

Using Machine Learning to Suppress the Skin Response in Breast Microwave Sensing



Jordan Krenkevich, Tyson Reimer, Dr. Stephen Pistorius
Department of Physics and Astronomy, University of Manitoba
krenkev@myumanitoba.ca



Introduction

It is estimated that 1 in 8 Canadian women will get breast cancer in their lifetime and 1 in 33 will die from breast cancer [1]

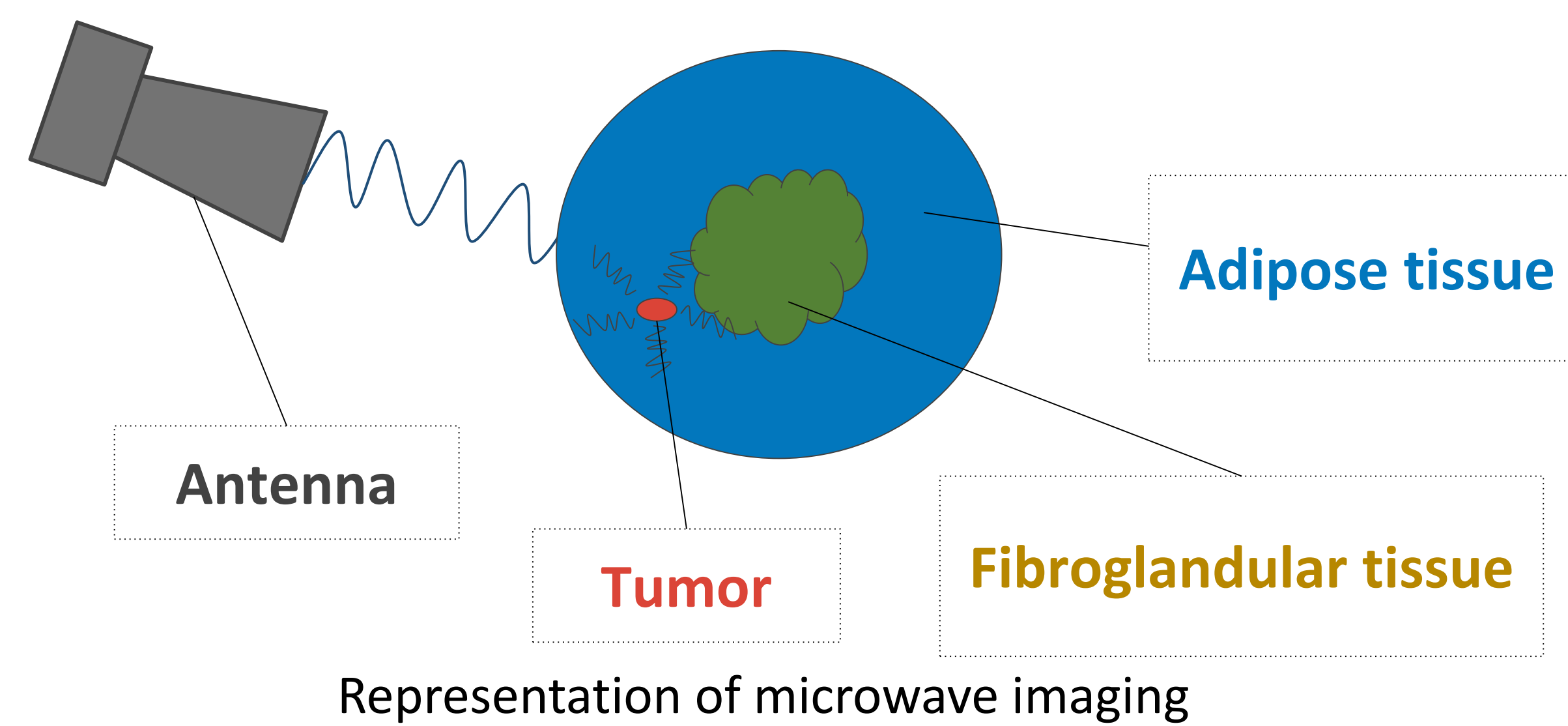
Breast Cancer Screening

Currently, x-ray mammography is the most used breast cancer screening modality, but mammography has drawbacks [2]:

