Optical tomography in media with varying index of refraction.

Stephen McDowall, Western Washington University.

Abstract

Optical tomography is the use of near-infrared light to determine the optical absorption and scattering properties of a medium. In the stationary Euclidean setting the dynamics are modeled by the radiative transport equation, which assumes that in the absence of interaction particles follow straight lines. Here we shall study the problem in the presence of a (simple) Riemannian metric where particles follow the geodesic flow of the metric. This non-Euclidean geometry models a medium which has a continuously varying refractive index. We will present results for all dimensions, in the case of full angular-dependent measurements and in the case where the information available at the boundary is averaged over angle. We show that knowledge of the albedo operator, that which maps incoming flux to outgoing flux at the boundary, uniquely determines the absorption and scattering properties of the medium. In dimensions three and higher we assume prior knowledge of the metric while in dimension two it can be shown that the albedo operator also determines the metric. When the measurements are averaged over angle, we are able to determine the absorption, and spatial dependence of the scattering assuming a-priori knowledge of its angular dependence. The results pertaining to averaged measurements are joint with Ian Langmore (UW).