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Understanding Cognitive Fatigue From FMRI Scans With Self-supervised Learning

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Abstract : Functional magnetic resonance imaging (fMRI) is a neuroimaging technique that records neural activations in the brain by capturing the blood oxygen level in different regions based on the task performed by a subject. Given fMRI data, the problem of predicting the state of cognitive fatigue in a person has not been investigated to its full extent. This paper proposes tackling this issue as a multi-class classification problem by dividing the state of cognitive fatigue into six different levels, ranging from no-fatigue to extreme fatigue conditions. We built a spatio-temporal model that uses convolutional neural networks (CNN) for spatial feature extraction and a long short-term memory (LSTM) network for temporal modeling of 4D fMRI scans. We also applied a self-supervised method called MoCo (Momentum Contrast) to pre-train our model on a public dataset BOLD5000 and fine-tuned it on our labeled dataset to predict cognitive fatigue. Our novel dataset contains fMRI scans from Traumatic Brain Injury (TBI) patients and healthy controls (HCs) while performing a series of N-back cognitive tasks. This method establishes a state-of-the-art technique to analyze cognitive fatigue from fMRI data and beats previous approaches to solve this problem.

Keywords : fMRI, brain imaging, deep learning, self-supervised learning, contrastive learning, cognitive fatigue
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