- Use of ionizing x-rays
- Compression of the breast can be uncomfortable for women
- High false positivity rate leads to unnecessary levels of stress and anxiety in women and families

Microwave Imaging

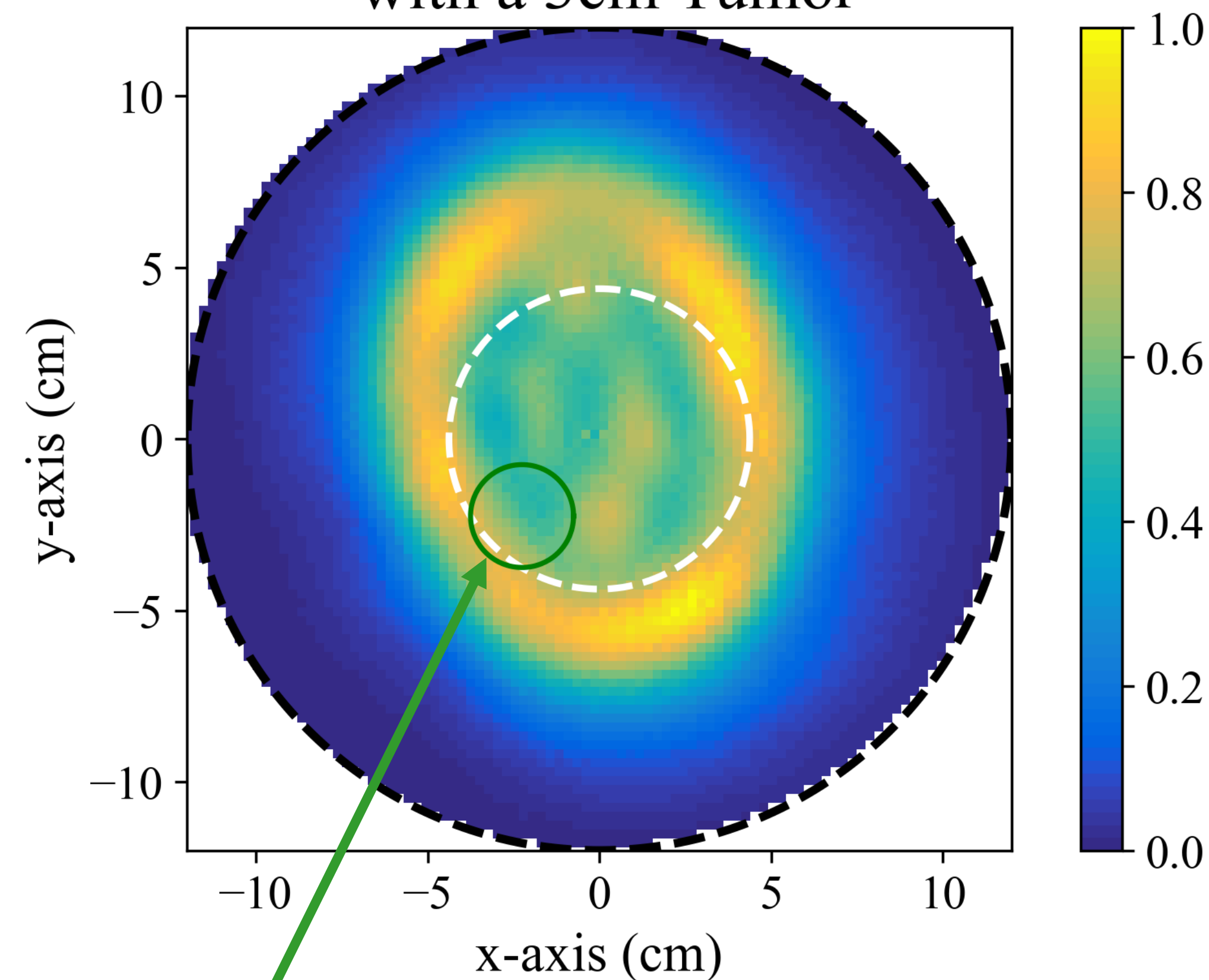
Microwave imaging uses non-ionizing radiation and is based on the dielectric contrast between healthy and malignant tissues



