Motor neuroprostheses: Basic principles and applications

C. Jouvrais
CNRS – UMR5505, institut de recherche en informatique de toulouse (IRIT), 118, route de Narbonne, 31062 Toulouse, France
E-mail address: jouvrais@irit.fr.

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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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Rapid development of assistive technologies for quadriplegics

P. Truillet *, P. Raynal, C. Jouvrais
Institut de recherche en informatique de Toulouse (IRIT); université Paul-Sabatier, 118, route de Narbonne, 31062 Toulouse cedex 9, France
E-mail address: truillet@irit.fr.

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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.

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