MAXIMIZING THE INFORMATION CONTENT IN ACQUIRED MEASUREMENTS OF A PARALLEL PLATE NON-CONTACT FDOT WHILE MINIMIZING THE COMPUTATIONAL COST: SINGULAR VALUE ANALYSIS

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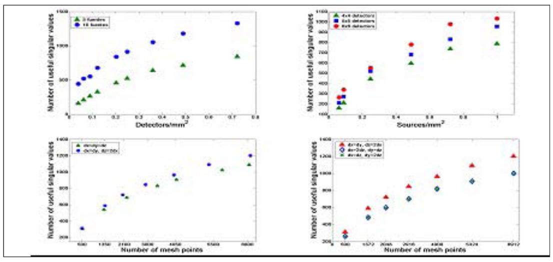
Introduction: Fluorescence Enhanced Diffuse Optical Tomography (FDOT) retrieves three dimensional distributions of extrinsic fluorophores in small animals, non-invasively and in vivo. To reconstruct FDOT, the collected data can be seen as a system of equations d=Wf, where d is a vector that contains the measurements corresponding to each source detector pair, f is the unknown fluorophore concentration at each voxel, and W is a weight matrix that represents the contribution of each voxel to the measurement for each source-detector pair (forward problem). This work assesses the effect of different settings of the acquisition parameters (distribution of mesh points, density of sources and detectors) of a parallel-plate non-contact FDOT, in order to achieve the best possible imaging performance, i.e. using the minimum number of singular values of W to maximize the information content in acquired measurements while minimizing the computational cost.

Methods: We constructed weight matrices of FDOT settings with different density of sources, detectors and distribution of mesh points, for a slab-shaped phantom containing a capillary tip filled with Alexa Fluor 700. After decomposition into their singular values (SVA), we assessed:

(a) The influence of the density of sources and detectors on the imaging performance, using a mesh FOV of 2x2x1.5cm (20x20x10 points), and source and detectors FOV of 1.9x1.9cm.

(b) The influence of the number of voxels and their distribution, for a mesh FOV of 1.5x1.5x1.5 cm, 12x12 detectors and 10x10 sources equally spaced.

Results: The next figure shows the results of study (a) on the top row and the results of study (b) on the bottom row:



Conclusions: The use of a mesh with lower density in the direction perpendicular to the plates achieves better performance than the usual isotropic mesh point distribution Any increase in the number of mesh points, sources and detectors at distances closer than the photon mean free path leads to a slight improvement in image quality at the cost of a large increase in computational burden (worse performance). These results can guide the selection of optimum acquisition parameters for a given FDOT experiment.

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