A 2.45 GHz Textile-based RF Rectenna Array for Sensor Applications

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As is well known, there is a high demand for wearables electronics due to their numerous applications in sports, fitness and healthcare, childcare, military, home security, etc. But despite their functionality, existing IoT devices and sensor-equipped modules are rigid, breakable, bulky, obtrusive, battery dependent, and expensive. Therefore, there is a need for flexible electronic surfaces that can withstand continuous mechanical deformation, particularly when integrated into garments.

In this paper, we propose a flexible, textile-based power harvesting system integrated into garments. The integration of these wearable interfaces into textiles allows for the realization of systems that are a) comfortable and lightweight, and which are b) durable to many cycles of use and washing. The proposed power harvesting system is fabricated of robust and unobtrusive antennas and rectifying circuits integrated into fabric substrates. We already developed a 6-element rectenna array that demonstrated a DC power collection of up to 600μW. To demonstrate practical usage, the array is used to harvest power sufficient to light up an LED and power an LCD temperature sensor. Using on-fabric supercapacitors and management circuit, we envision a power harvesting system to power a built-in textile-based sensor network for smart sensing. Further optimizations were made to enhance the performance of the developed array. Specifically, the RF performance of the array was optimized using an embroidery technique on a fabric substrate. It was found that the prototype performance depended on the tension of the threads, their density, and the chosen stitching patterns. At the conference, we will present example rectennas (antennas + rectifying circuits) developed on textile substrates. Analysis, simulations, and measurement results will be presented for the developed rectenna prototypes.