Mid-IR Photoacoustic Spectroscopy on Different Skin Locations for Non-invasive Blood Glucose Measurements

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With approximately 350 million people worldwide afflicted diabetes provides a serious challenge to healthsystems around the globe [1]. A major component of the current treatment is the invasive measurement of blood glucose levels with enzymatic test strips. Pulsed photoacoustics in the mid-IR has been shown to offer the possibility of a non-invasive alternative to the current method [2]. Hereby, a sample is irradiated by light pulses from a laser. The absorption of the light in turn causes a local heating that leads to the adiabatic expansion of a small sample volume. This expansion, which is related to the strength of the absorption, causes a pressure wave that can be, in combination with an ultrasound resonance cell, detected by a microphone. With such a setup it is possible to correlate spectra of skin with enzymatically measured blood glucose [2]. As the penetration depth of the beam is limited to approximately 70 µm it only reaches the *Stratum spinosum*. Therefore, the photoacoustic signal from glucose is from the interstitial fluid, which correlates with the blood glucose. However, since glucose is not the only absorbing constituent in the skin, multivariate chemometric algorithms, like partial least squares regression, are necessary to extract information from the spectra. The nature of skin as an *in-vivo* sample with multiple different compounds of varying content leads to the question which location is the most suitable for non invasive blood glucose measurements. The ideal measurement spot would be comfortable to reach for an extended period of time with a thin *Stratum corneum*. For this we investigated four different locations: the arm, the hypothenar, the index finger and the thumb. The quality of the location was determined by the size of the root-mean-square error of cross-validation for each location.

References

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