# BRAIN COMPUTER INTERFACE FOR SPELLING AND WRITING

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A brain-computer interface (BCI) is a man-to-machine communication channel operating solely on brain signatures of voluntary commands independent from muscolar output. Thus, a person can write messages using a virtual keyboard on a computer screen and also browse the internet without producing any movement. Alternatively, subjects can operate simple computer games, and interact with educational software. The majority of brain signal that have been used as input signals for BCI to maintain or reinstall motor control are slow cortical potentials (SCP), sensorimotor rhythms (SMR), a combination of both and the P300 response of the visually or auditorily evoked potentials. Both SCI-BCI and the SMR-BCI require regulation of the brain response, whereas the P300-BCI requires the specific evoked potential to be present in the EEG.

Even if the number of laboratories dedicated to BCIs is rapidly growing, the shift from research to everyday life is still at a primordial level and a variety of pathological conditions of the nervous system still lack any BCI support.

In our laboratory we have recently started a new study aimed at developing mobile, low expensive and easy to use BCI strategies to assist disabled people in spelling and writing. In our intention, the system has to be reliable and fast enough as not to discourage the patient, who often uses BCI in the hospital but not at home. For this reason, we are focusing on SMR-BCI.

As a matter of fact, SMR or μ rhythm refers to 8-12 Hz EEG activity, that can be recorded in awake people over primary motor cortical areas, which decreases or desynchronizes with movement, or preparation or imagination of movement. Operant learning of SMR regulation is achieved through activation and deactivation of the central motor loops. To learn to modulate the power of SMR, subjects are presented with feedback, as cursor movements on a computer screen in one or more dimensions.

In a typical session, the subject wears an EEG cap with 8 to 12 electrodes over the cortical motor strip of each hemisphere and is asked to move/imagine to move different parts of his body in such a way as to change the related SMR activity differently under different electrodes. When at least three different foci are found on each side of the brain, the combined left/right activity is used to identify one of a 3 x 3 grid of symbols or letters on a computer screen. By using binary logic and combining the activity from different parts of the body, the grid can be increased up to a 7 x 7 matrix, which is enough to contain all the letters of the alphabet.