-scale network SDN.

LIST OF PUBLICATIONS

Preprints
- **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

- 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)*
- **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.

- **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.

- **X. Xu***, Y. Sun*, Z. Wu*, B. Wohlberg, and U. S. Kamilov, "Scalable Plug-and-Play ADMM With Convergence Guarantees," IEEE Transactions on Computational Imaging, vol. 7, pp. 849–863, 2021.

- 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 Transactions on Computational Imaging, vol. 7, pp. 598–610, 2021.

- 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.

- **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.

- 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.

- **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 (expected)

Reviewer experience

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

Teaching & Supervision Experience

(Head) TA for Optimization
Assistant Instructor

1/2019–Present

St. Louis

- Worked as an assistant instructor for course "Optimization" and "Large-Scale Optimization for Data Science" for four semesters. Teach tutorial sessions, give guest lectures, hold office hours, answer questions online, design homework/exams.

Selected students supervision
Research Supervisor

7/2018–Present

St. Louis

- E.Chandler, "Neural representation for fast MRI reconstruction" , now B.S. student at WUSTL
- Y.Luo, "Deep learning for calf muscle and fat segmentation", now M.S. student at WUSTL
- H.Tang, "Adversarially robust classifiers for image reconstruction", now B.S. student at WUSTL
- Ryogo Suzuki, "Unfolding networks for image restoration", now at Rakuten, Japan
- W.Gan, "Learning for fast MRI reconstruction and artifacts correction" , now Ph.D student at WUSTL
- J.Xing, "Deep-learning-based MRI artifacts correction" , now Ph.D student at UV
- S.Xu, "Sparse Fourier ptychographic microscopy with dictionary learning", now Ph.D student at Duke University

Skills

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

Awards & Honors

Honors

Honored Ph.D student in Computer Science & Engineering department (WUSTL)	2021

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
- Outstanding Graduate Student	2015
- Second Prize of Electronic Design Competition in UESTC	2011