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The Application of EEG related

Shuli Huang^a, Huabo Xiao^b

^aFundamental Education Department Jiangxi Bluesy University Nanchang, Jiangxi Province, China

^bDepartment of Computer Science and Technology, Jiangxi Bluesy University, Jiangxi

Abstract

The development of information and electronic technology to promote the convergence of various disciplines, EEG evolved from biological information, combined with information technology, extend the application of many related, that many have about the application of EEG Mature, there are many applications of EEG are related to research, this paper related to the application of EEG summary.

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Key words: EEG, ERP, Frequency, Applications

1. Introduction

Since 1929, Hans Berger first recorded the mark to the evidence of brain activity - electroencephalogram (EEG) [1], people began to use EEG, brain activity analysis, the various applications for the EEG will Come into being, now, in the psychology, physiology, cognitive science, neuroscience, medicine and other life science related areas, very high, at the same time to help disabled people in rehabilitation and life to the BCI system has also been Put into operation, the paper related to the application of EEG sum, expectations help to peer .

2. About the Component of EEG

Some special stimulus produced EEG , overlapped it, there will be some special features, we call this type of event-related potential (ERP). Higher mental activity, such as the brain to make an objective assessment of cognitive processes, we can hardly be attributed to simple awareness or thinking a certain part of the brain tissue, cells, or neurotransmitters change, because only the use of specific, micro-molecules of natural scientific methods such as neural biology, neuroscience and biochemistry is difficult to address specific mental activity. Event-related potential (ERP) is a special kind of brain evoked

potentials, stimulation by deliberately giving a special psychological significance, the use of multiple or a variety of stimulating the brain caused by the potential. It reflects the cognitive processes of the brain nerve points in the physiological changes, also known as cognitive potential, that is, when people refer to cognitive processing of a subject, from head to record brain surface points. Major components, including the classic ERP P1, N1, P2, N2, P3, which is called the first three as exogenous, the latter two known as the derived materials. It is characterized by several components: first, the brain is not just a manifestation of physical activity alone, but also reflects some aspects of mental activity; Second, they must have a particular stimulus leads to the arrangements and the stimulation of two or more or to stimulate change.

Event-related potential (ERP) is a special kind of brain evoked potentials, evoked potentials (EPs), also known as evoked response (Evoked Response), is given to the nervous system (from the receptors to the cerebral cortex)-specific stimulus, or the brain stimulation (positive or negative) information processing, in the system and corresponding parts of the brain can be detected arising, and to stimulate a relatively fixed time intervals (lock relationship) and a specific phase of the bio-electric response .

classification have different kinds method to classify the evoked potentials, according to stimulate the channel is divided into auditory evoked potentials, visual evoked potential, somatosensory evoked potentials, etc.; according to the length of incubation period is divided into early latency evoked potentials, middle latency evoked potentials, late (L) and evoked potential latency slow. Practical clinical purposes, the evoked potential is divided into two categories: sensory or motor function and related exogenous stimuli related potential and cognitive function with an endogenous event-related potential (Event-Related Potentials, ERPs). Endogenous and exogenous event-related potential stimulus-related potential is significantly different. ERPs are based on the attention, and recognition, comparison, judgments, memories, decisions and other mental activities, reflecting the different aspects of cognitive processes, is to understand the activities of cognitive functions "window." ERPs components, including the classic P1, N1, P2, N2, P3 (P300), of which P1, N1, P2 for the exogenous ERPs (physiological) component, by the physical properties of stimuli; N2, P3 for the endogenous ERPs of (psychological) component, not the physical characteristics of stimuli, and the subject's mental state and focus on. ERPs are now widening the scope of the concept, broadly speaking, ERPs also include the N4 (N400), the negative wave mismatch (Mismatch Negativity, MMN), with negative reaction (Contingent Negative Variation, CNV) and so on.

Most ERP-related applications in clinical medicine-related, such as dementia, epilepsy, testing and application of vegetable wake-up detection, detection of the polygraph, are using components of ERPs related applications.

3. On EEG frequency domain analysis application

Many studies indicate that different EEG frequency bands, representing the corresponding activities of the brain, this stage are divided into the following EEG frequency bands:

σ Band (1-4 Hz) reflects sleep, relaxation and fatigue.

θ Band (4-8 Hz) reflects the excitement and shock.

α Band (8-14 Hz) reflects the calm of the brain work.

β Band (14-30 Hz) reflects the concentrated work of a busy brain.

