Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 84 (2016) 147 – 151

Procedia Computer Science

7th International conference on Intelligent Human Computer Interaction, IHCI 2015

# Trajectory path planning of EEG controlled robotic arm using GA

Rinku Roy[a], M. Mahadevappa[b]*, C.S.Kumar[c]

[a]Advanced Technology and development centre, Indian Institute of Technology Kharagpur, India
[b]School of Medical Science and Technology, Indian Institute of Technology Kharagpur, India
[c]Department of Mechanical Engineering, Indian Institute of Technology Kharagpur, India

**Abstract**

Brain- Computer Interface (BCI) is used to control a system through which people with motor disabilities could achieve a better quality of life by improving their interaction ability with the surrounding environment. Using BCI, patients suffering from severe motor disabilities can also control variety of applications by generating control commands using their own EEG signals. There are many assistive devices are available to reduce the personal, social, and economic burdens of their disabilities and improve their independence but many of these individuals do not have the normal neuromuscular pathway for using their hands to control an assistive device. Hence, EEG could be used to control artificial arm which can help those people to interact with their physical environment and carry out their activity of daily living. In this paper, a genetic algorithm is proposed for trajectory planning of an EEG controlled robotic arm. EEG data for motor imagery were captured from five healthy subjects and left-right hand movement was classified using Support Vector Machine classifier (SVM) with the feature used as Power feature co-efficient and wavelet co-efficient. EEG processing and GA algorithm was developed using Matlab.

Peer-review under responsibility of the Organizing Committee of IHCI 2015

*Keywords:* Brain-computer interface (BCI); Motor imagination (MI); Electroencephalography (EEG); Wavelet coefficients; Support Vector Machine (SVM); Genetic Algorithm (GA)

## 1. Introduction

Due to several neuromuscular disorders people can lose their normal neuromuscular pathway through which brain communicates with their external environment. Brain Computer Interface (BCI) is a controlling technique between human and computer through which motor-disabled persons are able to communicate with their surroundings[1]. BCI records signals directly from the brain and converts them into commands for controlling a device. With combination of a neuro-prosthesis, BCI can be used to replace the lost motor functions with artificially

* Corresponding author. Tel.: +91-3222-282300
*E-mail address:mmaha2@smst.iitkgp.ernet.in*


Peer-review under responsibility of the Organizing Committee of IHCI 2015
doi:10.1016/j.procs.2016.04.080

generated controlled signals. Ideally, a person suffering with motor disabilities can imagine a certain movement which is generally executed instantly by BCI system. The BCI system is used to decode the movement imagination (MI) from the brain signal and a neuro-prosthesis is used to produce the movement.

In this paper, EEG signals for left-right arm movement imagination were captured from motor cortex area of the subjects. Power feature co-efficient and wavelet co-efficient were extracted as feature from the acquired EEG signal. Features for the movement imagination are then classified to generate control signal using Support vector machine (SVM) classifier. Genetic algorithm (GA) was used for path planning and to reach the object position. 3 Degree of freedom (DOF) of the human hand was used for all forward and inverse kinematics calculation. Overall process of the experiment is described in Fig. 1.

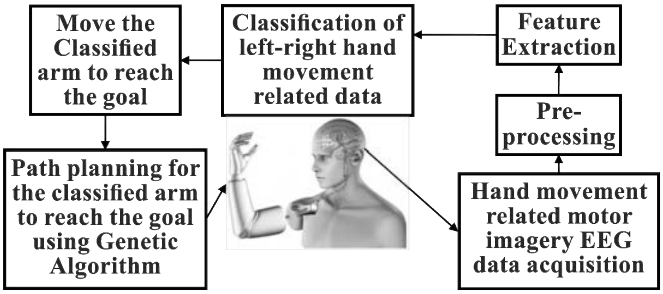


Fig. 1. Overall process of trajectory planning for EEG controlled arm using GA

## 2. Methods

### *2.1 Subjects & EEG recording*

Five healthy right-handed subjects (4 male and 1 female, mean age: 25 years) participated in this experiment. Before this experiment, none of the subjects were informed about the experimental procedure. C3, C4 and Cz (Fig. 2) electrodes were selected for this experiment as they are nearest to the various motor areas from the scalp. The EEG data were captured using FlexComp Infiniti System (Thought Technology Inc., Canada) with the sampling frequency of 256 Hz.

### *2.2 Experimental paradigm*

During experiment, Subjects were seated comfortably in an arm chair in front of a computer screen in which visual cues were shown. They were trained with actual hand movement for 20 trials. After completion of the training procedure, the subjects were instructed to think about their left or right hand movement as per displaying cues.

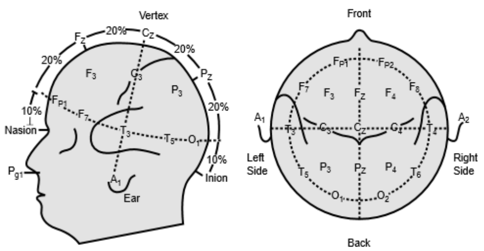


Fig. 2. Electrode position based on 10/20 system

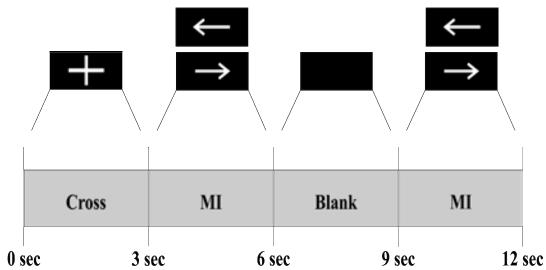


Fig. 3. Timing details for the visual stimulus

In the instruction set, one cue contains an arrow pointing to the right, indicating right hand motor imagery (MI), other is pointing left, indicating left hand movement imagination. Between each two successive motor imagination task, there was a blank cue was included in the instruction set. At that time subject sit in the resting position, he