Reconstructing a thin absorbing obstacle in a half space of tissue

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Abstract

We solve direct and inverse obstacle scattering problems in a half space composed of a uniform absorbing and scattering medium. Scattering is sharply forward-peaked, so we use the modified Fokker-Planck approximation to the radiative transport equation. The obstacle is an absorbing inhomogeneity that is thin with respect to depth. Using the first Born approximation, we derive a method to recover the depth and shape of the absorbing obstacle. This method requires only continuous plane wave illumination at two incident angles and a detector with a fixed numerical aperture. First we recover the depth of the obstacle through solution of a simple nonlinear least-squares problem. Using that depth, we compute a point spread function explicitly. We use that point spread function in a standard deconvolution algorithm to reconstruct the shape of the obstacle. Numerical results show the utility of this method even in the presence of measurement noise.