Biomedical Imaging Application of Open-Circuit Resonators

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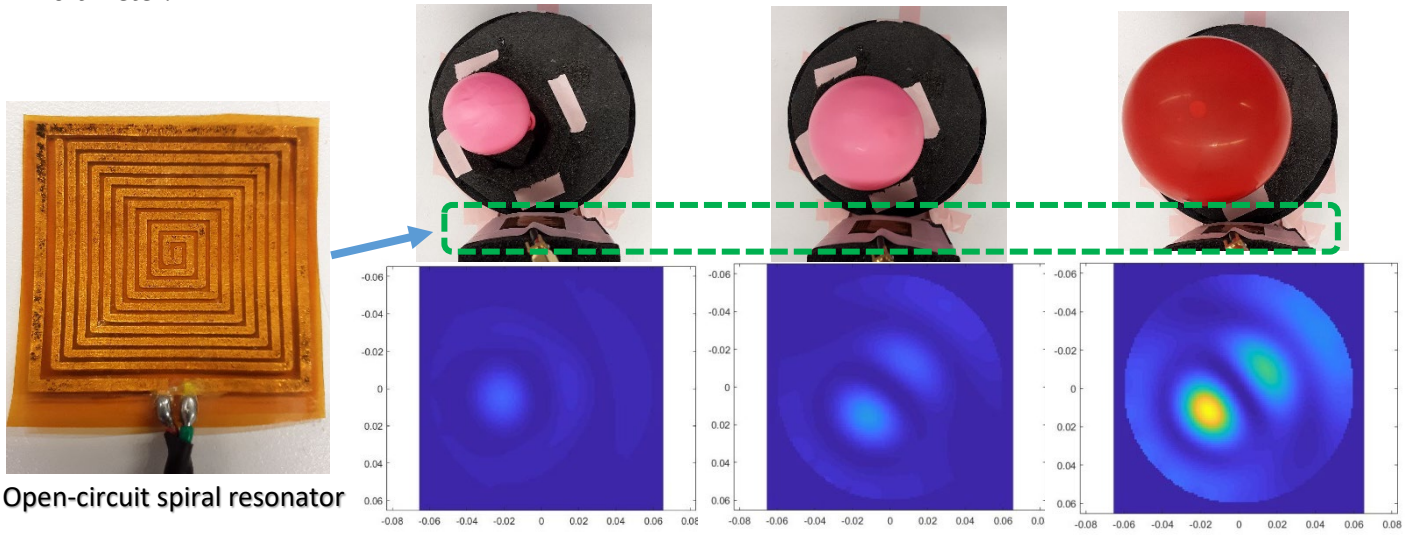
INTRODUCTION: While modern medical imaging technology like computed tomography (CT) and magnetic resonance imaging (MRI) can now reproduce the anatomy of the human body with astounding detail, there remains a need for new imaging modalities that are less expensive, portable, and free from harmful ionizing radiation (as is present during CT scans). These factors lessen the applicability of traditional medical imaging techniques in limited resource environments and in rapidly evolving medical emergencies. Microwave imaging is a promising alternative in these situations being able to produce images in minutes with no ionizing radiation with a greatly reduced volume of hardware.

PURPOSE: This study was conducted to begin evaluating the imaging capabilities of an open-circuit spiral resonator antenna that has been previously used in sensing applications to monitor biofluid shifts. The ability to simultaneously sense fluid shifts *and* localize them in an image using the same sensor is of interest.

METHODS: A single open-circuit antenna was positioned in front of a rotating platform upon which three sizes of water-filled balloons (diameters: 4.6cm, 6.6cm, and 8.9cm) were mounted approximately 2cm off from center. Complex reflection coefficients were collected at 16 locations around the imaging platform for each. Images were reconstructed using an average subtraction preprocessing technique and delay-and-sum (DAS) beamforming algorithm.

RESULTS: Reconstructed images of the three balloon diameters are shown below. The balloon was successfully localized in all three cases, and the intensity of the water region scaled with balloon diameter.



CONCLUSION: The findings of this study support the use of an open-circuit spiral resonator as an imaging antenna for the localization and quantification of biofluid shifts in the human body.