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On-Chip RF FDD Duplexers for 3G and 4G Handsets

by

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Abstract: Mobile handsets are one of the biggest markets in the semiconductor industry. About 1.8 billion mobile handsets are sold each year. This is a big thrust for research in this area to enhance the features and lower the cost. Software defined radio (SDR) was proposed to support multi-standard operation with only one transceiver, however this was not enough because each standard will need an external surface acoustic wave (SAW) filter for band selection. This research aims to replace the off-chip bulky SAW duplexers for each band with a single on-chip tunable duplexer for all the bands.

The problem can be divided into two categories depending on the generation of the standard. For 2G standards, the transmitter (TX) and the receiver (RX) are not working on the same time. Thus, a T/R switch will be needed alone to isolate between TX and RX. The SAW filter in 2G is required to filter the out of band blockers. A recent approach was proposed to develop SAW-less receivers for 2G using passive mixing to filter the out of band blockers.

For 3G and 4G standards, the TX is working simultaneously with the RX. The SAW duplexer is used to filter the TX signal at the receiver based on the frequency band of TX and RX. These filters need very high Q to achieve the selectivity and the insertion loss needed which is impossible to be achieved using CMOS technology. Another approach is to use on-chip electrical balanced duplexers (EBDs), where there are two paths for the TX signal to the receiver. These two signals will be cancelled at the receiver. This seminar will discuss the design of EBDs and the research opportunities in this area.

Mohamed Elkholy received the B.S. and M.S. degrees in electrical engineering from Ain Shams University, Cairo, Egypt, in 2005 and 2010 respectively, and is currently working toward the Ph.D. degree in electrical engineering at Texas A&M University, College Station, TX, USA. His research interests are in RF transceivers, RF integrated duplexers and RF bio-sensors. He worked in Broadcom Corp. for one year on research project to develop on-chip integrated RF duplexers.

From 2005 to 2007, he was with Sysdsoft Inc., Cairo, Egypt, where he designed different analog blocks like filters, variable gain amplifiers (VGAs), and low-noise amplifiers (LNAs). From 2007 to 2010, he was with Si-ware Systems, Cairo, Egypt, where he designed VCOs, bandgap and biasing circuits, and micro-electromechanical systems (MEMS) interfacing circuits.