In the analysis of EEG frequency bands, applications are generally divided into two types, one is the direct use of the different EEG frequency bands, in the research, such as the AR model using wavelet analysis and other methods will be able to extract the signals of different frequency bands of EEG The purpose of the signal, currently in medical applications, there are many successful cases. Such as band, physically, in the θ wave state, the physical and mental recovery was fastest. Psychologically, this is the best to eliminate the mental stress suffered during the day. "BIOPIT" EEG into the static import apparatus, by recording the information in this band, when the user to a certain proportion θ of arrival, automatically

send a special signal to inform users, remain in this state; use "BIOPIT" pyramid-type instrument with two training in the Department of α wave recorder for learning, the training induced a tape recorder into the static broadcast music, another tape recorder is started in the α wave generator such as foreign language or special programs broadcast by state in the α wave easy access to the subconscious level of short-term memory the formation of permanent memory; by strengthening the sensorimotor rhythm (SMR wave) and inhibition of 4-7HZ the slow improvement of attention, impulsivity, mild hyperactivity, so as to achieve the treatment of ADHD has been fairly effective;

The other is through a method of training, continuous training enhance a band, this utilization, use the highest degree of attention is on the application, for example, the attention of the U.S. competition game, the game originated in 1992, American Airlines Space Administration (NASA). Different from traditional athletic events, to compete through the brain EEG. Participating parties need to be connected to the brain, EEG biofeedback device, through the attention of brain waves (SMR), to compete with rivals. The two sides can not be used to match the body operating model, we must use the brain's attention. In the U.S., the pilot and astronaut selection and training, often have to compete with the attention of thinking of ways to achieve. Reflects the quality of the brain, the brain is often the strength of radio attention. Attention to the strength of the particular frequency can be expressed by EEG. So competition is very important to focus attention on the quality of the examination a way.

the attention band of EEG after a simple extraction, was used in many recreational games, such as the attention of the United States xwave company head the ball, the game of neruosky company, etc., are used to the attention of EEG entertainment, Xi'an University of Electronic Science and Technology related to frequency of use of EEG, simple training, feature extraction, used in shooting games such as fish meal, there are impressive results.

4. Feature extraction and classification of EEG signal analysis application

When people see certain things, will have to possess certain characteristics of the EEG, so if the use of various analytical methods for analysis of such EEG, in which the corresponding features extracted and classified to be control the use of EEG to the purpose of the outside world.

Using EEG, with some auxiliary equipment, can directly signal the brain thinking activities to communicate with the outside world, to achieve "heart to heart" communication, even to the control of the surrounding environment, which is the brain-computer interface system. The so-called brain-computer interface, is a not rely on peripheral nerve and muscle tissues such as the brain is usually output channel communication system.

According to fit the human brain and machine level, BCI implanted into some non-implanted and implanted three. And some of them implanted implantable messengers have been due to the presence of the risk of injury, so BCI are often divided into two types of trauma and no trauma.

Research in the BCI system, the past few years, each research team has made great achievements. In 2000, Pfurtscheller et al describes a self-thinking with the brain control cursor movement experiments. E. Donchin, who built a character using P300 input system. In addition, people use steady-state visual evoked potential (SSVEP) realized on the screen menu options. In 2002, Tsinghua University Professor Gao Shangkai, who developed a dial-up achieved using SSVEP experimental system, in 2003 they achieved such as the use of BCI on the lights, television, telephone and other indoor environmental control. In 2006, Tsinghua University, the realization of successful control of the robot dog to play with the EEG; 2007 at the International Conference on Orga Techno 2007, showed a video tennis game using the brain.

In these studies, through a training program to keep the increase to stimulate reflection on such subjects, so that these EEG features are enhanced, and then smooth out the feature extraction is the key.

For EEG feature extraction and classification methods, in order to improve the accuracy of the algorithm used in many algorithms used are not generally divided into two stages, first feature extraction stage, the main algorithm in the following areas:

- (1) the characteristics of time-domain signal extraction: including Fourier transform, wavelet transform, autoregressive model, a specific band filtering, Kalman filtering;
- (2) the spatial domain feature extraction include: Laplace transform, principal component analysis, independent component analysis;
- (3), - spatial domain feature extraction: including time - spatial domain component analysis, multivariate autoregressive models;
- (4) feature extraction transformation model: including EEG into brain ECoG, EEG dipole source such conversion.

Second, the classification stage, mainly the following algorithm:

- (1) linear Category: including linear discriminant classification, perceptron classification, etc.;
- (2) nonlinear classification: There are support vector machines, partial least squares, neural networks.

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