

Center for AI and Robotics in medicine (CARE)



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***Novel Piezoelectric Transducers for
Endovascular & Wearable Ultrasound
Imaging & Therapy***

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ABSTRACT

Ultrasound devices have been increasingly utilized for the diagnosis and treatment of diseases such as cardiovascular disease (CVD), cancer, and conditions relevant to rehabilitation medicine. In this talk, the design, fabrication, and experimental validation of micro- and nanotechnology-enabled piezoelectric transducers for ultrasound sensing, imaging, and therapy are presented.

High-frequency micromachined piezoelectric 1–3 composite transducers were investigated for advanced intravascular ultrasound (IVUS) imaging. In addition, small-aperture, forward-looking multilayer piezoelectric transducers and vortex ultrasound transducers were demonstrated for effective microbubble- and nanodroplet-mediated intravenous sonothrombolysis. Furthermore, miniaturized piezoelectric transducers were developed for catheter and needle based sonoporation, resulting in significantly enhanced localized drug delivery.

More recently, flexible piezoelectric transducers were developed for wearable ultrasound monitoring of blood pressure and muscle activity in assistive robotic applications. A wearable ultrasound sensing framework integrated with machine learning (ML) was demonstrated for muscle-specific tremor monitoring, in which both tremor frequency and displacement were extracted in real time, supporting promising future deployment in adaptive neuromodulation systems.

Collectively, these results indicate that novel piezoelectric transducer technologies can play a significant role in advancing ultrasound imaging, therapy, and drug delivery for next-generation robotic and intelligent medicine.

BIOGRAPHY

Xiaoning Jiang is the Dean F. Duncan Distinguished Professor of Mechanical and Aerospace Engineering and a University Faculty Scholar at North Carolina State University. He is also an Adjunct Professor of Biomedical Engineering at North Carolina State University and University of North Carolina, Chapel Hill, and an Adjunct Professor of Neurology in Duke University. Dr. Jiang received his B.S. degree in ME from Shanghai Jiaotong University (1990), M.S. degree in ME from Tianjin University (1992) and his Ph.D. degree in Precision Instruments from Tsinghua University (1997). Dr. Jiang received his Postdoctoral training from the Nanyang Technological University (1996-1997) and Penn State (1997-2001). He was the Chief Scientist and Vice President for TRS Technologies, Inc. prior to joining NC State in 2009. Dr. Jiang is the author and co-author of two books, 6 book chapters, 12 issued US Patents, more than 240 peer reviewed journal papers and over 170 conference papers on piezoelectric ultrasound transducers, ultrasound for medical imaging and therapy, drug delivery, ultrasound NDT/NDE, smart materials and structures and M/NEMS. Dr. Jiang served as the Vice President for Technical Activities in IEEE Nanotechnology Council (NTC) (2022-2023). He was the Co-Editor-in-Chief of IEEE Nanotechnology Magazine (2020 - 2021) and an IEEE NTC Distinguished Lecturer in 2018-2019. Dr. Jiang is currently the Vice President for Publications of IEEE Nanotechnology Council. Dr. Jiang is an ASME Fellow, a SPIE Fellow and an IEEE Fellow.