Postdoctoral position: Adaptive Brain-Motor Mapping

Neuroprosthetics is an interdisciplinary field related to neuroscience, bioelectronics and biomedical engineering, which aims to substitute a motor, sensory or cognitive function that might have been damaged as a result of an injury or a disease. One of the challenging issues in motor prosthesis is the large variety of patient situations depending on the type of neurological disorder. To overcome the current limited performance of such systems, a robust bio-signal processing and a model-based control taking about the actual sensory motor state with biosignal feedback would bring a break-through and allow to progress toward adaptive neuroprosthesis.

Recent advances of Brain-Computer-Interfaces (BCI) have opened a new communication channel for patients, who can transmit their movement intention via brain signals.

The functionality and controllability of motor prosthesis can be further improved by taking advantage of computational mapping between EMG (Electromyography) of muscle, EEG (Electroencephalography) of brain, and other modalities of biofeedback information.

The first objective is to enhance the classification algorithm to extract the subject’s motor intention from EEG signal in motor-imagery based BCI. The computational modeling between multichannel EMG and EEG will involve advanced feature extraction, dimension reduction and classification algorithms. Moreover EMG signals of multiple muscles and muscle modeling including skeletal dynamics models will help in obtaining the detailed motion intention of the subject.

The second objective is to develop a bilateral learning architecture. In BCI, adaptive decoding of EEG signals is desirable because brain signals change over time during the learning of the task. In motor control, it is also known that we change how we use our joints and a way to deal
with redundancy problems in articulation. In EMG analysis, the change of motor usage can be captured. Adaptive modeling of EMG allows the evaluation of skill acquisition.

By jointly analyzing both the EEG and EMG modifications, we investigate how EEG signal may change along with actual motor coordination changes. By modeling both of these adaptive features, this framework will try to capture the bilateral learning architecture of both the brain and the motor system.

Required skills: A strong background in signal processing, control, and machine learning is required. Fluency in English, and excellent programming skills (C++ and Matlab) are necessary.

To start from Sep/Oct 2014, for 1-2 years.

To apply for this position, please contact

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Demar team is working on the use of functional electrical stimulation both surface and implanted, to restore deficient functions. We have several open positions at post doc (2 years) and Phd (3 years) level in the field of Peripheral nerve stimulation and recording. We are looking for highly motivated students / researchers who may apply with at least one of the following main competencies:
- neuroelectrophysiology (nerve stimulation principles, ENG signal)
- biosignal processing (ENG and / or EMG, numeric filtering, time frequency analysis)
- modeling and identification algorithms (HH model, FEM methods, optimization methods)

It would be valuable that applicants have competencies in some of the following tools:
- Matlab, Labview
- Basics in programming to develop simple custom interfaces for experimental setups (whatever the language C / C++ / Java)
- Use of FEM / BEM software : OpenMEEG, Comsol

English is mandatory. 3 positions are available and students may be able to travel through Europe for the one linked to the European project Epione managed by Aalborg University.

The laboratory is located in south of France close to the mediterranean seaside in the lively city of Montpellier

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