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DESIGN METHOD OF MORPHOLOGICAL STRUCTURING FUNCTION FOR PATTERN RECOGNITION OF EEG SIGNALS DURING MOTOR IMAGERY AND COGNITION

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Abstract. *It is known that Electroencephalograph (EEG) signal shows specific responses according to the event (e.g., visual stimulus, cognition and motor imagery). Especially, by classifying short time EEG signal, features are used to control an electronic device (such a system is called brain computer interface: BCI). Generally, in feature extraction from EEG signal, these features are extracted by using linear method such as FIR filter and wavelet transform. Though, linear method is not suitable because impulse noise distorts the important features. To avoid this, the morphological analysis method with non-linear characteristics has been used in this field. In this paper, we propose a design method of structuring function that determines the filter characteristic of morphology. The morphological method is compared with discrete wavelet transform (DWT) method from the view point of filter characteristics. We apply our method to real data observed from motor imagery and cognition simultaneously.*

Keywords: Mathematical morphology, Multiresolution analysis, Filter design, EEG, BCI, Error potential

1. **Introduction.** In human EEG, it is known that response waveforms such as visual and audial evoked responses respectively caused by photic and auditory stimuli appear and that being required selective reactions for several sorts of stimuli, event related potentials are observed [8]. It is also known that, when a person is going to move a limb, event related synchronization/desynchronization (ERD/ERS) and other relevant event related potentials are observed in EEG. In particular, event related potentials are known to be observed even if he only intends to move his limb without actual movement. These facts mean that information about changes of human brain activity in cognitive process or movement decision process is contained in the observed EEG and suggest that the extraction of this information enables us to guess from EEG of a person what he is going to do. According to this principle, brain computer interface (BCI) actualizes computer interface for handicapped persons and has been rapidly progressing recently [13, 15].

There are two types of actualizations of BCI, i.e., invasive and non-invasive ones. Invasive BCIs make use of electrocorticogram (ECoG) measured from electrodes implanted directly into the brain and have advantage to obtain the electric activity of the cortex without noise or power decreasing [10]. However, this kind of system has surgical infection risk. On the other hand, as non-invasive BCIs, magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI), optical topography and BCI using EEG are known. Among them, the BCI using EEG measured from electrodes attached to the scalp is inexpensive and widely researched. For example, the research group of J. R. Wolpaw