EE Department Seminar

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# CMUTs with Monolithically Integrated Electronics for Intravascular Ultrasound Imaging

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Capacitive micromachined ultrasonic transducers (CMUTs) have emerged as an enabling technology for ultrasound imaging especially for applications requiring highly dense 2-D arrays and miniature arrays requiring high level of integration. A key premise of CMUT technology is that it allows for front-end electronics integration while providing equal or better transduction performance as compared to piezoelectric transducers, the current dominant transducer array technology. In this talk, we describe our progress towards these goals, especially for intravascular ultrasound (IVUS) imaging applications. We use a low-temperature Plasma Enhanced CVD based process to fabricate CMUTs on silicon wafers containing CMOS electronics for intravascular imaging arrays operating in the 10-60MHz range. These arrays have novel array geometry and front-end electronics structures. We have successfully tested forward looking CMUT IVUS arrays built on custom designed 0.35u CMOS front-end electronics fabricated at a commercial foundry. With these arrays we demonstrate volumetric imaging at 100 frames/s rate using synthetic aperture signal processing. The integrated CMOS electronics eliminate the parasitic capacitances and allows us to measure signals down to the thermal mechanical noise of the CMUTs in the 5-30MHz range. We show that the thermal mechanical noise information can be used for array characterization and possibly performing totally passive sensing and imaging. We also discuss our current efforts in developing electrical interconnects for catheter implementation.

***Prof. Dr. F. Levent Degertekin*** *is the George W. Woodruff Chair in Mechanical Systems and Professor in the G.W. Woodruff School of Mechanical Engineering at Georgia Institute of Technology with a joint appointment in the School of Electrical and Computer Engineering. He received his Ph.D. degree in 1997 from Stanford University, the MS degree in 1991 from Bilkent University and the BS degree from METU, respectively, all in Electrical Engineering. His research interests are in micromachined acoustic transducers, particularly CMUTs, opto-acoustic devices, ultrasound imaging, MEMS metrology, bioanalytical instruments, and atomic force microscopy (AFM). Dr. Degertekin is an associate editor for the IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control. He has received an NSF CAREER award for his work on ultrasonic AFM in 2004, and with his students, the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society 2004 Outstanding Paper award for their work on CMUT design and fabrication. Dr. Degertekin holds 40 U.S. patents and has authored over 150 scientific publications.*