On the Development of a Clinical Full-Vectorial 3D Microwave Breast Imaging System

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Adopting microwave imaging (MWI) for breast cancer detection has been of interest to researchers around the globe due to its use of non-ionizing radiation, low cost and potential portability.

We have developed a 3D full-vectorial microwave breast imaging system comprised of 120 microwave transmitter/receivers, a switching unit, a microwave transceiver and a data processing unit. The immersion medium within the chamber is water purified via reverse osmosis filtration. The microwave transmitters are waveguide slots and the receivers can be configured as the slots themselves, or as switching diodes across the slots to implement the Modulated Scattering Technique (M. Ostadrahimi, *et al.*, 2014 USNC-URSI, 54, 2014). The presence of the water immersion medium within the slotted waveguides offers some advantages for MWI, which will be discussed. Using scattered field measurements performed with the breast immersed within the chamber, the ultimate goal of this MWI system is to produce accurate quantitative images of the breast tissues' complex permittivity.

In addition to scans of non-biological phantom targets using this prototype system, *in vivo* measurements of human breast tissue have been carried out with the help of female volunteer test subjects. These measurement results will be summarized and the phantom measurements will be compared to synthetic data obtained from a numerical model of the system. Preliminary imaging results of the phantoms and female volunteers will be presented. Various models of the MWI system appropriate for use in the inversion algorithm, as well as different calibration techniques, have been investigated. Their advantages and disadvantages in obtaining accurate images, as well as the remaining technical challenges involved in the development of this clinical system, will be discussed.