Motor Imagery Classification Using Convolutional Neural Networks (CNNs)

Olawunmi GEORGE 1, Sarthak DABAS 1, Abdur SIKDER 1, Sheikh Iqbal AHAMED 1, Roger SMITH 2, Praveen MADIRAJU 1, Nasim YAHYASOLTANI 1

1. Marquette University, 2. University of Wisconsin-Milwaukee

INTRODUCTION

- EEG-based Brain-Computer Interfaces (BCI) enhance communication between computers and humans [1].
- They can be used in gaming systems and vehicles.
- Imagined activities elicit similar neuronal mechanisms as actual action [2].
- Sensorimotor cortex is the well-known site responsible for actual & imagined movements.
- Existing publicly available datasets can aid motor imagery analyses.

OBJECTIVE

To classify the imagined movements of users, given two classes of imagined tasks - left & right hand imaginations.

METHODOLOGY

- Data from 5 subjects were used from a publicly available dataset [3].
- Age range of all subjects: 18-33yrs.
- Trials lasted 7s, with 2s, 3s & 2s for the pre-cue time, imagination & intertrial rest period.
- Number of class trials between 100 & 120.
- 64-electrode 1010-based montage.
- 2s pre-cue period used for baseline correction.
- Segments of the data were rejected based on voltage amplitude & electromyographic (EMG) correlation.
- Subject-by-subject offline analyses was done.
- A convolutional neural network was used for the classification task.
- Periodograms of each trial were used as features in training the network.

SAMPLE PERIODOGRAMS

DISCUSSION

- Subject-specific accuracies varied, with highest accuracy achieved by the last subject.
- Lowest accuracy - 51%
- Highest accuracy - 69%
- Accuracies may depend on subjects’ ability to generate the necessary signals.
- Only one CNN architecture was utilized.
- Results can be improved by using other feature extraction techniques.
- Comparison with approaches not utilizing feature extraction techniques.

CONCLUSION

- Motor imagery activity can be classified using CNN architectures.
- Feature extraction techniques such as the periodogram and spectrograms extract frequency-specific information as features.
- Combinations of more than one technique should yield better results.

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CONTACT INFORMATION

Olawunmi GEORGE: olawunmi.george@marquette.edu
Sarthak DABAS: sarthak.dabas@marquette.edu
Abdur SIKDER: abdur.sikder@marquette.edu
Sheikh Iqbal AHAMED: sheikh.ahamed@marquette.edu
Roger SMITH: smithro@uwm.edu
Praveen MADIRAJU: praveen.madiraju@marquette.edu
Nasim YAHYASOLTANI: nasim.yahyasoltani@marquette.edu

REFERENCES