Wideband RF Self-Interference Cancellation Filter for Simultaneous Transmit/Receive Systems

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Modern wireless systems employ a variety of techniques to overcome limited spectrum issues. Current wired and wireless communication systems employ either frequency division duplex (FDD) or time division duplex (TDD) transceivers. Due to the orthogonality of the time/frequency resources, transmitted signals do not interfere with the received in these systems. However, they require double the time and/or frequency resources as compared to full duplex systems. A popular approach for implementing full duplex communication without increasing resource utilization is by realizing simultaneous transmit and receive (STAR) scheme. This is often referred to as in-band full-duplex (IBFD). Successful implementation of such a system could reduce spectrum requirement by 100%. However, simultaneous transmission and reception at the same frequency implies significant self-interference (SI) due to coupling between the transmitter and receiver antennas. Such coupling must be mitigated to enable acceptable operation of such systems.

Typically, the SI includes direct and reflected/echo/multipath signals, harmonics from the power amplifier (PA), and noise from the transmit chain. In spite of the collocated transmitter (Tx) and receiver (Rx), more than 100dB isolation is required to realize a practical STAR system. Such a requirement is even more challenging for large bandwidth transceivers (> 1GHz).

In this paper, we propose a novel STAR architecture that incorporates four stages of self-interference cancellation (SIC) across a wide bandwidth. Specifically, a 100dB reduction in SI is projected across at least 500MHz bandwidth. This cancellation is achieved by, 1) higher antenna isolation, 2) RF analog cancellation, 3) Baseband analog cancellation, and 4) digital backend cancellation.

At the conference, we will show cancellation process. We will present analysis, design, simulation, fabrication and measurements of a 6-tap SIC filter. The SIC filter is designed to provide ~30 dB of cancellation across 500MHz of bandwidth. To date, this is the first SIC filter that can achieve such unprecedented bandwidth and cancellation level.