Technische Universität München

Neurowissenschaftliche Systemtheorie

Advanced Seminar

Deep Learning for Non-Invasive Brain Machine Interfaces

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Problem description:

Brain-machine interface (BMI) technologies aim to provide a bridge between the human brain and external devices. The main difficulty faced thus far in building an effective non-invasive BCI using EEG is identifying and selecting the most reliable features from EEG signals [1].
Over the last decade, it has been shown that deep learning techniques could be used to solve the problem of feature identification and selection. Thus, they have become very popular in several application domains such as computer vision, automatic speech recognition, natural language processing, and bioinformatics where they produce state-of-the-art results on various tasks [2]. Therefore, there has been also some progress investigating the application of deep learning in non-invasive brain machine interfaces research [3].
Consequently, the student shall give an overview of the use of deep learning techniques/algorithms in the field of BMI. Furthermore, he must provide a comparison between deep learning and classical techniques used in BMIs and present the advantages and limitations of each technique.

Tasks:

This seminar requires the student to:

- Familiarize with scientific literature and research papers
- Present the state of the art of the use of deep learning techniques to decode EEG signals
- Compare between deep learning techniques and standard machine learning techniques in BMIs
- Write down the results in a scientific report
- Present the results of the scientific seminar in oral form

Bibliography:

[1] L. Jingwei, C. Yin and Z. Weidong, "Deep learning EEG response representation for brain computer interface," *2015 34th Chinese Control Conference (CCC)*, Hangzhou, 2015, pp. 3518-3523. doi: 10.1109/ChiCC.2015.7260182
[2] Vernon J. Lawhern, Amelia J. Solon, Nicholas R. Waytowich, Stephen M. Gordon, Chou P. Hung, and Brent J. Lance, "EEGNet: A Compact Convolutional Network for EEG-based Brain-Computer Interfaces", arXiv preprint arXiv:1611.08024, 2016
[3] N. Lu; T. Li; X. Ren; H. Miao, "A Deep Learning Scheme for Motor Imagery Classification based on Restricted Boltzmann Machines," in IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. PP, no.99, pp.1-1. doi: 10.1109/TNSRE.2016.2601240

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