Jiaming Liu

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RESEARCH INTERESTS

Computer Vision, Computational Imaging, Deep Learning, Signal/Image Processing, Large-scale Optimization.

EDUCATION

Washington University in St. Louis (WUSTL), St. Louis, MO, USA   Aug. 2019 – Expected 2023
Ph.D. student in Electrical & Systems Engineering
Advisor: Prof. Ulugbek Kamilov

WUSTL, St. Louis, MO, USA   Aug. 2017 – Dec. 2018
M.S. in Electrical & Systems Engineering

University of Electronic Science and Technology of China (UESTC), Chengdu, China   Sep. 2013 – Jun. 2017
B.S. in Electronic and Information Engineering

WORK EXPERIENCE

Mitsubishi Electric Research Laboratories (MERL), Cambridge, MA, USA   May. 2023 – Aug. 2023
Research Intern
Mentor: Dr. Tim Marks

Lawrence Livermore National Laboratory (LLNL), Livermore, CA, USA   Jun. 2022 – Aug. 2022
Research Intern
Mentor: Dr. Rushil Anirudh

Los Alamos National Laboratory (LANL), Los Alamos, NM, USA   Jun. 2021 – Aug. 2021
Research Intern
Mentor: Dr. Brendt Wohlberg

AWARDS & HONORS

NeurIPS 2022 Scholar Award, NeurIPS 2019 Travel Award, WUSTL Dean's Select PhD Fellowship, 2019

RESEARCH EXPERIENCE

- **Model-based Deep Learning Methods**

  – Proposed DOLCE, a new conditional *diffusion probabilistic model* based framework for limited-angle computational tomography. This work was performed on LLNL HPC with distributed training.

  – Proposed ODER, a first *online deep equilibrium RED* framework for data-intensive imaging modalities that adopts stochastic processing of measurements within an implicit neural network.

  – Provided a *coordinate-based internal learning* (CoIL) method for continuously representation of the measurement filed, 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.
- Proposed to considerably improve the performance and stability of deep image prior (DIP) by incorporating traditional total variation (TV) regularization.

- **Plug-and-Play priors (PnP)** and **Regularization by Denoising (RED)**

  - 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 removal operators).
  - Studied and provided a practically efficient denoiser scaling technique to explicitly control the amount of PnP regularization (noise level σ).
  - 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.

SELECTED PUBLICATIONS

('*' indicates equal contribution)
Preprints

[1] S. Shoushtari*, **J. Liu***, and U. S. Kamilov, "DOLPH: Diffusion Models for Phase Retrieval." arXiv:2211.00529, 2022.

Published

[1] **J. Liu**, R. Anirudh, J. J. Thiagarajan, S. He, K. A. Mohan, U. S. Kamilov, and H. Kim, "DOLCE: A Model-Based Probabilistic Diffusion Framework for Limited-Angle CT Reconstruction." **ICCV 2023**, [**Acceptance rate: 2160/8088 = 27%**], in press.

[2] Z. Zou, **J. Liu**, B. Wohlberg, and U. S. Kamilov, "Deep Equilibrium Learning of Explicit Regularization Functionals for Imaging Inverse Problems." **IEEE Open J. Signal Process.**, in press.

[3] T. Kerepecky, **J. Liu**, X.W. Ng, D.W. Piston, and U.S. Kamilov, "Dual-Cycle: Self-Supervised Dual-View Fluorescence Microscopy Image Reconstruction using CycleGAN." Proc. IEEE Int. Conf. Acoustics, Speech and Signal Process. (**ICASSP 2023**).

[4] **J. Liu**, R. Hyder, M.S. Asif, and U.S. Kamilov, "Chapter 3 - Optimization Algorithms for MR Reconstruction." Advances in Magnetic Resonance Technology and Applications, vol 7, pp. 59–72, 2022.

[5] S. Shoushtari, **J. Liu**, Y. Hu, and U. S. Kamilov, "Deep Model-Based Architectures for Inverse Problems under Mismatched Priors." **IEEE J. Sel. Areas Inf. Theory.**, pp. 1–1, 2022.

