Towards a Brain-Controlled Wheelchair by discrimination of two mental states

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Recently, BCI research has been targeted at the rehabilitation of motor-disabled individuals because it helps to establish a communication and control channel for them. This new channel could be used to restore motor functions or to provide them with mobility using a BCI controlled motorized wheelchair.

One of the most important limitations of these systems is to guarantee that a person can, through his mental activity, safely control the variety of navigation commands that provide control of the wheelchair: advance, turn, move back, and stop. The vast majority of the mobile robot navigation applications that are controlled via a BCI demand that the user performs as many different mental tasks as there are different control commands. Having a higher number of commands makes it easier for the subjects to navigate through the environment, since they have more choices to move. However, despite this is an intuitive solution, the classification accuracy of such systems gets worse as the number of mental tasks to identify increases. Some studies proved that the best classification accuracy is achieved when only two classes are discriminated

In order to enable an effective and autonomous wheelchair navigation with a BCI system without worsening user performance, our group proposed and later developed a new paradigm based on the discrimination of only two classes (one active mental task versus any other mental activity), which enabled the selection of four commands: move forwards, turn right, move backward and turn left. In its final version, this BCI system informs the user of the available navigation command at every moment with auditory cues. The main objective of this work is to test the usability of the proposed paradigm to control a wheelchair (see figure) trough the discrimination of two different mental tasks. The obtained results from a sample of three healthy naïve participants suggest that it is an effective option to freely control a wheelchair.

Figure: Robotic wheelchair controlled by the BCI system

Acknowledgements. This work was partially supported by the Spanish Ministry of Science and Innovation, project TEC 2011-26395, the European fund ERDF and by The “Universidad de Málaga. Campus de Excelencia Internacional Andalucía Tech”.