Give a Hand: Designing and Developing a Neuroprosthetic Hand

Tan, Vanessa Yun Han

Tetraplegia is a state of paralysis involving the loss of muscle functions of all four limbs in the human body. There is currently no cure for such severe forms of paralysis, though neural prosthetic devices are able to present a favorable case for improving the quality of life of tetraplegic patients. However, current state-of-the-art neural prosthetic devices are often expensive and carry an element of surgical risk due to their invasive nature. Therefore, a possible alternative could be the use of neural prosthetic devices employing non-invasive Electroencephalogram-based Brain Computer Interface (EEG-BCI). Hence, the aim of this project is two-fold: first, to design and develop a prosthetic arm and second, to investigate the performance of a Motor Imagery (MI)-type EEG-BCI in the operation of the prosthetic arm. EEG data from one calibration run was used to create a mathematical model through the multi-class Filter Bank Common Spatial Pattern (FBCSP) algorithm to perform classification of three types of mental activities (MA) – Left Hand MI, Right Hand MI, and Idle State – tested over three evaluative runs. Preliminary results on two healthy subjects have shown that the FBCSP algorithm was able to distinguish between the three classes of MA with an accuracy of 92.50% and 80.34% for subjects 1 and 2 respectively. Further evaluative runs of experimentation revealed that the algorithm was able to classify between the three classes of MA with an accuracy of 83.81% and 77.50% on cue-based feedback and 52.04% and 69.17% when coupled with the prosthetic arm for subjects 1 and 2 respectively. Therefore, our study indicates that the use of non-invasive EEG-BCI to develop cheaper and safer neural prosthetic devices is a viable option.

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