Yang Zhang

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CURRENT POSITION

California Institute of Technology Aug. 2019 - Present
Senior Postdoctoral Scholar Research Associate in *Medical Engineering* with Prof. Lihong Wang

My research interests involve developing life-saving technologies that rely on sound, light, sensors and algorithms, to generate images of the human brain and body, with a focus on: **1) photoacoustic computed tomography; 2) ultrafast ultrasound imaging; 3) multi-modal imaging system.**

EDUCATION

The University of Hong Kong Sep. 2015 - Dec. 2018
Ph.D. in *Electrical and Electronic Engineering*, Supervisor: Prof. Wei-Ning Lee and Prof. Ed X. Wu
Dissertation: Functional ultrafast ultrasound imaging of the cardiovascular system

Peking University Sep. 2012 - Jul. 2015
M.S. in *Signal and Information Processing*, Supervisor: Prof. Zhaohui Li
Thesis: Research on the key technologies in endoscopic medical ultrasound

South China University of Technology Sep. 2008 - Jul. 2012
B.S. in *Information Engineering*, Supervisor: Prof. Yuli Fu
Thesis: Design of the ultrasonic heat meter system

PUBLICATIONS

Under Review

1. [Y. Zhang, J. O. Gibson], K. Sastry, L.V. Wang*. "**Functional photoacoustic noninvasive Doppler angiography in humans.**", revised and resubmitted.
2. [Y. Zhang, S. Na, JJ. Russin], L. Lin, Y. Luo, P. Hu, K. Sastry, K. Maslov, C. Y. Liu*, L.V. Wang*. "**Rotational ultrasound and photoacoustic tomography of the human body.**", second revision and resubmitted.

Selected Journal Papers

1. [Y. Zhang, J. O. Gibson], A. Khadria, L.V. Wang*. "**Photoacoustic vector tomography for deep hemodynamic imaging.**" ***Nature Biomedical Engineering***, 2023.
2. [Y. Zhang, S. Na, K. Sastry, JJ. Russin], P. Hu, L. Lin, X. Tong, KB. Jann, DJ. Wang, C. Y. Liu*, L.V. Wang*. "**Transcranial photoacoustic computed tomography of human brain function.**" *arXiv*, 2022.
3. [S. Na, Y. Zhang], L.V. Wang*. "**Cross-Ray ultrasound tomography and photoacoustic tomography of cerebral hemodynamics in rodents,**" *Advanced Science*, 2022.
4. [A. Khadria, C. D. Paavola], Y. Zhang, S. P. Davis, P. F. Grealish, K. Maslov, ... L. V. Wang*. "**Long-duration and non-invasive photoacoustic imaging of multiple anatomical structures in a live mouse using a single contrast agent**". *Advanced Science*, 2022.
5. [X. Tong, L. Lin], P. Hu, R. Cao, Y. Zhang, J. Olick-Gibson, L. V. Wang*, "**Non-Invasive 3D photoacoustic tomography of angiographic anatomy and hemodynamics of fatty livers in rats**". *Advanced Science*, 2022.

6. J. Dong, Y. Zhang, W.-N. Lee*. "**Walled vessel-mimicking phantom for ultrasound imaging using 3D printing**" *Physics in Medicine Biology*, 2020.
7. Y. Zhang, H. Li, W.-N. Lee*. "**Imaging heart dynamics with ultrafast cascaded-wave ultrasound**," *IEEE Transactions on Ultrason. Ferroelectr. Freq. Control*, 2019.
8. Y. Zhang, Y. Guo, W.-N. Lee*. "**Ultrafast ultrasound imaging with cascaded dual-polarity waves,**" ***IEEE Transactions on Medical Imaging***, 2018.
9. Y. Zhang, Y. Guo, W.-N. Lee*. "**Ultrafast ultrasound imaging using combined transmissions with cross-coherence based reconstruction**," ***IEEE Transactions on Medical Imaging***, 2018.
10. Y. Zhang, Z. Li*, "**Improving the accuracy of time difference measurement by reducing the impact of baseline shift,**" *IEEE Transactions on Instrum. Meas.*, 2015.