The Skin Response

The skin response obscures the response of the tumor making it difficult to determine if a tumor is present

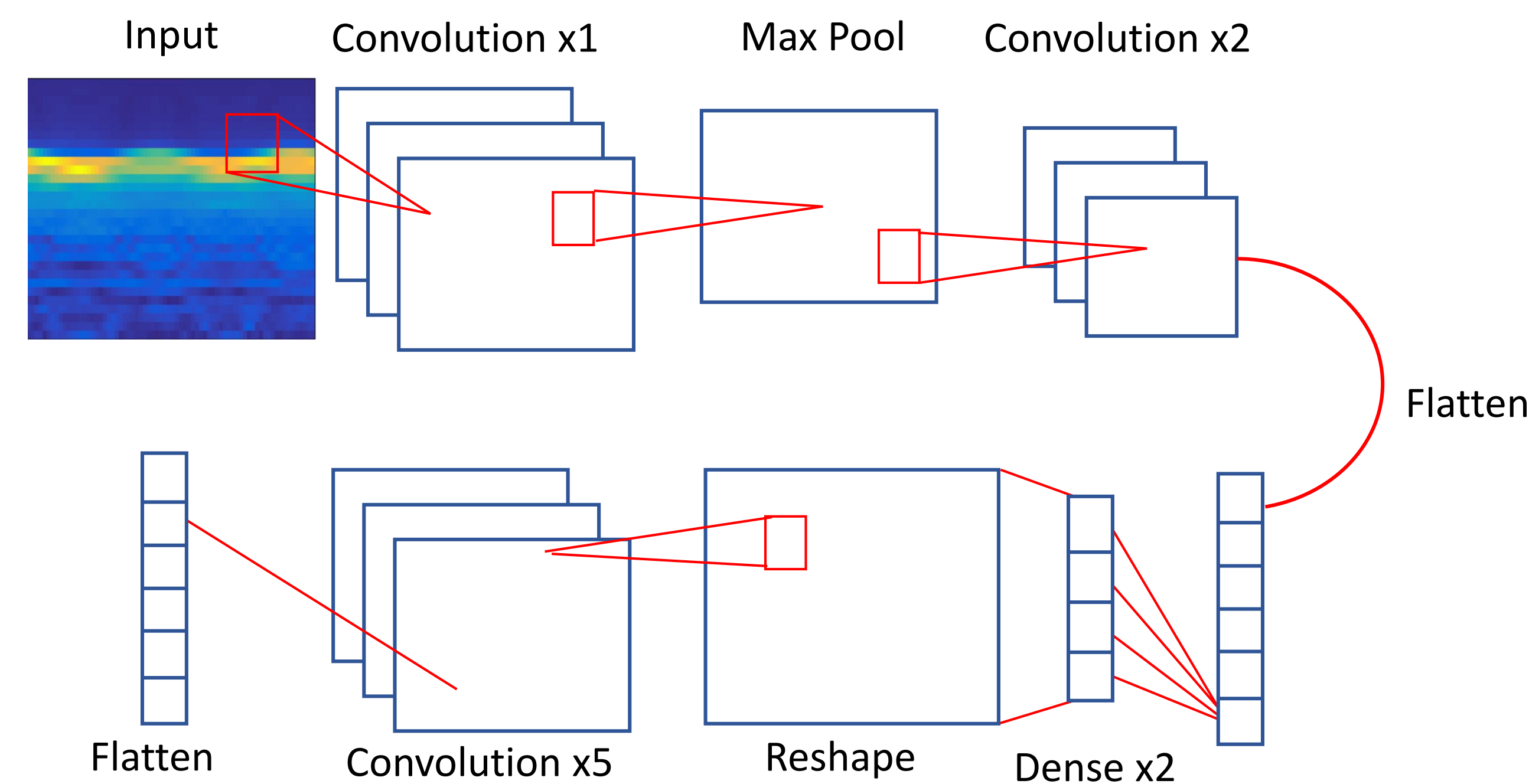
Initial Reconstruction of A13F3
with a 3cm Tumor



