Conformal Strongly Coupled Magnetic Resonant Antennas for Wearable Applications

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Wireless Power Transfer (WPT) is an emerging technology that is attractive for applications in which no physical wired connections between the transmitter and receiver are practical. Conformal Strongly Coupled Magnetic Resonance (SCMR), a mid-range wireless powering method, is suitable for applications in the healthcare field, structural monitoring and more recently, wearable devices. A near-field wireless power system based on Conformal SCMR (CSMR) technology consists of four elements: a source, load, and planar transmitter and receiver elements. The receiver and load elements are designed on a printed circuit board that is attached to a wearable band. The system is compact in size, can be easily printed on substrates, and achieves high efficiency.

A comprehensive study on the performance of a compact wearable CSCMR system is presented in this paper. Studies are performed with the receiver and transmitter element in free space, and when in contact with the human skin. In these scenarios, the relationship between efficiency and distance from receiver to transmitter elements is studied for two cases: (a) when TX and RX are aligned and (b) when TX and RX are misaligned. Also, measurements demonstrate that lossy human tissue in close vicinity to SCMR elements disrupts the reactive near field and causes absorption losses. When the receiver and transmitter elements are aligned and separated by a distance of 55 mm in free space, WPT efficiency is approximately 70%. When the receiver is then placed on the arm of an individual, WPT efficiency drops to 60%. Relative element misalignment also reduces the efficiency of wearable CSCMR systems. When the transmitter element is rotated past a 60° angle relative to the receiver element, the efficiency of the CSCMR system is reduced by approximately 10% both in free space and on the arm of an individual.

The studies performed in this paper pertain to human body and misalignment effects on wearable CSCMR systems. These studies will provide critical information for future investigations that will focus on improving the performance of wearable CSCMR systems. Also, our paper proposes tunable transmitter and receiver elements to achieve optimal performance and improve the efficiency of wearable CSCMR systems.