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ABSTRACT BOOK



P220
Estimating Sedation Depth Using Correlation Dimension of Spontaneous EEG and Auditory Steady-State Responses

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In this study, the depth of anaesthesia was tried to be predicted by post-processing of EEG signals taken during surgery. The recordings included spontaneous segments and 40 Hz ASSRs (Auditory Steady-State Response) segments which were separately analyzed. It is possible to show different behaviours of brain using nonlinear methods beside traditional time and frequency methods. Since EEG signals are complex and non-linear, we chose the correlation dimension (CD) as a non-linear chaotic parameter for estimating the sedation depth. There are various dimension parameters in the literature, but CD is easier to be calculated and reveals the changes in the complexity of the signal better. The 40 Hz ASSRs were analyzed by using Fourier magnitude and phase spectrums. Data acquisition was in the standard 10-20 system having 15 channels at 500 Hz sampling rate. For comparison, BIS Index values were also recorded during operations as a reference for post-processing. Processing algorithms were performed under MATLAB platform. For CD analysis of spontaneous EEG, we used Grassberger-Procaccia estimator. We observed that the CD of EEG decreased with increasing sedative depth through the whole brain, but dynamic range of the CD at the frontal area was bigger than in other areas. Therefore, we chose frontal electrodes to analyze the EEG as in the BIS monitor. The changes of CD values revealed similarity with BIS index alteration during operation under the sedative drug. The CD values were between 4.5 and 5 in the awake state and about 3.5 in the sedative state. In the analysis of ASSRs using smoothed overlapping short-time Fourier transform, the differences between spontaneous and ASSR segments were clear, revealing a fundamental peak at 40 Hz and harmonic peaks at 80 and 120 Hz in the spectrum. As the BIS index decreased, the magnitude of the fundamental frequency (40 Hz) component also decreased, whereas the magnitude of the first harmonic at 80 Hz remained the same. In addition to this, phase of the first harmonic at 80 Hz, which had a random shape under spontaneous state, became more linear. This suggests that the sedation status may be more easily detected by the inspection of phase responses rather than the peak magnitudes of the 40 Hz ASSR. Our initial observations suggest that there exists a relation between the depth of sedation and the phase parameters of this first harmonic response at 80 Hz such as the initial phase and the drift rate of the phase response along the 40 Hz stimulation.

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EVENT ABSTRACT « Back to Event

Event-related brain oscillations associated with color-word interference

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Stroop color-word test requires subjects to read (semantic processing) a color word printed in a different ink color. The interference between word meaning and ink color slows down the reactions to incongruent stimuli. EEG was recorded from 23 subjects during a computerized version of Stroop test. The longer reaction time for incongruent condition was replicated. N4 potential was found to be more negative for incongruent condition, which is also in line with the previous findings. The wavelet transforms of the averaged ERP and the single trials were computed to investigate the amplitudes of the evoked (phase-locked) and total (phase-locked + non-phase-locked) oscillatory responses. Evoked delta (250-600 ms) was larger in response to congruent trial ($p<0.01$), which can be interpreted as somewhat coherent with our earlier studies on oddball experiments. Since the delta response has been related with stimulus evaluation and decision making, a larger delta response for congruent condition which involves a relatively simpler decision process was predicted. The total theta activity (300-700 ms) was significantly increased incongruent trials ($p=0.05$), and this effect was more prominent over fronto-central region ($p<0.05$). The late timing and frontal scalp distribution of theta suggest that it could be related to resolution of the conflict in response production stage, due to color-word interference. The evoked alpha response (100-200 ms) in incongruent trials was higher with trend level significance, and this finding leads to the reconsideration of the assumption based on the time-domain analyses that the processes dealing with the color-word interference start around 450 ms. Finally, the results on time-frequency plane, allowed further characterization of the cognitive processes during resolution of Stroop interference.

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