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BIOGRAPHY

I am a **third-year Ph.D.** student at the Department of CSE, **Washington University in St. Louis (Wash U)**, working under the supervision of **Dr. Ulugbek Kamilov**. I am currently working on efficient optimization frameworks for large-scale inverse problems by using trainable deep learning priors. The applications include image reconstruction from big noisy data, such as optical imaging and tomography. My research covers both algorithmic design and theoretical proofs.

Reach Interests: Machine Learning, Convex/Non-convex Optimization, Deep Learning, Image Reconstruction.

EDUCATION

Washington University in St. Louis, St. Louis, MO Ph.D. student in Computer Science Advisor: Prof. Ulugbek Kamilov	Aug. 2018 – Expected 2022
Washington University in St. Louis, St. Louis, MO M.S. in Data Analytics & Statistics	Aug. 2015 – May. 2017
Sichuan University, Chengdu, China B.S. in Electronic and Information Engineering Advisor: Prof. Qinggong Guo	Sep. 2011 – Jun. 2015

AWARDS

- NeurIPS 2019 Travel Award
- CSE Dept. Honor (top 10%), 2019-2020

WORKING EXPERIENCE & TECHNICAL SKILLS

Research Intern, Nvidia, Santa Clara, CA May 2021 – August. 2021

- Will work with **Dr. Orazio Gallo** in this summer on real-world computational imaging problems.

Deep learning platform: TensorFlow, Pytorch, Matlab. **Languages:** Python and Matlab

RESEARCH EXPERIENCE

Graduate Research Assistant Jan. 2018 – Current
Computational Imaging Group, Washington University in St. Louis

- *Deep Learning for Computational Imaging (see reference in Publication)*
 - First to propose a deep learning model for reconstructing high-quality images from multiple-scattered light measurements [b.1, b.2].
 - Improved the the performance and stability of the unsupervised learning approach —deep image prior (DIP)—by infusing the traditional total variation (TV) regularization [b.8].
 - Used deep learning for joint image reconstruction and registration (similar to the optical flow in video processing) without using the ground-truth images [b.17].
- *Plug-and-play priors (PnP)*

- PnP generalized the proximal methods by replacing the proximal map with a (deep) denoiser for white Gaussian noise.
- Proposed and analyzed multiple online/stochastic PnP algorithms and validated its performance on real microscope data [a.2, b.3, b.4, b.5].
- Studied and designed a practically efficient way to fine-tune the denoising strength (noise level σ) of the deep learning denoiser used in PnP algorithms [b.16].
- *Regularization by Denoising (RED)*
 - Proposed and analyzed scalable RED algorithms, including online and block-coordinate variants, for large-scale image recovery [b.6, b.9, b.10, b.11].
 - First to propose asynchronous parallel settings where a cluster of processors is considered (Async-RED), which simultaneously implements stochastic gradients and block-coordinate decomposition. $O(1/t)$ Convergence is also proved under transparent assumptions [b.18].
 - Unrolling the online RED algorithm to build an end-to-end deep unfolding network to allow fast and memory-efficient training in the presence of complex physical models [a.3].
- *Coordinate-based Neural Representation*
 - Proposed *coordinate-based internal learning (CoIL)* for continuous representation of the measurement field [a.4].
 - Super-resolve the measurements from the continuous representation to enable high-quality reconstruction.
 - Experiments showed that CoIL can constantly improve the final imaging quality for a wide range of reconstruction methods including model-based optimization and deep learning models.

PUBLICATIONS

Pre-print: (*' indicates equal contribution)

- [a 4.] **Y. Sun**, J. Liu, M. Xie, B. Wohlberg, and U. S. Kamilov, "CoIL: Coordinate-based Internal Learning for Imaging Inverse Problems." arXiv:2102.05181, **preprint**, 2021
- [a 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." arXiv:2101.09379, **preprint**, 2021
- [a 2.] M. Xie, **Y. Sun**, J. Liu, B. Wohlberg, U. S. Kamilov "Joint Reconstruction and Calibration using Regularization by Denoising." arXiv:2011.13391, **preprint**, 2020
- [a 1.] **Y. Sun***, Z. Wu*, X. Xu*, B. Wohlberg, and U. S. Kamilov, "Scalable Plug-and-Play ADMM with Convergence Guarantees." arXiv:1912.07087, **preprint**, 2020.

Published: (*' indicates equal contribution)

- [b 19.] 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**), in press.
- [b 18.] **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." International Conference on Learning Representations (**ICLR 2021**), in press. [**Spotlight: 114/2997 = 4%**]
- [b 17.] W. Gan, **Y. Sun**, C. Eldeniz, H. An and U. S. Kamilov, "Deep Image Reconstruction using Unregistered Measurements without Groundtruth." Proc. Int. Symp. Biomedical Imaging 2021 (**ISBI 2021**), in press.
- [b 16.] 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 (**ACSSC 2020**), in press.
- [b 15.] 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 (RoAR) of quantitative and artifact-free R2* images." **Magn. Reson. Med.**, vol. 84, pp. 2932-2942, 2020.
- [b 14.] 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.

