

# Jiaming Liu

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## RESEARCH INTERESTS

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Computational Imaging, Deep Learning, Signal Processing, Large-scale Optimization, Sparsity and Compressive Sensing.

## EDUCATION

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<b>Washington University in St. Louis (WUSTL)</b> , St. Louis, MO, USA Ph.D. student in Electrical & Systems Engineering Advisor: Prof. Ulugbek Kamilov	Aug. 2019 – Expected 2024
<b>WUSTL, St. Louis</b> , MO, USA M.S. in Electrical & Systems Engineering	Aug. 2017 – May 2019
<b>University of Electronic Science and Technology of China (UESTC)</b> , Chengdu, China B.S. in Electronic and Information Engineering Advisor: Prof. Zhiqin Zhao	Sep. 2013 – Jun. 2017

## WORK EXPERIENCE

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<b>Los Alamos National Laboratory (LANL)</b> , Los Alamos, NM, USA Research Intern Mentor: Dr. Brendt Wohlberg	Jun. 2021 – Aug. 2021
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## AWARDS & HONORS

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- WUSTL Dean's Select PhD Fellowship, 2019
- NeurIPS 2019 Travel Award

## RESEARCH EXPERIENCE

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- **Plug-and-Play priors (PnP)**
  - Established theoretical recovery guarantees for PnP by assuming that the solution of these methods lies near the fixed-points of a deep neural network (i.e. denoisers and artifact remove operators).
  - Studied and provided a practically efficient denoiser scaling technique to explicitly control the amount of PnP regularization (noise level  $\sigma$ ).
- **Regularization by Denoising (RED)**
  - Improved RED efficiency by providing various scalable RED algorithms for large-scale image reconstruction, including stochastic, block-coordinate, and asynchronous distributed variants.
  - Proposed a new Calibrated RED (Cal-RED) method that enables joint calibration of the measurement operator along with reconstruction of the unknown image.
- **Model-based Deep Learning for Image Inverse Problem**

- Proposed to considerably improve the performance and stability of deep image prior (DIP) by incorporating traditional total variation (TV) regularization.
- Provided a coordinate-based internal learning (CoIL) method for continuous representation of the measurement field, inspired by neural representation fields (NeRF).
- Proposed and analyzed SGD-Net as a new methodology for improving the efficiency of deep unfolding through stochastic approximations of the data-consistency layers.
- Proposed RARE algorithm to broaden the current denoiser-centric view of RED by considering priors corresponding to networks trained for more general artifact-removal on datasets containing only undersampled measurements.
- Studied and provided a deep learning method for joint accelerated MRI reconstruction and registration without using the ground-truth images.

## PUBLICATIONS

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(\*' indicates equal contribution)

### Preprints

- [1] **J. Liu**, M. S. Asif, B. Wohlberg and U. S. Kamilov, "Recovery Analysis for Plug-and-Play Priors using the Restricted Eigenvalue Condition" arXiv:2106.03668.
- [2] Y. Sun, **J. Liu**, M. Xie, B. Wohlberg and U. S. Kamilov, "Coil: Coordinate-based internal learning for imaging inverse problem" arXiv:2102.05181.
- [3] W. Gan, Y. Sun, C. Eldeniz, **J. Liu**, H. An, and U. S. Kamilov, "MoDIR: Motion-Compensated Training for Deep Image Reconstruction without Ground Truth" arXiv:2107.05533.

