Zhiyang Fu

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CITIZENSHIP

People's Republic of China

SUMMARY

- Ph.D. in Electrical & Computer Engineering with research related to image reconstruction and quantitative parameter mapping of Magnetic Resonance Imaging (MRI)
- Broad knowledge in Engineering: information theory, detection and estimation in engineering systems, channel coding, linear and nonlinear optimization, etc.
- Knowledge of digital image processing, medical image science and computer vision
- Knowledge of fundamental theories of machine learning and convolutional neural networks
- Knowledge of k-space sampling design for non-Cartesian parallel imaging
- Experience of undergraduate laboratory teaching in Engineering
- Experience of compressed sensing based image reconstruction for MR parameter mapping
- Experience of deep learning based image reconstruction for MR parameter mapping
- Experience of deep learning based image reconstruction for dedicated breast CT
- 5-year experience of Unix/Linux operating system
- Operation of Siemens MRI scanner user interface for image acquisition
- Operation of electronic test and instrumentation and design of electronic circuits
- Operation of inverted confocal microscope and digital I/O device
- Project on stock price volatility forecasting using machine learning
- Proficient in Python, MATLAB, and PyTorch, familiar with Torch7, Lua, Caffe, LabView, etc

EDUCATION

Ph.D. in Electrical & Computer Engineering

University of Arizona — Tucson, AZ | Aug 2014 - Present

- GPA 4.0/4.0, minored in College of Optical Science
- Advised by Ali Bilgin and Maria I. Altbach
- **Expected to graduate in Jan 2021**

M.S. in Electrical & Computer Engineering

University of Arizona — Tucson, AZ | Sep 2014 - May 2017

- GPA 4.00/4.00

B.S. in Optical Engineering

Zhejiang University — Hangzhou, Zhejiang | Sep 2010 - Jun 2014

- GPA 3.85/4.00
- Thesis: Positioning Quantum Dots using Video Particle Tracking

Graduate Coursework

ECE 559	Fundamentals of Optics for Electrical Engineers
ECE 503	Probability and Random Processes for Engineering Applications
OPTI 637	Principles of Image Science
OPTI 536	Introduction to Image Science
SIE 545	Fundamentals of Optimization
OPTI 636	Noise in Imaging Systems
ECE 501B	Advanced Linear Systems Theory
OPTI 638	Advanced Medical Imaging

ECE 639	Detection and Estimation in Engineering Systems
ECE 529	Digital Signal Processing
ECE 637	Channel Coding
ECE 532	Digital Image Analysis
ECE 523	Engineering Applications of Machine Learning and Data Analytics
ECE 578	Fundamentals of Computer Networks
CSC 577	Introduction to Computer Vision
CS 231n	Convolutional Neural Networks for Visual Recognition (Stanford course, self-taught online)

RESEARCH EXPERIENCE

Graduate Research Assistant

Dept. of Medical Imaging, University of Arizona — Tucson, AZ | Aug 2015 – Present

- **1D GRAPPA in the k_z direction for non-cartesian k-space sampling**
  To accelerate k-space acquisition with slice parallel imaging, formulated and implemented a 1D GRAPPA algorithm in the k_z direction for 3D non-cartesian k-space sampling, e.g. stack-of-stars.
- **Developed compressed sensing approaches for highly accelerated MR parameter mapping**
  To reduce reconstruction time of MR parameter mapping using highly undersampled radial data acquisition, proposed an alternative constrained formulation of MR parameter mapping problem using Alternating Direction Method of Multipliers (ADMM); Showed at least two times faster convergence and reduced sensitivity to regularization parameters in both simulations and in vivo data.
- **Developed deep learning based approaches for accelerated MR parameter mapping**
  Demonstrated feasibility of deep learning based approaches for accelerated MR parameter mapping; Constructed a multi-scale ResNet that yields accurate parameter maps with reconstruction times several orders of magnitude faster than model-based compressed sensing methods.
- **Investigated impact of priors on deep learning driven MR parameter mapping**
  (1) Designed a multi-input ResNet for MR parameter mapping where data acquired to estimate one parameter can be used to enhance the reoncstruction of another at extremely high undersampling rate. (2) Evaluated the use of relaxation signal model driven constraints in deep learning based MR parameter mapping; Showed these subspace constraints can be incorporated either as pre-processing step or into the loss function to improve accuracy and sensitivity of MR parameter estimations.
- **Dedicated breast computed tomography using deep neural networks**
  (also under supervision of Prof. Andrew Karellas and Prof. Srinivasan Vedantham)
  To reduce radiation dose in breast CT to a level that may be suitable for breast cancer screening, designed a multi-slice residual dense network for highly sparse-view (100 views) breast CT data; Quantitatively illustrated significantly reduced MSE and bias compared to FDK method ($p < 0.001$).

