Sensing Volume of Breast Tissue for Microwave Dielectric Characterization

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An estimated 300,000 people will be diagnosed with breast cancer in the United States in the year 2017 alone. Currently, mammograms are an important tool in the screening and diagnosis of possible malignancy. Despite its effectiveness, this procedure utilizes x-ray imaging which increases radiation exposure that can potentially result in cancer. Although screening benefits still outweigh the risks, safer and more effective imaging solutions are still being sought. One prospective replacement for x-ray imaging is microwave imaging as it uses lower frequencies reducing radiation exposure. Lower frequencies require a larger sensing volume which has a lower resolution. Since breast tissue samples range from 1 to 10 cm and are heterogeneous, understanding how smaller samples may affect the reliability of data at microwave frequencies is of critical importance. A better understanding of the sensing volume at microwave frequencies is needed to effectively prepare for future microwave imaging and related research that will pave the road for safer detection and diagnostic tools.

This study investigates the accurate sensing volume for breast cancer microwave imaging by means of simulations as well as in-vitro and ex-vivo testing. Our research focuses on how sensing volume changes with different measurement protocols and with different compositions of skin, adipose, and fibroglandular tissue within the breast. By measuring changes in the reflection coefficient in accordance to volume, these simulations are compared and contrasted with measurements performed on tissue mimicking gels and porcine mammary samples. The sensing volume will be optimized through the analysis and comparison of each experimental method.