

Fu Li

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Education

University of Illinois Urbana-Champaign

Ph.D. in Bioengineering

06/2019 - Present

Urbana, IL

Washington University in St. Louis

08/2018 - 06/2019

Ph.D. in Imaging Science (Transferred)

St. Louis, MO

Sun Yat-sen University

09/2012 - 07/2016

B. S. in Information and Computing Science

Guangzhou, China

Technical Skills

Core skills: Numerical optimization, image processing, image reconstruction, computational imaging, wave simulation, full waveform inversion, inverse problem, signal processing, machine learning, computer vision, high performance computing

Programming languages: C/C++, Python, MATLAB, CUDA

Frameworks/Tools: MPI, TensorFlow, PyTorch, Docker, Git, Slurm

Work Experience

Perception Vision Medical Technologies

07/2016 - 06/2018

Computer Vision Algorithm Engineer

Guangzhou, China

- Developed automated image segmentation algorithm for computer-aided diagnosis of nasopharyngeal carcinoma.
- Communicated with stakeholders to gather feedback on developed software and implemented improvements to address concerns.

Research Experience

Advanced High-resolution Reconstruction for 3-D Quantitative Ultrasound Computed Tomography In progress

Computational Imaging Science Lab at UIUC (Dr. Mark A. Anastasio)

Collaborative project with Delphinus Medical Technology, Inc

- Developed time-of-flight and bent-ray tomography methods based on Eikonal equation to estimate initial speed-of-sound model.
- Utilized a full wave equation-based inversion method (FWI) to estimate high-resolution speed-of-sound and acoustic attenuation distribution in biological tissues using clinical patient data.
- Modeled elevation-focused transducers of ring-array USCT to enable an accurate 3D wave simulation.
- Developed a distributed multi-GPU implementation of multi-ring 3D FWI that significantly reduces the image reconstruction times with improved image quality compared to 2D slice-by-slice FWI.
- Developed a speed-of-sound corrected sum-and-delay reflectivity tomography method, which reveals improved image quality of tissue impedance, comparing to the model assuming a constant speed-of-sound.

Computationally Efficient Algorithms for Ultrasound Tomography Using Deep Learning

In progress

Computational Imaging Science Lab at UIUC

- Developed a deep learning-based method for 2D-3D model mismatch compensation on waveform data using CNN-LSTM network to allow for an accurate and fast 2D full waveform inversion image reconstruction.
- Developed computationally efficient, high-resolution speed-of-sound imaging approach by use of multi-modal inputs and image-to-image neural networks.

Anatomically Realistic 3-D Breast Phantom Modeling

02/2020 - 01/2021

Computational Imaging Science Lab at UIUC

- Generated 3-D realistic breast phantoms by use of virtual imaging clinical trials sourced from FDA, including four types of anatomically phantoms (dense, hetero, scattered, and fatty breasts) in diverse shapes.
- Modeled the realistic acoustic properties distribution, designed truncated gaussian sampling function for acoustic properties assignment and modeled tissue texture by spatial autocorrelation acoustic impedance function.
- Released open-source datasets of both the generated 3D and 2D data along with the simulation code.

Perception Vision Medical Technologies

Collaborative project with Dept. of Radiation Oncology, SYSU Cancer Center and Philips Healthcare.

- Adopted the association rules learning method to capture region relations from clinical data.
- Designed a novel Markov graph model to simulate the tumor growth process.
- Validated our approach with an average dice score of 90% compared to radiotherapists' ground truth segmentation.
- Developed a user interface of a computer-aid-diagnosis system for clinical radiotherapy treatment planning using QT and VTK with Client-Server architecture.
- Implemented a radiotherapy treatment plan predication software on Philips IntelliSpace Discovery system for commercial application.

