

Rui Luo

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SUMMARY

I am an M.S. candidate at the School of Biomedical Engineering, ShanghaiTech University. I am experienced in non-Cartesian MRI techniques, including non-Cartesian gradient waveform design and non-Cartesian image reconstruction. My techniques can be integrated with a wide range of traditional MRI applications for enhanced performance, such as quantitative MRI and real-time MRI.

Keywords: MRI, non-Cartesian MRI, method development, engineering, numerical optimization.

RESEARCH

Though non-Cartesian MRI is efficient in data acquisition, there are several barriers to overcome before widespread clinical adoption. My M.S. research focuses on addressing those barriers, including currently inefficient gradient waveform design and sampling density compensation.

Real-Time Gradient Waveform Design for Arbitrary k -Space Trajectories

Non-Cartesian MRI is known for its highly efficient sampling, while its gradient waveform design is still time-consuming and remains a barrier to clinical adoption. In this work, I propose a general-purpose, highly efficient method for non-Cartesian gradient waveform design. Comprehensive simulation and imaging experiments are conducted across seven different 2D and 3D trajectories. Results demonstrate a 90% relative reduction in computation time and simultaneously a 99% relative reduction in slew-rate error compared to the baseline method. Computation time is reduced to less than the duration of the acquisition window, enabling real-time gradient waveform design and new possibilities for trajectory design. This work is under review at *IEEE Transactions on Biomedical Engineering*. The preprint is available at <https://arxiv.org/abs/2507.21625>.

Non-Iterative Sampling Density Compensation for 3D Non-Cartesian MRI

Another drawback to the clinical translation of non-Cartesian MRI is its relatively slow and complex reconstruction. An important step in non-Cartesian reconstruction is the sampling density compensation. The conventional method involves direct non-Cartesian convolution and iterative optimization, which is inefficient and takes a prohibitively long time for 3D trajectories. In this work, I propose deconvolving the point spread function with Fast Fourier Deconvolution. This method is capable of deriving the density compensation function in at most two steps. Preliminary results show that this method substantially reduces computation time and enables efficient computation of the 3D density compensation function. I have completed the software development, feasibility study and simulation experiments.

In summary, I aim to make non-Cartesian MRI not only efficient, but also practical and reliable. Future publications are expected to concentrate on optimizing a wide range of traditional MRI applications with my non-Cartesian techniques, and also on the new challenges and possibilities introduced by these techniques.

EXPERIENCE

September 2025, Reviewer, *IEEE Transactions on Medical Imaging*

I independently reviewed one manuscript for *IEEE Transactions on Medical Imaging* via ScholarOne, and my comment was adopted as the primary concern in the decision letter.

Fall 2024, Teaching Assistant, *Principle of Magnetic Resonance Imaging*

I independently designed the final project, including Fourier simulation and compressed sensing reconstruction of non-Cartesian MRI, and mentored 33 students by helping them connect the Fourier transform with the principle of MRI.

EDUCATION

2023 - present	M.S. (Biomedical Engineering) at ShanghaiTech University	(GPA: 3.92/4.00)
2018 - 2022	B.S. (Automation) at Shandong University	

SKILLS

Pulse sequence design (non-Cartesian MRI),
Image reconstruction (non-Cartesian MRI),
Python (with C++ backend / GPU acceleration) / MATLAB / C++ / CUDA programming,
Academic writing and publishing,
Numerical optimization (CG, ADMM, etc.),
Deep-learning (UNet, Transformer, etc.),
Circuit design and embedded programming.