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Continuous wave near-infrared spectroscopy in monitoring cerebral haemodynamics

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Near-Infrared (NIR) light can propagate deep with biological tissue as compared to other wavelengths of light due to low absorption of tissue at 650-100 nm. It is now commonly used for non-invasive monitoring of brain health, specifically looking at functional response by observing cerebral hemodynamics i.e. the changes in hemoglobin concentrations and level of tissue oxygenation which is defined as the ratio of oxygenated to total hemoglobin. NIR is transmitted through the tissue and the measured transmitted/reflected light depends on the optical properties of the tissue i.e. the spectrally varying absorption and scattering. A spectroscopic analysis of its absorption related properties can then retrieve the concentrations of the light absorbing tissue constituents such as oxygenated and deoxygenated hemoglobin. Among different available NIR Spectroscopy (NIRS) instrumentations, continuous wave NIRS which measure only the attenuation of light intensity is the most widely used due to its low cost, high signal quality and robustness. However, the existing methods utilized for CW NIRS based hemodynamics parameter recovery is based on several factors with the most prominent being the often inaccurate assumption of the underlying scattering properties of tissue (how far the light has travelled, the so-called path-length). This assumption is known and shown to lead to uncertainty in the recovered hemoglobin concentration levels and tissue oxygenation, as the scattering properties show a significant inter-subject variability. Here, we present a new modified method that uses the spatially resolved measurement of measured data at multiple wavelengths, to recover not only the normalized hemoglobin concentrations and absolute tissue oxygenation, but also the often-ignored scattering related parameters. This method is shown to overcome many limitations of the parameter recovery algorithms incorporated into commercial systems and will be demonstrated to be a much more reliable and accurate methodology for absolute parameter recovery, using only 3 CW NIR wavelengths.

Biography

Joshua Deepak Veesa has his expertise in theoretical and computational optics, developing models and algorithms to understand the tissue optical properties by studying the propagation of light in the tissue.

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