Deep Tissue Biomedical Imaging Using a Wearable Sensor

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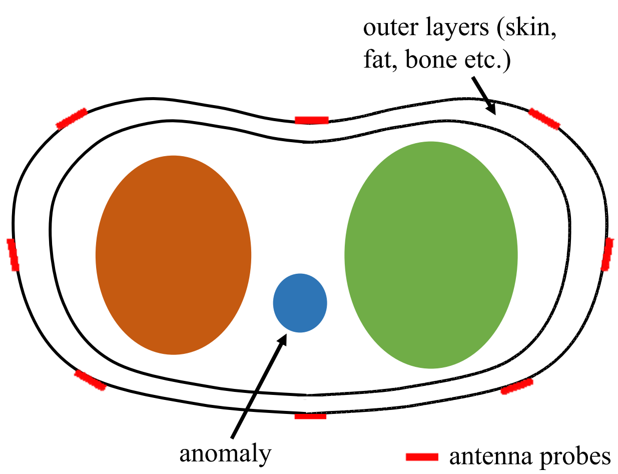
A microwave imaging method in the context of a wearable sensor for deep tissue imaging is presented. For continuous and low-cost monitoring of vital human body signals, several portable body-worn sensors have been reported in the recent past. Such sensors may pursue continuous monitoring of respiratory and heart rates, temperature or blood pressure. However, they do not include imaging capabilities. Recently, we proposed a wearable sensor (Islam et. al. IEEE Sensors Journal, 16, 1, 265-270, 2016) using a set of dipole antennas to image tissues as deep as 10 cm inside the torso. Though the accuracy of this sensor is fairly good for high-contrast body tissues, it has several limitations mostly attributed to the oversimplification of the realistic imaging scenario. For example, it assumes a perfectly known geometry/shape of the imaging domain which is highly unlikely in biomedical imaging applications with wearable sensors.

To overcome these limitations, we propose a sensor with a novel imaging method that uses the formulation of line source scattering from a PEC cylinder. The required Green's function is estimated using electromagnetic reciprocity. It will be shown at the conference that the subject sensor can extract differential change in the medium permittivity of a human torso model in real time, even when the shape of the imaging domain is not exactly known. Also, the proposed can overcome reflections from the outer layers of the domain, implying robustness in terms of placement and sensor contact with the skin's surface. Overall, these new capabilities can provide a potential solution for deep tissue imaging in a casual and out-of-hospital setting.



(a)

Figure 1. A representative human torso imaging domain, 2D cross-section.