Adaptive Training Strategies for BCI

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Abstract

Research on Brain-Computer Interface (BCI) systems consists amongst others of preprocessing the signals, artifact reduction, dimensionality reduction, applying filters and learning classifiers to generate actions that can be sent to actuators of exoskeletons or computer programs [1]. A problem with current BCI systems is that performance can decrease rapidly over time, since training can be tiring and the signals are non-stationary [2]. Furthermore, the motivation of the subject can drop quickly if no success in controlling the BCI system is experienced. Like in everyday life, if we want to learn a skill, we need feedback to be able to judge our current performance. A potential solution to the aforementioned problem is to develop adaptive training strategies. These strategies use a classifier to classify the data provided by the BCI system and an optimal agent which assists the subject to modulate and improve her/his signals. Continuous visual feedback about the performance is provided during the whole training time. With increasing training time, more and more control is given to the subject, reducing the effect of the optimal agent. With this approach, we want to increase the convergence rate of the subject's performance at controlling a BCI system. To verify this, we developed a simple computer game, closely related to the Cybathlon BCI challenge. In this game, the subject has to control an avatar to avoid obstacles by using different commands. The agent's policy to assist the subject is trained through reinforcement learning. Finally, we are interested in the generalization abilities of the subject to previously unseen situations. Therefore, we implemented different difficulty levels with higher or faster obstacles. Initial results indicate that our system supports faster learning of controlling the avatar. To further verify this, we need more subjects and do more exhaustive tests with the system.

References

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Short Biography

David Sharma acquired his Bachelor of Science in Computer Science in 2012 at Technische Universität Darmstadt. Currently he is writing his master thesis on the adaptive training strategies for BCI. He is interested in exploring neural data with machine learning techniques to find out more about how the human brain works and how diseases affect the brain. In the Cybathlon competition, he is responsible for implementing and evaluating classifiers for the data.

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