Weijie Gan

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ABOUT ME

Research Interest: My research focuses on **algorithm design and theoretical analysis for computational imaging**. My work lies at the intersection of computational imaging, computer vision, machine learning, optimization, image processing, and physics. I am passionate about incorporating cross-domain knowledge to develop the state-of-the-art computer vision and generative AI models to solve the real-world challenging problems for various imaging systems as well as establishing theoretical analysis.

Expertise: Image reconstruction/restoration, Inverse problems, Generative AI, Computational photography, Computational imaging/sensing, Image registration, Medical imaging, Self-supervised representation learning, Neural rendering.

Skills: Diffusion models, Transformer, GAN, NeRF, CLIP, Deep equilibrium models (DEQ), CNN, MLP, Pytorch, Tensorflow, Linux, CUDA, Python, C, Matlab

EDUCATION

Washington University in St. Louis, St. Louis, MO, United States 2020.08 - present
Ph.D. Candidate in Computer Science
Advisor: Prof. Ulugbek Kamilov and Prof. Hongyu An.
Awards: 2021 & 2023 Honor PhD (**top 15%**).

Washington University in St. Louis, St. Louis, MO, United States 2018.08 - 2020.05
M.Sc. in Computer Science
Awards: 2019 & 2020 Master's Fellowship and Engineering School Tuition Scholarship.

South China University of Technology, Guangzhou, China 2014.08 - 2018.05
B.Eng. in Automation & B.Business in Administration (dual-degree)
Awards: 2015 & 2016 Annual Third Prize Scholarship.

WORK EXPERIENCE

Siemens Healthineers, Princeton, NJ, United States 2024.05 - 2024.08
Research Intern in Generative AI and Inverse Problems with Dr. Mariappan Nadar.

Siemens Healthineers, Knoxville, TN, United States 2023.05 - 2023.08
Research Intern in the Reconstruction Group of Molecular Imaging with Dr. Jorge Cabello and Dr. Maurizio Conti.
Worked on an image-to-image translation conditional diffusion model for medical imaging.

Los Alamos National Laboratory (LANL), Los Alamos, NM, United States 2022.05 - 2022.10
Research Intern in the Applied Mathematics and Plasma Physics Group (T-5) with Dr. Brendt Wohlberg.
Worked on a DL-based ptychographic image reconstruction method and Scientific Computational Imaging Code (SCICO) codebase.

RESEARCH EXPERIENCE

Diffusion Models for Imaging Inverse Problems

- Developed variants of novel diffusion models to address real-world imaging tasks, such as image reconstruction, image processing, and image-to-image translation.
- [a1.] Proposed a novel conditional diffusion model for ultra-low dose positron emission tomography (PET) image denoising, achieving state-of-the-art performance.
- [a2.] Developed a diffusion model for translating low-quality PET images to MRI, used for subsequently PET reconstruction.
- [a3. WACV 2025] Proposed an innovative conditional diffusion model for state-of-the-art face video restoration.

Physics-informed Deep Learning Methods

- Extensively investigated and developed variants of learning-based optimization algorithms for various imaging tasks by combining imaging models with deep learning priors in both theory and practice.
- [a4. ICLR 2024] Developed a state-of-the-art algorithm for deformable image registration (optical flow estimation) that trains a recurrent network with effectively infinite layers, each consisting of a CNN prior and an explicit data-fidelity penalty based on the energy function.

- [a7. NeurIPS 2023] Proposed a novel and provable iterative method for solving blind inverse problems (*e.g.,* blind image deblurring) that uses pre-trained deep learning denoisers as priors on both the unknown image and the unknown measurement operator (*e.g.,* blur kernel).

Supervision without High-quality Ground-truth

- Developed variants of ground-truth-free learning algorithms for image reconstruction, leveraging dataset partitioning along temporal, spatial, or sampling dimensions in both theoretical and practical aspects.
- [a9. IEEE TCI] Developed an algorithm to train deep equilibrium models on noisy measurements (self-supervised) for image reconstruction, *provably* achieving performance comparable to supervised counterparts.
- [a12. IEEE TMI] Proposed training DL models for imaging exclusively on unregistered (motion-involved) noisy measurements by jointly performing image reconstruction and image registration.

