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A NOVEL CONTINUOUS NONINVASIVE ESTIMATION OF SYSTOLIC BLOOD PRESSURE

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ABSTRACT

Continuous non-invasive blood pressure (BP) monitoring has been under intensive investigation by the clinical and technical community. The photoplethysmography (PPG) signal, measured unobtrusively at distal sites, serves as a popular surrogate. This is due to the fact that it indicates pulsatile blood volume changes and is morphologically similar to the continuous BP signal. From PPG and ECG, pulse arrival time (PAT) based methods are widely studied. However, PAT is determined not only by BP but also vasoregulation and vascular properties, making it an unstable estimator per se.

Multiple features derived from a PPG signal have been used to estimate BP, but they either require calibration, fail to validate its ability to track BP, or ignore the abundant information contained within the PPG waveform [1,2]. In this study, we introduce BP changes in 18 healthy subjects, explore a number of features from various perspectives, and determine the performance of tracking Systolic Blood Pressure (SBP) in the absence of calibration.

Besides PAT, we include timing features (time from systolic slope to dicrotic notch), and amplitude features (normalized systolic slope mean, variance and diastolic slope mean, variance), spectral features (Teager energy mean, variance, skewness). We fuse these features using Random Forest as regression model, and obtain an estimate of SBP every 30 seconds. By using leave-one-out cross-validation (LOOCV), recursively training on 17 subjects and testing on 1 subject, the resulting correlation coefficient is 0.85 and R-squared is 0.31.

With a very limited number of subjects, we build a universal model to estimate SBP. This model is applied to all subjects without calibration, to estimate and track variations in their SBP. The result is promising and further work should investigate the potential of sensor fusion and PPG waveform analysis for blood pressure estimation. Sources of improvement might be found in involving more subjects and creating an appropriate model for fitting and analyzing PPG waveforms.

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