

PULSEAR

Heart Rate Monitor

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For too long time, heart rate monitoring in sports and outdoor activities has been limited to chest belt sensors. PULSEAR is a novel belt-free device for heart rate estimation fully integrated in a commercial earphone. The device relies on the multiparametric processing of optical and inertial signals and provides accurate heart rate measurements in real time even during high intensity activity periods.



Key features

- Robust heart rate monitoring
- Chest belt free
- Integrated in commercial earphone
- Low power consumption

Sensing Technology

Pulsear is based on the multi-channel monitoring of subcutaneous blood flow. An optical emitter provides infra-red light at 875nm which is then scattered through the tissue of the ear cartilage, where it is submitted to modifications due to reflection, refraction and absorption. The analysis of the light received by a photo-diode allows the detection of the cardiac activity, i.e. heart rate, through the effects of arterial pulse waves reaching the cartilage at each cardiac systole. This is the so-called photo-plethysmographic effect.

However, human motion masks cardiac patterns in the received light, specially during sport activities. In order to circumvent the drawback of motion artifacts, an inertial sensor has been integrated in PULSEAR providing a motion reference. Efficient removal of motion related artifacts in the optical signals is achieved by applying model-based processing techniques.

The combined processing of opto-inertial signals has demonstrated to be a solution for the robust and practical measurement of the heart rate at the ear cartilage even during high intensity sports.



