Theoretical analysis and experimental validation of a two-fiber probe for biomedical spectroscopy applications

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Abstract

The goal of the present work is to characterize theoretically and experimentally a simple two-fiber optic probe for spectroscopy applications in turbid biological media such as human skin and cervix. First, we perform a review of the wavelength dependence of optical parameters of these tissues. The validity of the diffusion approximation is evaluated for simple models of skin and cervix in term of the restriction that scattering should dominate over absorption. The spectral bands where the diffusion theory fails are found for skin and cervix models. Second, radially-resolved diffuse reflectance is compared using both Monte Carlo and the diffusion techniques. The optimal source-detector distance that minimizes errors is identified. Using, these spectral and spatial constraints together with known optical properties, a set of synthetic spectra are generated using a valid diffusion approximation. These spectra are used to evaluate an algorithm to extract intrinsic tissue optical properties. Finally, a two-fiber optic probe was built and used to record spectra from in-vivo skin and phantoms mimicking the cervix tissue. The derived optical properties will be presented.