MECHATRONICS BOOK SERIES

CONTROL AND INTELLIGENT SYSTEMS

Momoh Jimoh E. Salami
Abiodun Musa Aibinu
Yasir Mohd Mustafah

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EDITOR

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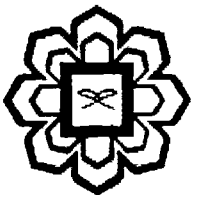

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Tel +6**03-6188 1542 / 44 / 45** Fax: +6**03-6188 1543**
EMAIL: iiumprinting@yahoo.com

Table of Content

Chapter 20
EEG based robot control

A. Khorshidtalab and M. J. E. Salami

Department of Mechatronics Engineering,
International Islamic University Malaysia, Gombak, Malaysia
aida.khorshid@student.iium.edu.my; momoh@iiu.edu.my

20.1 Introduction

Almost 5,600 people in the U.S.A are diagnosed with Amyotrophic lateral sclerosis (ALS) each year. It is also estimated that at any time, near 30,000 American may have the disease. Anyone can be diagnosed for ALS regardless of his race, ethnic or any of his especial activities [1]. More than 25,000 people bear severe paralysis in U.S.A; also, as a result of accident or disease, millions of people worldwide suffer from a severe loss of motor function [2].

Brain–Machine Interface (BMI) is a direct communication between brain and an external device. The external device can be a robot for assisting purposes, in this case, it is called brain controlled robot. Also the device can be a computer for communication or entertainment purposes which is called Brain-Computer Interface (BCI).

Brain controlled robot is the only option for totally locked-in patients as these patients have virtually minimal voluntary muscle functions like eye or eyelid movement or facial muscle control. Most interfaces such as hand joysticks or gaze tracking need some muscles control by them to express themselves or achieve their desires. Paralyzed people depend on others due to limited effectiveness of technologies and requirement of muscles control for communication via computers or controlling devices such as wheelchair.

Brain controlled robot, often refers to Brain-Machine Interface, tends to be a promising way for individual to control devices with signals measured from their brain [2]. Considering the fact that motor behavior is not only about movements, it is also about interaction with challenging environment. Therefore, the desired device should be controlled wisely and consciously, which can be done in a reliable way with Brain Controlled Robot; as in this situation, command is from the human's brain.

This chapter is organized as follows. First, it reviews some existing BMI/BCI systems and discusses about EEG acquisition approach. The section after discusses about EEG analysis which includes recording techniques, feature extraction, and classification methods. Section V presents result and discussion, and eventually, section VI is conclusion.

20.2 EEG Acquisition

One of the major goals of research in BMI area is to find advanced communication interface that allow individuals to control devices such as a machine, robot, or computer with signals measured from brain. This interface increases the level of independency of locked–in patient, improves quality of life, and reduces social costs [2].

An activity in a normal human brain can generate various responses including electrical, magnetic, and metabolic responses. Appropriate sensors can detect these signals and they can be applied to control BMI systems. BMIs recording can be noninvasive or invasive. Noninvasive BMIs are the user's intent from brain activity recorded from scalp. While, invasive BMIs are the user's intent from neuronal action potentials or local field potentials recorded within the brain which are studied mainly in nonhuman subjects like rats and monkeys [3-11].