Amsterdam UMC
Universitair Medische Centra

Single Fiber Reflectance spectroscopy – photon pathlength distributions

Background – Single Fiber Reflectance spectroscopy (SFR) allows for measurement of absolute tissue reflectance. This reflectance is analyzed using a model in terms of scattering and absorption properties after which these optical properties are related to characteristics of tissue structure and metabolic function (such as oxygen saturation). Improvements in the signal model are continuously made by a combination of analytical theory, Monte Carlo simulations and experiments.

Path length distributions – Key to improving the signal model is understanding the path length distribution of the detected photons. Currently this distribution is examined using Monte Carlo simulation, but it can also be accessed experimentally when considering that the absolute reflectance as a function of the absorption coefficient $R(\mu_a)$ is given by the Laplace transform of the pathlength distribution $R(\mu_a) = \mathcal{L}\{p(l)\}$. Unfortunately, numerical inversion of the Laplace transform $p(l) = \mathcal{L}^{-1}\{R(\mu_a)\}$ is difficult, especially on experimental data of $R(\mu_a)$

Goal –Measure $R(\mu_a)$ using SFR for scattering solution of different scattering strengths using known added absorbers. Compare experimentally determined path length distributions to Monte Carlo simulations of the same SFR geometry.

Requirements – This assignment has a theoretical, numerical and experimental component. Affinity with programming, experience with Matlab or LabVIEW or desire to gain experience in these languages is required.

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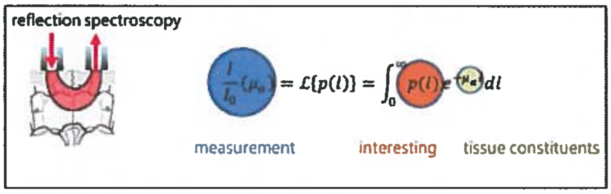

Illustration of $R(\mu_a) = I/I_0\,(\mu_a)$ and the Laplace relation with the photon path length distribution for a general reflection spectroscopy scenario of separate source and detection fibers. SFR uses only one fiber for both.