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BREAKDOWN OF THE DIFFUSION-APPROXIMATION IN DESCRIBING PHOTON MIGRATION THROUGH RANDOM-MEDIA

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Breakdown of the diffusion approximation in describing photon migration through random media.

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Abstract

The diffusion approximation to the Boltzmann transport equation is valid only in the multiple scattering regime. We determined at what scatterer concentration and distance from a light source that light propagation through random media is described by this approximation. We performed frequencydomain measurements in the MHz to GHz range in which we studied the properties of intensity-modulated light propagating through media containing different concentrations of light scatterers and absorbers. The experimental data are compared to the predictions of the diffusion approximation to the Boltzmann transport equation. The scattering and absorption conditions under which the diffusion approximation fails are compared with typical scattering and absorption conditions found in animal tissues. This work was performed at the Laboratory for Fluorescence Dynamics (LFD) at the University of Illinois at Urbana-Champaign (UIUC). The LFD is supported jointly by the National Institutes of Health (RR03155) and by UIUC.