More Reliable Remote Heart Rate Measurement by Signal Quality Indexes

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Introduction

Accuracy of camera-based heart rate (HR_{cb}) measurement is often impaired by artifacts, e.g. from motion. Distorted signals lead to erroneous HR_{cb} and reduced confidence in remote photoplethysmographic measurements.

Methods

To avoid erroneous HR_{cb}, we investigated six signal quality indexes (SQIs) from the literature in terms of their effect size and improved conventional SQI usage by developing a technique to combine them for identifying and sorting out distorted signals. We call this technique SQI-filtering. The influence of SQI-filtering on HR_{cb} accuracy (ACC) was investigated using the "Binghamton-Pittsburgh-RPI Multimodal Spontaneous Emotion Database" (BP4D+). All analyses were performed in three important color channels.

Results

Table 1 shows the most important results. The most powerful SQIs were $snrSQI$, $aCCmSQI$ and $rdspSQI$. The SQI-filter increased accuracies of all color channels. Largest improvements (up to $+60\,\%$) were achieved in the green channel (RGB-G) resulting in $80\,\%$ accuracy. The overall highest accuracy of $84\,\%$ was reached in the hue channel (HSV-H). Motion-rich videos from BP4D+ benefited most from the developed SQI-filter.

Table 1: Results by color channel with SQI effect size r (rank-biserial correlation). ACC and ACC' are HR_{cb} accuracies before and after SQI-filtering. I_{ACC} is the relative accuracy increase.

Color Channel	RGB-G	HSV-H	NTSC-Q
$r(sSQI)$	$+0.44$	$+0.34$	$+0.11$
$r(psSQI)$	$+0.48$	$+0.35$	$+0.12$
$r(rdspSQI)$	$\mathbf{-0.54}$	-0.43	-0.46
$r(snrSQI)$	-0.52	$\mathbf{-0.55}$	$\mathbf{-0.54}$
$r(aCCmSQI)$	-0.51	-0.50	-0.50
$r(sCCmSQI)$	$+0.26$	$+0.21$	$+0.23$
ACC	0.50	$\mathbf{0.73}$	0.70
ACC'	0.80	$\mathbf{0.84}$	0.83
I_{ACC}	$\mathbf{+60\,\%}$	$+15\,\%$	$+19\,\%$

Conclusion

The presented methodology helps to identify and discard distorted signals. This enables more reliable HR_{cb} data in further applications and increases confidence in remote photoplethysmographic measurements.