Patent Applications

1. Y. Zhang, J. O. Gibson, and L.V. Wang. "Functional photoacoustic computed tomography of blood flow," US Provisional application CIT-8841-P, 2022; CIT1P067US, 2023.
2. Y. Zhang, Y. Guo, and W.-N. Lee. "Ultrafast ultrasound imaging with cascaded dual-polarity waves," International application number and filling date: PCT/CN2018/119321, 05 Dec. 2018; International publication number and publication date: WO 2019/114585 A1, 20 June 2019.

Conference Presentations and Proceedings

1. [Y. Zhang, J. O. Gibson], A. Khadria, L.V. Wang. "Photoacoutic vector tomography for deep hemodynamic imaging," in *SPIE Photonics West-Photons Plus Ultrasound: Imaging and Sensing*, San Francisco, USA, 2023. (**Best paper award**).
2. [S. Na, Y. Zhang], L.V. Wang. "Cross-ray ultrasound photoacoustic computed tomography of brain function," in *SPIE Photonics West-Photons Plus Ultrasound: Imaging and Sensing*, San Francisco, USA, 2022. (**Best paper award**).
3. Y. Zhang, H. Li, and W.-N. Lee. "Ultrafast imaging of heart dynamics with cascaded-wave ultrasound ," in *IEEE International Ultrasonics Symposium*, Japan, Oct., 2018 (Oral presentation).
4. Y. Zhang, Y. Guo, and W.-N. Lee. "A novel coding scheme and its application to ultrafast ultrasound imaging," *174th Meeting of the Acoustical Society of America*, New Orleans, Louisiana, Dec. 4-8, 2017 (**Student travel award,** oral presentation).
5. Y. Zhang, and W.-N. Lee. "Ultrafast ultrasound cascaded wave imaging," *5th International Conference on Biomedical Ultrasound*, Hong Kong, Dec. 2-4, 2017 (**Best student poster award**).
6. Y. Zhang, Y. Guo, and W.-N. Lee. "High contrast ultrafast ultrasound plane wave imaging with angular coherence based reconstruction," *IEEE International Symposium on Biomedical Imaging*, Melbourne, Australia, April 18-21, 2017. (Oral presentation).
7. Y. Zhang, Y. Guo, and W.-N. Lee. "Ultrafast imaging using combined transmissions with coherence-based reconstruction," *IEEE International Ultrasonics Symposium*, Tours, France, Sep 18-21, 2016. (Oral presentation).

RESEARCH EXPERIENCE

Photoacoustic Computed Tomography — Aug. 2019 - Present
Postdoc, California Institute of Technology — Pasadena, USA

- **Photoacoustic vector tomography for deep hemodynamic imaging**

· Discovered a synergistic effect between the spatial heterogeneity of blood and photoacoustic contrast, extending the capability of deep photoacoustic blood flow imaging beyond a hurdle previously considered by the field to be insurmountable.

· Achieved a penetration depth five times greater than that of existing high-resolution optical techniques, thus enabling us to form vector maps of deep human blood flow *in vivo*.
· Introduced a uniquely positioned technique within the field of biomedical imaging that has the potential for tremendous clinical impact because it can enable simultaneous measurement of blood flow and hemoglobin content.

- **Wearable ultrasound imaging of the human brain in patients**

· Presented a helmet-based wearable ultrasound scanner that, to our knowledge, is the first wearable human brain ultrasound imager with high spatiotemporal resolution, bridging the gap between high-resolution brain imaging and wearable convenience.
· Captured images of brain tissue at centimeter-scale depths, with submillimeter and millisecond resolutions, including cerebral blood flow images, while the subject was in a sitting position.
· Offered continuous monitoring of blood flow in the brains of hemicraniectomy patients over extended periods, even in situations prone to motion.

- **Transcranial photoacoustic computed tomography of human brain function**

· Reported the first known in-human transcranial imaging of brain function using photoacoustic computed tomography.
· Functional responses to benchmark motor tasks were imaged on both the skull-less and the skull-intact hemispheres of a hemicraniectomy patient.
· The observed brain responses in these preliminary results demonstrate the potential of photoacoustic computed tomography for achieving transcranial functional imaging.

- **Hybrid ultrasound and photoacoustic tomography of brain function and the human body**

· Proposed a cross-ray ultrasound tomography method, which provides omnidirectional sensitivity to cerebral blood flow and solved the angle-dependent sensitivity problem in conventional functional ultrasound.
· Integrated cross-ray ultrasound tomography with photoacoustic computed tomography to offer synergistic characterization of cerebral hemodynamics, such as the cerebral blood flow, oxygen saturation, and hemoglobin concentration changes of the brain.
· Hybrid rotational ultrasound and photoacoustic tomography system obtains the first known large field-of-view, volumetric, and high spatiotemporal resolution images of representative parts of whole human body's morphological and angiographic characteristics.

