Poster

INFLUENCE OF SCATTERING ANISOTROPY ON DYNAMIC DIFFUSE REFLECTION LIGHT

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Probing diffuse light in the multiple scattering regime has become a very active field of research. The backscattering regime is of particular importance for biomedical imaging techniques using visible or near-infrared diffuse light. At sufficiently large length scales (larger than the transport mean free path l*) and at long times (larger than the collision time l*/c, where c is the energy velocity), the transport of intensity is well described in the diffusion approximation. The simplicity of the diffusion approximation makes it an important tool in the analysis of experimental data in practical situations. Nevertheless, it suffers from drawbacks which limit its validity. On the one hand, boundary conditions can only be introduced in an approximate manner, using extrapolation distances and angle-averaged reflection factors when internal reflections cannot be neglected. On the other hand, the scalar diffusion approximation overestimates the contribution from the short paths the error becoming more and more severe as the anisotropy of scattering increases.

In this work, we study theoretically and experimentally the diffuse reflection of light on scattering media, and show how the limits of the diffusion approximation can be overcome using improved models. We focus on Diffusing-Wave Spectroscopy (DWS) measurements, which provide access to the distribution of light paths via the time correlation function of light fluctuations induced by the motion of scatterers. Since both the influence of polarization and scattering anisotropy lead to deviations from scalar diffusion theory [1], we consider unpolarized light in order to analyze the impact of the scattering anisotropy. The standard DWS theory relies on the diffusion approximation. In the non-diffusive regime, the modelling of optical reflection can be improved by using more refined transport equations in order to compute the photon path-length distribution. Recently, the Radiative Transfer Equation (RTE) has been introduced to model the transition from the single-scattering to the diffusive regime in DWS [2]. In the present study, we show experimentally that for backscattered light, anisotropic scattering strongly influences the time decay of the field correlation function, a behaviour which is not described by the standard DWS theory. A good agreement with the data is obtained using an RTE calculation of the path-length distribution. The possibility of using a corrected diffusion model [1] for practical applications is also examined. These results should be very useful in order to improve biomedical imaging devices based on light fluctuations measurements as well as optical probing techniques for soft materials.

References:

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