Neurofeedback for State of the Art Paradigms in Brain-Computer Interfacing

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Abstract

The modern day paradigm used for decoding signals in brain-computer interfaces (BCIs) recorded with an electroencephalogram (EEG) is the motor imagery (MI) paradigm. To classify EEG signals, it is necessary that the recorded signals are sufficiently discriminable. Unfortunately, not all people are able to modulate motor imagery tasks very well.

This work investigates and tests several paradigms on people with disabilities as well as on healthy people to obtain sufficiently many discriminable paradigm related conditions. Investigated paradigms include MI, imagery of audio, mental subtraction of numbers, word association, spatial navigation, and mental rotation. Each of these paradigms will be compared against each other with recent transfer learning approaches regarding paradigm specific task enjoyment [1], discriminability in terms of decoding performance, and peak latency. The best performing paradigms for individual subjects are further improved by using an extension of the adaptive neurofeedback training initially proposed in [2]. During neurofeedback training, the application determines the modulation ability of the subjects' paradigm specific signal in the cortical region of interest compared to the relevant resting state rhythms and provides real time feedback to the subject on how well he is modulating this signal.

Initial results of the neurofeedback training show a visible improvement in the log mean band power in the cortical region of interest. To obtain significant results more neurofeedback studies have to be conducted.

References

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Short Biography

Natalie Faber is 26 years old and holds a M.Sc. in Computer Science from the Technische Universität Darmstadt. She is coordinating the Athena-Minerva Team and undertook the signal processing as well as the paradigm design part for the Cybathlon competition. In these parts Natalie implemented and evaluated several paradigms as well as some signal processing approaches for preprocessing the recorded EEG signals. Natalie uses neurofeedback training on the teams pilot to improve his modulation ability for his paradigm specific signals.