Monitoring driver's respiration and drowsiness using smart seatbelt

Background

Suboptimal states of the driver (e.g. drowsiness and inattention) is a key cause of poor driving performance and accidents where researchers are constantly working on solutions for the assessment. Chalmers and Autoliv Development AB are in collaboration to develop a platform to perform real-time driver monitoring through non-obtrusive measurement and analysis of driver physiological data such as heart rate and respiration, as well as data related to driver performance, with the applications to monitor driver's statues and detect health issues that can influence the driving capability, or in post-cash situations.

The seat belt tension sensor is developed for occupant presence detection, but also has a great potential to also serve as respiration monitor. In this thesis we want to evaluate respiration sensing through seat belt tension. The feasibility of detecting driver's yawning and drowsiness though this measurement shall be explored. For this purpose, the student will need to develop an algorithm toolbox to extract the proper respiration data by removing movement artefacts originating from vehicle or occupant. Autoliv's platform for in vehicle physiological monitoring and real road database will be available to this thesis work which provides great potential for development of preprocessing algorithms and applications based on artificial intelligence.

Aim

1. To develop processing algorithm to remove noise from other types of movement and extract useful information including breathing frequency and depth from the seat belt tension measurement. Data fusion (e.g. combining vehicle acceleration) can be applied in the preprocessing process. Compare the derived parameters with reference respiration measurement.

2. To develop algorithms to use seatbelt derived respiration sensing to detect interested driver status such as yawning or self-rated sleepy state. Machine learning algorithms can be applied.

3. To implement and test the algorithms developed in the thesis into Autoliv's physiological monitoring platform.

Materials and methods

The main tool for analysis will be Python, Matlab and/or other signal processing and machine learning platform the student(s) favor. Real road database that includes seatbelt tension, golden standard respiration measurement, driver drowsiness along with other measurements is available. New data acquisition and in field algorithm evaluation will be carried out in test vehicle from Autoliv, and structured evaluation can be performed in Autoliv's acoustics/vibration laboratory.

Information

Group size

1-2

Prerequisites

Students who have background and/or interest in physiological measurement, traffic safety, signal processing/machine learning/statistical analysis, are welcome to apply. Good programing skills (mainly using Python, Matlab, and/or other powerful computing software), and signal processing experience are advantageous.

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