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ABSTRACT

An introduction to optimal reconstructions in optical tomography

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Optical tomography is a technique employed for probing semi-transparent media with the help of light sources [1, 2]. In this method, the spatial distribution of the optical properties inside the probed medium is reconstructed by minimizing an objective function based on the errors between the experimental measurements and the predictions of the light transport (also called forward/direct model) with a numerical model of the medium at the detectors locations. So far, a number of reconstruction algorithms for optical tomography applications with light transport models based on the radiative transfer equation in steady, frequency and time domains [2, 3, 4] have been developed. Recently, a generalization with finite elements was introduced by using an integral form of the cost function which allows the use of any type of finite element formulation including the discontinuous formulations [5] while taking into account the real fact that the surface of the detectors are finite in practical applications. Filtering of the gradient in optical tomography was introduced in [5] where it is seen that the contrast of the reconstruction is improved.

Nowadays, attention is paid to the algorithms for the reconstruction scheme where gradient-based optimization techniques have proven to be computationally efficient [6]. In these reconstruction algorithms, the adjoint method is generally used to compute the gradient of the objective function regardless of the choice of inner product, and regularization are obtained through a conventional Tikhonov-type penalization which acts on the function to be minimized.

The proposed contribution to this Eurotherm seminar focuses on new strategies to improve the reconstruction by using gradient filtering. Preliminary results show the improvement of the contrast of the reconstruction.

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