Abstract

This thesis deals with functional coupling between different cortical regions based on the analysis of electrical potentials recorded using dense grid of scalp electrodes. The functional coupling was quantified using coherence function. Computation and coherence analysis problems are outlined. Methodological points associated with recording of electrical potentials and their pre-processing for purpose of coherence analysis are also discussed.

Pivotal part of the thesis refers to presentation of two original experimental studies. The first experiment analyzed the influence of force of isometric hand muscle contraction on the functional coupling between the primary and higher-order motor regions. The second experiment dealt with effects of brief painful stimulus applied to the right hand, and of simultaneous isometric hand muscle contraction on EEG coherence. EEG coherence in the α band between left and right primary sensorimotor areas and between these regions and supplementary motor area was stronger during forceful hand muscle contractions compared to mild force contractions. Brief painful stimuli were followed by decrease of the α-band coherence between bilateral primary sensorimotor areas and precentral medial regions or frontal cortex. The initial decrease of coherence was followed by increase of coherence between the contralateral primary sensorimotor area and the medial precentral cortex. In the β subband 16–32 Hz, painful stimulus induced increase of coherence between the contralateral primary sensorimotor area and the premotor or frontocentral medial cortex. These coherence changes were largely suppressed during isometric contraction of the stimulated hand except of the coupling between ipsilateral primary sensorimotor and posterior parietal regions showing increase of α band coherence during isometric hand muscle contraction.

Results from both experimental studies suggest that EEG coherence analysis contributes to understanding of functional coupling between cortical regions during somatomotor activity or somatosensory stimulation.