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ELECTRICAL & COMPUTER ENGINEERING
TEXAS A&M UNIVERSITY

S E M I N A R

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A 0.62–10 GHz Complex Dielectric Spectroscopy System in 0.18µm CMOS

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Abstract: Broadband dielectric spectroscopy (BDS) is a versatile and powerful technique for characterization of materials' properties with a wide range of industrial, scientific and medical applications such as oil exploration and processing, food and drug safety, chemical/biological sensing, and disease diagnosis, to name a few. More specifically, because of the noninvasive, label-free and real-time nature of dielectric spectroscopy, it has the great potential to become a valuable and cost effective tool for point-of-care medical applications. Existing instruments for BDS are constrained by high cost and bulky size of measurement setup and require large volume of MUT, making them unsuitable for portable applications. This motivates the development of a silicon-based integrated BDS system which in addition to considerable reduction in size and cost, can achieve high-throughput measurements with enormous data processing using only a small volume of MUT.

In this seminar, an integrated sensing system for complex dielectric spectroscopy in the 0.62–10 GHz frequency range is presented. A capacitive sensor exposed to the material under test (MUT) shows variations in its admittance according to the complex permittivity of MUT. The sensing capacitor along with a fixed capacitor forms a voltage divider circuit and is excited by an RF signal at the sensing frequency. The magnitude and phase of the voltages across the two capacitors which depend on the sensor admittance are measured using a quadrature down-conversion architecture to find the real and imaginary parts of the MUT's permittivity. Implemented in 0.18µm CMOS, the system is able to measure the permittivity of organic chemicals under test with an rms error of less than 1% over the entire operating range.

Masoud Moslehi-Bajestan received the M.Sc. degree in electronics engineering from Sharif University of Technology, Tehran, Iran, in 2010, and is currently working toward the Ph.D. degree at Texas A&M University, College Station, TX.

In 2014, he was an RFIC Design Intern with Qualcomm Inc., San Diego, CA, where he designed wide tuning range VCO for cellular transceivers. His current research mainly concerns RF/analog integrated circuits with a special interest in wideband and low phase-noise oscillators and frequency synthesizers.