

**Purpose:** To evaluate the performance of circular holography techniques to reconstruct Breast Microwave Radar (BMR) images using preclinical datasets recorded from synthetic phantoms. Unlike the majority of the previous BMR studies, the materials used in this work mimic the dielectric properties of healthy and malignant breast tissues to emulate the propagation losses and the reflections from dense tissue regions.

**Methods:** A custom data acquisition system was assembled to record the experimental datasets. This system was formed by a plexiglass tank, a vector network analyzer and a Vivaldi antenna. The bandwidth of this system was 6GHz. Two phantoms, one formed mostly by synthetic fatty tissue and one containing a fibroglandular tissue structure were constructed. A spherical 8mm synthetic tumor was inserted in both phantoms. The phantoms were radiated using a stepped frequency continuous waveform with 551 equidistant frequency values, along a circular geometry with 72 scan locations and a radius of 18.5 cm. The performance of the reconstruction approach was evaluated by calculating the signal to noise ratio and spatial accuracy of the reconstructed images.

**Results:** The images formed using the circular holography technique exhibited an average signal to noise ratio of 8.1dB and a spatial error of 1.5mm. In all the reconstructed datasets the synthetic tumor response can be clearly visualized. No artifacts were observed in any of the reconstructed images.

**Conclusions:** This work shows that images formed using circular holography presented similar spatial accuracy and a signal to noise ratio three times larger than datasets formed using current BMR reconstruction methods. In all the reconstructed datasets the tumor responses was clearly identifiable and consistent with its location in the experimental setups, suggesting that this approach can generate accurate and specific images in a realistic setting.