Location of tumor, tumor response cannot be seen

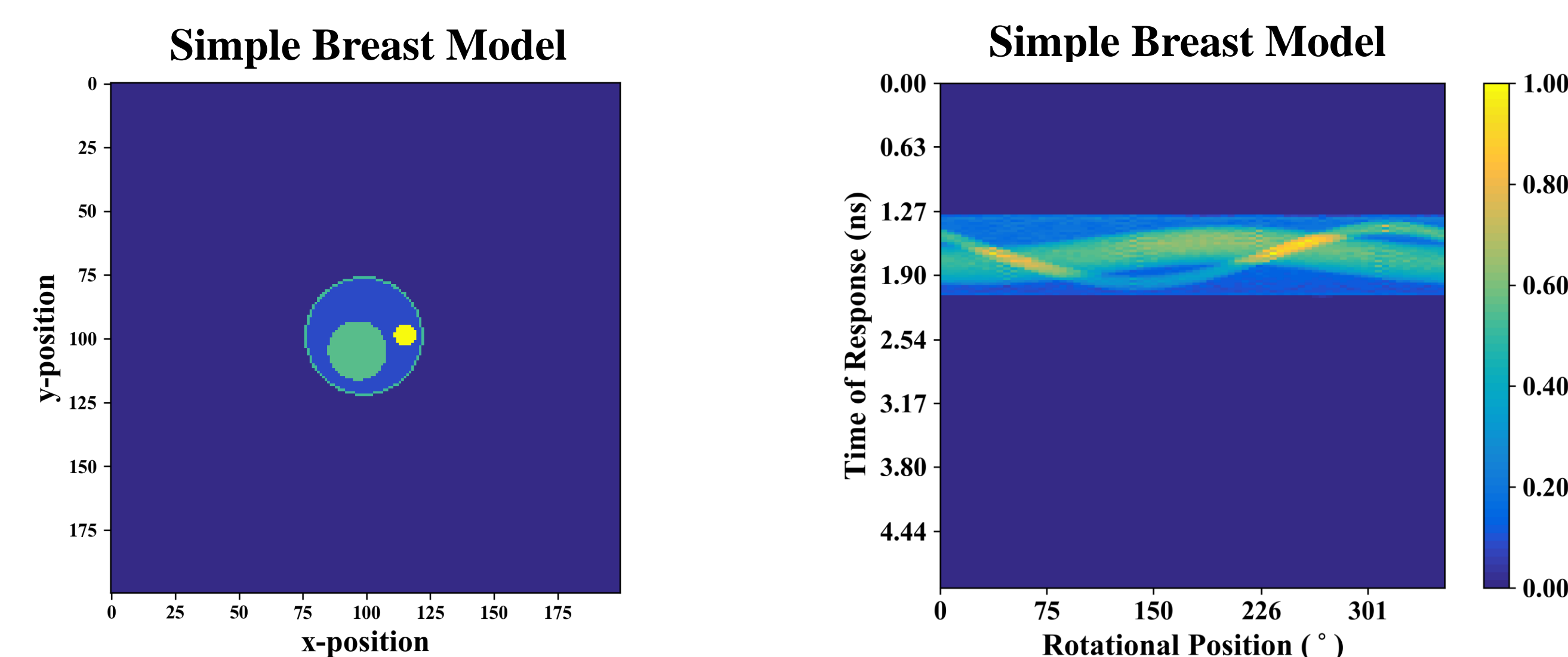
Methods

Network



Datasets

Simple Simulations:



Forward projection (right) of breast models that consist of circular adipose, fibroglandular, and cancerous tissue (left) were used to pre-train the network

