CO30-002-e

Motor neuroprostheses: Basic principles and applications
C. Jouffrais
CNRS – UMR 5505, institut de recherche en informatique de toulouse (IRIT), 118, route de Narbonne, 31062 Toulouse, France
E-mail address: jouffrais@irit.fr

Keywords: BCI; Invasive; Microelectrodes; Motor control; Severe disability

Since the late 1960s, behavioural neurophysiology has been focusing on understanding the organization of the primate motor system, as well as to decode some of the neural code enabling voluntary movements. After a brief review of the cortical areas involved in the control of voluntary movement and especially in the control of hand movement directed towards a visual target, I will describe the coding theory of motion by neural populations. I then explain how these fundamental developments on the coding of the movement were the basis of a series of recent work on motor neuroprostheses. The results of recent years show that it is possible for a patient with severe disabilities (quadriplegia after cervical spinal cord damage, for example) to control by thought various technical aids such as a robot arm, a computer cursor, a wheelchair or other devices.

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Electric wheelchair navigation using virtual reality: From intention to action
P. Abellard
Service d'handibio, IUT Toulouse, université du Sud-Toulon-Var, avenue de l'Université, BP 20132, 83957 La Garde cedex, France
Adresse e-mail : abellard@univ-tln.fr

Keywords: Electric wheelchair; Simulator; Virtual reality; Assistance; Rehabilitation

Objective.– The ISIDORE simulator for electric wheelchair mobility has been developed with a triple aim: to help the doctors give out a driving license for operating an electric wheelchair, to place the patient in a virtual environment in order to move about safely and to be able to observe both the patient’s behavior and to quantify important parameters to help the therapist develop actions of rehabilitation.

Material and method.– ISIDORE is a platform, which can be used with any electric wheelchair available on the market. It has a microcomputer, which can collect and process data from the movements of the wheels. To assess their performance moving around in a virtual environment (VIRTUOLS) will be used with an IMMSAPOD station. Then the patient will be able to move freely in a familiar environment (hospital, rehabilitation center, foyer for the disabled or a private home) and his or her trajectory will be compared to an optimized one. Then, studying the discrepancies will help set up or upgrade a number of additional (visual, sound…) devices to provide a better accessibility.

Results.– The patient can use three different steering modes: a manual mode with total control; an automatic mode where the wheelchair behaves like a mobile robot going from a starting point to a given target and a semi-automatic mode where the user only has to rely on the wheelchair when facing awkward positions (blocked passages, going through doors or obstacles to be avoided).

Discussion.– The piloting assistance can exploit the inference of intentions: the preliminary intention (for the mental representation of what the user wants to do; the intention in action for the supervision of the action process at a macroscopic level and the driving intention for the control of the action in progress. It will then become possible to improve the assistance thanks to a database of fuzzy logic rules using the data from different sensors (angles and speed of lever command movements, head and eyes movements and so on).

Further reading

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Rapid development of assistive technologies for quadriplegics
P. Truillet*, P. Raynal, C. Jouffrais
Institut de recherche en informatique de Toulouse (IRIT); université Paul-Sabatier, 118, route de Narbonne, 31062 Toulouse cedex 9, France
*Corresponding author.
E-mail address: truillet@irit.fr

Keywords: Disability; Human machine interface; Technical aids

Technical aids enable many quadriplegics to perform tasks they could not do otherwise: read their emails, change TV channel, etc. According to Laffont (2008), the ability to control its environment is crucial to the quality of rehabilitation, and family. Other works (Pino, 2000; Verdonck, 2009) studied the significance of the uses of assistive technologies by persons with tetraplegia. Five major categories were identified as: autonomy, freedom, security, time for oneself and relationships with others.

This work suggests that these aids should be seen as a "fundamental human right" and reaffirm the need to work with users. Nevertheless, there is a large proportion of technical aids on the market is little or no use. This low acceptance rate is due to several reasons summarized by Philips (1993) and Scherer (1996): lack of attention in the selection of aid, difficulty in obtaining aid, performance and change needs of the patient.