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Semi-Supervised One-Class Transfer Learning For Heart Rate Based Epileptic Seizure Detection[1]

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[1]This report is available by anonymous ftp from *ftp.esat.kuleuven.ac.be* in the directory *ftp://ftp.esat.kuleuven.be/pub/stadius/tdecooman/reports/SISTA_17_96.pdf*

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Aims: The electrocardiogram is a modality that can be used for automated seizure detection in a home environment. The downside of these seizure detection algorithms is their strong dependency on the patient's heart rate characteristics, which leads to mediocre performance if no patient-specific data are available. However, a large amount of patient-specific data is not always available, certainly if they have to be annotated by an expert neurologist. In addition, most algorithms require the occurrence of a seizure. Therefore the aim is to develop a robust patient-specific algorithm with only a limited amount of patient-specific unannotated data.

Methods: We illustrate the limited data problem by using only data from one night in order to construct a patient-specific algorithm. Because this typically does not contain sufficient data to develop a robust classifier, a transfer learning approach is applied to a support vector machine classifier. Hereby a previously developed patient-independent classifier is used as reference classifier. In order to avoid the necessity of fully annotated data and seizure data, a one-class version of transfer learning is applied. The only knowledge that is required is an estimation of the number of severe seizures that occurred during this night (done by the patient/relatives) in order to estimate the number of correct outliers.

Results: The algorithm was evaluated on a dataset of 8 pediatric patients containing 25 severe convulsive seizures during 428 hours of nocturnal data. The patient-independent algorithm resulted in an overall sensitivity of 92%, whereas 0.39 false alarms/ hour were found. By training the classifiers on one night of data, the false alarm rate dropped to 0.09 false alarms/hour. The results show that by incorporating only one night of data, performance of heart rate based seizure detection can already be strongly improved with this approach.