EVALUATION OF TIME-FREQUENCY BASED DETECTION METHOD FOR MYOCLONIC SEIZURES

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1 Introduction

Myoclonic seizures are brief, involuntary muscle contractions, with a very subtle clinical manifestation. Detection of these seizures can be important. Previously the possible value of time-frequency methods for detecting myoclonic seizures from accelerometric data was reported [1]. The Short time Fourier transform (STFT) and the continuous wavelet transform (CWT) were analyzed for their ability of detecting myoclonic seizures. It was shown that there is a visual difference between myoclonic seizures and other movements (Fig. 1).This study presents quantitative detection results using time-frequency features on data of 36 patients. Besides STFT and CWT, also the Wigner distribution (WD) is used and a newly introduced model based matched wavelet (MOD), which is especially designed for myoclonic waveforms in accelerometric data [2].

2 Methods

For each time-frequency measure, spectral powers or wavelet coefficients are evaluated as features in a detection setup. Fisher's linear discriminant analysis (FLDA) is used for classification. A threshold is set by optimizing a cost function on training data, which takes into account the distance between the means of the two classes and the variance within each class. A ROC analysis is performed to study the influence of a varying threshold on the results. Accelerometric data are used from 36 mentally retarded patients with refractory epilepsy. Data from 15 patients are used for training (100.2 minutes). Data from the other 16 patients are used for testing (79.2 minutes).

3 Results

Per feature set, for train and test data, sensitivity (SEN) and positive predictive value (PPV) for the 'optimal' threshold are listed in Table 1.

Table 1 Detection results

	Training data		***Test data***	
Features	**SEN**	**PPV**	**SEN**	**PPV**
STFT	0.97	0.13	0.71	0.16
WD	0.62	0.16	0.34	0.15
CWT	0.83	0.19	0.80	0.16
MOD	0.83	0.13	0.80	0.15

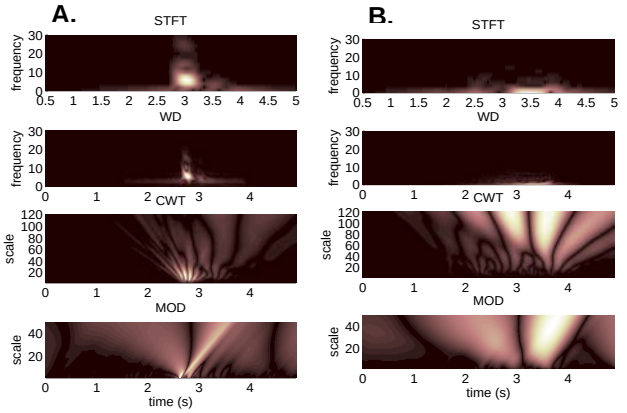

Fig. 1. Examples of time-frequency representations of A. myoclonic pattern in ACM-data. B. Other movement pattern.

For STFT and WD, sensitivities are higher in the training data. For CWT and MOD, sensitivities are similar between training and test data. PPV values are similar between training- and test data for all methods. ROC analysis shows that the optimal threshold found by FLDA is truly optimal. Shifting either leads to a too low sensitivity or too much false positives. Analyzing the false positives reveals that they are clonic seizures, the onset of tonic seizures, or sharp peaks in 'normal' movements indicating that the patient is making jerky movements. All these movements are considered important to detect. Preliminary results on the use of time-frequency features for clonic seizures will be presented.

4 Conclusion

The results of this evaluation show that both CWT and MOD are useful for detection of myoclonic seizures. Furthermore, MOD has the advantage that it consists of parameters that are related to seizure duration and intensity. In future work, the model will also be used for detecting other motor seizure types.

References

[1] Nijsen T.M.E. et al. Short time Fourier and wavelet transform for accelerometric detection of myoclonic seizures. *EMBS Benelux symposium, Brussels*, 2006.

[2] Nijsen T.M.E. et al. Model for arm movements during myoclonic seizures. *29th Annual International Conference of the IEEE EMBS,* 1582-1585, 2007.