[6] Z. Zhang, **J. Liu** and D. Yang and U.S. Kamilov, and G. Hugo, "Best in Physics (Imaging): Deep Learning-Based Motion Compensation for 4D-CBCT Reconstruction." **Medical Physics**, vol 49, 2022.

[7] **J. Liu***, X. Xu*, W. Gan, S. Shoushtari, and U. S. Kamilov, "Online Deep Equilibrium Learning for Regularization by Denoising." **NeurIPS 2022**, [**Acceptance rate: 2665/10411 = 26%**].

[8] Y. Sun, **J. Liu**, M. Xie, B. Wohlberg, and U. S. Kamilov, "CoIL: Coordinate-Based Internal Learning for Tomographic Imaging." **IEEE Trans. Comput. Imag.**, vol 7, pp. 1400-1412, 2021.

[9] **J. Liu**, M. S. Asif, B. Wohlberg, and U. S. Kamilov, "Recovery Analysis for Plug-and-Play Priors using the Restricted Eigenvalue Condition." **NeurIPS 2021**, [**Acceptance rate: 2371/9122 = 26%**].

[10] **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." **ICCV Workshop 2021 [Oral]**.

[11] 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," **ICCV Workshop 2021**.

[12] **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.

[13] **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**).

[14] 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." **ICLR 2021**, [**Spotlight: 114/2997 = 4%**].

[15] 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.

[16] 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.

[17] **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.

[18] 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.

[19] W. Gan, C. Eldeniz, **J. Liu**, H. An, and U. S. Kamilov, "Image Reconstruction for MRI using Deep CNN Priors Trained without Groundtruth," **Proc. 54th Asilomar Conf. Signals, Systems, & Computers**, 2020.

[20] 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.

[21] 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.

[22] Y. Sun*, **J. Liu***, and U. S. Kamilov, "Block Coordinate Regularization by Denoising." **IEEE Trans. Comput. Imag.**, vol 6, pp. 908-921, 2020.

[23] 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 R_2^* Images," **Magn. Reson. Med.**, vol 84, pp. 2932-2942, 2020.

[24] 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.

[25] **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**).

[26] Y. Sun, **J. Liu**, and U. S. Kamilov, "Block Coordinate Regularization by Denoising." **NeurIPS 2019**, [**Acceptance rate: 1428/6743 = 21%**].

[27] Z. Wu, Y. Sun, **J. Liu**, and U. S. Kamilov, "Online Regularization by Denoising with Application to Phase Retrieval." **ICCV Workshop 2019**, [**Oral**].

[28] **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.

TECHNICAL SKILLS

- Proficient with programming languages: Java, Python, C Programming, Matlab.

- Proficient with deep learning frameworks: Pytorch/Pytorch Lightning, TensorFlow, and Jax.

- Five years of experience in computer vision, deep learning, optimization, inverse problems and medical imaging.

- Fluency in imaging modality: single image super-resolution (SR), image deblur, compressive sensing, CT/MRI.

APPLICABLE COURSEWORK

- *Sparse Modeling for Imaging and Vision*
- *Machine Learning*
- *Probability and Stochastic Process*
- *Biological Imaging Technology*
- *Algorithms for Nonlinear Optimization*
- *Mathematics of Imaging Science*
- *Digital Signal Processing*
- *Topology*
- *Optimization*
- *Stochastic Process*
- *Digital Image Processing*

PROFESSIONAL SERVICES

Reviewer for journals

Neurocomputing, Neural Computing and Applications (**NCAA**) , Optical Communication, IEEE Transactions on Image Processing (**TIP**), IEEE Transactions on Signal Processing (**TSP**), International Journal of Intelligent Systems (**IJIS**), IEEE Transactions on Computational Imaging (**TCI**), Applied Mathematical Modelling.

Reviewer for conferences

International Conference on Machine Learning (**ICML**), International Conference on Learning Representations (**ICLR**), Neural Information Processing Systems (**NeurIPS**), IEEE/CVF Computer Vision and Pattern Recognition Conference (**CVPR**), IEEE International Conference on Acoustics, Speech and Signal Processing (**ICASSP**), IEEE International Conference on Image Processing (**ICIP**), IEEE International Symposium on Biomedical Imaging (**ISBI**), IEEE/CVF International Conference on Computer Vision (**ICCV / ICCV Workshop**).

Others

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