Image reconstruction methods for fluorescence diffuse optical tomography

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Abstract

Fluorescence diffuse optical tomography (fDOT) is an imaging modality that aims at reconstructing 3D distributions of fluorescent markers embedded within biological tissues. This technology has facilitated monitoring of molecular activity, tumour growth, response to drug therapy, etc., mostly in small animals.

In fDOT, a near-infrared excitation light source is used to obtain fluorescence emission measurements. Detection can be performed using a CCD camera, placed opposite the source, that is rotated around the subject of study. However, due to the diffusive nature of light propagation in biological tissue, the image reconstruction problem is highly ill-posed and the images have relatively low resolution. I will show how prior assumptions on the solution and *a priori* structural information obtained from other imaging methods such as X-ray computed tomography can be incorporated into the image reconstruction to improve the accuracy of fDOT images [1].

Other main issues in fDOT are the large data sets and solution spaces and the presence of heterogeneities in the tissues. I will show possible solutions to overcome these challenges [2, 3].

[1] T. Correia, J. Aguirre, A Sisniega, J Chamorro-Servent, J. Abascal, J. Vaquero, M. Desco, V. Kolehmainen, and S. Arridge "Split operator method for fluorescence diffue optical tomography using anisotropic diffusion regularisation with prior anatomical information,"Biomed. Opt. Exp. **2**(9), 2632-2648 (2011).

[2] T. Correia, T. Rudge, M. Koch, V. Ntziachristos and S. Arridge, "Wavelet-based data and solution compression for efficient image reconstruction in fuorescence diffusion optical tomography, "J. Biomed. Opt. **18**(8), 086008 (2013).

[3] T. Correia, N. Ducros, C. D'Andrea, M. Schweiger and S. Arridge, "Quantitative fluorescence diffuse optical tomography in the presence of heterogeneities,"Opt.Lett. **38**(11), 1903-1905 (2013).