EARLY FINGER MOVEMENT PREDICTION FROM A GENETIC SEARCH OF EEG SPECTRA

David A. Peterson[1,2,3,4], Charles W. Anderson[1,2], Michael H. Thaut[2,4]
[1] Department of Computer Science
[2] Program in Molecular, Cellular, and Integrative Neuroscience
[3] Department of Psychology
[4] Center for Biomedical Research in Music
Colorado State University
Fort Collins, CO 80523

We used EEG spectra to predict laterality of finger movement in a self-paced key typing experiment (Blankertz et al 2002). Our goal was to determine how well key types could be predicted from temporal windows well before the keystroke. We hypothesized that a custom spectral representation consisting of a composition of multi-resolution frequency bands would provide better classification than the standard EEG frequency bands.

We used the EEG recorded from each of 6 bilateral frontal, central, and centroparietal electrodes. We used a support vector machine (SVM) with a Gaussian kernel for classifying a test set of 10% of 413 trials. We searched the high-dimensional feature space using a genetic algorithm (GA) as a wrapper around the SVM classifier.

Both standard and custom features could be classified at a greater than chance level. The custom spectral features performed significantly better than the standard EEG spectra. The genetic search of feature spaces illuminates unconventional frequency band compositions that provide better classification accuracy.

The results suggest that EEG frequency information can be used for distinguishing between different motor intentions well before the actual movement. The results also suggest that compositions of multiresolution EEG spectra may be more informative than standard EEG frequency bands. Given the complex, noisy, and relatively unknown relationship between EEG and mental processes like motor intentions, global stochastic search methods like GAs may be a preferred method of selecting features from a high-dimensional EEG feature space.

References:

Benjamin Blankertz and Gabriel Curio and Klaus-Robert Muller, “Classifying Single Trial EEG: Towards Brain Computer Interfacing”, Advances in Neural Information Processing Systems, Vol. 14, ed. by T. G. Diettrich and S. Becker and Z. Ghahramani, MIT Press, 2002.