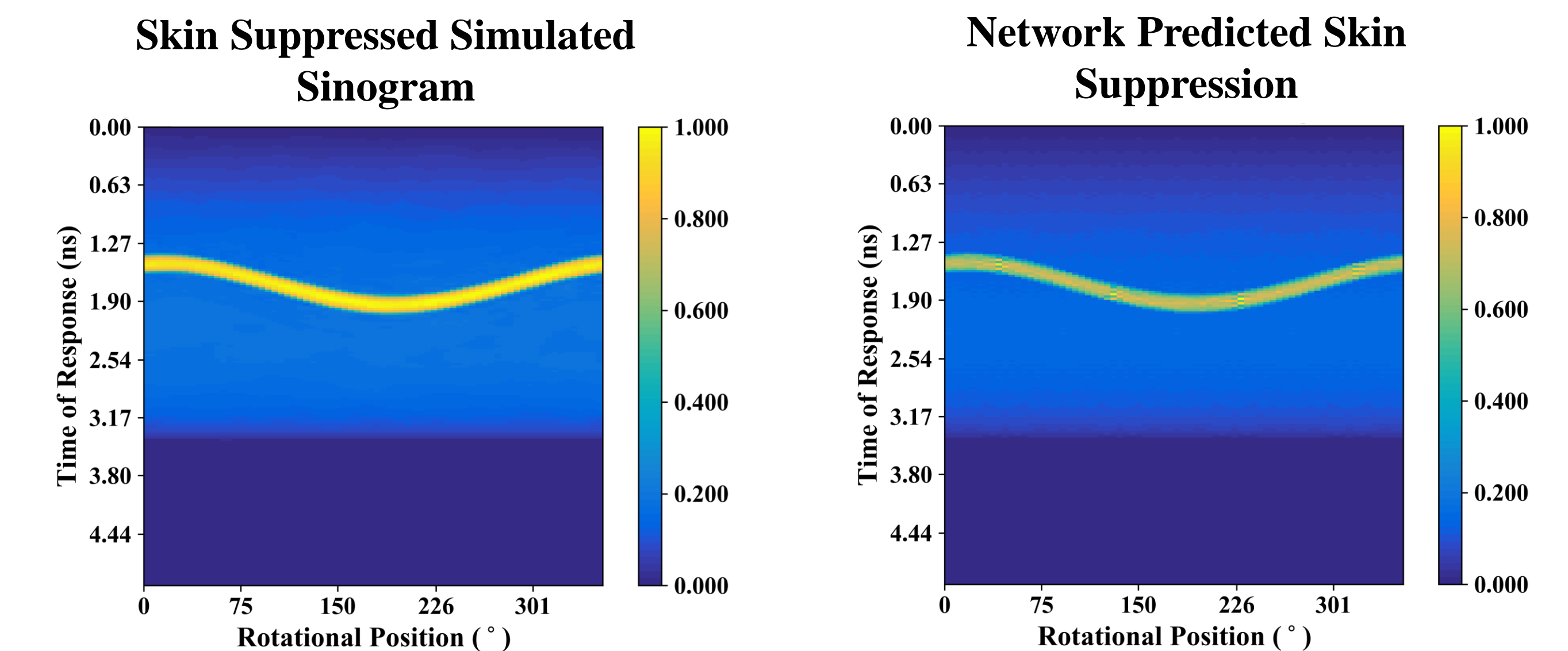
Experimental Dataset:



UM-BMID Gen II dataset [3], consisting of experimental scans of phantoms displayed above used to train last layers of network in a transfer learning approach

