Technische Universität München

Neurowissenschaftliche Systemtheorie

Engineering Practical Project

Optimization of an Existing Deep Convolutional Neural Network Algorithm for EEG Brain Signals Decoding

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Problem description:

Electroencephalography (EEG) is a noninvasive way to record brain activity by means of measuring electrical fields arising from neural activation. Previous attempts to analyze EEG signals have focused on well-characterized sensorimotor data features. However, the brain-machine interface field seems to have stagnated in improving motor decoding using this method. One way to overcome this hurdle is to use neural-network-based classification methods to analyze brain-activity data. In one of our current projects at NST, we are investigating the use of both deep convolutional neural networks (CNNs) [1] and recurrent neural networks (LSTM) [2] for our recorded EEG data classification.
Therefore, the main objective of this project is to optimize and improve our existing deep learning algorithm [3]. The student will join a group of students at NST who are currently working on designing and testing different deep learning algorithms for EEG decoding. In addition, the student will have access to our recorded EEG data and the developed algorithm.

Tasks:

This practical project requires the student to:

- Optimize and improve a developed/existing CNN algorithm for EEG signals decoding.
- Test and evaluate the obtained results

Optional Task:

- Combine the developed CNN and LSTM algorithms for a deep convolutional recurrent neural network (CRNN) decoder of EEG signals [4]

Requirements:

- Good knowledge of TensorFlow or Theano

Bibliography:

[1] Robin Tibor Schirrmeister, Jost Tobias Springenberg, Lukas Dominique Josef Fiederer, Martin Glasstetter, Katharina Eggensperger, Michael Tangermann, Frank Hutter, Wolfram Burgard, Tonio Ball, Deep learning with convolutional neural networks for EEG decoding and visualization, Human Brain Mapping, 2017
[2] Mingai Li, Meng Zhang, Xinyong Luo and Jinfu Yang, "*Combined Long Short-Term Memory based Network employing wavelet coefficients for MI-EEG recognition*", International Conference on Mechatronics and Automation China, 2016
[3] Juri Fedjaev, "Decoding of EEG Brain Signals Using LSTM Recurrent Neural Networks", Master Thesis, Technische Universität München, 2017
[4] Pouya Bashivan, Irina Rish, Mohammed Yeasin, Noel Codella, Learning Representations from EEG with Deep Recurrent-Convolutional Neural Networks, ICLR, 2016

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