A Compact Simultaneous Transmit and Receive (STAR) Antenna with High-Isolation and Monopole-Like Radiation Characteristics

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Antennas that are able to simultaneously transmit and receive (STAR) at the same frequency and the same time can potentially double the spectral efficiency and data throughput of wireless systems. The development of such STAR antennas is key to in-band full-duplex communication and applications such as narrow-band internet of things (IoT), millimeter-wave systems, and next-generation electronic warfare. For STAR antennas to operate efficiently, it is critical to suppress the self-interference below the receiver noise floor. This requires a high isolation between the transmitter (TX) and receiver (RX) paths. In some military applications that take advantage of STAR antennas, while wide bandwidth is not necessary, it is desired that the antennas are compact and possess monopole-like radiation patterns.

In this paper, we present a compact STAR antenna with high-isolation for in-band full-duplex applications. In this design, a simple monopole antenna is employed for the TX path, while a double-helical antenna with closed strands functions as the RX antenna. The proposed TX and RX antennas radiate with the same polarization and with monopole-like radiation patterns. The helical antenna has been designed to operate in its normal mode to provide the desired radiation characteristics. To achieve high isolation, the two strands of the double-helix RX antenna are fed by 180° phase difference. With this design setup, the complexity of the antenna feed network is drastically reduced (i.e. only a single balun is needed to provide the desired phase difference). The STAR antenna is simulated using Altair FEKO. The design is tested at 1 GHz and the simulation results demonstrate that the TX and RX antennas have the same vertically-polarized radiation patterns. Both TX and RX antennas can operate from 0.96 GHz to 1.05 GHz. The isolation between the TX and the RX paths remains greater than 91 dB throughout the operating frequency. The proposed STAR antenna has the dimensions of $0.12\lambda \times 0.12\lambda \times 0.25\lambda$, where λ is the free-space wavelength at the center frequency of operation (1 GHz). The design details and the measurement results of the fabricated antenna prototype will be presented and discussed at the symposium.