Results

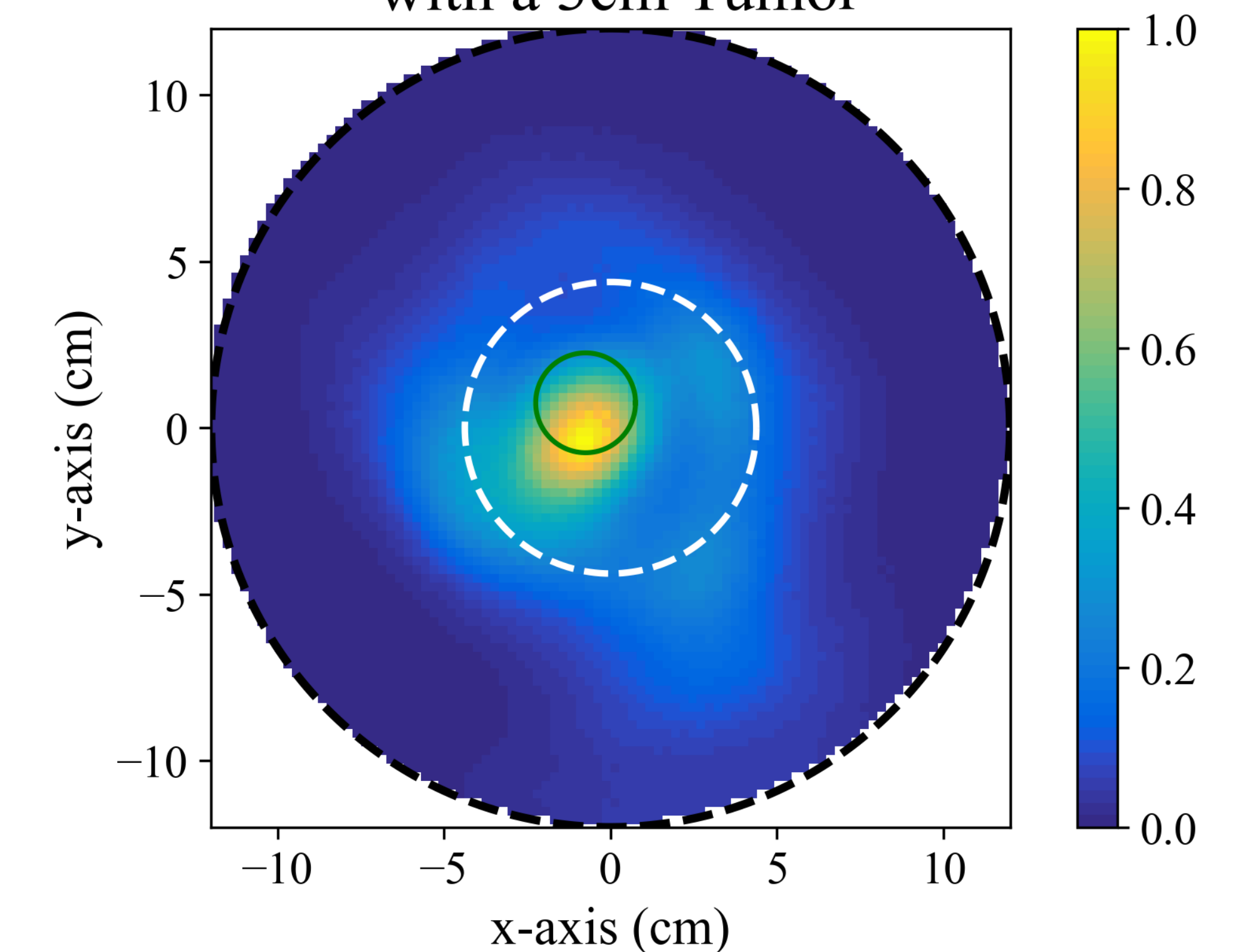
Simulated dataset



Network was capable of suppressing skin response and showing tumor response on simulated dataset

Experimental dataset using transfer learning

Network Calibrated Reconstruction of A13F12
with a 3cm Tumor



Network shows promise on experimental dataset, but this one **good** example out of a set of reconstructions. More often than not artifacts were created by the network.

Conclusion

Machine learning shows promise in suppressing the skin response in breast microwave sensing, although more work is required to determine the feasibility of this method.

References and Acknowledgements

- [1] Canadian Cancer Society's Advisory Committee on Cancer Statistics. (2019). *Canadian Cancer Statistics 2019*. Toronto, ON: Canadian Cancer Society
- [2] P. Gotzsche K. J. Jorgensen, "Screening for breast cancer with mammography (Review)", *Cochrane Database of Systematic Reviews*, vol. 6, 2013
- [3] T. Reimer, J. Krenkevich, S. Pistorius, "An Open-Access Experimental Dataset for Breast Microwave Imaging", *2020 14th European Conference on Antennas and Propagation (EUCAP)*, 2020