### Published

- [1] **J. Liu\***, M. Xie\*, Y. Sun, W. Gan, B. Wohlberg, and U. S. Kamilov, "Joint Reconstruction and Calibration using Regularization by Denoising with Application to Computed Tomography". Proc. IEEE Int. Conf. Comp. Vis. Workshops (ICCVW 2021), in press.
- [2] W. Gan, Y. Hu, C. Eldeniz, **J. Liu**, Y. Chen, H. An, and U. S. Kamilov, "SS-JIRCS: Self-Supervised Joint Image Reconstruction and Coil Sensitivity Calibration in Parallel MRI without Ground Truth," Proc. IEEE Int. Conf. Comp. Vis. Workshops (ICCVW 2021), in press.
- [3] **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. Comput. Imag.**, vol 7, pp. 598-610, 2021.
- [4] **J. Liu**, Y. Sun, W. Gan, X. Xu, B. Wohlberg and U. S. Kamilov, "Stochastic Deep Unfolding for Imaging Inverse Problems," Proc. IEEE Int. Conf. Acoustics, Speech and Signal Process. (ICASSP 2021).
- [5] Y. Sun, **J. Liu**, Y. Sun, B. Wohlberg, and U. S. Kamilov, "Async-RED: A Provably Convergent Asynchronous Block Parallel Stochastic Method using Deep Denoising Priors" Proc. Int. Conf. Learn. Represent. (ICLR 2021), [**Spotlight: 114/2997 = 4%**].
- [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.**
- [7] W. Gan, Y. Sun, C. Eldeniz, **J. Liu**, H. An, and U. S. Kamilov, "Deep Image Reconstruction using Unregistered Measurements without Groundtruth," Proc. Int. Symp. Biomedical Imaging 2021 (ISBI 2021), pp. 1531-1534.
- [8] C. Eldeniz, W. Gan, S. Chen, T. J. Fraum, D. R. Ludwig, Y. Yan, **J. Liu**, T. Vahle, U. B. Krishnamurthy, U. S. Kamilov, and H. An, "Phase2Phase: Respiratory Motion-Resolved Reconstruction of Free-Breathing Magnetic Resonance Imaging Using Deep Learning Without a Ground Truth for Improved Liver Imaging," **Invest. Radiol.**, in press.
- [9] W. Gan, C. Eldeniz, **J. Liu**, H. An, and U. S. Kamilov, "Image reconstruction for MRI using deep CNN priors trained without ground truth," **Proc. 54th Asilomar Conf. Signals, Systems, & Computers**, 2020.
- [10] X. Xu, **J. Liu**, Y. Sun, B. Wohlberg, and U. S. Kamilov, "Boosting the Performance of Plug-and-Play Priors via Denoiser Scaling" **Proc. 54th Asilomar Conf. Signals, Systems, & Computers**, 2020.

- [11] **J. Liu**, Y. Sun, C. Eldeniz, W. Gan, H. An, and U. S. Kamilov, "RARE: Image Reconstruction using Deep Priors Learned without Ground Truth." **IEEE J.sel.Topics Signal Process.** pp. 1–1, 2020.
- [12] Z. Wu, Y. Sun, A. Matlock, **J. Liu**, L. Tian, and U. S. Kamilov, "SIMBA: Scalable Inversion in Optical Tomography using Deep Denoising Priors." **IEEE J.sel.Topics Signal Process.** pp. 1–1, 2020.
- [13] **J. Liu\***, Y. Sun\*, and U. S. Kamilov, "Block Coordinate Regularization by Denoising," **IEEE Trans. Comput. Imag.**, vol 6, pp. 908-921, 2020.
- [14] M. Torop, S. Kothapalli, Y. Sun, **J. Liu**, S. Kahali, D. A. Yablonskiy, and U. S. Kamilov, "Deep learning using a biophysical model for robust and accelerated reconstruction of quantitative, artifact-free and denoised images." **Magn. Reson. Med.**, vol 84, pp. 2932-2942, 2020.
- [15] G. Song, Y. Sun, **J. Liu**, and U. S. Kamilov, "A New Recurrent Plug-and-Play Prior Based on the Multiple Self-Similarity Network." **IEEE Signal Process. Lett.**, vol.27, pp 451-455, 2020.
- [16] **J. Liu**, Y. Sun, and U. S. Kamilov, "Infusing Learned Priors into Model-Based Multispectral Imaging," IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (**CAMSAP 2019**), in press.
- [17] Y. Sun, **J. Liu**, and U. S. Kamilov, "Block Coordinate Regularization by Denoising," Proc. Ann. Conf. Neural Information Processing Systems (**NeurIPS 2019**), [**Acceptance rate: 1428/6743 = 21%**].
- [18] Z. Wu, Y. Sun, **J. Liu**, and U. S. Kamilov, "Online Regularization by Denoising with Application to Phase Retrieval," Proc. IEEE Int. Conf. Comp. Vis. Workshops, (**ICCVW 2019**). [**Oral**].
- [19] **J. Liu**, Y. Sun, X. Xu, and U. S. Kamilov, "Image Restoration using Total Variation Regularized Deep Image Prior," Proc. IEEE Int. Conf. Acoustics, Speech and Signal Process. (**ICASSP 2019**), pp.7715-7719.

