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Microwave Imaging Systems in Breast Health Applications

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Breast cancer poses a high risk as the second most common cause of death in women, with early stage discovery significantly improving 5-year survival rates. Conventional screening methods include X-ray mammography, ultrasound and magnetic resonance imaging (MRI), followed up by a biopsy [1]. All these standard points-of-care suffer from drawbacks, such as use of ionizing radiation, painful breast compression, expensive operational costs and hence limited access. Over the past years, microwave imaging (MWI) has been investigated as a complementary screening technology for breast health monitoring and cancer detection [2-8] due to its accessibility and low cost, as well as use of non-ionizing radiation. Microwave imaging relies on reported inherent dielectric contrast between malignant, benign and healthy breast tissue. The two major explored concepts include microwave tomography (MWT), in which the dielectric profile of the breast is recovered, and microwave radar (MWR), in which the dielectric scatters in the breast are mapped. While some of the previously introduced systems have undergone clinical trials [3-5, 9], novel development aspects require testing using tissue mimicking models (phantoms) for system validation and safety assessment [10-13]. This tutorial will introduce the fundamentals of microwaves for breast cancer detection as well as phantom models for system validation, and discuss state-of-the-art research that is investigating the usability and development new devices for breast cancer detection using MWI.

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