

## Transmission of information during Continuous Attention Test

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The Short-Time Directed Transfer Function (SDTF) is an estimator based on a multivariate autoregressive model which has proved to be successful in ERP experiments, e.g. those connected with motor action and its imagination. The aim of this study is the evaluation of the performance of SDTF in the cognitive experiment. We have applied SDTF for the estimation of the pattern of EEG signal transmissions during a Continuous Attention Test (CAT). Time-frequency patterns of propagation were estimated for two experimental conditions. Statistical procedures based on thin-plate spline model were used for estimation of significant changes in respect to the reference epoch. The repeatability of the results for a subject and across the subjects were investigated. The effect of prolonged transmission in the gamma band from the prefrontal electrodes found in all subjects was explained by the active inhibition in the case when a subject had to sustain from performing the action.

Key words: EEG, multivariate AR model, SDTF, CAT, gamma activity, cognitive test, motor action

Modern imaging techniques, especially functional magnetic resonance (fMRI) provide information on the localization of active sites in brain under different experimental conditions. However, their limitations are connected with low time resolution, a not well known connection between hemodynamic response and brain activity and, finally, a lack of information on spectral properties of brain activity. EEG provides, despite its lower topographic resolution, information on time-variable brain rhythms and is at the same time a relatively cheap technique broadly available in clinics. Another advantage of the EEG technique is the possibility of estimating the transmission of brain activity which may reflect the interactions within and among networks synchronized at multiple different frequencies.

The method which allows for estimation of propagation of brain activity is Directed Transfer Function introduced by Kaminski and Blinowska (1993). It has

been applied for localization of epileptic foci (Franaszczuk and Bergey 1998), transmission of brain activity during locomotion in animals (Korzeniewska et al. 1997), for propagation of EEG during sleep (Kaminski et al. 1997, 1995), for investigation of epileptogenesis (Medvedev and Willoughby 1999), for estimation of brain connectivity (Astolfi et al. 2005, Babiloni et al. 2005).

The dynamical propagation of brain activity can be estimated by means of the Short-time Directed Transfer Function (SDTF) (Ginter et al. 2001, Kaminski et al. 2001). A comparison of different methods estimating directionality of signal flow was made by Kus and coauthors (2004) and Blinowska and others (2004), which demonstrated that only the multivariate (not bivariate) approach allows for correct estimation of directionality of flows. SDTF has been applied in the investigations concerning motor related tasks. A very good performance of the method was demonstrated – among others, similarities and differences between EEG propagation during real and imagined movement were found (Ginter et al. 2001, 2005, Kus et al. 2006).

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