Yu Sun

Email: sun.yu@wustl.edu
Phone: (+1)314-269-3402
Address: 849 Longacre Dr. APT D,
St. Louis, MO.
Homepage: sunyumark.github.io
Google Scholar: scholar.google.com/sun.yu

BIOGRAPHY

I am a **final-year Ph.D.** student at the Department of CSE, **Washington University in St. Louis (Wash U)**, working under the supervision of **Dr. Ulugbek Kamilov**. My research goal is to develop fast, efficient, and interpretable algorithms for solving large-scale imaging inverse problems. My work has been applied to several imaging applications, including computed tomography (CT), magnetic resonance imaging (MRI), and microscopy. I work on both algorithmic design and theoretical proofs.

Reach Interests: Computational Imaging, Neural Representation, Convex/Non-convex Optimization, Deep Learning, Machine Learning.

EDUCATION

Washington University in St. Louis, St. Louis, MO Aug. 2018 – Expected 2022
Ph.D. student in Computer Science
Advisor: Prof. Ulugbek Kamilov

Washington University in St. Louis, St. Louis, MO Aug. 2015 – May. 2017
M.S. in Data Analytics & Statistics

Sichuan University, Chengdu, China Sep. 2011 – Jun. 2015
B.S. in Electronic and Information Engineering
Advisor: Prof. Qinggong Guo

WORKING EXPERIENCE

Nvidia, Santa Clara, CA May 2021 – Aug. 2021
Research Intern
Mentor: Orazio Gallo

Capacity, St. Louis, MO May 2017 – Aug. 2017
Developer Intern

AWARDS

- NeurIPS 2019 Travel Award
- CSE Dept. Honor (top 15%), 2019-2020, 2020-2021

RESEARCH SUMMARY

- **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 earning approach—deep image prior (DIP)—by infusing the traditional total variation (TV) regularization [b.8].
  - Used deep learning for joint image reconstruction and registration without using the ground-truth images [a.3, b.17].
- **Plug-and-play priors (PnP)**

- Proposed and analyzed multiple online/stochastic PnP algorithms and validated its performance on real microscope data [b.3, b.4, b.5, b.20].
- 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, block-coordinate, and asynchronous distributed variants, for large-scale image recovery [b.6, b.9, b.10, b.11, 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 continuously representation of the measurement field [a.4].
  - Super-resolve the measurements using 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 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, **preprint**, 2021

[a 2.] **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 1.] M. Xie, **Y. Sun**, J. Liu, B. Wohlberg, U. S. Kamilov "Joint Reconstruction and Calibration using Regularization by Denoising." arXiv:2011.13391, **preprint**, 2020

Published: (*'$*$' indicates equal contribution*)

[b 21.] 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, June 2021

[b 20.] **Y. Sun***, Z. Wu*, X. Xu*, B. Wohlberg, and U. S. Kamilov, "Scalable Plug-and-Play ADMM with Convergence Guarantees. arXiv:1912.07087, **IEEE Trans. Comput. Imag.**, in press, 2020.

[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 Retrival," 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 Desnoising." 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

- **Journal Reviewer:** OSA **Optica**, 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**).
- **Conference Reviewer/PC:** Neural Information Processing Systems (**NeurIPS 2021**), International Joint Conference on Artificial Intelligence (**IJCAI 2020**), IEEE International Conference on Acoustics, Speech and Signal Processing (**ICASSP 2019/2020**).
- 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):

- Renhao Liu (B.S./M.S. CSE)
- Wentao Shangguan (M.S. CSE)

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

- Mingyang Xie (B.S. CSE, 2021), *Now Ph.D student at U. Maryland*
- 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, 2020), *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)