Molin Zhang

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http://molinzhang.github.io/

Biography

My name is Molin Zhang and I'm a fifth-year PhD student at Electrical Engineering and Computer Science at MIT working with Prof. Elfar Adalsteinsson.
My research centers on the intersection of computational imaging, computer vision, and signal processing, with a particular emphasis on medical imaging. I delve into the realm of inverse problems, utilizing numerical simulations to develop innovative solutions.

Employment History

06/2023 – 09/2023 **Computational Camera Imaging Intern**
Mobile Processor Innovation, Samsung Research America
Developed novel prototypes of memory-efficient AI-powered camera imaging pipelines, showcasing their tangible viability across diverse imaging applications such as image demosaicing, denoising, registration, and more.

06/2021 – 09/2021 **AI/ML Research Intern**
GE Healthcare
Designed and implemented an AI model utilizing Convolutional Neural Networks (CNN) for the precise assessment of Leg Length Discrepancy (LLD) and angle measurement through X-ray image analysis. **Patent granted.**

Education

2021 – Now **Ph.D., Massachusetts Institute of Technology**
Electrical Engineering and Computer Science
GPA: *5.0/5.0*
Research focus: *Computational imaging; Computer vision; Signal processing; Medical imaging; Inverse problem; Numerical simulation*
Supervisor: Professor Elfar Adalsteinsson

2019 – 2021 **M.Sc. Massachusetts Institute of Technology**
Electrical Engineering and Computer Science
Thesis title: *A pipeline for zoomed fetal MRI.*

2015 – 2019 **B.S. Tsinghua University**
Engineering Physics
GPA: *3.8/4.0.* **Ranking:** $1^{st}/140$.

Research Project

04/2023 – Now **Multi-contrast super-resolution MR with generative AI**
Electrical Engineering and Computer Science, MIT, Prof. Elfar Adalsteinsson.
Improving super-resolution performance by exploiting shared information among multi-contrast MR images to solve the inverse problem with diffusion model.

Research Project (continued)

06/2022 –08/2022 **Uncertainty estimation with CRLB on quantitative MR with dictionary matching**
Electrical Engineering, Stanford, Prof. Kawin Setsompop.
Optimized parameters of acquisition parameters based on the uncertainty estimation of quantitative MR with dictionary matching.

11/2021 –04/2022 **Self-supervised inverse problem solving for MR reconstruction**
Electrical Engineering and Computer Science, MIT, Prof. Elfar Adalsteinsson.
Developed a novel self-supervised method for single MR data point reconstruction with the incorporation of linear subspace model.

09/2021 –02/2023 **Novel selective MR pulse design with auto-differentiation**
Electrical Engineering and Computer Science, MIT, Prof. Elfar Adalsteinsson.
Designed a novel pipeline for the optimization of MR excitation pulses with derived crusher gradient effect based on Fourier transform analysis and decomposition property of MR Bloch equation.

09/2019 –05/2021 **Novel pose estimation techniques in MRI**
Electrical Engineering and Computer Science, MIT, Prof. Elfar Adalsteinsson.
Exploited and developed methods with Convolutional Neural Network (CNN) and Deep Reinforcement Learning (DRL) for pose estimation in 3D fetal MRI.

Research Publications

Journal Articles

1. Y. Arefeen, J. Xu, **M. Zhang**, *et al.*, "Latent signal models: Learning compact representations of signal evolution for improved time-resolved, multi-contrast mri," *Magnetic Resonance in Medicine*, 2023.
2. **M. Zhang**, Y. Arefeen, N. Arango, J. P. Stockmann, J. White, and E. Adalsteinsson, "Stochastic-offset-enhanced restricted slice excitation and 180° refocusing designs with spatially non-linear Δbo shim array fields.," *Magnetic Resonance in Medicine*, 2023.
3. **M. Zhang**, N. Arango, J. P. Stockmann, J. White, and E. Adalsteinsson, "Selective rf excitation designs enabled by time-varying spatially non-linear Δbo fields with applications in fetal mri," *Magnetic Resonance in Medicine*, vol. 87, no. 5, pp. 2161–2177, 2022.

