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Human Fine Motion Analysis Using Biological Signals

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Abstract— In the field of the interface research, confusion had been discussed since before. However, the research that focused on link of interface and confusion motion is very little. In contrast, in the field of the cognitive research, a lot of study about confusion is researching as a popular theme since before. These studies use video camera or motion capture system as a method to observation and analysis of confusion [1].

Consequently, in the study, we acquire and analyze confusion seen from aspect of the field of cognitive research, and we have aimed to create some application at the interface. In this regard, in the field of the cognitive research use very large-scale system for observe to confusion motion. So, it is difficult to application to interface. For the reason, we experiment on surface Electromyogram. Surface Electromyogram (EMG) is researched new interface and can observe change in muscle force or fine motion for observe of confusion motion. In the result, we were able to confirm some tendency of the EMG in people puzzled.

Keywords-confusion; surface Electromyogram; biological signal; interface; orbital change

I. INTRODUCTION

In the field of the interface research, confusion had been discussed since before. When we make some interface, the interface in which confusion happened quite often has been question. However, the research that focused on link of interface and confusion motion is very little.

When someone use some interface, if they use the interface for the first time, they will be confused about the usage. So they think about usage from their past experiences because they did not understand the usage of the interface. Then, they often stopped their aim in the midair or dangled their aim in the midair.

So, in order to use such person's characteristic, we developed intuitive interface. The intuitive interface uses action and image in daily life. For example, actions that "wave my arm" or "bend my arm" and images that "button is able to push" or "arrow is able to move" are uses. These action and image are easy to understand to use interface, because we are able to image easily their motion from our past experiences. As a result, the development of intuitive interface make we could decrease confusion. Then a lot of interface became easy to use/

In fact, the intuitive interface has decreased confusion. However, the intuitive interface was able to decrease confusion though the intuitive interface was not able to erase confusion. In case of personal computer, a lot of young people can use easily personal computers because personal computers are used in a lot of place. But it is difficult for some people who have hardly used personal computers such as elderly people. In addition, people who have usually used personal computers make same mistake that the position of the button is changed. So, intuitive interface is inescapably-tied to confusion.

In the field of the cognitive research, a lot of studies about confusion are researching as a popular theme of confusion. But these studies are aimed to understand behavior psychology. So these studies do not think about interface.

In IRISHIMA's study [2], he researches those changes in functional activity with prediction during cycling exercise. In the study, he uses various biological signals. And he confirmed some tendency. However, his measuring system is very big size and heavy weight. So, it use for interface is difficult.

II. USE OF SURFACE ELECTROMYOGRAM

In this study, we use biological signal for observation of confusion. Especially, we use Electromyogram that generated when the muscle shrinks. There is some reason to use Electromyogram.

- Electromyogram is able to estimation of motion
- Electromyogram is able to acquirable change in power that does not acquirable the motion capture system and the video camera.
- Measuring system can downscale.
- Studies which use for an interface are researching.

First, when we do something motion, our muscle are shrinks. These motions are include a lot of information about direction and severity of power. So we acquire these information from Electromyogram, we are able to estimation of motion.

Secondly, for example, when we lift a ball on the desk by one hand, most people does the same motion for lift it. However, if the ball is very lightweight, we lift it little power, and if the ball is very heavy, we lift it big power. Motion capture system and video camera are not able to acquirable these change in power. In case of Electromyogram, if power is strong, it show big reaction, and if power is little, it show little reaction. That is why, Electromyogram is able to acquirable these change in power.

Thirdly, Electromyogram measuring system is smaller than motion capture system and video camera.

Fourth, studies which use for an interface are researching. For example, in the field of medical, myoelectric hand and power assist robot are developing.

In these reason we decide to use Electromyogram.

III. ASSUMPTION

First, we research the action when we were confusion. Therefore we dose an experiment that is popular in the field of cognitive research. It called coffee experiment [2] (figure.1). In coffee experiment, examinees make a cup of coffee, and we observe examinee action to use video camera. In the result, we confirm one tendency. When we are confusion, we do rapid motion change. For example, we change direction or speed of our arm.



Figure 1 Coffee experiment

Second, the agonist muscle and the antagonist muscle exist in the muscle. If the agonist muscle shrinks, antagonist muscle extends. We focus the relationship. If these two kinds of muscle affect each other, different tendency are confirm when we do rapid motion change. And we are able to understand some distinction to confirm these differences of Electromyogram when we are confusion.

That is why, we focus these tendency.

IV. EXPERIMENT

In this study, acquisition of Electromyogram is only by the arm. There are two reasons why we acquire only the arm.

- General interface operated by aim.
- Muscle of arm is large, and it is able to acquire Electromyogram with poise.

In these reasons, we decide to focus arm muscle, and we think two experiment.

First experiment use playing card. The purpose of this experiment is research of Electromyogram tendency when we confusion.

Second experiment uses two kinds of light. The purpose of this experiment is research of Electromyogram difference when we do rapid motion change or not.

A. Playing Card Experiment (figure.2)

The experiment environment of this experiment is as follows.

- Examinee: Two healthy adult males.
- Measuring point: seven point (latissimus dorsi muscle, cowl muscle, biceps, triceps, flexor carpi ulnaris muscle, flexor carpi radialis muscle, musculus brachioradialis)
- Playing Card: 30 sets of 20 piece ten pairs.
- Metronome time: 80 times per minute



Figure 2 Playing Card Experiment

The rule of this experiment is as follows.