- [b 13.] 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.
- [b 12.] 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.**, vol. 14, no. 6, pp. 1088-1099, 2020.
- [b 11.] 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.**, vol. 14, no. 6, pp. 1163-1175, 2020.
- [b 10.] **Y. Sun**^{*}, J. Liu^{*}, and U. S. Kamilov, "Block Coordinate Regularization by Denoising," **IEEE Trans. Comput. Imag.**, vol. 6, pp. 908-921, 2020.
- [b 9.] Z. Wu, **Y. Sun**, J. Liu, and U. S. Kamilov, "Online Regularization by Denoising with Application to Phase Retrieval," Workshop on Learning for Computational Imaging, **ICCVW 2019**, pp. 3887-3895.
- [b 8.] 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.
- [b 7.] 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**).
- [b 6.] **Y. Sun**, J. Liu, and U. S. Kamilov, "Block Coordinate Regularization by Denoising," Proc. Ann. Conf. Neural Information Processing Systems (**NeurIPS 2019**), pp. 382-392. [**Acceptance rate: 1428/6743 = 21%**]
- [b 5.] **Y. Sun**, B. Wohlberg, and U. S. Kamilov, "Plug-In Stochastic Gradient Method," Proc. International Biomedical and Astronomical Signal Processing Frontiers Workshop (**BASP 2019**), p.75.
- [b 4.] **Y. Sun**, S. Xu, Y. Li, L. Tian, B. Wohlberg, and U. S. Kamilov, "Regularized Fourier Ptychography using an Online Plug-and-Play Algorithm," Proc. IEEE Int. Conf. Acoustics, Speech and Signal Process. (**ICASSP 2019**), pp.7665-7669. [**Oral**]
- [b 3.] **Y. Sun**, B. Wohlberg, and U. S. Kamilov, "An Online Plug-and-Play Algorithm for Regularized Image Reconstruction." **IEEE Trans. Comput. Imag.**, vol.5, no.3, pp.395-408, September 2019.
- [b 2.] **Y. Sun** and U. S. Kamilov, "Stability of Scattering Decoder For Nonlinear Diffractive Imaging," Proc. 4th International Traveling Workshop on Interactions between Sparse models and Technology (**iTWIST 2018**), p.31. [**Oral**]
- [b 1.] **Y. Sun**, Z. Xia, and U. S. Kamilov, "Efficient and accurate inversion of multiple scattering with deep learning," **Optics Express**, vol.26, no.11, pp.14678-14688, May 2018.

PRESENTATIONS & TALKS

- [c 3.] "Async-RED: A Provably Convergent Asynchronous Block Parallel Stochastic Method using Deep Denoising Priors." Virtual, ICLR 2021.
- [c 2.] "Block-coordinate Regularization by Denoising." Vancouver, Canada, Dec. 8-14, NeurIPS 2019.
- [c 1.] "Stability of Scattering Decoder for Nonlinear Diffractive Imaging" Marseille, France, Nov. 21-23, iTWIST 2018.

PROFESSIONAL SERVICES

- **Reviewer** for SIAM Journal on Imaging Sciences (**SIIMS**), IEEE Journal of Selected Topics in Signal Processing (**JSTSP**), IEEE Transaction on Computational Imaging (**TCI**), IEEE Transaction on Signal Processing (**TSP**), IEEE Transaction on Image Processing (**TIP**), IEEE Signal Processing Letters (**SPL**), Digital Signal Process (**DSP**), SPIE Journal on Electronic Imaging (**JEI**), International Joint Conference on Artificial Intelligence (**IJCAI**), IEEE International Conference on Acoustics, Speech and Signal Processing (**ICASSP**)
- Student Member, IEEE (2018-present)

TEACHING SERVICE

As Course Teaching Assistant:

- CSE 585T Sparse Model for Imaging, Wash U. 2018 Fall.
- ESE 415 Optimization, Wash U. 2018 Spring.
- CSE 427S Cloud Computing and Big Data Application, Wash U. 2016 Fall, 2017 Spring, 2017 Fall.

SUPERVISED STUDENTS

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

- Mingyang Xie (B.S. CSE)
- Renhao Liu (M.S. CSE)

Past Students (Co-advised with Prof. Kamilov):

- Weijie Gan (M.S. CSE, 2020), *Now Ph.D. student at Wash U.*
- Zihui Wu (B.S. CSE, 2020), *Now Ph.D. student at Caltech*
- Max Torop (M.S. CSE, 2019), *Now Ph.D. student at Northeastern U.*
- Shiqi Xu (M.S. ESE, 2019), *Now Ph.D. student at Duke U.*
- Jiaming Liu (M.S. ESE, 2018), *Now Ph.D. student at Wash U.*
- Zach Pewitt (M.S. ESE, 2018), *Now at Boeing*
- Josehp Han (M.S. ESE, 2018), *Now at Deloitte*
- Jialong Zhang (M.S. ESE, 2018), *Now at Schlumberger*
- Fangying Zhai (M.S. ESE, 2018)
- Chunyuan Li (M.S. CSE, 2018)