ISBN 978-1-9996465-0-9

BioMedEng18

Implementation and Evaluation of Different Time and Frequency Domain Feature Extraction Methods for a Two Class Motor Imagery BCI Applications: A Performance Comparison between GPU and CPU

J. Arnin[1], D. Kahani [1], B.A. Conway [1]

[1] *Centre of Excellence in Rehabilitation Engineering, Department of Biomedical Engineering, University of Strathclyde, Glasgow, G1 1QE, United Kingdom.*

Introduction

OpenCL platform is widely used in high-performance computing such as multicore CPUs, GPUs, or other accelerators [1] which employed heterogeneous computing concept resulting in execution acceleration. As the advantages of parallel computing, it has been applied to brain-computer interface (BCI) applications especially speeding up signal processing pipelines such as feature selection [2]. In this study, we used OpenCL to implement some feature extraction methods on a IEEE open-access dataset [3] which provides 2-class motor imagery EEG recordings.

Methods

Different feature extraction methods including template matching, statistical moments, selective bandpower and fast Fourier transform power spectrum were selected to evaluate their computational performance on both CPU and GPU using OpenCL. This study used an open-access dataset that contains data presenting a 2-class motor imagery tasks. The dataset used to compare the performance of proposed feature extraction approaches in terms of accuracy and computation time. The study processed following a standard signal processing pipeline including pre-processing for artifact rejection, feature extraction, and classification.

Results & Discussion

The preliminary results show that running feature extraction methods on GPU yields a computing speed up at least to five times compared to CPU. In addition, amending parameters of parallel computing such as the number of work-items or work-groups could reduce computing time more.

Conclusion

The complexity of the proposed algorithm can be assessed by the heterogeneous computing concept. Fine-tuning the parameters of parallel computing and system optimization could increase the performance.

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Acknowledgments

We gratefully acknowledge the support of Scottish Government Health Directorates and the Royal Thai Government scholarship. The authors do not have any conflicts of interest to declare.

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