IMAGING WITH DIFFUSE PHOTON DENSITY WAVES

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DEDICATION

This work is dedicated to
Mom, Dad,
Terry, Stephen, Kathleen,
and Surge.

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ABSTRACT

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Diffusing photons can be used to probe and characterize optically thick turbid samples such as paints, foams and human tissue. In this work, we present experiments which illustrate the properties of diffuse photon density waves. Our observations demonstrate the manipulation of these waves by adjustment of the photon diffusion coefficients of adjacent media. The waves are imaged, and are shown to obey simple relations such as Snell's Law.

Next we present images of heterogeneous turbid media derived from measurements of diffuse photon density waves. These images are the first experimental reconstructions based on frequency-domain optical tomography. We demonstrate images of both absorbing and scattering homogeneities, and show that this method is sensitive to the optical properties of a heterogeneity. The algorithm employs a differential measurement scheme which reduces the effect of errors resulting from incorrect estimations of the background optical properties.

In addition to imaging absorption and scattering changes, we are also able to image the lifetime and concentration profile of heterogeneous fluorescent media.

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