Guanxiong Luo, Dr. rer. nat. (Computer Science)

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Summary: My academic background overlaps machine learning, magnetic resonance imaging, computational imaging, signal/image processing, and inverse problems. I am passionate about remaining at the intersection of these fields and driving innovation from the sides of both imaging and machine learning.

Expertise: Machine learning | Bayesian inference | Computational imaging | Generative modeling | Computer vision | Image/Signal processing | MRI physics | My projects @ ggluo.github.io

Employment

01/2020–present **Research Scientist** at University Medical Center Göttingen, Germany

1. Employed under the project "Learning quantitative imaging biomarkers from MRI raw data," funded by the Lower Saxony Ministry of Science and Culture.
2. Develop and implement machine learning models for large-scale data analysis for MR application.
3. Collaborate with cross-disciplinary teams from clinicians at UMG and computation teams from Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen (GWDG).
4. Publish multiple papers in journals and conferences and tutor students in their research projects.

09/2017–11/2019 **Research Assistant** at LKS Faculty of Medicine, University of Hong Kong

1. Improved MR Fingerprinting by incorporating physics information into numerical optimization technique via MR signal simulation. 2. Applied Bayesian estimation to MRI reconstruction from incomplete k-space by exploiting the prior knowledge learned by generative models.

Projects (see relevant publications in later sections)

Solving inverse problems by distilling diffusion models via expectation maximization **2024 Ongoing**

1. 3D reconstruction in computer vision and k-space interpolation in MRI are formulated as inverse problem, solved by maximizing the expectation over the pretrained probabilistic diffusion space.

Autoregressive image diffusion: generation of image sequence and its application in MRI **2023,2024**

1. Combined the autoregressive model with diffusion model to generate sequentially coherent images.
2. Applied it to fast MRI reconstruction, which outperformed standard diffusion model and reduced hallucinations in various MRI reconstruction tasks.

Train generative priors magnitude-only images using phase augmentation for MRI **2022,2023**

1. Implemented workflow to synthesize complex-valued images for training robust and generic priors.
2. Performed distributed training on HPC across multiple GPU-nodes by data parallelism (~1mil images).

Bayesian MRI reconstruction with joint uncertainty estimation using diffusion models **2021, 2022**

1. Presented Bayesian framework for simulating images from posterior probability in the setting of MRI.
2. Performed statistic analysis on the samples to evaluate the trustworthiness of the reconstruction.

Deploy generative image priors for image reconstruction using BART **2020, 2021**

1. Integrated deep learning models into BART (a MRI reconstruction toolbox) using Tensorflow C API.
2. Developed a command line tool to convert models implemented with Tensorflow/Pytorch/JAX and deploy them with TensorRT as backend for inference.

Technical Skills (see relevant code repositories in my GitHub)

Open source repos:	git: **spreco**, **AID**, **c++/c-trt**, **image priors**, **bart-trt**
Use often:	Python, PyTorch, TensorFlow, C, JAX, LaTeX **less often:** C++, Matlab
Development environment:	VS Code + Shell + Git on Debian, HPC, Docker

Academic Records

Education

10/2020–11/2023 PhD in Computer Science, University of Göttingen, Göttingen, Germany
09/2017–10/2019 M.Phil in Biomedical Engineering, The University of Hong Kong, China
09/2013–07/2017 B. Eng in Biomedical Engineering, Xi'an Jiaotong University, Xi'an, China

Thesis

[1] *Development of Advanced Generative Priors for MRI Reconstruction*, PhD thesis, 2023. Download
[2] *The application of generative networks in MR image reconstruction*, M.Phil thesis, 2019. Download

Award & Honor

2023	PhD Graduated with Magna cum Laude, University of Göttingen
2017	Postgraduate Scholarship awarded by The University of Hong Kong
2017	Outstanding Graduate of Class 2017 awarded by Xi'an Jiaotong University
2015	National Encouragement Scholarship awarded by Xi'an Jiaotong University
2015	Meritorious Winner in American Mathematical Contest in Modeling (MCM)

