# Fu Li

**Email**: fuli2@illinois.edu **Mobile**: +1 314-224-0690

**Mailing Address**: 3142 Everitt Lab, 1406 West Green Street, Urbana, IL 61801

## Personal Summary

My research interests include ultrasound tomography, medical image reconstruction and inverse problems. I am interested in applying computational models in biomedical imaging, especially for practical clinical problems.

## Education

**University of Illinois Urbana-Champaign (UIUC)** **06/2019-Present**
Ph.D. student in Bioengineering, Grainger College of Engineering Urbana, IL
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 St. Louis, MO
(Transfer to UIUC at 2019 Summer)

**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 accurate bio-parameters estimation of breast tissues.

- Applied acoustic wave equation-based reconstruction method to estimate high resolution of speed-of-sound and acoustic attenuation distribution in biological tissues on clinical patient data
- Modeling focused transducers of ring array USCT for accurate three-dimensional full waveform inversion
- Used a partial differential equation-based travel-time tomography reconstruction method without raytracing. The results are used for initial estimation of speed-of-sound
- 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*." 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 **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