UWB Reconfigurable RF Self-Interference Cancellation Filter for Simultaneous Transmit and Receive System

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Wireless technology is growing at a fast rate to accommodate the expanding user demands. Currently, the RF spectrum is highly congested and more susceptible to signal fratricide and interference. Therefore, full duplexing techniques are required to enhance the access to the spectrum. Simultaneous Transmit and receive systems (STAR), also known as in band full duplex systems, are gaining higher attention due to their capability to double spectral efficiency. However, successful implementation of STAR requires significant isolation between the transmit and receive signals to reduce self-interference (SI) signal.

Typically, the sources of SI are direct coupled and reflected/echo/multipath signals, harmonics from the power amplifier (PA), and added noise from the transmit chain. Coupled signals can be as high as 30dBm and can saturate or completely desensitize the receiver. To reduce SI, high isolation transmit and receive antennas (or equivalently a high isolation circulator for single antenna systems) are used. However, antenna isolation is usually <50dB and does not provide enough suppression to the coupled transmit signal. Therefore, additional cancellation stages are required to reduce the coupled SI to a level below the receiver's noise floor. To do so, multi-tap finite impulse response (FIR) RF filters have been recently considered as an effective solution for interference cancellation in STAR systems (S. B. Venkatakrishnan, E. A. Alwan, and J. L. Volakis, IEEE Acc., 6, 3425-3432, 2018). These filters are microstrip based and are constructed using parallel combination of delayed lines and attenuators. The goal is to create a filter response that is conjugately matched to the coupling channel between transmit and receive antennas. By performing gain-delay adjustment, the desired filter's frequency response can be realized across the required range of frequencies.

Recent implementations of RF-SIC have shown an approximate ~25dB of cancellation across 1GHz bandwidth (S. B. Venkatakrishnan, E. A. Alwan, and J. L. Volakis, Antennas Propag. Symposium, 2018). In this effort, we present, for the first time, a reconfigurable RF SIC filter for STAR systems with tunable operation across >3:1 bandwidth. To do so, reconfigurable filter bank is designed using multiple narrowband FIR filters operating in the frequency range between 2 GHz to 6 GHz. Each of these filters is optimized to achieve >30dB of SIC at a specific frequency band. Notably, a filter bank solution with multiple narrow band filter is desirable to suppress any out-of-band interference from adjacent frequency bands as well as prevent second order harmonics. To our knowledge, this is the first RF-SIC filter with reconfigurable solution that can achieve such wide bandwidth in STAR system. In the conference, the design, fabrication, and testing of our UWB reconfigurable SIC filter will be presented.