T58. Automatic seizure detection based on multimodal signal quantification—Franz Fürbass *, Johannes Koren, Christoph Baumgartner, Tilmann Kluge (Austria)

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Introduction: Quantitative analysis and automated seizure detection is able to increase efficiency of EEG review. However, acceptance of software assisted review is often low because results are inaccurate in real world patient cohorts and the reason for false detections cannot be deduced. The graphical software tool encevis visualizes detections of fast rhythmic activity and patterns defined by the ACNS critical care EEG terminology. Based on these detections as well as quantitative information of EEG, ECG, and EMG a multimodal seizure detection algorithm was developed. Simple rule based classification is utilized that facilitates easy interpretability. Aim of this work was to assess detection performance of different modalities and patient groups.

Methods: Our computer algorithm automatically detects seizures including rhythmic EEG patterns that show an increased amplitude compared to baseline. EMG signal is extracted by bandpass filtering EEG (30–60 Hz) to measure line length (LL) for detection of sustained and excessive ictal EMG activity of generalized tonic-clonic seizures (GTCS). High absolute values of LL and an increase of 500% to baseline trigger detections. Heart rate is calculated from ECG signals to detect ictal tachycardia (ITC) with more than 100 beats per minute and an increase of over 30% compared to baseline. To assess sensitivity and false detection rate a retrospective study was conducted including EEG/ECG recordings of 92 patients from two epilepsy monitoring units. Inclusion criteria were an age above 18 and at least one recorded epileptic seizure. EEGs were used without modification or manual editing of any kind. Automatic seizure detection was calculated for all 11,978 h of EEG (min = 23 h, max = 547 h). In total 410 manual seizure annotations were compared to automatic detections to define sensitivity (SE) and false detection in 24 h (FD/24 h).

Results: Combination of all three seizure detection methods (EMG + ECG + EEG) resulted in SE = 88% with 10.5 FD/24 h on average. By using only EMG based detections 100% of GTCS (n = 49) were found with an average false detection rate of 3.39 FD/24 h. Seizure detection solely based on ECG yielded SE = 31% with 1.35 FD/24 h. Analysis of the temporal lobe epilepsy patients showed SE = 93.3% and 6.75 FD/24 h, the extra temporal lobe patient group resulted in SE = 80% at 15.3 FD/24 h.

Conclusion: We showed that automatic seizure detection based on multimodal signal quantification can reach high sensitivity. The low false detection rate results in an average of 20 false detections per week than can be validated quickly by using EEG and time synchronized quantitative screens in parallel. By visualizing quantitative information that is the source of automatic seizure detection the interpretability of results is improved. Our proposed approach to automatic EEG analysis will raise efficiency of post hoc analysis compared to the current state of the art.

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T59. EEG artifacts removal using machine learning algorithms and independent component analysis—Guiyeom Kang, Seung-Hyun Jin, Dae Keun Kim *, Seung Wan Kang (Republic of Korea)

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Introduction: Elimination of electroencephalogram (EEG) artifacts is an important process in EEG analysis and research because artifacts can disturb EEG signals, resulting in serious misinterpretation. Independent component analysis (ICA) is a statistical method to separate independent sources from multivariate data. It has been used to identify and remove the artifacts from raw EEG signals. Topographic maps and power spectrum resulted from ICA show different characteristics for EEG artifact types such as muscle and ocular artifacts. One problem with ICA is that it needs visual inspection by EEG experts. In this study, a new method was developed for automatically classifying and eliminating EEG artifacts using image recognition of topographic maps using the machine learning algorithms.

Methods: The EEGs recorded from 841 healthy subjects were used in this study. The pipeline for EEG artifacts removal consists of preprocessing including filtering, common average referencing and ICA. Data for training and testing the machine learning algorithms were obtained from manual inspection of the topographic maps and power spectrum by EEG experts. Since the volume of data was important for the machine learning algorithms, generation of additional data was implemented as follows. The pre-processed signals were divided into several segments to extend data for deep learning algorithms. ICA was then applied to the segments and topographic maps and power spectrum for independent components were generated. Artificial neural network (ANN), one of the machine learning algorithms was then used to classify neural signal and 3 different artifacts including EMG, horizontal eye movements (eye blinks), and vertical eye movements.

Results: The ANN applied to the topographic maps obtained from ICA studies presented its effectiveness to automatically classify and remove the EEG artifacts. An accuracy rate of 91.01 ± 5.12% was obtained and eye blinks were most effectively classified with a recognition rate of 98.29 ± 4.76%. The error rates of missing neural signals and artifacts were 9.19 ± 1.23% and 7.65 ± 2.63% respectively. Finally, the execution time of the system was acquired for real-time applicability.

Conclusion: A method of the machine learning algorithms applied to ICA has been presented to identify and remove EEG artifacts. The results demonstrate that the proposed method can effectively, automatically remove muscle and ocular artifacts in EEG signals. This study supports that the deep learning is capable of strong potential for removing EEG artifacts resulting high quality of EEG signal analysis without manual inspection by EEG experts. Funding: This work was supported by Ministry of Science and ICTGrant 20170010980011001.

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T60. Continuous EEG after moderate to severe traumatic brain injury: Seizures, ictal-interictal patterns and neurophysiologic predictors of functional outcome—Hyunjo Lee *, Moshe Mizrahi, Jed Hartings, Brian Moseley, Michael Privitera, Brandon Foreman (USA)

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Introduction: Traumatic brain injury is common and the leading source of disability in the US. International guidelines for the use of EEG in those requiring ICU admission include indications to detect nonconvulsive seizures in those with altered mental status or in those at high-risk, although evidence is lacking for which patients might be at risk. Further, there is no evidence for the prognostic importance of continuous EEG (cEEG) in the context of established clinical indicators.

Methods: We performed a post hoc analysis of data from the INTREPD2566 study (NCT00805818), a randomized controlled clinical trial of NNZ-2566, a synthetic neurotrophic IGF-1 derivative for