An On-Body Wrap-Around Sensor for Monitoring Changes in Lung Permittivity

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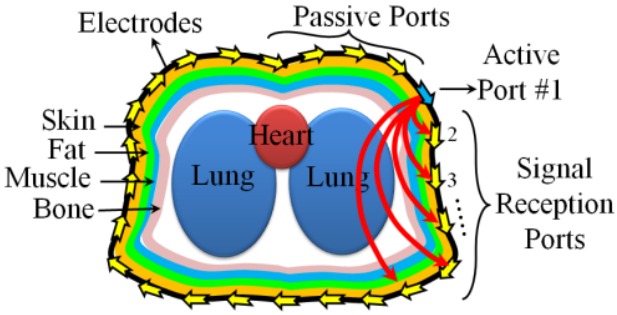
Non-invasive diagnosis methods are of great practical importance. We propose an on-body, non-invasive and wearable health monitoring sensor that forms a convenient wrap-around belt to be part of the clothing or worn under the clothing. This sensor serves to identify tissue abnormalities by measuring their permittivity. A schematic of the proposed sensor is shown in the figure below. The sensor is composed of a plurality of electrodes populated around the band, and is wrapped around the human torso. Ports (in between the electrodes) are excited sequentially with an RF signal at 40 MHz, and scattering parameters are collected from the neighboring passive ports (unused ports are terminated with 50 Ω). We note that receiving ports far away from the active (transmitting) one allow for deeper penetration. Thus, we in principle associate each probe with a certain penetration depth. Post processing is applied to extract the permittivity of deep tissues as a weighted sum of the measured scattering parameters. The uniqueness of this approach is that it suppresses interference from the outer body layers (skin, fat, muscle, and bone).



Schematic of the proposed on-body, wrap-around sensor for health monitoring.

The proposed sensor has been evaluated on a phantom making use of tissue-emulating gels to represent the human torso. Measurements showed that the error in calculating the permittivity of deep tissues remains below 11%. For medical applications, the sensor can be used to monitor the permittivity of lungs or other organs. In the case of lungs, the sensor serves as a precursor to congestive heart failure. At the conference, we will provide experimental results on the evaluation of the sensor. We will show its feasibility for imaging the electrical properties of the body.