AbstractID: 12723 Title: Computer Aided Detection for Diffuse Optical Mammography

Purpose:
Diffuse Optical Tomography (DOT) provides multi-parameter data on metabolic function, however interpretation of these data can be challenging. Computer Aided Detection (CAD) data analysis procedures for DOT are introduced and applied to derive composite signatures of malignancy in human breast tissue. In contrast to previous optical mammography analysis schemes, the new statistical approach utilizes distributions of several optical properties across multiple subjects and across the many voxels from each subject. The methodology is tested in a population of biopsy-confirmed malignant (35) and benign (8) lesions.

Methods:
DOT CAD employs multi-parameter, multi-voxel, multi-subject measurements to derive a simple function which transforms DOT images of tissue chromophores and scattering into a 'probability of malignancy' tomogram. The formalism incorporates both intra-subject spatial heterogeneity and inter-subject distributions of physiological properties derived from a population of cancer-containing breasts. A weighted combination of physiological parameters define a 'Malignancy Parameter' (M). Logistic regression is currently utilized for weighting factor optimization. The utility of M is examined, employing 3D DOT images from an additional subject in a leave-one-out cross validation procedure.

Results:
Initial results confirm the automated technique can, without any human intervention, produce tomograms that distinguish healthy from malignant tissue. When compared with a gold standard tissue segmentation, this protocol produced an average true positive rate (sensitivity) of 89% and true negative rate (specificity) of 94% using an empirically chosen probability threshold.

Conclusions:
This study suggests the automated multi-subject, multi-voxel, multi-parameter statistical analysis of diffuse optical data are potentially quite useful, producing tomograms which distinguish healthy from malignant tissue using the relatively simple logistic regression classifier. This type of data analysis may also prove useful for suppression of image artifacts.