Clear layers in optical tomography: forward and inverse modelling

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Abstract

Clear layers are known to hamper the use of diffusion approximations to model near-infra-red photon propagation in the (highly scattering) human head. I will present a generalized diffusion model that allows one to account for both the scattering regions and the clear layers. Clear layers are modelled by tangential diffusion processes supported on interfaces. Next I will show that under practically reasonable assumptions the clear layer as well as the absorption and scattering properties of tissues inside the head can uniquely be reconstructed from boundary measurements modelled by the full or partial Dirichlet-to-Neumann map. Yet the inverse problem is severely ill-posed and only limited information on the clear layer and the tissue properties should be expected from such measurements. This is demonstrated in numerical reconstructions of the clear layer obtained by shape sensitivity analysis and the level set method. Most of the presented work is joined with Kui Ren.