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Microscale addressable arrays for ultrasonic stimulation, imaging, and communication

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Abstract

Developments in MEMS fabrication technology over the past two decades have yielded new opportunities to design high quality factor (*Q*) micromechanical structures for ultra-low-power frequency-domain signal processing, sensing, and timing applications. Our goal is to harness the benefits of new and high-impact micromechanical devices and circuits for low-power, compact wireless communication, physical sensors, and timing applications. In the *Hybrid*MEMS Lab we invent new mechanical designs and efficient transducers to demonstrate channel-select filters and synchronized oscillators, and explore inter-domain coupling to design merged MEMS-CMOS and MEMS-HEMT devices. We further investigate the extension of these devices and systems into unreleased structures, eradicating the need for costly packaging, improving yield and robustness in harsh environments, and making MEMS resonators more accessible for a wide range of applications. Most recently, we have begun research in new materials of microactuators and piezoelectric ultrasound transducers on flexible substrates, both fueled by exciting collaborations with fellow researchers at Purdue. Applications of these new transducers range from autonomous microrobotics to high resolution biomedical imaging and IoT large-area sensors and communication. I will discuss how ultrasound transducers in several material platforms, including piezoelectrics like AlN, GaN, and LiNbO3, and ferroelectrics such as PZT, HZO, and Si:HfO2 could be harnessed for infrastructure monitoring and smart buildings.

Bio

Dana Weinstein is an Associate Professor in Purdue's School of Electrical and Computer Engineering, and the Associate Dean of Graduate Education in the College of Engineering. Prior to joining Purdue in 2015, Dr. Weinstein joined the Department of Electrical Engineering and Computer Science at MIT as an Assistant Professor, and as an Associate Professor there between 2013 and 2015. She received her B.A. in Physics and Astrophysics from University of California - Berkeley in 2004 and her Ph.D. in Applied Physics in 2009 from Cornell, working on multi-GHz MEMS. She is the recipient of Purdue Faculty Scholars award, the NSF CAREER Award, the DARPA Young Faculty Award, the first Intel Early Career Award, the first TRF Transducers Early Career Award, and the IEEE IEDM Roger A. Haken Best Paper Award. Dr. Weinstein's current research focuses on innovative microelectromechanical devices for applications ranging from MEMS-IC wireless communications, clocking, and physical sensors to micro robotic actuators and flexible substrate ultrasonic transducers.