Tumor tracking with microwave breast imaging using refined patient specific prior information

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Microwave imaging has been proposed as a complementary method for breast imaging as it is sensitive to the electrical properties of tissues. Two techniques that exploit imaging at microwave frequencies are radar-based imaging and microwave tomography (MWT). A combined radar/MWT method has been developed jointly between the Universities of Manitoba and Calgary (Baran *et. al.*, Pier, 149, 161-171, 2014) for monitoring tumor size changes to assess treatment progress. The findings of a comprehensive study investigating how patient specific prior information affects image quality using this combined technique are presented.

The study starts by establishing a reference case that does not use any prior information other than knowledge of the dielectric properties of the immersion medium. This initial base-line case is referred to as a blind reconstruction. Next, patient specific information in the form of the location of the skin surface is used as prior information for the algorithm. After the skin surface and immersion medium dielectric property values are included with the prior knowledge, the existing set of prior information is augmented with the dielectric properties of the skin and its thickness. This is followed by augmenting the prior data with the mean values of the dielectric properties of the breast interior. Finally, the structural patient specific information is refined by including glandular and adipose regional information (Kurrant and Fear, Inverse Problems, 28, 1-27, 2012). This information is in the form of an approximate location of the glandular region within the breast along with an estimate of the mean dielectric properties over the adipose and glandular regions.

After each refinement of the prior information, metrics are applied to the resulting reconstructed images to quantify the improvement in image quality in terms of how accurately the algorithm reconstructs the adipose, glandular, and tumor regions of the breast. In particular, the location of each region and the accuracy of the dielectric properties reconstructed within the region are quantified. The image quality metrics may be used to provide inferences related to the ability of the algorithm to resolve fine details within the glandular region. More important, since this work is developed in the context of tracking tumor changes while a patient is undergoing therapy, the metrics may also infer improvements in the reconstruction algorithm's sensitivity to changes in the size and location of a tumor with the use of progressively more detailed patient specific structural information.