Selected Publications

- **Fu Li**, Umberto Villa, Nebojsa Duric, and Mark A. Anastasio (2023). "A forward model incorporating elevation-focused transducer properties for 3D full-waveform inversion in ultrasound computed tomography." IEEE transactions on ultrasonics, ferroelectrics, and frequency control.
- Park, Seonyeong, Umberto Villa, **Fu Li**, Refik Mert Cam, Alexander A. Oraevsky, and Mark A. Anastasio (2023). "Stochastic three-dimensional numerical phantoms to enable computational studies in quantitative optoacoustic computed tomography of breast cancer." Journal of Biomedical Optics 28, no. 6.
- Lozenski, Luke, Hanchen Wang, **Fu Li**, Mark A. Anastasio, Brendt Wohlberg, Youzuo Lin, and Umberto Villa (2023). "Learned Full Waveform Inversion Incorporating Task Information for Ultrasound Computed Tomography." IEEE transactions on computational imaging.
- **Fu Li**, Umberto Villa, Nebojsa Duric, and Mark A. Anastasio (2023). "3D full-waveform inversion in ultrasound computed tomography employing a ring-array." In Medical Imaging 2023: Ultrasonic Imaging and Tomography, vol. 12470, pp. 99-104-1. SPIE.
- Gangwon Jeong, **Fu Li**, Umberto Villa, and Mark A. Anastasio (2023). "A deep learning-based image reconstruction method for USCT that employs multimodality inputs." In Medical Imaging 2023: Ultrasonic Imaging and Tomography, vol. 12470, pp. 105-110. SPIE.
- **Fu Li**, Umberto Villa, Seonyeong Park, and Mark A. Anastasio (2022). "Three-dimensional stochastic numerical breast phantoms for enabling virtual imaging trials of ultrasound computed tomography". IEEE transactions on ultrasonics, ferroelectrics, and frequency control 69, 135 – 146.
- Jason L. Granstedt, **Fu Li**, Umberto Villa, and Mark A. Anastasio (2022). "Learned Hotelling observers for use with multi-modal data." In Medical Imaging 2022: Image Perception, Observer Performance, and Technology Assessment, vol. 12035, pp. 262-268. SPIE.

Conference Presentations & Invited Seminars

- "Advanced image reconstruction for accurate and high-resolution breast ultrasound tomography." Seminar, Bioengineering Distinguished Seminar Series, University of Illinois Urbana-Champaign, Urbana, 2023.
- "Three-dimensional time-domain full-waveform inversion for ring-array-based ultrasound computed tomography." 184th Acoustic society meeting, Chicago, 2023.
- "Automatic Gross Tumor Volume Delineation for Nasopharyngeal Carcinoma Radiotherapy on Multi-modal MRI: A Deep Learning Model Trained from 1000 Patient Dataset." Annual Meeting of the Radiological Society of North America (RSNA), Oral Presentation, Chicago, 2018.
- "Prediction of Clinical Target Volume for Nasopharyngeal Carcinoma Using Hidden Markov Model Trained from 2000 Patient Dataset." Annual Meeting of the Radiological Society of North America (RSNA), Oral Presentation, Chicago, 2017.

Patents

Yao Lu, Ying Sun, Sha Yu, Jiao Tian, Li Lin, **Fu Li**. "An association rule based Clinical Target Volume automatically delineation algorithm for Nasopharyngeal Carcinoma." Chinese Patent, Disclosure, 2017. (CN106875367A)

Awards

Honors:

- Honorable Mention in the Mathematical Contest in Modeling for undergraduate student
- Scholarship for Outstanding Students in Sun Yat-sen University
- Conference Presentation Award for Graduate Students, UIUC

2015
2013, 2014, 2015
2021, 2022, 2023

Computational Resources Awards:

- Distributed GPU-accelerated image reconstruction methods for breast ultrasound computed tomography, Illinois Delta research allocation, 25,000 GPU-hours **2022**
- A computational framework integrating wave physics simulation and machine learning for fast and accurate transcranial photoacoustic tomography reconstruction, Illinois Blue Waters research allocation, 210,000 node-hours **2021**