SELECTED PUBLICATION

Please see my full publication list in my *Google Scholar*. '*' indicates equal contribution.

a1. **W. Gan***, H. Xie*, B. Zhou, X. Chen, Q. Liu, X. Guo, L. Guo, H. An, U. S. Kamilov, G. Wang, and C. Liu. "Dose-aware Diffusion Model for 3D Ultra Low-dose PET Imaging", [arXiv:2311.04248].

a2. **W. Gan**, H. Xie, C. von Gall, G. Platsch, M.T. Jurkiewicz, A. Andrade, U.C. Anazodo, U.S. Kamilov, H. An, J. Cabello. "Pseudo-MRI-Guided PET Image Reconstruction Method Based on a Diffusion Probabilistic Model", [arXiv:2403.18139].

a3. Z. Zou, J. Liu, S. Shoushtari, Y. Wang, **W. Gan**, U. S. Kamilov. "FLAIR: A Conditional Diffusion Framework with Applications to Face Video Restoration", Winter Conference on Applications of Computer Vision (**WACV**), 2025

a4. **W. Gan***, J. Hu*, Z. Sun, H. An, and U. S. Kamilov. "A Plug-and-Play Image Registration Network", Proc. Int. Conf. Learn. Represent. (**ICLR**), 2024.

a5. **W. Gan***, Y. Hu*, C. Ying, T. Wang, C. Eldeniz, J. Liu, Y. Chen, H. An, and U. S. Kamilov, "SPICER: Self-Supervised Learning for MRI with Automatic Coil Sensitivity Estimation and Reconstruction", **Magn. Reson. Med. (MRM)**, 2024.

a6. **W. Gan**, Q. Zhai, M. T. McCann, C. G. Cardona, U. S. Kamilov, and B. Wohlberg. "PtychoDV: Vision Transformer-Based Deep Unrolling Network for Ptychographic Image Reconstruction", **IEEE Open J. Signal Process. (OJSP)**, 2024.

a7. **W. Gan**, S. Shoushtari, Y. Hu, J. Liu, H. An, and U. S. Kamilov, "Block Coordinate Plug-and-Play Methods for Blind Inverse Problems", Proc. Adv. Neural Inf. Process. Syst. **(NeurIPS)**, 2023.

a8. **W. Gan***, H. Gao*, Z. Sun, and U. S. Kamilov, "SINCO: A Novel structural regularizer for image compression using implicit neural representations", Proc. IEEE Int. Conf. Acoustics, Speech and Signal Process. (**ICASSP**), 2023.

a9. **W. Gan**, C. Ying, P. E. Boroojeni, T. Wang, C. Eldeniz, Y. Hu, J. Liu, Y. Chen, H. An, and U. S. Kamilov, "Self-Supervised Deep Equilibrium Models for Inverse Problems with Theoretical Guarantees and Applications to MRI Reconstruction", **IEEE Trans. Comput. Imag. (TCI)**, 2023.

a10. J. Liu, X. Xu, **W. Gan**, S. Shoushtari, U. S. Kamilov, "Online Deep Equilibrium Learning for Regularization by Denoising", Proc. Adv. Neural Inf. Process. Syst. **(NeurIPS)**, 2022.

a11. W. Shangguan, Y. Sun, **W. Gan**, U. S. Kamilov, "Learning Cross-Video Neural Representations for High-Quality Frame Interpolation", Proc. European Conference on Computer Vision (**ECCV**), 2022.

a12. **W. Gan**, Y. Sun, C. Eldeniz, J. Liu, H. An, and U. S. Kamilov, "Deformation-Compensated Learning for Image Reconstruction without Ground Truth", **IEEE Trans. Med. Imag. (TMI)**, 2022. **[impact factor=11.03]**

a13. **W. Gan***, C. Eldeniz*, S. Chen, T. J. Fraum, D. R. Ludwig, Y. Yan, J. Liu, T. Vahle, U. B. Krishnamurthy, U. S. Kamilov, H. An, "Phase2Phase: Respiratory Motion-Resolved Reconstruction of Free-Breathing MRI Using Deep Learning Without a Ground Truth for Improved Liver Imaging", **Investig. Radiol.**, 2021. **[impact factor=10.06]**

a14. **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.

a15. **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 (**ISBI**), 2021.

a16. **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 (**Asilomar**), 2020.