Ultrafast Ultrasound Imaging Sep. 2015 - Dec. 2018
Ph.D., The University of Hong Kong Hong Kong, China

- [**See deeper**] **Ultrafast cascaded-wave ultrasound imaging**

· Proposed a temporal coding scheme with "cascaded dual-polarity waves (CDW)" for ultrafast ultrasound imaging and show the enhanced delineation of *in vivo* human muscle fibers in deep regions as well as the vasculature in human heart.
· Proposed a spatial-temporal coding and decoding scheme "cascaded synthetic aperture imaging (CaSA)" for ultrafast cardiac imaging and show the enhanced imaging quality for *in vivo* mapping the human heart's anatomical structure, myocardial motion and blood dynamics.

- [**See clearer**] **Ultrafast imaging using combined transmissions and coherence reconstruction**

· Designed a mixed wave excitation technique for axial-lobe artifact reduction.
· Proposed the coherence-based image reconstruction techniques for side-lobe artifact reduction.
· Implemented the new ultrasound imaging sequence 'combined transmissions with cross-coherence based reconstruction (US-CTCC)' in the Verasonics Vantage system.
· Conducted an *in vivo* pig's heart experiments and showed the reduction of artifacts by US-CTCC.

- [**See more**] **Functional ultrasound observation of blood flow in heart and brain**

· Demonstrated the advantage of our newly developed high-quality (i.e., signal-to-noise ratio) ultrafast image acquisition methods for not only the mapping of myocardial motion but also the blood flow in the circulation system.
· Observed the spatiotemporal variations of the blood flow in both the *in vivo* porcine myocardial perfusion and the *in vivo* rat brain perfusion.

Endoscopic Ultrasound and Flowmeter Sep. 2012 - Jul. 2015
M.S., Peking University Beijing, China

- **Developed new beamforming techniques for endoscopic ultrasound**

· Designed the simulation software for endoscopic ultrasound imaging, which could be a general ultrasound imaging simulation toolbox.
· Proposed a virtual array transform technique to improve the image contrast, and applied the simulated annealing algorithm to design optimal array beam patterns.

- **Designed a high precision ultrasonic flow measurement system**

· Developed the hardware and software of an ultrasonic flow measurement system.
· Proposed a novel signal detection method "multiple edge detection" and improved the precision and reliability of the system.

Electronic System Design Sep. 2008 - Jul. 2012
B.S., South China University of Technology Guangzhou, China

· Designed a smart hospital service system with speech recognition.
· Implemented an intelligent motor speed measurement system based on ultrasonic Doppler effect.
· Built an intelligent air conditioning fan control system.
· Designed an infrared remote control system

TEACHING EXPERIENCE

Teaching Assistant Sep. 2015 - Jul. 2018
Faculty of Engineering, The University of Hong Kong Hong Kong, China

· Mathematical Analysis in Medical Engineering: Worked on the Matlab tutorials, and the homework assignments for undergraduate students.

Teaching Assistant Sep. 2012 - Jul. 2015
School of Electronics Engineering and Computer Science, Peking University Beijing, China

· Mechanics: Worked on the questions, homework, and tests for undergraduate students.

HONORS AND AWARDS

- Best Paper Award, SPIE Photonics West - Photons Plus Ultrasound: Imaging and Sensing 2023
- Best Paper Award, SPIE Photonics West - Photons Plus Ultrasound: Imaging and Sensing 2022
- Best Student Poster Award, International Conference on Biomedical Ultrasound 2017
- Champion in the HKU Interdisciplinary Research Competition (IRC) 2017

KNOWLEDGE AND SKILLS

- Rich experience in developing both the hardware and software components of imaging systems.
- Rich experience with human subjects, nonprimate animals, and small animals.
- Programming: Matlab (proficient), C/C++ (skilled), Python (skilled).

REVIEWER SERVICES

- IEEE Transactions on Medical Imaging
- IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control
- Photoacoustics
- Ultrasonics
- Ultrasound in Medicine and Biology
- Optical Letters