Crosstalk and error analysis of fat layer on continuous wave near-infrared spectroscopy measurements

Ömer Şayli; E. Burteçin Aksel; Ata Akin

Abstract

Accurate estimation of concentration changes in muscles by continuous wave near-IR spectroscopy for muscle measurements suffers from underestimation and crosstalk problems due to the presence of superficial skin and fat layers. Underestimation error is basically caused by a homogeneous medium assumption in the calculations leading to the partial volume effect. The homogeneous medium assumption and wavelength dependence of mean partial path length in the muscle layer cause the crosstalk. We investigate underestimation errors and crosstalk by Monte Carlo simulations with a three layered (skin-fat-muscle) tissue model for a twowavelength system where the choice of first wavelength is in the 675- to 775-nm range and the second wavelength is in the 825- to 900-nm range. Means of absolute underestimation errors and crosstalk over the considered wavelength pairs are found to be higher for greater fat thicknesses. Estimation errors of concentration changes for Hb and HbO₂ are calculated to be close for an ischemia type protocol where both Hb and HbO₂ are assumed to have equal magnitude but opposite concentration changes. The minimum estimation errors are found for the 700 / 825- and 725 / 825-nm pairs for this protocol.
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