

Classification of Vigilance Levels Related EEG Spectrograms

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Extended abstract: We summarize recent results achieved in the area of classification of electroencephalographic spectrograms for monitoring vigilance levels of a car driver. The research consists of two parts 1. Experimental data acquisition and preprocessing; 2. Developing a classification model.

The data acquisition is performed in the Joint Laboratory of Systems Reliability located at the Czech Technical University where the fully equipped car simulator is installed altogether with interconnected recording devices. During experimental sessions volunteer drivers undergo different driving scenarios and a record of electroencephalographic signals is stored. Drivers attend the sessions after a long period of sleep deprivation in order to simulate the episodes of microsleeps. The records are in the preprocessing phase transformed into the form of EEG spectrograms by means of frequency transform.

The classifier is built up on the basis of the concept of implicative radial fuzzy system. These systems allow accommodate and process multidimensional vague data and due to the radial property the processing is highly computationally effective. The fuzzy system is constructed in two phases on the basis of experimental data obtained in experiments. In the first phase structure learning is performed employing fuzzy clustering algorithms. In the second phase the parameter learning is performed employing the Levenberg-Marquardt algorithm. Three individual fuzzy systems were constructed for each of three vigilance levels recognized – mentation, wakefulness and microsleep.

Finally, the aggregation of individual fuzzy systems operating as classifiers completes the process of classifier development. The aggregation was performed by employing standard fuzzy logic operations of conjunction and negation. The aggregated classifier achieved the promising results exceeding the performances of individual classifiers.

Keywords: microsleeps, fuzzy classifier, EEG spectrograms

Acknowledgement

The research presented in the paper was supported by grant 1F84B/042/520 “MESPIN” of The Ministry of Transportation of the Czech Republic and the project MEB 040901 of the program KONTAKT of Czech-Hungarian collaboration.