Predicting Age From a Real World Smartphone Acquired PPG Signal Using Deep Learning

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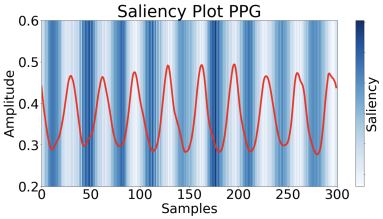
Introduction Aging is linked to structural and mechanical changes in the vascular wall. These changes lead to increased arterial stiffness, which is a primary indicator for assessing risk of cardiovascular diseases. Photoplethysmography (PPG) is a technology to detect blood volume variations in the arteries and can be measured using a smartphone camera. PPG is influenced by arterial stiffness and shows promise as a potential marker for vascular aging. Using deep learning, we aim to predict age from PPG and identify how age is represented in the waveform of the PPG.

Methods We utilised real world smartphone acquired PPG signals with patient reported age and gender. PPGs were excluded if the quality was too low or there was no record of age and/or gender. The model architecture of InceptionTime was used for the regression task and a grid search was performed to select the optimal model hyperparameters and PPG window size. Saliency plots were calculated to highlight predictive regions for age within the PPG.



Saliency plot of the median PPG signal. Dark shades indicate regions with the greatest influence on the age prediction.

Results We included 23 237 PPG of 5 505 patients with a mean age of 46.8 ± 16.1 years. The grid search indicated the best results for the default hyperparameters and a signal length of 16 consecutive heartbeats. The optimal model resulted in a mean absolute error of 9.52 ± 7.34 years and an r2-score of 0.32. Saliency plots highlighted the region around the dicrotic notch as most determining for age prediction, which has been previously linked to arterial stiffness and vascular age.

Conclusion Real world smartphone acquired PPG allows for the estimation of aging trends . The gravity of the dicrotic notch in saliency plots provides a rationale for its prediction and suggests that PPG-derived age may serve as a potential marker for vascular aging.