DETECTION AND PREDICTION OF DRIVER'S MICROSLEEP EVENTS

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ABSTRACT

The detection of spontaneous behavioral events like short episodes of unintentional sleep onset during driving, which are usually called microsleep events, still poses a challenge. The analysis of only a small number of signals seems to be useful to detect such events on a second-by-second basis. Here we present an experimental investigation of 22 young drivers in our real car driving simulation lab. The experimental design was chosen to raise many microsleep events. A framework for adaptive signal processing and subsequent discriminant analysis was applied. In addition to the common estimation of Power Spectral Densities, the recently introduced method of Delay Vector Variance is utilized in order to get an estimate if the signal has undergone a modality change or not during the microsleep event under analysis. The fusion of the outcomes of both methods applied to three different types of signals, to the Electroencephalogram, the Electrooculogram and to Eyetracking signals, by modern methods of Computational Intelligence, namely the Support Vector Machine, leads to a high classification accuracies with mean errors down to 9% for all subjects. It turned out that such low errors are only achievable in a relatively small temporal window around the onset of microsleep. Their prediction is feasible but with much higher errors. The signal processing framework has the potential to establish a reference standard for drowsiness and microsleep detection.