DETECTION OF NOCTURNAL PROLONGED ACUTE CONVULSIVE SEIZURES IN CHILDREN BY INTEGRATING VIDEO AND ACCELEROMETER RECORDINGS

Kris Cuppens[1,2], Anouk Van de Vel[3], Peter Karsmakers[1,2], Bert Bonroy[1], Milica Milosevic[2], Stijn Luca[1,2], Tom Croonenborghs[1,4], Tinne Tuytelaars[5], Lieven Lagae[6], Berten Ceulemans[3], Sabine Van Huffel[2], Bart Vanrumste[1,2]

[1]Mobilab, Thomas More Kempen, Belgium
[2]ESAT SCD SISTA / iMinds Future Health Department, KU Leuven, Belgium
[3]University Hospital of Antwerp, Belgium
[4]Computer Science Department, KU Leuven, Belgium
[5]ESAT PSI / iMinds Future Health Department, KU Leuven, Belgium
[6]University Hospital of Leuven, Belgium
e-mail: kris.cuppens@khk.be

ABSTRACT

Prolonged acute convulsive seizures (PCS) are epileptic seizures with a motor component (convulsive) that last for a relatively long period of time. If PCS are uncontrolled they may lead to status epilepticus which is associated with significant morbidity [1]. Their early treatment may prevent consequences such as severe cerebral damage or mortality [2].

Epileptic seizure detection is traditionally done using video/ electroencephalogram (EEG) monitoring, which is not applicable in a home situation. In recent years, attempts have been made to detect the seizures using other modalities. In this research we investigate if a combined usage of accelerometers attached to the limbs and video data would increase the performance compared to a single modality approach. Therefore, we used two existing approaches for seizure detection in accelerometers and video and combined them using a linear discriminant analysis (LDA) classifier. The video detection method makes use of STIP features proposed by Laptev [3], the accelerometer approach makes use of different features from the time and frequency domain. In both approaches, an SVM classifier is used for classification.

The seizure data is acquired at the Pulderbos rehabilitation center for children and youth where epileptic children are monitored and treated. The data is labeled based on the EEG and video. To be able to objectively compare both approaches, based on acceleration and on video, we use the same segmentation of the data for both modalities. The training and testing is done in a 10-fold randomization. This means that we randomly select a number of normal and epileptic movements for the training and test set and perform the modeling and validation 10 times using a different combination of movements, and average out the obtained results. This makes the results less dependent on the division of the data in a training and test set. The same randomizations are used in both approaches and for the acceleration/video integration.

In a first test we combined the normalized features from both approaches, in an early integration. In a second test, we combined the outputs of both individual classifiers from the video and accelerometer detection, in a late integration using an LDA classifier. The output values of both classifiers give a probability of the sequence belonging to the epileptic seizure class, as we use the libsvm implementation for extending SVM to give probability estimates based on Wu et al. [4] and Lin and Weng [5].

The combined detection using the early integration seems to give a lower performance

(sensitivity: 83.33%, positive predictive value (PPV): 96.00%) than the accelerometer detection alone (sens: 83.33%, PPV: 100.00%). This means that the video features does not have any added value in this integration. The late integration of both modalities has a little positive influence on the performance. Although there is a decline in the PPV from 100.00% to 97.50% compared with the accelerometer detection, the sensitivity increases to 86.67%.

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