PhD Open Days

Feasibility of Benign and Malignant Tumor Detection Using Microwave Breast Imaging

ELECTRICAL AND COMPUTER ENGINEERING

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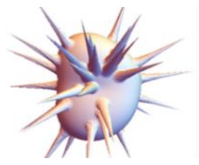
Motivation

Breast cancer is one of the most common cancers in the world.
Current imaging modalities are ionizing (mammography), time consuming (ultrasounds) and expensive (MRI).

Solution: Microwave Imaging (MWI)

MWI is based on the contrast between the dielectric properties of tissues.
Malignant and benign tumors may present overlapped dielectric properties, but can be distinguishable by their architectural features.

Benign =  Malignant = 

Goals

- Test if benign and malignant tumours are distinguishable using MWI
- Detect the minimum tumour size detected by our MWI system

MWI System

It comprises a Styrofoam base serving as support to a breast phantom and an antenna rotating around the breast, acquiring backscattering signals.

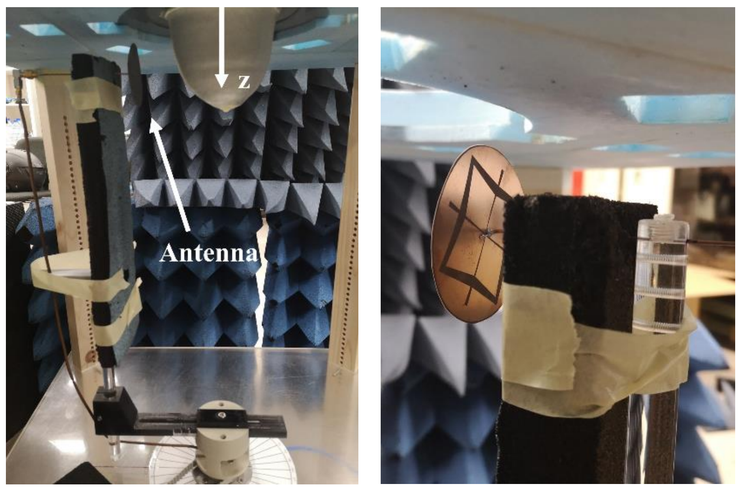


FIGURE 1: MWI setup with antenna directed to a breast phantom placed in a Styrofoam base.

Breast mimicking model

Homogeneous breast (without fibroglandular tissue).

- Skin: MRI-derived 3D-printed breast shell
- Adipose Tissue: Liquid (TX-100) inside breast shell
- Tumors: 3D-printed 8 smooth and 8 spiculated rounded random shapes with average radius 3, 4,…, 10 mm

FIGURE 2: Printed breast shell, and benign and malignant tumors.

Antenna

Collecting data at every 9º (40 positions).
Low power emission.
Band of operation: 2-5GHz.

Algorithms for MWI reconstruction

MW signals were processed, and images of the breast were produced using:

- Adaptive algorithm to remove intense skin reflection
- Image reconstruction algorithm based on wave-migration

Experimental Imaging Results

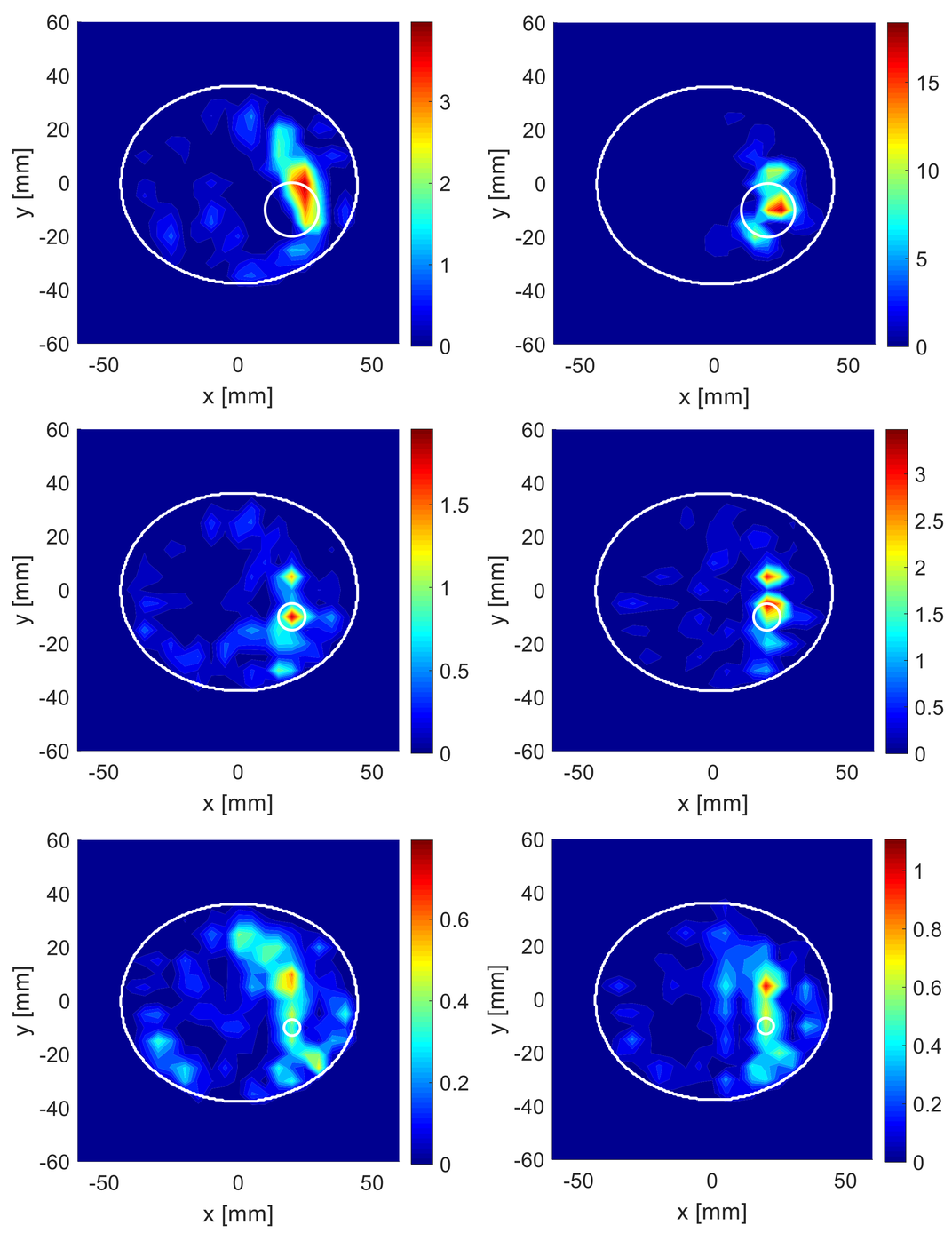


FIGURE 3: Two-dimensional images using one breast phantom and benign (left) and malignant (right) tumors of average radius 10, 5 and 3 mm.

Conclusions and Future Work

Both types of tumours were detected down to a 4-mm radius size (being the 3-mm size, the detection limit of our dry MW setup).
Malignant and benign tumours couldn't be discerned only via MW.
Future work includes the study of complementary techniques, such as Machine Learning to allow this distinction.

TÉCNICO LISBOA

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