Fu Li

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Education

University of Illinois Urbana-Champaign **06/2019 - Present**
Ph.D. in Bioengineering 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
Frameworks/Tools: CUDA, MPI, TensorFlow, PyTorch, Docker, Git, Slurm, k-wave

Work Experience

Perception Vision Medical Technologies **07/2016 - 06/2018**
Imaging Algorithm Engineer Guangzhou, China

- Developed automated image segmentation algorithm for computer-aided diagnosis of nasopharyngeal carcinoma.
- Medical image processing and clinical data analysis.

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-fight 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.
- Developed GPU-accelerated pseudo-spectral time-domain wave simulation solver (based on cuFFT).
- Modeled grid-based focused transducers of ring-array USCT system 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 data mismatch compensation on spatial-temporal data using CNN-LSTM network to allow for an accurate and fast 2D image reconstruction.
- Developed high-resolution speed-of-sound imaging approach by use of multi-modal inputs and image-to-image neural networks.
- Developed learning based-data redatuming approaches using physical-informed neural networks.

Open-source Project: Anatomically Realistic 3-D Breast Phantom Modeling **2020 - 2021**
Computational Imaging Science Lab at UIUC

- Generated 3D 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 to enable meaningful virtual imaging studies and assist development of deep learning-based reconstruction algorithms in ultrasound/photoacoustic tomography.

Automated Clinical Target Volume Delineation Model for Nasopharyngeal Carcinoma **2016 - 2017**
Perception Vision Medical Technologies
Collaborative project with Dept. of Radiation Oncology, SYSU Cancer Center and Philips Healthcare, Suzhou.

- 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.
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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). *"Investigating the Use of Traveltime and Reflection Tomography for Deep Learning-Based Sound-Speed Estimation in Ultrasound Computed Tomography."* arXiv preprint.
- **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:

- Scholarship for Outstanding Students in Sun Yat-sen University **2013, 2014, 2015**
- Conference Presentation Award for Graduate Students, UIUC **2021, 2022, 2023**
- Cum Laude poster award at SPIE Medical Imaging **2024**

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**