Tumour Detection in Glandular Breast Phantoms

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Objective
Assess the tumour detection capabilities of an inexpensive microwave-based breast cancer detection system on life like breast phantoms.

Introduction
- On average, 14 Canadian women die of breast cancer every day and 64 others receive a positive test making it the second most common form of cancer among Canadian women [1].
- Early tumour detection increases the chances for successful treatment [2].
- We are studying microwave-based cancer detection because Mammography involves ionizing radiation and MRI is expensive.

Background
- Microwave-based cancer detection relies on the difference in electrical properties between healthy and malignant tissues.

Antennas:
- Designed to be ultra wideband.
- Operates best in a medium of relative permittivity \( \varepsilon_r \approx 10.2 \) which is close to that of the average healthy breast tissue. [5]
- Held in place by the radome (\( \varepsilon_r \approx 9.6 \)) that contains the phantoms.

System Setup

Glandular breast phantoms:
- Used for preclinical tests.
- Breast phantoms are made out of skin, gland, and fat mimicking tissues with appropriate electrical properties.
- We made measurements on three phantoms of different gland percentages 30%, 50% and 80%.
- Gland has dielectric properties closer to tumour [4], detection may be more difficult in higher gland percentage phantom.
- A tumour-like tissue is inserted in the phantoms to mimic a cancerous breast.

Antenna arrangements:
- We tested five antenna arrangements with three spherical tumours: 3 cm, 2 cm and 0.5 cm of diameter.
- Arrangements C and D yielded good tumour responses for all tumour sizes in all three phantoms.
- The quality of the tumour response is measured by the maximum of its absolute value, the peak tumour response.
- A tumour is detectable when the peak tumour response is above noise level.
- The table depicts the lowest peak tumour responses for each phantom for each case [6].

Conclusion and Future work
- Tumour detection was achieved in all phantoms.
- High gland percent does not seriously compromise the detection.
- Seek further improvement of the detection on more sophisticated phantoms.

References