Conference Proceedings

1. **M. Zhang**, J. Xu, Y. Arefeen, and E. Adalsteinsson, "Zero-shot self-supervised joint temporal image and sensitivity map reconstruction via linear latent space," in *Medical Imaging with Deep Learning*, 2023.
2. J. Xu, **M. Zhang**, L. Vasung, *et al.*, "An automated pose and motion estimation pipeline in dynamic 3d fetal mri," in *International Society for Magnetic Resonance in Medicine 30th Scientific Meeting*, 2022.
3. **M. Zhang**, Y. Arefeen, N. Arango, J. P. Stockmann, J. White, and E. Adalsteinsson, "Selective refocusing pulse design via time-varying nonlinear shim array fields and rf pulse with decomposition property," in *International Society for Magnetic Resonance in Medicine 30th Scientific Meeting*, 2022.
4. **M. Zhang**, J. Xu, Y. Arefeen, and E. Adalsteinsson, "Zero-shot self-supervised learning for 2d t2-shuffling mri reconstruction," in *International Society for Magnetic Resonance in Medicine 30th Scientific Meeting*, 2022.

5. **M. Zhang**, J. Xu, Y. Arefeen, and E. Adalsteinsson, "Inner volume excitation via joint design of time-varying nonlinear shim-array fields and rf pulse," in *International Society for Magnetic Resonance in Medicine 29th Scientific Meeting*, 2021.

6. J. Xu, **M. Zhang**, E. A. Turk, P. E. Grant, P. Golland, and E. Adalsteinsson, "3d fetal pose estimation with adaptive variance and conditional generative adversarial network," in *Medical Ultrasound, and Preterm, Perinatal and Paediatric Image Analysis: First International Workshop, ASMUS 2020, and 5th International Workshop, PIPPI 2020, Held in Conjunction with MICCAI 2020, Lima, Peru, October 4-8, 2020, Proceedings 1*, Springer, 2020, pp. 201–210.

7. **M. Zhang**, J. Xu, E. Abaci Turk, P. E. Grant, P. Golland, and E. Adalsteinsson, "Enhanced detection of fetal pose in 3d mri by deep reinforcement learning with physical structure priors on anatomy," in *Medical Image Computing and Computer Assisted Intervention–MICCAI 2020: 23rd International Conference, Lima, Peru, October 4–8, 2020, Proceedings, Part VI 23*, Springer, 2020, pp. 396–405.

8. **M. Zhang**, J. Xu, E. Turk, *et al.*, "Landmark detection of fetal pose in volumetric mri via deep reinforcement learning," in *International Society for Magnetic Resonance in Medicine 28th Scientific Meeting*, 2020.

9. J. Xu, **M. Zhang**, E. A. Turk, *et al.*, "Fetal pose estimation in volumetric mri using a 3d convolution neural network," in *Medical Image Computing and Computer Assisted Intervention–MICCAI 2019: 22nd International Conference, Shenzhen, China, October 13–17, 2019, Proceedings, Part IV 22*, Springer, 2019, pp. 403–410.

10. **M. Zhang**, J. Xu, E. Turk, *et al.*, "Fetal pose estimation via deep neural network by detection of fetal joints, eyes, and bladder," in *International Society for Magnetic Resonance in Medicine 27th Scientific Meeting*, 2019.

Skills

Languages	English and Chinese.
Coding	Python and MATLAB
Domain knowledge	Computational Photography; Camera/ISP pipeline; Medical Imaging; Image processing; Image analysis; Pose estimation and tracking; Denoising; Demosaicing; Registration; Simulation; Inverse problem; Deep learning; Machine Learning; Reinforcement learning; MR pulse optimization; Tensorflow; Pytorch.

Miscellaneous Experience

Awards and Achievements

2019 **Presidental Scholarship**, Massachusetts Institute of Technology.

2018 **National Scholarship**, Tsinghua University.

Services

2023 **Reviewer**, MICCAI 2023.

Reviewer, AAAI 2024, AAAI workshop 2024.

References

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