Accuracy during running sessions

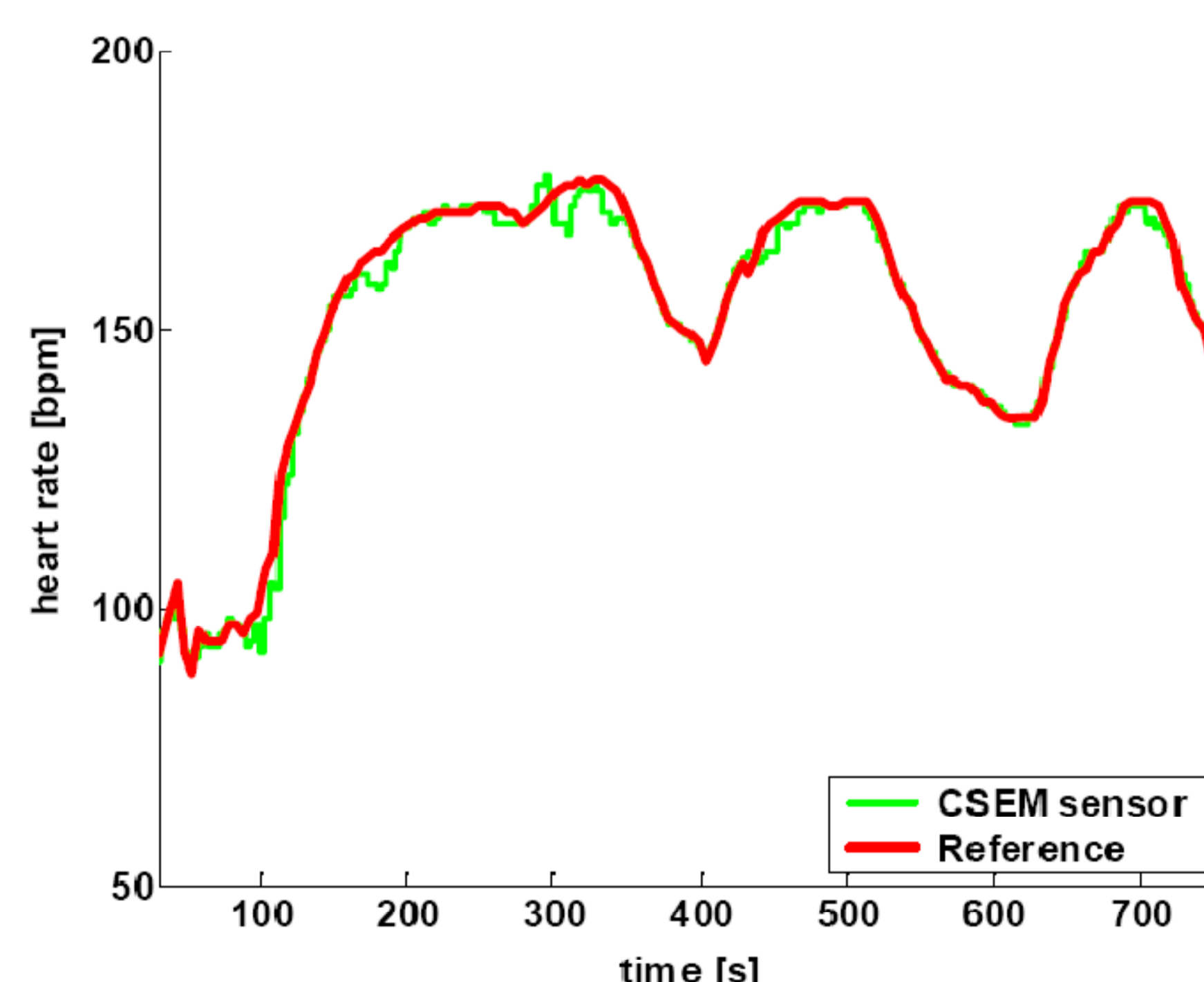


Figure 1

The accuracy of the heart rate monitor during a 13 minutes running session is here illustrated. Figure 1 shows the temporal evolution of heart rate measured with both, a commercial chest belt monitor (POLAR), and the ear cartilage monitor (PULSEAR).

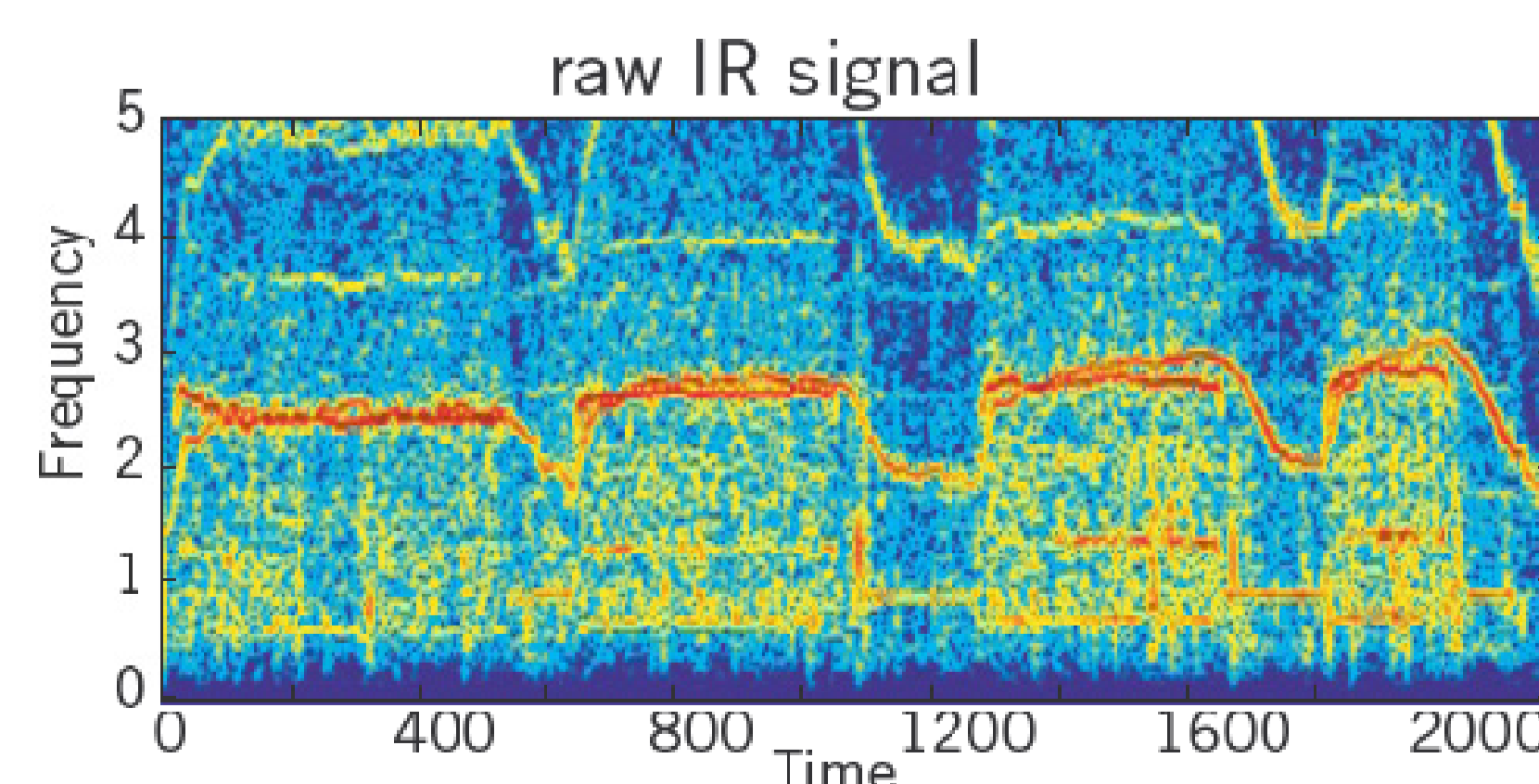


Figure 2

Figure 2 illustrates the spectrogram of a 30 minutes running session. Motion artifacts entirely mask the cardiac activity, centered around 2.5Hz. Figure 3 displays the spectrogram of the same running session after the multi-parametric processing. Cardiac activity has been successfully isolated from motion noise.