Journal Publications

[1] **G. Luo**, S. Huang, M. Uecker. *Autoregressive Image Diffusion: Generating Image Sequence and Application in MRI*, arXiv:2405.14327

[2] Z. Wang, **G. Luo**, Y. Li, et al. *Using a Deep Learning Prior for Accelerating Hyperpolarized 13C Magnetic Resonance Spectroscopic Imaging on Synthetic Cancer Datasets*, MRM 2024

[3] **G. Luo**, X. Wang, M. Blumenthal, et al. *Generative Image Priors for MRI Reconstruction Trained from Magnitude-Only Images*, arXiv:2308.02340

[4] **G. Luo**, M. Blumenthal, M. Heide, et al. *Bayesian MRI Reconstruction with Joint Uncertainty Estimation Using Diffusion Priors*, MRM 2023.

[5] M. Blumenthal, **G. Luo**, M. Schilling, H. C. M. Holme, et al. *Deep, deep learning with BART*, MRM 2023.

[6] **G. Luo**, N. Zhao, W. Jiang, et al. *MRI reconstruction using deep Bayesian estimation* , MRM 2020.

Conference Publications

[1] S. Huang, **G. Luo***, X. Wang, et al. *Noise Level Adaptive Diffusion Model for Robust Reconstruction of Accelerated MRI*, MICCAI 2024: 27th International Conference, Marrakesh, Morocco. (*equal contribution)

[2] **G. Luo**, M. Blumenthal, M. Heide, et al. *MRI Reconstruction Via Data-Driven Markov Chains With Joint Uncertainty Estimation: Extended Analysis*, Oral Session, ISMRM 2023.

[3] **G. Luo**, M. Kuang, P. Cao. *Generalized Deep Learning-based Proximal Gradient Descent for MR Reconstruction*, Portoroz, Slovenia, AIME 2023.

[4] **G. Luo**, M. Heide, M. Uecker. *Using data-driven Markov chains for MRI reconstruction with Joint Uncertainty Estimation*, Power Pitch Session, ISMRM 2022.

[5] M. Blumenthal, **G. Luo**, M. Schilling, et al. *NLINV-Net: Self-Supervised End-2-End Learning for Reconstructing Undersampled Radial Cardiac Real-Time Data*, Oral Session, ISMRM 2022.

[6] **G. Luo**, M. Blumenthal, X. Wang, et al. *All you need are DICOM images*, Poster Session, ISMRM 2022.

[7] **G. Luo**, X. Wang, V. Roeloffs, et al. *Joint estimation of coil sensitivities and image content using a deep image prior*, Oral Session, ISMRM 2021.

[8] **G. Luo**, P. Cao. *MRI Reconstruction Using Deep Bayesian Inference*, Oral Session, ISMRM 2020.

Talks

09/2023	About *Bayesian MRI reconstruction with joint uncertainty estimation using diffusion priors* at 11th Applied Inverse Problems Conference, Göttingen
01/2023	About *Estimate the uncertainty for MRI reconstruction with learned Bayesian models* at Institute for Numerical and Applied Mathematics, University of Göttingen
07/2022	About *Data Driven Methods for Fast MRI reconstruction* at Cardiac MRI Lab, SJTU
09/2021	About *Bayesian Image Reconstruction with Learned Prior* at Workshop on MRI Acquisition & Reconstruction, MGH Harvard
05/2021	About *Using image priors with BART* at ISMRM 2021 Software Session on BART

Teaching and Tutoring

WS 2021	Tutorials for undergraduates and graduates, teaching assistant for a course on deep learning
WS 2021	Teaching assistant for a course on the application of data science to smart city
WS 2022	Tutored one master thesis on MRI reconstruction using deep learning
WS 2023	Tutored one bachelor thesis on MRI reconstruction using diffusion models

Service to the Profession

Reviews for NeurIPS(2024), IEEE TMI, IEEE TCI, Artificial Intelligence in Medicine, ISMRM

Other

Languages Mandarin, English | **Hobbies** Soccer, Tennis, Photography, Calligraphy | **Citizenship** Chinese