Abstracts

A clinical prototype for active microwave imaging of the breast

P.M. Meaney, M.W. Fanning, Dun Li, S.P. Poplack and K.D. Paulsen. "A clinical prototype for active microwave imaging of the breast." 2000 Transactions on Microwave Theory and Techniques 48.11 (Nov. 2000, Part I [T-MTT] (Mini-Special Issue on RF/Microwave Applications in Medicine)): 1841-1853.

Despite its recognized value in detecting and characterizing breast disease, X-ray mammography has important limitations that motivate the quest for alternatives to augment the diagnostic tools that are currently available to the radiologist. The rationale for pursuing electromagnetic methods is strong given the data in the literature, which show that the electromagnetic properties of breast malignancy are significantly different than normal in the high megahertz to low gigahertz spectral range, microwave illumination can effectively penetrate the breast at these frequencies, and the breast is a small readily accessible tissue volume, making it an ideal site for deploying advanced near-field imaging concepts that exploit model-based image reconstruction methodology. In this paper a clinical prototype of a microwave imaging system, which actively illuminates the breast with a 16-element transceiving monopole antenna array in the 300-1000 MHz range, is reported. Microwave exams have been delivered to five women through a water-coupled interface to the pendant breast with the participant positioned prone on an examination table. This configuration has been found to be a practical, comfortable approach to microwave breast imaging. Sessions lasted 10-15 min per breast and included full tomographic data acquisition at seven different array heights beginning at the chest wall and moving anteriorly toward the nipple for seven different frequencies at each array position. This clinical experience appears to be the first report of active near-field microwave imaging of the breast and is certainly the first attempt to exploit model-based image reconstructions from in vivo breast data in order to convert the measured microwave signals into spatial maps of electrical permittivity and conductivity. While clearly preliminary, the results are encouraging and have supplied some interesting findings. Specifically, it appears that the average relative permittivity of the breast as a whole correlates with radiologic breast density categorization and may be considerably higher than previously published values, which have been based on ex vivo tissue specimens.

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