Deliang Wei

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Education

East China Normal University — Shanghai, China
B.Sc. in Mathematics and Applied Mathematics; — *Sep 2015 – Jun 2019*
M.Sc and Ph.D. in Mathematics; under the supervision of Prof. Fang Li; — *Sep 2019 – Present*

Chinese University of Hong Kong — Hong Kong, China
Research Assistant in Mathematics; under the supervision of Prof. Tieyong Zeng; — *Dec 2022 – Feb 2023*

Research Interests and Experiences

School of mathematics — East China Normal University
Ph.D. candidate — *Sep 2021 – Present, Full-time*

- Interested in solving imaging inverse problems via deep neural networks. Implemented various image processing tasks, including denoising, deblurring, super resolution, and medical imaging. Conducted a general review on convex analysis, first-order optimization methods, monotone operator theory, while staying updated on the state-of-the-art iterative image processing methods, especially the plug-and-play (PnP) methods with deep denoisers and convergence guarantee.
- Proposed a new convergent PnP method with weaker assumptions (pseudo-contractiveness) on the deep denoisers. Developed a special training strategy based on holomorphic transformation and functional calculi to ensure the assumptions while not compromising network performance. We give the first proof that a pseudo-contractive operator composed with an averaged operator is still pseudo-contractive. Established new PnP methods by incorporating Ishikawa methods into operator splitting methods.
- Proposed a Hamiltonian and spectral regularized denoiser for PnP-ADMM method on Poisson inverse problems. The denoiser is proved to be cocoericve and conversative. We prove the convergence of PnP-ADMM without requiring a Lipschitz gradient of the fidelity, or strong convexity. The paper is under preparation.
- Developed a convergent PnP method based on an adaptively averaged Douglas-Rachfold splitting method for Rician noise removal and Cauchy noise removal.
- Developed a convergent algorithm DeepSPIM based on a semi-proximal ADMM framework and gradient step denoiser assumption for sparse-view CT reconstruction. Applied for an invention patent.

School of mathematics — East China Normal University
M.Sc — *Sep 2019 – Jun 2021, Full-time*

- Interested in solving differential games via second-order methods.
- Participated in the project "*Intelligent Basic Model Based on Harmonic (Symplectic) Game Dynamics*", and developed an efficient second-order method with predictions for differential games like GANs.

Honor and Research Project

- National scholarship for doctoral students, 2024.
- East China Normal University Academic Innovation Promotion Program for Excellent Doctoral Students, YBNLTS2024-018: A spectral regularization method for neural networks via holomorphic functional calculi.
- Selected for the 2024 China Association for Science and Technology (CAST) Young Talent Support Program - Special Project for Doctoral Students, supported by China Computer Federation (CCF) society.

Invention Patent

- Invention Patent: A semi-proximal based low dose electronic computed tomography imaging method. Under review.

Preprints

- Wei D, Chen P, Li F. Plug-and-Play Ishikawa Methods with Pseudo-Contractive Denoisers[J]. Submitted to *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 2024, under review.
- Wei D et al.. Learning Cocoercive Conservative Denoisers via Helmholtz-Hodge Decomposition for Poisson Imaging Inverse Problems. 2024, under preparation.

Publications

- Wei D, Chen P, Li F. Learning pseudo-contractive denoisers for inverse problems[C]. *Proceedings of the 41st International Conference on Machine Learning, PMLR,* 235:52500-52524, 2024.
- Wei D, Li F, Shen X, Zeng T. DeepSPIM: Deep Semi-Proximal Iterative Method for Sparse-View CT Reconstruction with Convergence Guarantee[J]. *CSIAM Transactions on Applied Mathematics,* 5(3): 421–447, 2024.
- Chen P, Li F, Wei D, Lv C. Spatiotemporal traffic data completion with truncated minimax-concave penalty[J]. *Transportation Research Part C: Emerging Technologies*, 2024, 164: 104657.
- Chen P, Li F, Wei D, Lv C. Low-Rank and Deep Plug-and-play Priors for Missing Traffic Data Imputation[J]. *IEEE Transactions on Intelligent Transportation Systems*, 2024.
- Wei D, Weng S, Li F. Nonconvex Rician noise removal via convergent plug-and-play framework[J]. *Applied Mathematical Modelling*, 2023, 123: 197-212.
- Wei D, Li F, Weng S. Cauchy Noise Removal via Convergent Plug-and-Play Framework with Outliers Detection[J]. *Journal of Scientific Computing*, 2023, 96(3): 76.
- Wei D, Chen P, Li F, Zhang X. Efficient second-order optimization with predictions in differential games[J]. *Optimization Methods and Software*, 2023: 1-26.
- Wei D, Li F. Flexible parameter selection methods for Rician noise removal with convergence guarantee[J]. *International Journal of Computer Mathematics*, 2022, 99(11): 2250-2271.

Conferences Attended

- International Conference on Machine Learning, 2024, Vienna, Austria.
  Poster Title: 'Learning Pseudo-Contractive Denoisers for Inverse Problems'
- International Conference of Union of Mathematical Imaging, 2024, Jinhua, China.

Given talks

- December 12, 2024, in the seminar of Hopkins Computational Imaging Group of Professor Sun Yu.
  Presentation: 'Plug-and-Play Ishikawa Process with Pseudo-Contractive Denoisers for Imaging Inverse Problems'

Skills

Languages:	Chinese, English
Technologies:	MATLAB, Pytorch, Linux
Teaching:	Prof. Cheng's teaching assistant for the real analysis class from Sep 2020 to Jun 2021 Organizer of the monotone operator seminar from Sep 2023 to Dec 2023

References

- Professor Fang Li, Ph.D. supervisor
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  East China Normal University
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- Professor Tieyong Zeng
  Department of Mathematics
  The Chinese University of Hong Kong
  (zeng@math.cuhk.edu.hk)

- Professor Hang Wang
  School of Mathematical Sciences
  East China Normal University
  (wanghang@math.ecnu.edu.cn)
- Professor Tao Cheng, teaching reference
  Associate Dean of the School of Mathematical Sciences
  East China Normal University
  (tcheng@math.ecnu.edu.cn)