On the development of an imaging system at millimetre-wave frequencies for early breast cancer detection

Simona Di Meo*

*Microwave Lab. - Dept. of Electrical, Computer and Biomedical Engineering - University of Pavia - Italy

Abstract - *In recent years, it is growing the interest toward the utilization of electromagnetic waves for biomedical applications. One of the most promising application is the use of microwaves and millimetre waves for diagnostic purpose, in particular for breast cancer detection. In this poster, a complete overview of the work done at the University of Pavia about the development of an innovative mm-wave imaging system for early-stage breast cancer detection in fatty tissues is given.*

1. INTRODUCTION

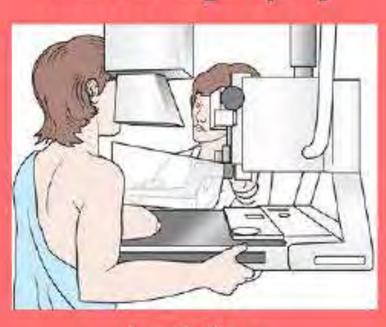
Ultrasound

Useless in fatty tissues

Breast-MRI

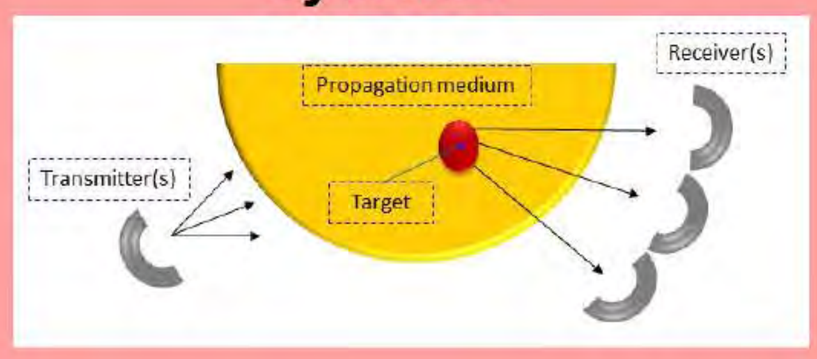
High cost

Mammography



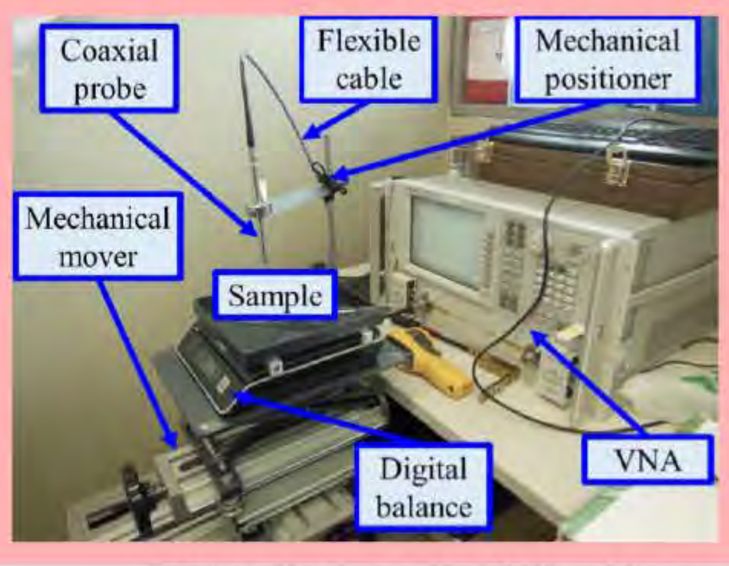
Ionizing radiations

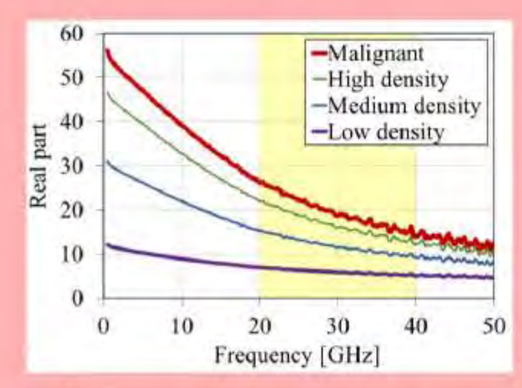
Microwave and mm-Wave Imaging Systems

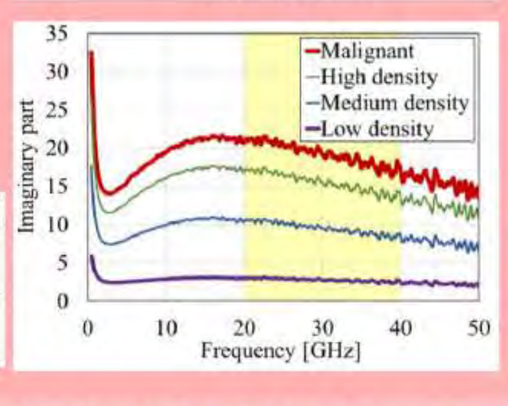


Physical working principle

2. DIELECTRIC CHARACTERIZATION OF HUMAN BREAST ex-vivo TISSUES



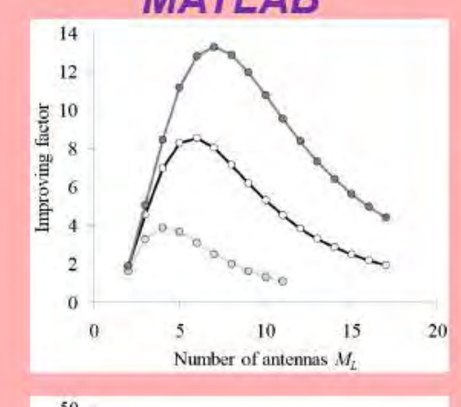


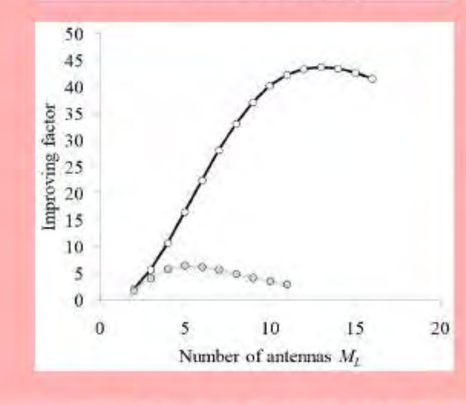


	Categories of women healthy breast tissues		
	Low density tissues	***Medium density tissues***	***High density tissues***
Fat percentage	Greater than or equal to 80%	From 20% to 80%	Lower than or equal to 20%

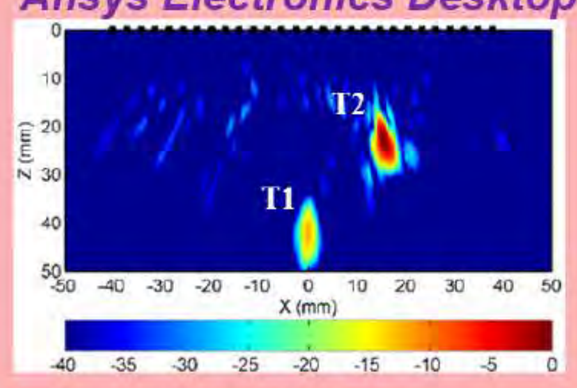
3. FEASIBILITY STUDY OF THE mm-WAVE IMAGING SYSTEM