## APPLICABLE COURSEWORK

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- |   |  |                                     |
|---|--|-------------------------------------|
| • <i>Sparse Modeling for Imaging and Vision</i> | • <i>Algorithms for Nonlinear Optimization</i> | • <i>Optimization</i>               |
| • <i>Machine Learning</i>                       | • <i>Mathematics of Imaging Science</i>        | • <i>Stochastic Process</i>         |
| • <i>Probability and Stochastic Process</i>     | • <i>Digital signal processing</i>             | • <i>Digital Imaging processing</i> |
| • <i>Biological imaging Technology</i>          | • <i>Topology</i>                              |                                     |

## TECHNICAL SKILLS

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- Three years of experience in machine learning and image processing.
- Proficient with deep learning frameworks: Pytorch, TensorFlow, and Jax.
- Proficient with programming languages: Matlab, Java and Python.
- Fluency in imaging modality: Single image super-resolution (SR), Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Intensity Diffraction Tomography (IDT).

## PROFESSIONAL SERVICES

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### Reviewer for journals

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| • Neurocomputing                                       | • IEEE Transactions on Signal Processing ( <b>TSP</b> )        |
| • Optical Communication                                | • International Journal of Intelligent Systems ( <b>IJIS</b> ) |
| • IEEE Transactions on Image Processing ( <b>TIP</b> ) | • IEEE Transactions on Computational Imaging ( <b>TCI</b> )    |

### Reviewer for conferences

- Proc. Int. Symp. Biomedical Imaging (**ISBI**)
- Int. Conf. Comp. Vis. Workshops (**ICCVW**)
- Conf. Neural Information Processing Systems (**NeurIPS**)
- Proc. Int. Conf. Learn. Represent. (**ICLR**)

#### **Others**

- Student Member, IEEE Signal Processing Society (2019-present)

### **TEACHING SERVICE**

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#### **As Course Teaching Assistant:**

- ESE 415 Optimization, Wash U. 2020 Spring, 2021 Spring.
- CSE 534 Large-Scale Optimization, Wash U. 2020 Fall, 2021 Fall.

### **SUPERVISED STUDENTS**

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#### **Current Students (Co-advised with Prof. Kamilov):**

- Zichen Zhang (M.S. ESE), *Now M.S. student at Wash U.*

#### **Former Students (Co-advised with Prof. Kamilov):**

- Weijie Gan (M.S. CSE), *Now Ph.D student at Wash U.*
- Guangyu Meng (M.S. CSE), *Now Ph.D student at Uni. of Notre Dame*
- Jialu Wang (B.S. CSE) *Now B.S. student at Wash U.*
- Peter Ming (B.S. CSE), *Now in Google*
- Max Trop (M.S. CSE), *Now Ph.D student at Northeastern U.*
- Mingyang Xie (B.S. CSE), *Now Ph.D student at University of Maryland*
- Ziwen Wang (B.S. CSE), *Now B.S. student at Wash U.*