Using anisotropies to compensate for inaccurately known boundary shape in optical tomography

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Abstract

In optical tomography, generally the purpose is to reconstruct the optical properties inside the body based on boundary measurements. A common approximation in optical tomography is to assume that the body is isotropic and that the boundary shape and the optode locations of the body being imaged are known. In reality the boundary shape and optode locations are only known up to certain accuracy, and when solving the inverse problem, the differences between the model used and the reality are likely to degrade the quality of the obtained estimates. One way to reduce these effects is to take them into account, e.g., using calibration algorithms.

Here, we propose an alternative approach to estimate the optical absorption when the geometry is not accurately known. It can be shown that geometric distortion of a body may correspond to transforming an otherwise isotropic body into an anisotropic one. Hence, using an anisotropic model may help to overcome the effects of discrepancies in modelling of the geometry. However, as the boundary shape is not known, the anisotropic structure induced in the model cannot be assumed known either. Therefore, we apply a simple statistical method, where the unknown anisotropies are treated as modelling errors and taken into account in the estimation. This approach enables us to improve the quality of the estimate of the absorption coefficient when the boundary shape of the body is not accurately known.

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