

# *Abstract*

Full-duplex mode is the future of modern wireless communication systems because of its ability to transmit and receive simultaneously. But the mutual coupling between the transmit (Tx) and receive (Rx) antennas of the same node is the biggest challenge for an in-band full-duplex system, also known as self-interference. This thesis presents the design and development of highly isolated, co-polarized, in-band, full-duplex planar antennas. In this dissertation, different simple and effective techniques are introduced for self-interference cancellation (SIC). The proposed decoupling schemes are formulated in a manner that they do not deteriorate the antenna's radiation performance.

In the first work, a dual-substrate-layer-based highly isolated in-band full-duplex antenna is introduced. The decoupling configuration consists of two resonated microstrip lines placed on the 2nd layer of substrate (beneath the patch) and a rectangular slot in the ground plane. The decoupling mechanism is illustrated based on mode cancellation theory. The feasibility of the reported method for array applications is also demonstrated.

One, a compact and highly isolated in-band full-duplex antenna is proposed. This work introduces the concept of neutralizing the electric field coupling between the adjacent edges of the antennas. This concept is validated and applied to increase the isolation between the Tx and Rx ports of the in-band full-duplex antenna. Furthermore, a method is presented to increase the antenna's bandwidth without compromising its isolation level. Additionally, the usability of the proposed work for the array is examined. The antenna is simple, compact, and has high isolation enhancement & bandwidth, which makes it a good candidate for the IBFD applications.

The capacity of in-band full-duplex antennas can be enhanced by using them for integrated sensing and communication applications (ISAC), and it can be extended to high gain by placing the antennas in an array configuration. One such possibility is explored by designing an in-band full-duplex array at mmWave frequencies for the array configurations. The coupled wave at the Rx antenna is cancelled by dividing the Tx wave into two parts of equal amplitude and 180° phase shift. In the presented array, the Tx and Rx ports are highly isolated and each port has a dual beam function (one of each beam for communication and sensing).

Furthermore, the coupling is also a major challenge for antenna arrays, specially for the compact configurations where antennas are placed in a very close proximity. So, the decoupling methods are discussed for both E-plane and H-plane array configurations.