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Interstitial point radiance spectroscopy in turbid media

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Optical spectroscopy has become a valuable tool in biomedical diagnostics because of its ability to provide biochemical information on endogenous and exogenous chromophores present in tissues. In this work, point radiance spectroscopy using a white light source is investigated 1) to measure the optical properties of bulk tissues and 2) to detect localized gold nanoparticles in tissue mimicking Intralipid and porcine muscle phantoms. An angular sensitive detector made from a side-firing fiber was developed and used to measure the angular distribution of light (up to 180 degree rotation of the fiber) in selected locations in a phantom. Rotation provides angular optical data for analysis. An alternative approach is to use non-directional fluence data, but for optical property recovery, this requires translation of the fiber which is not desirable. In our radiance approach, the white light source also provides some spectroscopic information (focused in the 650-900 nm band) in addition to spatial information of a target (i.e. gold nanoparticles). We have measured the effective attenuation coefficient, diffusion coefficient, absorption coefficient and reduced scattering coefficient of Intralipid phantoms and thermally coagulated porcine muscle. Further, gold nanoparticle inclusions embedded in tissue mimicking media and ex vivo tissues were detectable via a novel spectro-angular analysis technique. This work is focused on the development of a new optical fiber based tool for disease detection.

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