Port to Port Isolation of an Omnidirectional Antenna Through Perfect Symmetry for Simultaneous Transmit and Receive (STAR)

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Lack of readily available microwave spectrum has spurred the evolution of transceiver architectures that enables simultaneous transmit and receive (STAR) radio signals. STAR enables concomitant reception with spectrum assigned for transmission, promoting frequency reuse and boosting spectral efficiency. To realize STAR, it is imperative to suppress the leakage of power from the transmitter to the receiver. To cancel this self-interference (SI), the following approaches may be followed: (1) employ transmit/receive (Tx/Rx) antennas with high isolation, (2) incorporate RF filters to cancel duplicates of the transmitted signal from the receiver chain at the analog stage, and (3) post process the digitized signal to further remove SI using transmitted signal modulation details. As can be understood, the most important cancellation stage is that of the antenna as it is essential to ensure that the receiver is not saturated by the large power coupled from the transmitter. With this in mind, in this paper, we focus on the antenna port to port isolation, with an emphasis on wideband operation, specifically across a 1 GHz bandwidth.

Earlier wideband STAR antennas considered a circular array of Tx elements with progressive phase shifts at their feeds to produce a destructive interference at a single, central Rx element. However, this approach required bulky and heavy antenna structures (K. E. Kolodziej, et. al., IEEE APS-URSI Symposium, Chicago, IL, 2012; W. F. Moulder, et. al., IEEE APS-URSI Symposium, Memphis, TN, 2014).

For compactness and simplicity, in this paper we propose a collocated pair of omnidirectional antennas that achieves high Tx/Rx isolation for wideband STAR radios. An essential aspect of this STAR antenna is its perfectly symmetric radiating structure backed by a ground plane to achieve port to port isolation of > 50 dB across a > 1 GHz bandwidth (1.5-2.5 GHz). The antenna design is analogous to two dipoles with their arms wrapped in a circle. Also, the antenna baluns are placed below the ground plane to ensure better symmetry and simplicity. Simulations indicate that as much as 60 dB of Tx/Rx isolation is possible with the proposed configuration. Notably, this antenna achieves greater isolation than previous designs. Measurements will be presented using a fabricated model with precision laser manufacturing and assembly techniques to achieve tolerances on the order of 25 μm.