

# Fu Li

**Email:** [fuli2@illinois.edu](mailto:fuli2@illinois.edu) **Mobile:** +1 314-224-0690 **Homepage:** <https://fuli2bb.github.io/>  
**Mailing Address:** 3142 Everitt Lab, 1406 West Green Street, Urbana, IL 61801

## Personal Summary

My research interests include computational imaging, optimization, and inverse problems. My Ph.D. work mainly focuses on ultrasound computed tomography, medical image reconstruction.

## Education

### **University of Illinois Urbana-Champaign (UIUC)**

**06/2019-Present**  
Urbana, IL

Ph.D. student in Bioengineering, Grainger College of Engineering

Advisor: Dr. Mark A. Anastasio and Dr. Umberto Villa

### **Washington University in St. Louis**

**08/2018-06/2019**

Ph.D. student in Imaging Science Program, McKelvey School of Engineering  
(Transfer to UIUC at 2019 Summer)

St. Louis, MO

### **Sun Yat-sen University**

**09/2012-07/2016**

B. S. in Information and Computing Science, School of Mathematics, GPA 3.7/4

Guangzhou, China

Advisor: Dr. Yao Lu

## Work Experience

### **Perception Vision Medical Technologies**

**07/2016-06/2018**

*Imaging algorithm engineer*

Guangzhou, China

- Medical image processing and clinical data analysis
- Developed software and deep learning algorithms for computer-aided diagnosis of Nasopharyngeal Carcinoma

## Research Experience

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

*Computational Imaging Science Laboratory, UIUC (Dr. Mark A. Anastasio)*

*Collaborative project with Delphinus Medical Technology, Inc*

**Goal:** To develop advanced image reconstruction methods for the accurate estimation of bioparameters in breast tissues

- Utilized a full wave equation-based reconstruction method (refer as FWI) to estimate the high-resolution speed-of-sound and acoustic attenuation distribution in biological tissues using clinical patient data
- Modeling elevation-focused transducers of ring-array USCT to enable an accurate 3D wave simulation of reconstruction
- Developed a distributed multi-GPU implementation for multi-ring 3D FWI, which enhanced image quality and resolution compared to 2D slice-by-slice FWI
- Developed a reflectivity tomography method using speed-of-sound corrected sum-and-delay method. The results show reflection characteristics of each tissue and improved image quality comparing with the model assumed constant speed-of-sound

### **Anatomically Realistic 3-D Breast Phantom Modeling**

**02/2020-01/2021**

*Computational Imaging Science Laboratory, UIUC (Dr. Mark A. Anastasio)*

**Goal:** To public 3D realistic numerical breast phantoms datasets allows for virtual imaging trials of USCT

- Generated large amount of three-dimensional realistic breast phantoms by virtual imaging clinical trials from FDA, including four types of anatomically phantoms (dense, hetero, scattered, and fatty breasts) in various 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
- Published open-source datasets of the generated 3D and 2D data and simulation code

### **Automated Clinical Target Volume Delineation Model for Nasopharyngeal Carcinoma**

**10/2016-12/2017**

*Perception Vision Medical Technologies*

*Collaborative project with Department of Radiation Oncology, Sun Yat-sen University Cancer Center and Philips Healthcare, China*

**Goal:** To define a radiotherapy treatment plan, radiotherapists need to determine clinical target areas manually. In this study, we developed a general automatic method to determine clinical targeted area in 3D. Our method simulates tumor growth by considering different growth rates and different anatomies, which are learned from massive clinical data

- 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% between computed results and manual results of senior radiotherapists
- 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

## **Publications**

- Fu Li**, Umberto Villa, Nebojsa Duric, and Mark A. Anastasio. *"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 2023
- Park, Seonyeong, Umberto Villa, **Fu Li**, Refik Mert Cam, Alexander A. Oraevsky, and Mark A. Anastasio. *"Stochastic three-dimensional numerical phantoms to enable computational studies in quantitative optoacoustic computed tomography of breast cancer."* Journal of Biomedical Optics 28, no. 6 2023
- Lozenski, Luke, Hanchen Wang, **Fu Li**, Mark A. Anastasio, Brendt Wohlberg, Youzuo Lin, and Umberto Villa. *"Learned Full Waveform Inversion Incorporating Task Information for Ultrasound Computed Tomography."* arXiv preprint arXiv:2308.16290 2023
- Fu Li**, Umberto Villa, Nebojsa Duric, and Mark A. Anastasio. *"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 2023
- Gangwon Jeong, **Fu Li**, Umberto Villa, and Mark A. Anastasio. *"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 2023
- Fu Li**, Umberto Villa, Seonyeong Park, and Mark A. Anastasio. *"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 2022
- Fu Li**, Umberto Villa, Nebojsa Duric, and Mark A. Anastasio. *"Investigation of an elevation-focused transducer model for three-dimensional full-waveform inversion in ultrasound computed tomography."* In Medical Imaging 2022: Ultrasonic Imaging and Tomography, vol. 12038, pp. 206-214. SPIE 2022
- Jason L. Granstedt, **Fu Li**, Umberto Villa, and Mark A. Anastasio. *"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 2022
- Fu Li**, Umberto Villa, Seonyeong Park, Shenghua He, and Mark A. Anastasio. *"A framework for ultrasound computed tomography virtual imaging trials that employs anatomically realistic numerical breast phantoms."* In Medical Imaging 2021: Ultrasonic Imaging and Tomography, vol. 11602, p. 116020V. SPIE 2021

## **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."* 184<sup>th</sup> 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 2015
- Scholarship for Outstanding Students in Sun Yat-sen University 2013, 2014, 2015
- Conference Presentation Award for Graduate Students, UIUC 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**

#### Skills

General: Numerical optimization, Image processing, Image reconstruction, Wave simulation, Full waveform inversion, Deep learning

Programming language and libraries: C/C++, Python, MATLAB, CUDA, Tensorflow, Pytorch