2-D and 3-D shape and contrast reconstruction in optical tomography with level sets

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Abstract

The reconstruction problem in optical tomography often involves the recovery of high-contrast objects embedded in a background medium whose optical properties are only weakly varying. In such cases a shape-based reconstruction technique often yields better results than the conventional voxel-based parameter recovery.

We present a level-set method which simultaneously recovers absorption and diffusion features embedded in a medium with low-contrast background. This approach recovers both the shape and optical contrast of the inclusions.

Examples are presented for two- and three-dimensional problems of object recovery from frequency domain boundary data. We compare the level-set reconstruction results with a voxel-based parameter reconstruction method using a conjugate gradient solver. The level-set approach is shown to localise the high-contrast inclusions even in problems where the voxel-based method fails to recover contrast and location.