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Quantitative fluorescence imaging of protoporphyrin IX through determination of tissue optical properties in the spatial frequency domain.

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Abstract

The ability to quantitatively determine tissue fluorescence is of interest for the purpose of better understanding the details of photodynamic therapy of skin cancer. In particular, we are interested in quantifying protoporphyrin IX (PpIX) in vivo. We present a method of correcting fluorescence for effects of native tissue absorption and scattering properties in a spatially resolved manner that preserves the resolution of the fluorescence imaging system, based off a homogeneous representation of tissue. Validation was performed using a series of liquid turbid phantoms having varying concentrations of absorber, scatterer, and fluorophore (PpIX). Through the quantification of tissue optical properties via spatial frequency domain imaging, an empirical model based on Monte Carlo simulations was deployed to successfully decouple the effects of absorption and scattering from fluorescence. From this we were able to deduce the concentration of the PpIX to within 0.2 μg/ml of the known concentration. This method was subsequently applied to the determination of PpIX concentration from in vivo normal skin where the model-based correction determined a concentration of 1.6 μg/ml, which is in agreement with literature.

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