BSc/MSc-project

Title: **BCI controlled FES system for complete neurorehabilitation of post-stroke patients**

Description:

Brain Computer Interface (BCI) systems directly uses the brain signals (EEG – electroencephalogram) to allow the users to operate the environment without any muscular activation [1]. They are interactive devices in order to communicate between the brain and an external device (computer/machine). BCI translates the EEG signals into comprehensive commands which are necessary to run an external machine or video game interface. It is an assistive technology and has been used in a wide variety of physical and mental disorders. Due to the bidirectional interaction between the brain and the computer, BCI can also be used to alter the brain functions. This makes them suitable for neuro-rehabilitation applications since they exploit the neural plasticity in their functioning [2-4]. BCI technology has been used to help the stroke survivors basically in two different ways: (i) It is used to substitute for the loss of neuromuscular functions by using the brain signals of the stroke survivor to interact with the environment instead of using their impaired muscles (eg., controlling a computer cursor or a limb orthosis for word processing and accessing Internet etc.), and (ii) BCI as a method for stroke rehabilitation to restore the impaired motor functions. Functional electric stimulator (FES) uses electrical currents to activate nerves innervating extremities affected by paralysis.

A BCI controlled FES system is proposed as a complete neuro-rehabilitation tool for post-stroke patients to regain fine motor skills in the fingers. An inexpensive portable neuro-rehabilitating training system (Figure 1) is envisioned which can potentially cause neural plasticity and improvement in the motor skills. The method will be based on controlling a FES device attached on the affected arm, using the EEG signals of the patients.

The project includes understanding the different BCI systems, EEG signals and their characteristics, design of appropriate interface paradigms, choice of appropriate signal processing algorithms for the feature extraction and classification, getting acquainted with its implementation in Matlab and its performance evaluation.

[1]. H.Dose, J.S.Møller, H.K.Iversen, S.Puthusserypady, “An end-to-end deep learning approach to MI-EEG signal classification”, Expert Systems With Applications, 115 (2018) 532-542.

[2]. Wolpaw, JR, N. Birbaumer, D. J. McFarland, G. Pfurtscheller, and T. M. Vaughan, ”Brain-computer interface for communication and control”, *Clinical Neurophysiology*, vol. 113, no. 6, pp. 767-791, 2002.

[3]. Dobkin, B.H., (2007), “BCI technology as a tool to augment plasticity and outcomes for neurological rehabilitation”, *The Jl. Of Physiology*, 579, 637-642.

[4]. Allison BZ, Brunner C, Kaiser V, Müller-Putz GR, Neuper C, Pfurtscheller G. (2010), “Toward a hybrid brain-computer interface based on imagined movement and visual attention”, *J Neural Eng.* 7(2):26007. Epub 2010 Mar 23.

Prerequisites: Knowledge in signal processing, programming skills and experience with MATLAB

Responsible institution: DTU Elektro

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Allowed no of students per project: 1-2
The project description may be published on the website (yes/no): Yes

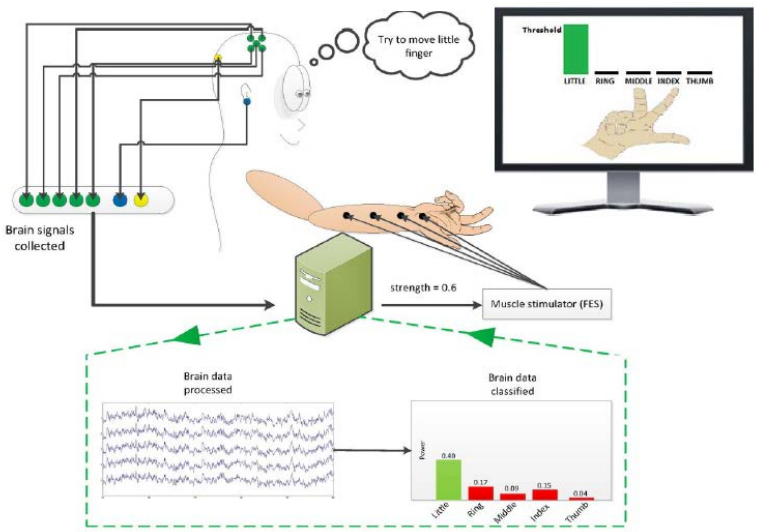

Figure 1: Illustration of the BCI-FES system for neurorehabilitation