Abstract

Heart rate monitoring during physical exercise is a useful feature in modern fitness equipments. Wearable devices such as smart-watches and wristbands allow exercisers to achieve the same goal anywhere and anytime, not necessarily in fitness rooms. Most of these products estimate heart rate using photoplethysmographic (PPG) signals which are recorded from wearers' wrist. The PPG signals are obtained by using pulse oximeters embedded in these wearable products. A pulse oximeter illuminates the skin with the light from a light-emitting diode (LED), and measures changes in the intensity of the light reflected from the skin.

Estimating heart rates from subjects' wrist when the subjects are performing various physical exercise is challenging because strong motions during the exercise can result in huge artifacts in recorded PPG signals, difficult to find its fundamental frequency that corresponds to the heart rate. We describe an algorithm for estimating heart rate from an optically measured PPG signal when physical exercises are performed.

To overcome the noise, a soft decision approach is taken, by which several candidates for the fundamental frequency of the PPG signal are extracted.
and assigned grades. By appropriate grade weighting, the candidate having the maximal grade is selected. The presented algorithm is of low complexity and shown to provide good results. As such, it can be used in low-power portable devices for real time heart rate estimation.

**Some results**

Ground-truth: BPM based on the ECG signal

Estimated: BPM estimated from the PPG signal during physical exercise