Spatio-Temporal Imaging of Compression-Induced Hemodynamics in the Breast With Diffuse Optical Tomography: Simulation Study and Preliminary Clinical Results

Gregory Boverman
Biomedical Engineering Department, Rensselaer Polytechnic Institute
boverg@rpi.edu

Abstract

Gregory Boverman, Qianqian Fang, Stefan Carp, Eric L. Miller, and David A. Boas

In the context of breast cancer screening, the dynamics of the oxygenation and blood flow within the breast, particularly in combination with breast compression, may prove to be of diagnostic relevance. We propose an algorithm for imaging the hemodynamics of the breast using DOT based on the use of spatio-temporal basis functions. As the disambiguation of the calibration parameters and the temporal variation can be difficult, we make use of differential measurements in order to reconstruct the temporal variation. Simultaneously considering all of the data at once, we have implemented and tested a Newton-based nonlinear reconstruction algorithm for estimation of the coefficients of the temporal basis functions, where iterative methods have been applied to make the high-dimensional estimation problem computationally tractable. We have also examined the use of temporal regularization to impose a further degree of smoothing. Simulation results have

shown the quantitative accuracy of the algorithm in a realistic breast-shaped geometry, and preliminary results are shown for a screening subject whose mammogram did not present any abnormalities.