A Non-Invasive Optical Blood Glucose Measurement Method Using Multi Wavelength Amplitude Ratios

Po-Lei Lee *
Department of Electrical Engineering, National Central University, Taoyuan City, Taiwan

Abstract

This study presents a novel multi-wavelength photoplethysmography (PPG)-based approach to enhance the accuracy of non-invasive blood glucose estimation. In this framework, green light is employed as a reference channel to normalize blood flow variations, while amplitude ratios derived from red-to-green (R/G) and infrared-to-green (IR/G) signals are utilized as key predictive features. By integrating both raw PPG amplitudes and multi-wavelength amplitude ratios, the proposed method effectively improves the robustness and reliability of glucose estimation. A major contribution of this work lies in the incorporation of curvature-based feature detection to accurately identify critical waveform landmarks, including the dicrotic notch and diastolic peak, which are often attenuated or indistinct in diabetic subjects. This enhancement significantly improves feature extraction under vascular-compromised conditions, a common challenge in non-invasive glucose monitoring. Experimental results demonstrate that, even with a conventional linear regression model, the proposed method achieves over 90% accuracy in Clarke Error Grid analysis, indicating strong clinical applicability. The combination of a simple yet effective feature engineering strategy with a robust analytical framework highlights the practicality of this approach. Furthermore, the integration of advanced machine learning or deep learning techniques in future work is expected to further enhance predictive performance, paving the way for more accurate and reliable non invasive glucose monitoring systems.

Keywords

Blood glucose, Diabetes, Multi-wavelength photoplethysmography.