Frequency Microstates as a Novel Approach to Classify Cerebral Performance of Comatose Patients

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Comatose patients after cardiac arrest require urgent and accurate classification to guide their management and predict their outcomes. In this study, we propose a new parameter for comatose patient classification based on microstate maps of frequency distribution.

Objective: The objective of this study is to evaluate the performance of the presented parameter for comatose patient classification compared to existing parameters, and to explore the potential of incorporating additional parameters and using more advanced machine learning models to improve classification accuracy.

Methods: We performed FFT on standardized channels of electroencephalogram recordings from comatose patients after cardiac arrest, and used microstate clustering to obtain maps of frequency distribution. We then sorted the microstate maps to minimize cross-entropy and averaged the cluster centres, which were further clustered into 5 microstates by cerebral performance category (CPC). The resulting microstate centres were used for classification using averaged cross-correlation. We compared the performance of our proposed parameter to those obtained from amplitude-microstates and frequency-microstates. We plan to train a 3D-CNN and SVM models to incorporate temporal-spatial information and extract additional parameters, including evoked potentials and transition probabilities of the dynamic matrix extracted from the microstates segmentation, which were observed to have significative differences between outcomes classification.

Results: Our suggested parameter performed better than those obtained from amplitude-microstates and frequency-microstates, increasing the score of a dummy model by 0.8 on local cross-validation. The presented parameter achieved a score of 0.382 in our local run and 0.24 on the platform. Figure 1 shows the good specificity of the proposed parameter across CPC classification in a confusion matrix.

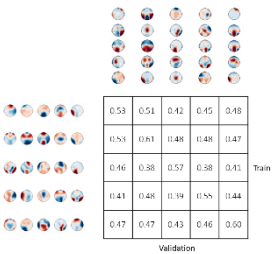

Figure 1. Confusion matrix of the parameter

Conclusion: The suggested parameter based on microstate maps of frequency distribution shows promise for improving comatose patient classification after cardiac arrest. Incorporating additional parameters and using more advanced machine learning models as described above, we expect a considerable increase in the accuracy of the classification.