

Hi, I'm Amrutha from Purdue University. My co-presenter, Aditi, and I are excited to present our work titled "A Microwave based method for early detection of congestive heart failure"

Congestive Heart Failure or CHF is a widespread condition that affects over 5 million Americans, with almost a million new diagnoses worldwide each year. CHF is frequently accompanied by pulmonary edema, or collection of fluid in the lungs. Hence, it is commonly diagnosed by using chest radiographs to detect pulmonary edema. However, chest radiographs have limited sensitivity, causing mild to moderate cases to often go undetected.

We propose a new microwave-based method for detecting pulmonary edema associated with CHF. The proposed method is more sensitive than current methods and hence results in earlier detection, while being safer due to the non-ionizing nature of microwaves.

The proposed system consists of a two-dimensional array of microwave transmitters and a two-dimensional array of receivers, placed on either side of the human subject's thoracic cavity. The attenuation of microwaves varies based on the amount of fluid present in the lungs. Through the use of suitable signal processing algorithms that analyze the received microwave strengths, we can infer the presence or absence of pulmonary edema.

To evaluate the feasibility of our proposal, we developed a simulation framework comprising models of the microwave source, the thoracic cavity, and the receiver. The thoracic cavity was modeled using a lumped equivalent electromagnetic circuit. We also implemented the signal processing algorithm required to analyze the receiver output.

We used the simulation framework to evaluate mild, moderate and severe levels of edema and found that the attenuation of microwaves increases by 10.8%, 24.3% and 43.2%, respectively, in these scenarios. Notably, the proposed method is able to detect the presence of 100-150 ml of pulmonary fluid, which is around 2.5 times lower than levels that can be reliably detected using chest radiographs.

In summary, microwave imaging holds significant promise in enabling earlier diagnosis of CHF, while being cost effective and safe to use. Please stop by our poster for further details.