Wideband In-band Full-duplex Dual Reflector Antenna System

Prathap Valale Prasannakumar(1), Mohamed A. Elmansouri(1),
and Dejan S. Filipovic (1)
(1) Department of Electrical, Computer, and Energy Engineering
University of Colorado, Boulder, CO 80309-0425
E-mail: mohamed.elmansouri@colorado.edu, dejan@colorado.edu

Abstract

In band full-duplex or simultaneous transmit and receive (STAR) systems have potential to transmit and receive at the same time and in frequency. Therefore, a STAR system can increase the efficiency of frequency utilization when implemented in communication systems. Similarly, the capability to receive while transmitting is critical for the effectiveness of an electronic warfare (EW) systems. However, self-interference or self-jamming is the main challenge for the practical implementation of an in-band full-duplex system. Hence, minimizing this interference is the primary design goal. Increasing the isolation at the antenna layer, that is, between the transmitter (TX) and receiver (RX) is the one approach to minimize the interference. Further, isolation between the TX and RX in the order of 110 dB can be realized, when the cancelation from the antenna layer is combined with cancelation from analog and digital signal processing layer. A full-duplex system aimed for mm-wave frequencies has lot of potential in both civilian and defense applications. However, implementing a STAR system in mm-wave is even more challenging, due to the requirement of high power and gain of the TX; and the high attenuation in the free space propagation. Furthermore, minimizing the losses in the transmission and reception path is critical, and hence the length of the transmission lines. Therefore, the design of a dual reflector based STAR system with high isolation between the TX and RX is proposed for 18-45 GHz. The TX aperture is a dual reflector antenna whereas the RX aperture is mounted on top of the sub-reflector. Further, the antennas are operated in the circular polarization (CP). The positioning of the TX and RX combined with the CP operation of the antennas could result in isolation ~ 110 dB, when the symmetry is maintained in the antenna geometry, and in the beam forming networks (BFN). A quad ridge horn (QRH) antenna fed by an ortho-mode transducer (OMT) is employed as the TX antenna, which can support high power operation. Similarly, the RX antenna is a QRH, fed by two coaxial probes, which minimizes the mechanical load on the sub-reflector. The TX and RX antennas have $|S_{11}| < -10$ dB, and gain > 24 dBic and > 13 dBic, respectively. Further, the design facilities seamless integration of superheterodyne receiver modules behind the sub-reflector itself. Thereby, the received signals can be transmitted to the back-reflector positioned processing sub-system at lower frequencies or digitally.