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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The development of content-consistent motor imagery brain computer interface for controlling the artificial intelligence robot

The logic of the dissertation is start from the problem we meet, then the originality we proposed and the final goal we expect.

The problems in the current research

First of all, let's talk about the problems we would like to solve in the brain computer interface. Motor imagery is a special branch of the brain computer interface because it focuses on the analysis of the subjects when imagining the body movement instead of a real body movement. Through analyzing motor imagery brain activities, lots of external devices can be controlled. The state-of-the-art research obtains over 90% accuracy in the motor imagery classification of right hand, left hand, feet and tongue. It's because the movement mapped brain areas are different which means it's easy to classify. As a result, the controlling of the external device based on motor imagery classification tends to be indirect, not from a real and specific motion. For example, if we would like to control the robotic arm to move left, we should imagine the left-hand movement while we imagine the right-hand movement so that we can control the robotic arm to move right. These commands to robots are not mapped with the motor imagery of a specific movement. However, it's far from satisfying to control a robot which can implement complex tasks by such simple, rough and indirect commands. We desire a robotic system that can understand more commands from a real motor imagery motion such as griping, opening, rotation and others. Moreover, the current controlling strategy cannot meet the controlling demand when controlling two prosthesis limbs such as the right hand and left hand.

In addition, there's still another problem. Although the current motor imagery classification of left hand versus right hand obtains a high accuracy, the indirect controlling strategy requires the subjects to practice themselves in order to control the robotic system. Even more, some subjects cannot control this kind of robot system though they have the practice. (the identification rate is about the chance level). As a result, we desire a content-consistent motor imagery to control the robot more directly.

On the other hand, the artificial intelligence techniques are developed rapidly these years. With the powerful sensors and processors, the robot equipped with AI algorithms has better and better performance. However, most robotic systems are served for specific industrial environments. As for

daily life, the performance of robots is not so stable. Besides, the robots can easily fail to implement the tasks when disturbed by the outside world. As a result, human intervention such as the command from brain computer interface is very important to help the robots. Therefore, we desire the motor imagery classification to be more specific so that the robotic controlling can be more natural and direct.

The originality of these study

Although the timing of grasping and rotation adjustment of hand posture are important to the robot controlling, the brain activity area of hand grasping and wrist rotation of the same hand are highly similar which means it's very challenging to distinguish the specific motor imagery motion. Besides, the robot tends to fail when planning the grasping motion without a suitable posture. It's essential to send the commands of grasping and rotation to the robot. As a result, I focus on the motor imagery classification of hand grasping and wrist rotation.

Moreover, the computer vision techniques help the robot to achieve great progress. While many of the current algorithms are still in the stage of a simulation environment, not a real scene. At the same time, in the condition of lacking depth information, robots have difficulty distinguishing between two-dimensional and three-dimensional target objects. As a result, I added depth information to help control a 7 degrees of freedom robotic system.

The final goal of the study

The final goal of this study is to apply the content-consistent motor imagery to control a robotic system. The system can meet most demands of the daily life environment with the performance of over 80% accuracy. Although we have not yet achieved a correct rate of more than 99% as a perfect brain computer interface robotic system, we can ask several motor imageries for one specific action to increase the accuracy of the content-consistent classification and improve the entire system success rate.

As a result, the current system and accuracy is not so perfect, but it's still acceptable for the robot to control. With the further development of content-consistent motor imagery, these kinds of robotic systems will certainly be expected.