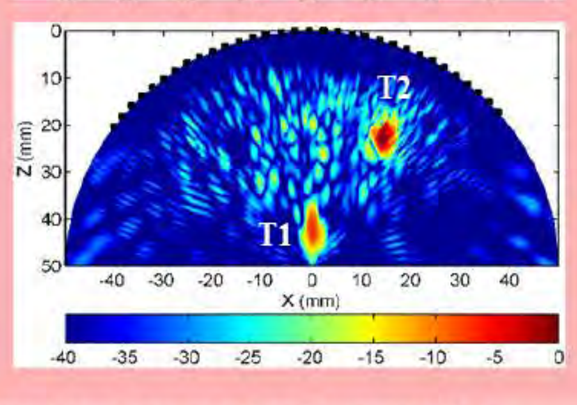
MATLAB



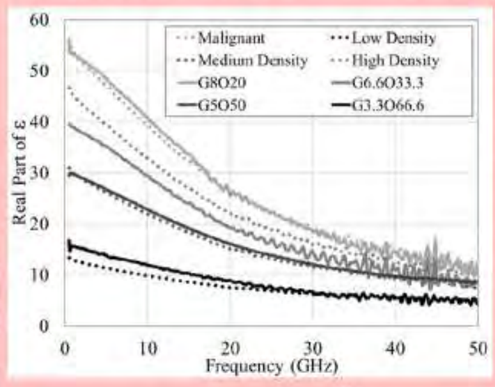


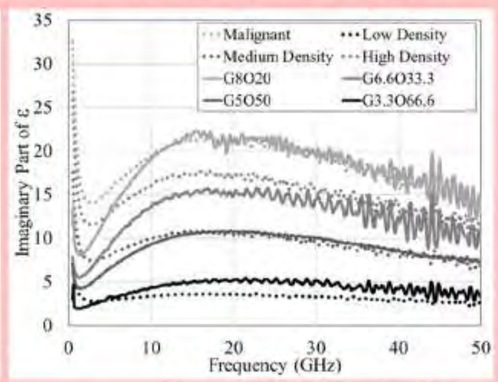
Ansys Electronics Desktop



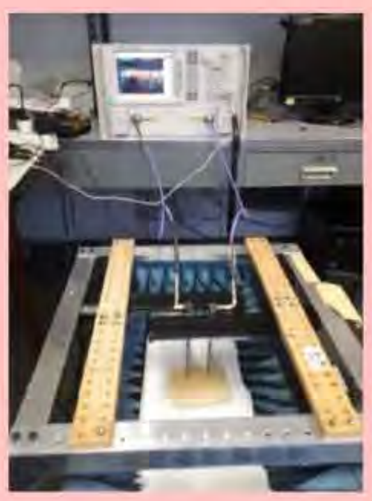


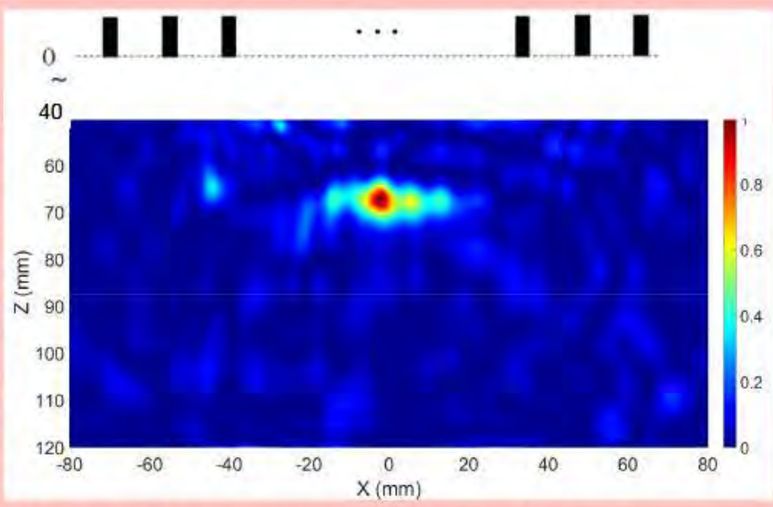
4. TISSUE MIMICKING BREAST PHANTOMS





5. PRELIMINARY EXPERIMENTAL MEASUREMENTS





Synthetic array: 24 double-ridge waveguides, [18-40] GHz
Phantom: (background) Polysorbate 80 & waste-oil hardener,
(inclusion) Deionized water & gelatine

References

[1] S. Di Meo, *et al.*, "Dielectric properties of breast tissues: experimental results up to 50 GHz", *EuCAP 2018*, London, UK, April 9-13, 2018.
[2] S. Di Meo, *et al.*, "On the Feasibility of Breast Cancer Imaging Systems at Millimeter-Waves Frequencies," *IEEE Transactions on Microwave Theory and Techniques*, vol. 65, no. 5, pp. 1795–1806, 2017.
[3] S. Di Meo, *et al.*, "High-Resolution mm-Wave Imaging Techniques and Systems For breast Cancer Detection", *IEEE MTT-S IMWS*, Pavia, Italy, September 20-22, 2017.
[4] S. Di Meo, *et al.*, "Tissue-mimicking materials for breast phantoms up to 50 GHz", *Physics in Medicine and Biology*, https://doi.org/10.1088/1361-6560/aafeec.

Acknowledgments

The author would like to thank all the medical staff of the European Institute of Oncology in Milan for their help during the work.

***Tutor of this work*:** Prof. Marco Pasian, Dept. of Electrical, Computer and Biomedical Engineering - University of Pavia - Italy
***Main partner*:** Dr. Giulia Matrone, Dept. of Electrical, Computer and Biomedical Engineering - University of Pavia - Italy

Collaborations:

Funded by:

Contact information: *simona.dimeo@unipv.it* - Phone number: *+39 0382 985223*