❖*This article has been translated from the original release in Japanese for your convenience*❖

Basic Experiment in the Application of Optical Topography as a Brain-Machine Interface to Operate Equipment

Tokyo, 6th November 2006 --- Hitachi, Ltd. (NYSE:HIT / TSE:6501) today announced that it has successfully conducted basic experiments indicating the applicability of Optical Topography as a non-invasive[*1] brain machine interface (BMI) for the operation of electrically-controlled equipment. In the experiments, signals due to changes in regional blood volume in the prefrontal cortex when subjects conducted mental arithmetic or imagined singing a song, were used to control the ON/OFF operation of a small railway model. This result is the first step in the development of technology to apply Optical Topography to applications such as the operation of man-machine interface devices by persons whose movements are restricted or rehabilitation exercises to restore brain functionality, and is part of the ongoing research to develop information systems which are gentle to users.

Recently, research on brain-machine interfaces that use neural activity to control machines has become quite active. This activity is supported by the development of non-invasive brain function measurement methods[*2], which enable brain activity to be measured without the administration of pharmaceutical drugs or injections. This new direction in research uses the measured brain activity as an input signal to control machine operation. Optical Topography[*3] a brain function imaging method developed by Hitachi, uses near infra-red light which is shone through the scalp to measure regional changes in blood volume which accompanies neural activity. The subject simply dons a special measurement "cap" to measure brain activity. In 1999, using this technology Hitachi confirmed that it was possible to obtain a Yes/No response from ALS[*4] patients, and in 2005, this was developed into a product "*Kokoro-gatari*," a "Yes/No" determining system, by Execl of Mechatronix K.K.
Hitachi continued in developing this technology with the aim of creating a new brain-machine interface which could provide assistance to persons having difficulty in operating machines through direct physical manipulation, and has now succeeded in using Optical Topography in a basic experiment to control machine movement using the signals obtained from changes in blood volume accompanying neural activity. This was made possible by the development of a new method of using the measured signals to control machine operation.

Details of the new developed technology are as below:

1. In this experiment, Optical Topography equipment is used to measure changes in blood volume at 22 positions in the prefrontal cortex. A learning-type drive scheme was developed based on the dynamic signal patterns resulting from neural activity, which is pre-obtained before actual operation. When a signal pattern similar to the

pre-recorded signal pattern is obtained, the machine is in operation, and when the pattern desists, the machine stops.
2. New control circuits and software were developed to convert the signals obtained from the Optical Topography measurement into voltage signals which could be used to control machine operation.

It is generally known that during mental arithmetic or silently singing, changes in blood volume occurs in the prefrontal cortex around the forehead. An experiment was conducted using Optical Topography to measure this change in several subjects who were asked to conduct mental arithmetic or sing silently, and control the movement of a small model train.

The following results were confirmed:
1. Movement of the train corresponded almost perfectly with the initiation of mental arithmetic or silent singing. Further, while some individual differences were observed, it was found that when the subject ceased calculations or singing, that the train could be slowed down or stopped.
2. By pre-recording changes in pattern in a subject, and using the pattern to adjust the conversion parameter for the input signal controlling the equipment, the equipment could be effectively controlled.
3. With increased training, subjects were able to improve their control in operating the machine.

This result is a basic experiment confirming the viability of using the principle of Optical Topography in achieving a non-invasive brain-machine interface. It is basic research opening the way to the development of new man-machine interface technology for welfare equipment to assist persons who experience difficulty in physically operating machines, or rehabilitation in brain functions. Hitachi will continue research to develop human-friendly information equipment gentle on the user.

Notes

*1 Noninvasive of the body

*2 Localized regions of the brain are known to be involved with certain functions. By measuring the activity of the localized region, it is possible to analyze the relationship between various stimuli and brain activity.

*3 As near-infrared light used in Optical Topography has a low photon energy level, it is basically safe and can be used without harming the human body. Further, as it passes through human tissue well; when the scalp is irradiated, the light penetrates the scalp and the cranium, and the light reflecting back from the cerebrum can be detected again at the surface of the scalp. As blood volume is known to increase in activated regions of the brain, and as near-infrared light is absorbed by hemoglobin, a chromo protein, in the blood, by measuring the intensity of the reflected light using Optical Topography, it is possible to simultaneously measure localized changes in blood volume at multiple points, and observe this brain activity as an image.

*4 ALS: Amyotrophic Lateral Sclerosis

About Hitachi, Ltd.

Hitachi, Ltd., (NYSE: HIT / TSE: 6501), headquartered in Tokyo, Japan, is a leading global electronics company with approximately 356,000 employees worldwide. Fiscal 2005 (ended March 31, 2006) consolidated sales totaled 9,464 billion yen ($80.9 billion). The company offers a wide range of systems, products and services in market sectors including information systems, electronic devices, power and industrial systems, consumer products, materials and financial services. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

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