PLoS ONE, 2016, vol.11, N10

# Origin of infrared light modulation in reflectance-mode photoplethysmography

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## Abstract

© 2016 Sidorov et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.We recently pointed out the important role of dermis deformation by pulsating arterial pressure in the formation of a photoplethysmographic signal at green light. The aim of this study was to explore the role of this novel finding in near-infrared (NIR) light. A light-emitting diode (LED)-based imaging photoplethysmography (IPPG) system was used to detect spatial distribution of blood pulsations under frame-to-frame switching green and NIR illumination in the palms of 34 healthy individuals. We observed a significant increase of lightintensity modulation at the heartbeat frequency for both illuminating wavelengths after a palm was contacted with a glass plate. Strong positive correlation between data measured at green and NIR light was found, suggesting that the same signal was read independently from the depth of penetration. Analysis of the data shows that an essential part of remitted NIR light is modulated in time as a result of elastic deformations of dermis caused by variable blood pressure in the arteries. Our observations suggest that in contrast with the classical model, photoplethysmographic waveform originates from the modulation of the density of capillaries caused by the variable pressure applied to the skin from large blood vessels. Particularly, beat-to-beat transmural pressure in arteries compresses/decompresses the dermis and deforms its connective-tissue components, thus affecting the distance between the capillaries, which results in the modulation of absorption and scattering coefficients of both green and NIR light. These findings are important for the correct interpretation of this widely used medical technique, which may have novel applications in diagnosis and treatment monitoring of aging and skin diseases.

http://dx.doi.org/10.1371/journal.pone.0165413