Wideband Dual-Polarized Cavity-Backed Vivaldi Array Antennas for Bi-Static Simultaneous Transmit Receive

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Abstract

With the congestion of the electromagnetic spectrum, it becomes more and more difficult to allocate contiguous spectrum to new wireless services. Researchers are therefore looking for new techniques to increase spectrum efficiency and means that can enable the aggregation of multiple services into a single platform. From the spectrum efficiency standpoint, having the capability to simultaneously transmit and receive (STAR) can theoretically double the spectral efficiency. The main challenge for STAR systems is the isolation between transmit and receive ports. The required level of isolation depends on applications and is often obtained by combining cancellation at the baseband, RF and antenna layers. For bi-static STAR systems relying on isolation at the antenna layer, increased separation between antennas is the main technique used to reduce coupling and therefore improve isolation. This leads to large antenna footprint and may not be suitable for space constraint platforms. From the service aggregation standpoint, wideband antennas that can cover multiple noncontiguous bands are of prime interest. Specifically, antennas with high gain, dual-polarization, and moderate/high power handling over the entire noncontiguous bandwidth. Easy concealment is another feature often required to mitigate the interaction of multiple antennas when used on a shared platform or for aerodynamic requirements in airborne platforms.

In this work, we propose an all-metal dual-polarized antenna for used in a bi-static STAR system. This configuration combines the features of Vivaldi antenna array and quadridge horn while maintaining symmetric modes of polarization over 3.5: 1 bandwidth. The proposed antenna is obtained by carefully recessing a 2-element dual-polarized Vivaldi array into a shaped metallic cavity. A high power stripline power divider/combiner operating from 1 to 10GHz is also designed and integrated with the antenna in a compact form, leading to only two feeding points associated with each polarization port. Two of the designed antennas are diagonally mounted on a 30 cm × 30 cm metallic ground plane for bi-static STAR performance demonstration. Measured and simulated isolation on a flat ground plane is >40dB. Different approaches to increase the transmit/receive isolation are also presented and performance trades are discussed.