ONLINE EPILEPTIC SEIZURE DETECTION AT HOME: A MULTIMODAL APPROACH

Kaat Vandecasteele[1*], Thomas De Cooman[1], Lieven Lagae[2], Sabine Van Huffel[1]

[1]KU Leuven, Stadius Center for Dynamical Systems, Signal Processing and Data Analytics, Belgium

[2]KU Leuven, Department of Child Neurology, UZ Gasthuisberg, Belgium

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1. INTRODUCTION

Epilepsy is one of the most common neurological disorders and it is affecting almost 1% of the population worldwide [1]. Children are the most vulnerable group of these epilepsy patients. Having epilepsy has a major impact on their life, but also their parents are facing hard times. They want to help their child when he or she has a seizure.

Therefore a long-term home monitoring system is needed, that warns the parents in case of a seizure. As EEG is not suitable in a home-situation, the monitoring system is based on other biomedical signals: Accelerometry (ACM), surface electromyography (EMG) and electrocardiography (ECG) [2]. This monitoring system will focus on two types of seizures: Tonic-Clonic (TC) and Hypermotor (H) seizures with a seizure duration of at least 10s.

2. MATERIALS AND METHODS

2.1 Data acquisition

The data is collected in the Pulderbos Rehabilitation Center for Children and Youth. During the acquisition the signals are recorded simultaneously with a sampling frequency of 250Hz. The data set consists of 7 TC patients with 21 seizures and 205 hours of recording, 9 H patients with 67 seizures and 684 hours of recording.

2.2 Seizure detection method

In a first step, an online automatic seizure detector for each of the 3 mentioned signals is proposed.

The EMG/ACM detection is based on a LS-SVM classifier. Feature selection is done with the maximal relevance minimal redundancy (mRMR) technique, followed by a backwards wrapper feature selection.

The ECG detection starts with a Pan-Tomkins algorithm to detect the R-peaks. When a real heart rate increase is detected, features are extracted and fed to a SVM classifier.

Next, the multimodal algorithm combines the outputs of the algorithms applied on the sensors separately using a late integration approach.

3. RESULTS AND DISCUSSION

In table 1 and 2 the results of the individual sensors and multimodal algorithm are shown. The average sensitivities, false detection rates per hour (FDR/h) and delays are calculated for both the TC patients and H patients.

The multimodal algorithm greatly reduces the FDR/h.

Table 1: Results TC patients

Sensor	Sensitivity[%]	FDR/h	delay[s]
ACM	80.95	1.70	15.02
EMG	90.39	2.35	5.75
ECG	88.46	1.72	6.9
Multimodal	85.71	0.60	8.46

Table 2: Results H patients

Sensor	Sensitivity[%]	FDR/h	delay[s]
ACM	77.74	1.89	6.08
EMG	57.53	1.05	6.44
ECG	70.90	1.60	10.13
Multimodal	86.51	0.61	6.95

References

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