

# Enhance Feature Representation of Electroencephalogram for Seizure Detection



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## Motivation

1. Epilepsy recognition through EEG signals can help a lot of patients to treat epilepsy more effectively.
2. The EEG signal contains many channel information, and then only the data of some channels will contain useful information.
3. Compared with the time domain feature, the frequency domain feature retains the energy feature. It has better performance in epilepsy recognition.

## Workflow

The block diagram of the proposed method is shown in Figure 1. The important processing steps are channel selection and feature extraction.

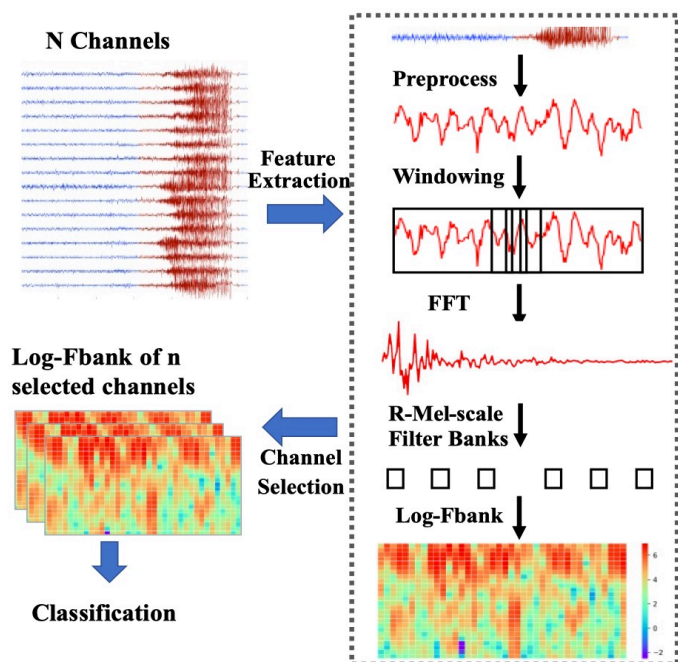


Fig. 1. The process of feature extraction

## 1. Sequential Forward Channel Selection

We propose SFCS for automatic channel selection to find a set of channels with a higher correlation with less computing consumption.

## 2. LogFbank Feature

We propose the frequency domain feature LogFbank, which retains the robust energy features of EEG signals according to get a log power spectrum on a non-linear Mel scale of frequency.

## Experiment

We evaluate the proposed method with 10 fold cross-validation in all experiments and adopt the mean area under the ROC curve as measurement of performance. The following table is our result.

Subject	proposed method			
	Full Channel	Channel Set 1	Channel Set 2	
Dog1	98.67	(10)	98.78	(10)
Dog2	99.56	(6,7,8,12)	<b>100.00</b>	(8,12)
Dog3	98.16	(1,2,3,4,6,7,8,10,11,13,14)	98.18	(3,7,8)
Dog4	<b>100.00</b>	(1,7,12,16)	<b>100.00</b>	(7,12,16)
Patient1	98.54	(19, 56)	<b>100.00</b>	(19,56)
Patient2	94.95	(1, 6, 8, 9, 14)	95.96	(1,6,8)
Patient3	99.92	(5,6,13,45,55)	<b>99.94</b>	(6,45,55)
Patient4	<b>100.00</b>	(2)	<b>100.00</b>	(2)
Patient5	96.94	(1,2,15,17)	<b>99.43</b>	(1,2,17)
Patient6	98.64	(16,17,24)	<b>99.82</b>	(16,17,24)
Patient7	98.91	(26,27,28,30,31,32,33)	99.23	(27,30,31)
Patient8	96.37	(11,13)	<b>98.25</b>	(11,13)
Average	98.39		<b>99.13</b>	98.65

Table1. Summary of results, Channel Set 1 is selected by SFCS and Channel Set 2 is top 3 channels by SFCS.

We summarize the overall performance on the recognition accuracy in Table1. The data shows that we can achieve 100% result for some subjects. 99.13% average accuracy is attained for the whole data set. The results in Table1 prove the feasibility of our method and the effectiveness of LogFbank and SFCS in recognizing epilepsy.

## Conclusion

We propose a novel EEG based seizure detection method, which is implemented through automatic feature selection in feature enhanced LogFbank space. Through extracting the log power spectrum of a non-linear Mel scale of frequency, the obtained representation is more discriminative to small differences of features and less sensitive to the noise. At the same time, the proposed SFCS channel selection algorithm is effective in choosing high correlation channels, which can reduce the computation complexity. Experiments demonstrate that our method has superior performance compared with the benchmark.

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