Design of Strongly Miniaturized, Inherently Matched, and Scalable Folded Dipole Antennas

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Despite suffering from limitations like reduced bandwidth and radiation efficiency, electrically small antennas have found widespread application in low-power sensing/monitoring applications such as biomedical implants, RFID tags, or Internet-of-Things (IoT) devices, where a moderate radiation efficiency over a narrow bandwidth usually suffices. In order to improve the detection range of these antennas, particular attention is paid towards increasing the power accepted by the antenna, which implies enhanced radiated power for a given radiation efficiency. A miniaturized antenna generally exhibits a small input resistance and a large input reactance, thus making it difficult to match to a practical source impedance. External matching networks are traditionally employed to address this issue, which often increases the size and complexity of the structure.

Dipole-like antennas are often the preferred choice for many sensing applications, particularly due to their well-defined radiation properties, low cost, compact size, and omnidirectional coverage. In this work, a folded dipole antenna is miniaturized to 75% of its resonant length by employing a novel series capacitive and inductive loading scheme. It is shown that the input-impedance response of the antenna can be engineered systematically by properly choosing the loading reactances and introducing asymmetries, in order to achieve good matching with both real (e.g., biomedical implants, IoT antennas) and complex (e.g., RFID tags) source impedances. For both cases, the final result is a highly miniaturized and inherently well-matched antenna that does not require an external matching network, demonstrates excellent co- to cross-polarization separation, and exhibits a much better radiation efficiency compared to an unloaded folded dipole of the same size. In this talk, we will discuss the performance of a few miniaturized folded-dipole-antenna prototypes suited for different sensing applications including those already mentioned. Furthermore, fully printed varieties of the proposed antenna can be explored as candidates for higher frequency applications by exploiting their frequency scalability.