Graduate Research Assistant

Electric & Computer Engineering, University of Arizona — Tucson, AZ | Aug 2014 – Aug 2015

- **Independent research with Prof. Mark A. Neifeld on image reconstruction of X-ray CT Imaging**
  Implemented both linear algorithms, such as Principal Component Analysis (PCA) based denoising and Wiener filtering, and non-linear methods including (fast) Iterative Soft-Thresholding Algorithm (ISTA) and Chambolle's Total Variation (TV) minimization for CT image reconstruction.

Graduate Teaching Assistant

Electric & Computer Engineering, University of Arizona — Tucson, AZ | Aug 2014 - May 2015

- **Taught the laboratory section of ECE 351C Electronic Circuits**
  Prepared step-by-step laboratory instructions and trained undergraduate students for operating electronic test equipment and building electronic circuits

PUBLICATIONS

[1] M. B. Keerthivasan, M. Saranathan, K. Johnson, Z. Fu, C. C. Weinkauf, D. R. Martin, A. Bilgin, and M. I. Altbach. An efficient 3d stack-of-stars turbo spin echo pulse sequence for simultaneous T2-weighted imaging and T2 mapping. Magnetic Resonance in Medicine, 82(1):326–341, July 2019.

[2] Z. Li, Z. Fu, A. Bilgin, K. Jonson, J.-P. Galons, D. R. Martin, and M. I. Altbach. Rapid high-resolution volumetric T1 mapping using a highly accelerated radial FLASH technique. Magnetic Resonance in Medicine, In Resubmission.

[3] Z. Fu, Z. Li, M. B. Keerthivasan, D. R. Martin, M. I. Altbach, and A. Bilgin. T1 and T2 mapping using highly accelerated radial data acquisition and alternating direction method of multipliers. In The International Society for Magnetic Resonance in Medicine (ISMRM), April 2017.

[4] Z. Fu, S. Mandava, M. B. Keerthivasan, Z. Li, D. R. Martin, M. I. Altbach, and A. Bilgin. A multi-scale residual network for accelerated radial MR parameter mapping. Magnetic Resonance in Medicine, In resubmission.

[5] Z. Fu, S. Mandava, M. B. Keerthivasan, D. R. Martin, M. I. Altbach, and A. Bilgin. MR parameter mapping using sequential multi-contrast acquisitions and multi-input multi-scale ResNet. In ISMRM Workshop on Machine Learning, Part II, October 2018.

[6] Z. Fu, S. Mandava, M. B. Keerthivasan, D. R. Martin, M. I. Altbach, and A. Bilgin. A multi-scale deep ResNet for radial MR parameter mapping. In The International Society for Magnetic Resonance in Medicine (ISMRM), June 2018 (**The ISMRM Magna Cum Laude Merit Award)** .

[7] Z. Fu, S. Mandava, Z. Li, D. R. Martin, M. I. Altbach, and A. Bilgin. Deep parameter mapping with relaxation signal model driven constraints. In The International Society for Magnetic Resonance in Medicine (ISMRM), May 2019.

[8] Z. Fu, D. R. Martin, M. I. Altbach, and A. Bilgin. Multi-objective deep learning for joint estimation and detection tasks in MRI. In The International Society for Magnetic Resonance in Medicine (ISMRM), August 2020.

[9] Z. Fu, H.-W. Tseng, S. Vedantham, A. Karellas, and A. Bilgin. Deep learning-driven sparse-view reconstruction for radiation dose reduction in dedicated breast CT: quantitative evaluation. In The Radiology Society of North America (RSNA), December 2019 (**Oral**).

[10] Z. Fu, H.-W. Tseng, S. Vedantham, A. Karellas, and A. Bilgin. Dedicated breast CT: Comparative evaluation of multi-scale residual dense network and residual encoder-decoder network for deep learning-driven sparse-view reconstruction. In American Association of Physicists in Medicine (AAPM), July 2020 (**Blue Ribbon ePoster**).

[11] Z. Fu, H.-W. Tseng, S. Vedantham, A. Karellas, and A. Bilgin. A multi-slice residual dense network assisted sparse-view reconstruction for breast computed tomography. Nature Scientific Reports, In Submission.