

Blood Pressure Estimation Based on Photoplethysmography: Finger versus Wrist

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Introduction: The photoplethysmogram (PPG) signal is an attractive candidate for unobtrusive blood pressure (BP) monitoring, as it is widely measured by wrist-worn devices. However, most studies of PPG-based BP estimation techniques have used finger PPG signals. The aim of this study is to compare PPG-based BP estimation when using finger and wrist optical sensors.

Materials and methods: Finger and wrist PPGs together with continuous reference BPs were obtained from 22 healthy participants performing two cold pressor tests. Three physiologically motivated features, pulse transit time, PPG intensity ratio and heart rate, were extracted from each PPG pulse. Subject-specific linear regression models for BP estimation were trained using the first cold pressor test. Data from the second cold pressor were used to assess agreement between reference and estimated BP values on a beat-to-beat basis, and to assess the ability to detect changes of at least 10 mmHg in systolic BP.

Results: Mean \pm standard deviation of differences, and mean absolute difference between reference and estimated systolic BPs were: 0.47 ± 10.44 mmHg and 7.78 mmHg for finger PPG signals; and 1.05 ± 12.86 mmHg and 9.69 mmHg for wrist PPG signals.

Performance of PPG-based detection of systolic BP changes.

	Sensitivity		Specificity		F ₁ score	
	Finger	Wrist	Finger	Wrist	Finger	Wrist
≥ 10 mmHg	0.79	0.64	0.93	0.97	0.81	0.75
≤ -10 mmHg	0.79	0.50	0.87	0.93	0.76	0.61

Conclusion: Models performed better with finger PPG signals. Different signal processing approaches were required for finger and wrist signals, indicating that finger-based models should not be generalized directly to wrist PPGs. With improved sensitivity, PPG-based detection of considerable BP changes may be useful in tracking BP trends and abrupt alterations. This could provide useful markers of cardiovascular health in the community, and provide early warning of acute deterioration in hospital patients.