



IEEE Syracuse - MTT/AP Chapter Presents

IEEE Syracuse Section Microwave Seminar



High Power Terahertz Signal Generation and Amplification on CMOS

by

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Abstract - Despite several recent efforts, the best reported f_{max} values of CMOS transistors fall well below terahertz frequencies. In this talk, we will show circuits in which nonlinear harmonic power from many transistors is combined in novel travelling wave circuit topologies to generate high power levels at frequencies well above the f_{max} of transistors.

First we introduce a traveling wave frequency doubler that effectively generates and combines the second harmonic from multiple transistors. The CMOS proof-of-concept operates from 220 GHz to 275 GHz in a 65 nm process. Output power of -6.6 dBm and conversion loss of 11.4 dB are achieved at 244 GHz. Next, we show an oscillator that provides optimum conditions for the transistor to generate high power and voltage swing, and efficiently transfers the 3rd harmonic to the load. The CMOS prototype generates -2 dBm at 482 GHz. This is higher than any other implementation on CMOS (by more than 30dB) or even InP HEMT (by 4dB) and InP HBT (by 8dB) at this frequency range despite the much lower f_{max} of CMOS transistors. Next, we show how this method can be applied to Nitride transistors to generate more than 15 dBm at 1 THz in simulation. Finally, we present our work on parametric amplifiers and show how this method can be used to realize broadband amplifiers with excellent noise performance using the concept of noise squeezing.

BIO: Ehsan Afshari was born in 1979. He received the B.Sc. degree in Electronics Engineering from the Sharif University of Technology, Tehran, Iran and the M.S. and Ph.D. degree in electrical engineering from the California Institute of Technology, Pasadena, in 2003, and 2006, respectively. In August 2006, he joined the faculty in Electrical and Computer Engineering at Cornell University. His research interests are high-speed and low-noise integrated circuits for applications in communication systems, sensing, and biomedical devices.

Prof. Afshari serves as the chair of the IEEE Ithaca section, as the chair of Cornell Highly Integrated Physical Systems (CHIPS), and as member of the Analog Signal Processing Technical Committee of the IEEE Circuits and Systems Society. He was awarded National Science Foundation CAREER award in 2010, Cornell College of Engineering Michael Tien excellence in teaching award in 2010, Defense Advanced Research Projects Agency Young Faculty Award in 2008, and Iran's Best Engineering Student award by the President of Iran in 2001. He is also the recipient of the best paper award in the Custom Integrated Circuits Conference (CICC), September 2003, the first place at Stanford-Berkeley-Caltech Inventors Challenge, March 2005, the best undergraduate paper award in Iranian Conference on Electrical Engineering, 1999, the recipient of the Silver Medal in the Physics Olympiad in 1997, and the recipient of the Award of Excellence in Engineering Education from Association of Professors and Scholars of Iranian Heritage (APSIH), May 2004.