

Reflectance Photoplethysmography as Non-Invasive Monitoring of Tissue Blood Perfusion.

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IEEE Trans Biomed Eng. 2015 Mar 30. [Epub ahead of print]

In the last decades Photoplethysmography (PPG) has been used as noninvasive technique for monitoring arterial oxygen saturation by Pulse Oximetry (PO), whereas Near Infrared Spectroscopy (NIRS) has been employed for monitoring tissue blood perfusion. While NIRS offers more parameters to evaluate oxygen delivery and consumption in deep tissues, PO only assesses the state of oxygen delivery. For a broader assessment of blood perfusion, this paper explores the utilization of dual-wavelength PPG by using the pulsatile (AC) and continuous (DC) PPG for the estimation of arterial oxygen saturation (SpO₂) by conventional PO. Additionally, the Beer-Lambert law is applied to the DC components only for the estimation of changes in deoxy-hemoglobin (HHb), oxy-hemoglobin (HbO₂) and total hemoglobin (tHb) as in NIRS. The system was evaluated on the forearm of 21 healthy volunteers during induction of venous occlusion (VO) and total occlusion (TO). A reflectance PPG probe and NIRS sensor were applied above the brachioradialis, PO sensors were applied on the fingers, and all the signals were acquired simultaneously. While NIRS and forearm SpO₂ indicated VO, SpO₂ from the finger did not exhibit any significant drop from baseline. During TO all the indexes indicated the change in blood perfusion. HHb, HbO₂ and tHb changes estimated by PPG presented high correlation with the same parameters obtained by NIRS during VO ($r^2=0.960$, $r^2=0.821$ and $r^2=0.974$ respectively) and during TO ($r^2=0.988$, $r^2=0.940$ and $r^2=0.938$ respectively). The system demonstrated the ability to extract valuable information from PPG signals for a broader assessment of tissue blood perfusion.