- A) The examinee selects a card from a couple of two pieces card that the experimenter put out in accordance with rule (B) and (C).
- B) The examinee touches one with a large figure of the card.
- C) If two cards are same figure, the examinee touches between two cards

B. Rapid Motion Change Experiment (figure 3, figure 4).

The experiment environment of this experiment is as follows.

- Examinee: a healthy adult male.
- Measuring point: six points (biceps \times 2 points, triceps \times 4 points).
- It is single-unit as for ten times of bending and stretching.
- Stop own arm only the light lights \times 24, Stop own arm only the orange light lights \times 10.

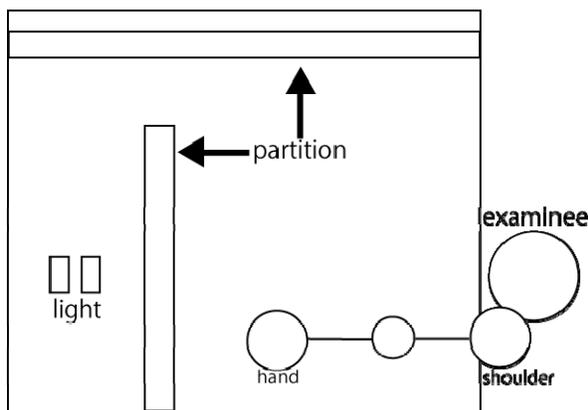


Figure 3 Rapid Motion Change Experiment

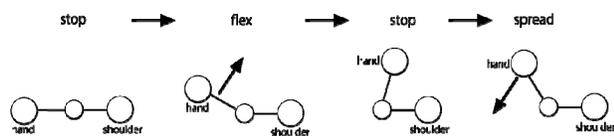


Figure 4 Rapid Motion Change Experiment flow

The rule of this experiment is as follows.

- A) Stop own arm only the light lights.
The examinee stops own arm only the red light lights in the middle of bending and stretching.
- B) Stop own arm only the orange light lights.
The examinee stops own arm only the orange light lights in the middle of bending and stretching.
The examinee do not stop own arm, If the red light lights.

V. CONCLUSION

A. Playing Card Experiment.

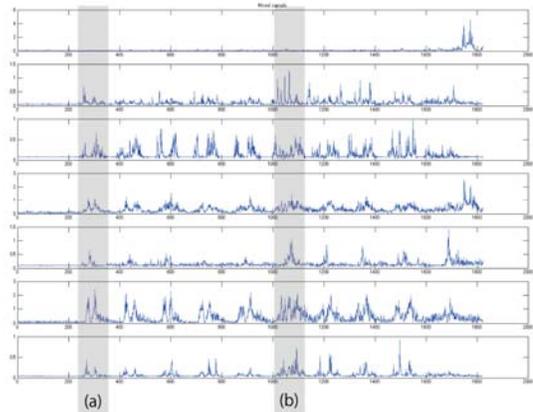


Figure 5 Playing Card Experiment result 1

The examinee selected collect card at (a). So, the signal shows two mountains. In case of (b), the examinee is confusion. So, the signal shows one mountain.

This tendency is confirm other signal of the experiment.

B. Rapid Motion Change Experiment.

If the examinee do rapid motion stop, the agonist muscle become remit, and the antagonist muscle become increase (figure 6).

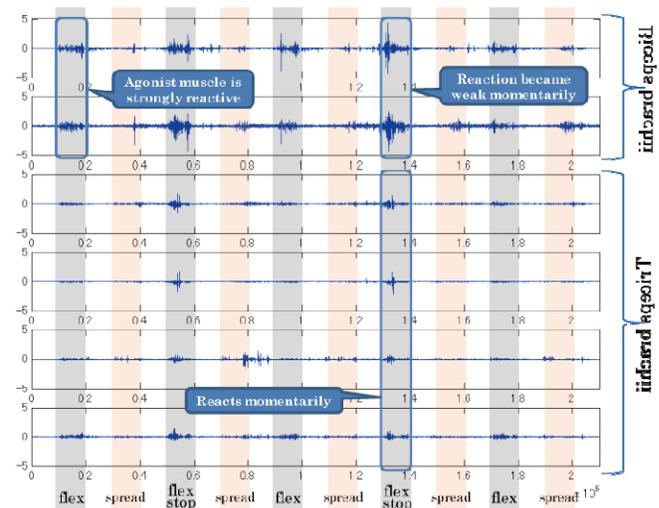


figure 6

This tendency is confirm other signal of the experiment. In addition, same tendency shows if the examinee did not know when the light lights (figure 7).

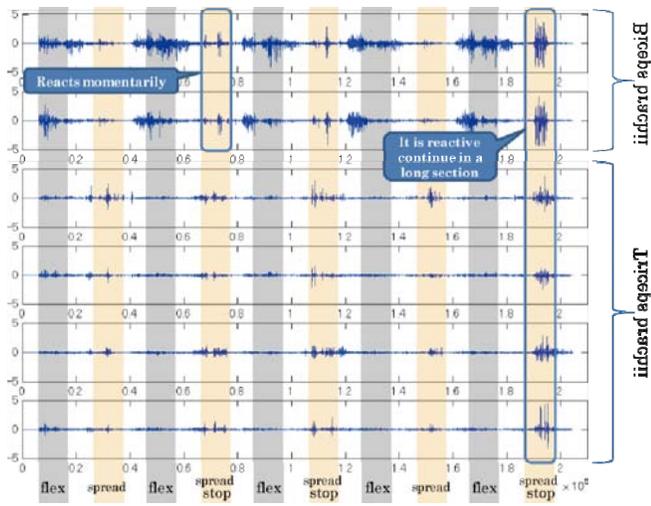


figure 7

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