

Brain Computer Interface with Genetic Algorithm

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ABSTRACT

Brain Computer Interfaces (BCIs) measure brain signals of brain activity intentionally and unintentionally induced by the user, and thus provide a promising communication channel that does not depend on the brain's normal output pathway consisting of peripheral nerves and muscles. Present-day Brain Computer Interfaces determine the intent of the user from a variety of different electrophysiological signals. They translate these signals in real-time commands that operate a computer display or other device. Successful operation requires that the user encode commands in these signals and that the BCI derive the commands from the signals. Thus, the user and the BCI system need to adapt to each other both initially and continually so as to ensure stable performance. Current BCIs have low information transfer rates (e.g. up to 10–25 bits/min). This is limited capacity for many possible applications of BCI technology, such as neuroprosthesis control, this device require higher information transfer rates. In non-invasive BCI, Signals from the brain are acquired by channels (i.e. electrodes) on the scalp. In new BCI systems for increase accuracy, increased number of electrodes. In this case the increased number of electrodes causes a non-linear increase in computational complexity (i.e. decrease transfer rate). This article used Genetic Algorithm for select the effective number of electrodes and Redundancy Reduction.

Keywords: Brain Computer Interfaces, Redundancy Reduction, Genetic Algorithm, artifact

1. INTRODUCTION

For many years people have speculated that electroencephalographic activity or other electrophysiological measures of brain function might provide a new non-muscular channel for sending messages and commands to the external world – a brain-computer interface (BCI) [1]. A BCI allows a person to communicate with or control the external world without using the brain's normal output pathways of peripheral nerves and muscles. Messages and commands are expressed not by muscle contractions but rather by electrophysiological phenomena such as evoked or spontaneous EEG features (e.g. SCPs, P300, mu/beta rhythms) or cortical neuronal activity [2]. BCI operation depends on the interaction of two adaptive controllers, the user, who must maintain close correlation between his or her intent and these phenomena, and the BCI, which must translate the phenomena into device commands that accomplish the user's intent [3].

Present-day BCIs have maximum information transfer rates ≤ 25 bits/min. With this capacity, they can provide basic communication and control functions (e.g. environmental controls, simple word processing) to those with the most severe neuromuscular disabilities, such as those locked in by late-stage ALS or brainstem stroke. They might also control a neuroprosthesis that provides hand grasp to those with mid-level cervical spinal cord injuries. More complex applications useful to a larger population of users depend on achievement of greater speed and accuracy, that is, higher information transfer rates [4].

Future progress hinges on attention to a number of crucial factors. These include: recognition that BCI development is an interdisciplinary problem, involving neurobiology, psychology, engineering, mathematics, computer science, and clinical rehabilitation; identification of the signal features, whether evoked potentials, spontaneous rhythms, or neuronal firing rates, that users are best able to control; the extent to which this control can be independent of activity in conventional motor output and sensory input channels; the extent to which this control depends on normal brain function; identification of the best feature extraction methods and the best algorithms for translating these features into device control commands; development of methods for maximizing each user's control of these signal features; attention to the identification and elimination of artifacts such as EMG and EOG activity; adoption of precise and objective procedures for evaluating BCI performance; recognition of the need for long-term as well as short-term assessment of performance; identification of appropriate applications; proper matching of BCI applications and users; close attention to factors that determine user acceptance of augmentative technology; and emphasis on peer reviewed publications and appropriately conservative response to media attention. With adequate recognition and effective engagement of these issues, BCI systems could provide an important new communication and control option for those with disabilities that impair normal communication and control channels. They might also provide to those without disabilities a supplementary control channel or a control channel useful in special circumstances.

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