Detailed Evaluation of Artifact Removal Algorithms for Radar-based Microwave Imaging of the Breast

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One of the most important components of radar-based microwave imaging systems for breast cancer detection is the early-stage artifact removal algorithm. The early-stage artifact is composed of the input signal, the reflection from the skin-fat interface and any antenna reverberation present. This artifact is typically several orders of magnitude greater than the reflections from any tumours present within the breast. If the early-stage artifact is not removed and the tumour response effectively preserved, the artifact could potentially mask energy reflected from shallow tumours located close to the surface of the skin, and also hinder the identification of tumours located deeper within the breast.

Several factors determine the effectiveness of an early-stage artifact removal algorithm for the detection of breast cancer using radar imaging. These include the ability to select the correct time window containing the artifact, to remove the artifact while being robust to normal inter-channel variances in the artifact, and to effectively preserve the tumour response in the resultant signal. While a wide variety of artifact removal algorithms have been presented in the literature, with varying levels of performance and complexity, two algorithms have been shown to be particularly effective in terms of tumour preservation and artifact removal: the hybrid artifact removal algorithm from National University of Ireland Galway and the neighbourhood-based filtering algorithm from the University of Calgary.

In this study, these two algorithms are compared and contrasted, across a wide range of experimental scenarios and performance metrics. These test scenarios include both numerical simulations and real-world phantom data. The performance metrics capture the effectiveness of the artifact removal process, and also the ability of each algorithm to preserve the tumour response. Graphs plotting the performance of each algorithm across the various test scenarios will be presented in the paper, along with the corresponding resultant breast images.