Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON
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Blind-Label Subwavelength Ultrasound Imaging

Chu Ma, PhD
Dugald C. Jackson Assistant Professor
Acoustic Sensing and Functional Materials (ASFM) Lab
Department of Electrical and Computer Engineering
University of Wisconsin-Madison

Ultrasound allows non-invasive, non-radiative imaging with sub-millimeter resolution, with broad applications in sensing, communication, biomedical diagnosis and non-destructive testing. In this talk, I will present our work on combining acoustic random scattering and computational imaging for improving the resolution of ultrasound imaging. Similar to all the other wave-based imaging modalities, ultrasound imaging suffers from diffraction limit, which is a trade-off between imaging resolution and wave penetration depth. Most existing acoustic subwavelength imaging technologies addressing this limit require controlled "labels," i.e., metamaterials or contrast agents, to be deposited close to the objects and to either remain static or be tracked precisely during imaging, restricting their practical applications. We propose a "blind-label" approach. The blind labels are randomly distributed subwavelength microstructures or microparticles. The originally evanescent components in the scattered waves from the object are first converted to propagating components and then extracted by computational algorithms. Compared to conventional ultrasound imaging systems, our approach achieves an order of magnitude improvement in the imaging resolution without sacrificing the wave penetration depth. Our "blind-label" approach relaxes the restrictions of existing acoustic subwavelength imaging technologies that rely on controlled labels, thereby substantially enhancing the practicality of acoustic subwavelength imaging in real-world applications.

ABOUT the SPEAKER

Chu Ma is currently the Dugald C. Jackson Assistant Professor at the Department of Electrical and Computer Engineering, and an affiliated faculty member at the Department of Mechanical Engineering, University of Wisconsin-Madison. She received her Ph.D. from the Department of Mechanical Engineering, Massachusetts Institute of Technology in 2019 and her B.S. and M.S. degrees at Shanghai Jiao Tong University. She was also a research intern at Samsung Audio Lab in Santa Clarita, CA in the summer of 2015. Her research lies in acoustic sensing, computational imaging, microwave-induced thermoacoustics, and acoustic functional materials. Her research work has been published in Nature Communications, Science Advances, Nature, Physical Review Letters, Advanced Functional Materials and other high impact journals. She is the recipient of NSF CAREER Award, ONR DURIP Award, 3M Non-Tenured Faculty Award, and Acoustical Society of America Young Investigator Travel Award. She was selected as a finalist of the WARF Innovator Award by Wisconsin Alumni Research Foundation.

Monday, January 27 at Noon
1003 Engineering Centers (Tong Auditorium)