Technical Meeting
Solid-State Circuit Society
Chapter Poland

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Prof. Bogdan Staszewski

"All-Digital Phase-Locked Loops (ADPLL): Direct Frequency Modulation"

Abstract: The past two decades has seen proliferation of all-digital phase-locked loops (ADPLL) for RF and high-performance frequency synthesis due to their clear benefits of flexibility, reconfigurability, transfer function precision, settling speed, frequency modulation capability, and amenability to integration with digital baseband and application processors. When implemented in nanoscale CMOS, the ADPLL also exhibits advantages of better performance, lower power consumption, lower area and cost over the traditional analog-intensive charge-pump PLL. In a typical ADPLL, a traditional VCO got directly replaced by a digitally controlled oscillator (DCO) for generating an output variable clock, a traditional phase/frequency detector and a charge pump got replaced by a time-to-digital converter (TDC) for detecting phase departures of the variable clock versus the frequency reference (FREF) clock, and an analog loop RC filter got replaced with a digital loop filter. The conversion gains of the DCO and TDC circuits are readily estimated and compensated using "free" but powerful digital logic.

The first three talks covered the fundamentals of ADPLL, its loop response and gear-shifting techniques. This fourth talk will cover direct frequency modulation capabilities of ADPLL and DCO fundamentals.

Bio: R. Bogdan Staszewski was born in Białystok, Poland. He received his PhD from University of Texas at Dallas, USA in 2002. He joined Texas Instruments in Dallas, Texas in 1995. In 1999 he co-started a Digital RF Processor (DRP) group in TI with a mission to invent new digitally intensive approaches to traditional RF functions. Dr. Staszewski served as a CTO of the DRP group between 2007 and 2009. In July 2009 he joined Delft University of Technology in the Netherlands. Since Sept. 2014 he has been a Full Professor at University College Dublin (UCD) in Ireland. He has co-authored over 180 journal and 230 conference publications, and holds over 210 issued US patents. His research interests include nanoscale CMOS architectures and circuits for frequency synthesizers, transmitters and receivers, as well as quantum computers. He is a co-founder of a startup company Equal1 Labs aiming at building the first practical CMOS quantum computer. He is an IEEE Fellow and a recipient of the 2012 IEEE Circuits and Systems Industrial Pioneer Award. He was the TPC Chair of 2019 ESSCIRC conference in Krakow, Poland.

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