Non-Intrusive ECG Measurement on Vehicle Steering Wheel and Driver Seat

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Driver drowsiness is one of the major causes of deadly traffic accidents. Continuous monitoring of drivers' drowsiness thus is of great importance for preventing drowsiness-caused accidents. Previous psychophysiological studies have shown that heart rate variability (HRV) has established differences between waking and sleep stages. This offers a way to detect driver's drowsiness by analyzing HRV, which is typically measured and analyzed from electrocardiogram (ECG) signal. Although ECG measurement techniques are well developed, most of them involve electrode contacts on chest or head. Wiring and discomfort problems inherent in those techniques prevent implementing them on cars. This research develops two non-intrusive real-time ECG measurement methods for drivers. In the first method, each half of the steering wheel is wrapped with conductive fabric as electrode and is isolated to each other. In the second one, two pieces of conductive fabric with the same dimension are placed on the driver seat's backrest. Signals from conductive fabric electrodes are filtered by differential low pass, band pass and notch filters to amplify ECG signals and suppress noise. Noise whose frequency overlaps with the frequency range of ECG signal cannot be eliminated by these filters. To address this challenge, an adaptive filter is employed for baseline noise cancellation. Experimental tests show that both ECG measurement methods can provide clear ECG signals for further HRV analysis, although signals from the steering wheel are of better quality. Test results also demonstrate that the adaptive filter can effectively cancel baseline noise.