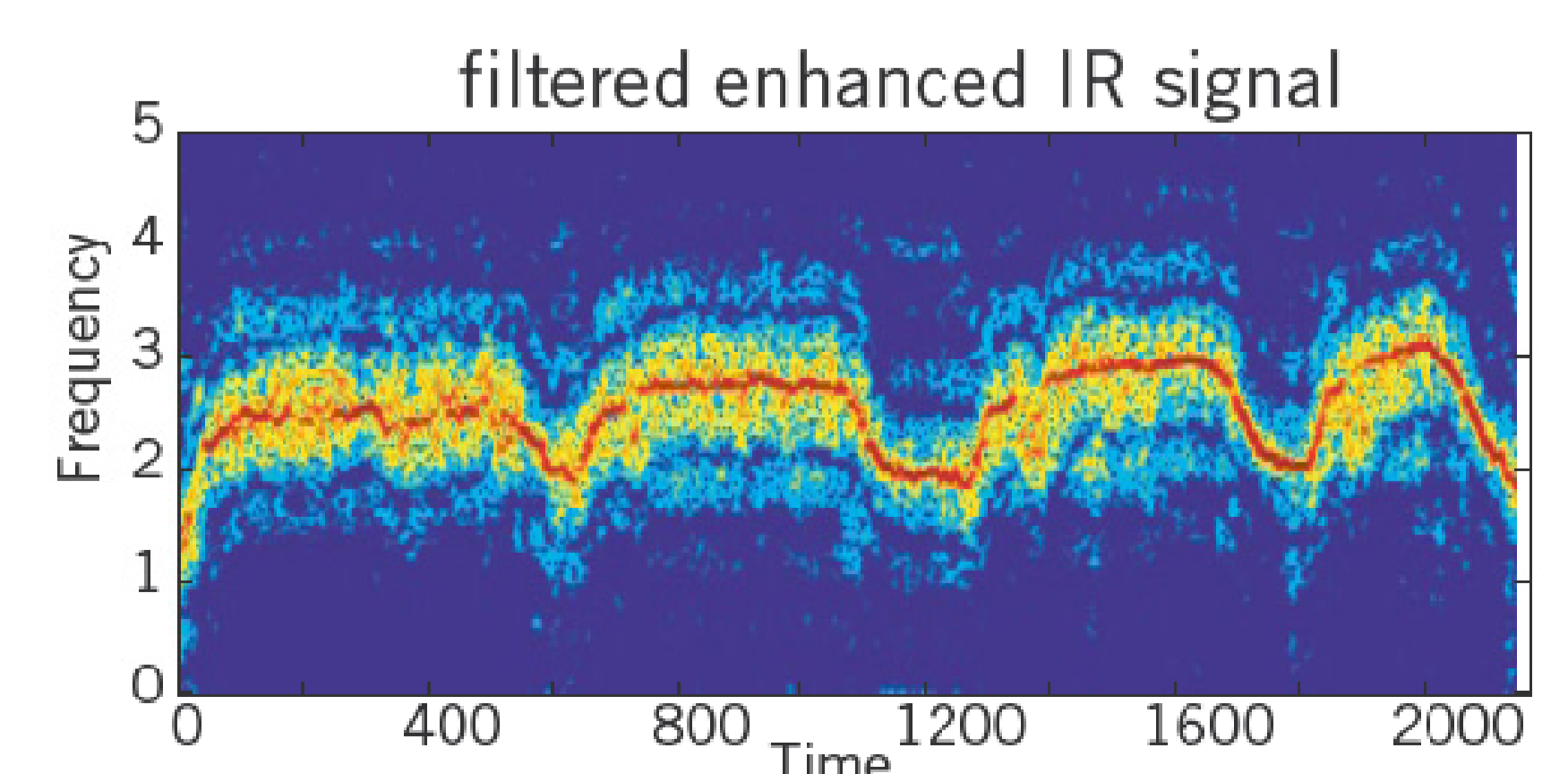


Figure 3