**Title (tentative):** Machine learning methods for reliable typewriting using a brain-machine interface based on error-related EEG potentials

**Thesis advisor(s):** Casadio Maura, Sergio Martinoia (DIBRIS)

**E-mail:** Maura.Casadio@unige.it

**Address:** Via Opera Pia 13, 16145 Genova (ITALY)

**Phone:** (+39) 010353 - 2749

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**Description**

**Motivation and application domain**

Brain computer interface systems can provide a communication channel to users with severe motor disabilities. Chavarriaga et al., (2016) developed a communication interface based on multimodal signals that allows users to communicate based on the decoding of error-related EEG activity. This thesis project aims at improving the current implementation of the system integrating machine learning algorithms that can increase both the speed and reliability of the interface.

**General objectives and main activities**

The general objective is to implement methods that use inferences from the language model to provide means for online adaptation of the ErrP decoders. Evaluation of real-time operation of the spelling application will be performed on healthy participants over multiple sessions to assess the stability of the system across days. If time provides, evaluation with a potential end-user with motor disability will be also performed. Specifically the student will be in charge of:

- Perform experiments of closed-loop BCI operation to characterize the ErrP signals and evaluate their decoding during online operation.
- Improve the current language model used by the speller to allow (i) prediction of words based on the ErrP decoding of previous characters, and (ii) autocorrection of written words
- Implement algorithms that allow backtracking the written characters in order to re-train the ErrP decoder in a non-supervised manner during online operation.

**Training Objectives (technical/analytical tools, experimental methodologies)**

The student will learn:

- To perform experiments of closed-loop BCI operation to characterize the ErrP signals and evaluate their decoding during online operation.
- To analyze the error-related EEG potentials with respect to the characteristics of the task
- To improve the knowledge of Matlab, statistical analysis, machine learning and reinforcement learning algorithms.

**Place(s) where the thesis work will be carried out:** DIBRIS & Campus Biotech di Ginevra, nel CNBI lab dell'EPFL.

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**Additional information**

**Maximum number of students:** 1