A COMPARISON OF FEATURE RANKING METRICS FOR MICROSLEEP DETECTION FROM THE EEG

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INTRODUCTION: In machine learning, feature selection is the process of selecting subsets of a larger set of features to eliminate redundant or irrelevant features. A previous paper [1] describes a filter feature selection method, ADEN (Average Distance between Events and Nonevents), which outperformed PCA for a simulated EEG feature-selection task. In this paper we describe the application of a single-variable classifier filter method, referred to here as discriminative feature ranking (DFR), which outperforms ADEN and another filter method, mutual information (MI), at selecting relevant features for microsleep detection on real EEG. DFR internally trains and validates a classifier for each feature, which contrasts it with statistical filter methods, including ADEN and MI.

METHODS: DFR was compared to ADEN and MI for the task of selecting the most microsleep-relevant features from a set of 544 spectral power features. The dataset used included 8 subjects, who had each performed two 1-hour sessions of a continuous tracking task, which was highly conducive to microsleep occurrence [2]. The data from each subject was split 20/80 into training/test sets by uniform random selection of 1-s EEG epochs within each class (microsleeps, background EEG). DFR, ADEN and MI were used to produce separate class-relevance rankings of the 544 features within each subject. Naïve Bayes classifiers were trained using the top 2, 4, 8, 16, 32, 64, 128, 256, and 512 features for each of the subjects and feature ranking methods, on the basis that the ranking method which is best able to identify class-relevant features would produce better classifiers. The classifiers were validated on their subjects' respective test sets, and their performance was measured using the Phi correlation coefficient.

RESULTS: In 7 of the 8 subjects, DFR produced the best classifier. MI produced the best classifier for one of the subjects but performed poorly on average. Figure 1 shows the subject-averaged Phi correlation of the classifiers trained using the top 2-512 features as ranked by the three methods.

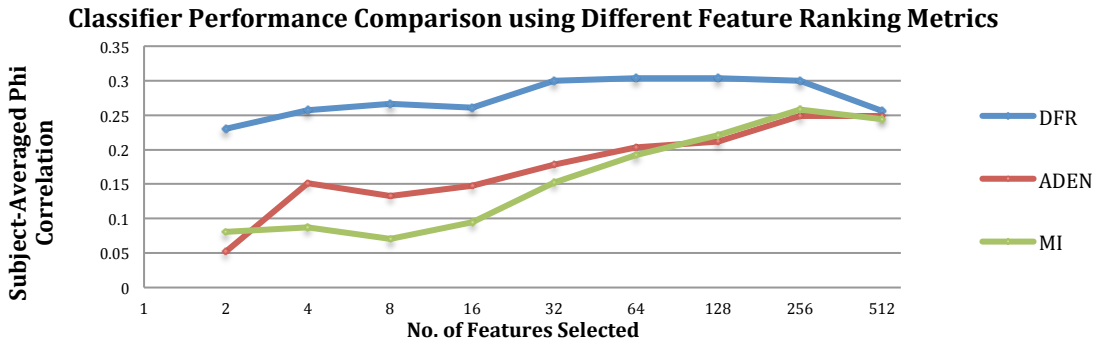

Fig. 1: Classifier performance vs. number of features selected for the two feature selection methods

DISCUSSION & CONCLUSIONS: At least with this data, DFR is superior to ADEN and MI at identifying class-relevant features. With DFR, the same average performance is achieved with only 4 features that requires 256 features when using ADEN and MI, and the performance of the DFR-based classifiers plateaus at only 32 features. These results imply that DFR will provide substantially more effective dimensionality reduction for microsleep classification from the EEG than alternative filter methods.

REFERENCES:

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