NEUROSCIENCE 2006

Program#/ Poster#: 25.12/QQ78

Title: Brain-machine interface for wheel chair control

Location: Georgia World Congress Center: Halls B3-B5

Presentation Start/End Time: Sunday, Oct 15, 2006, 11:00 AM -12:00 PM

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Abstract: One result of improved brain imaging technology of recent years is the rapid growth of neurorobotics. This project was initiated to develop a mechanism for controlling the movement of a motorized wheel chair using amplified brain waves. Previous analyses of EEG patterns have shown that people exhibit a significant response in the Rolandic mu-rhythm, generated in the sensorimotor cortex, when their hands are moved. This response consists of a decrease in amplitude of the normal mu-rhythm in the 8-12 Hz frequency range. This EEG pattern can be used for rudimentary regulation of wheel chair movement.
Using a newly designed EEG cap that does not require either abrasive cream pretreatment or the use of a conducting cream, we acquired EEG signals, focusing primarily on the C3 and C4 regions of the motor cortex. These signals were amplified using a portable wireless Compumedics Siesta amplifier and forwarded to a computer where they were processed by LabVIEW. The incoming data was band filtered 3-40Hz. A Laplacian Spatial Filter was applied to extract the mu rhythm. The ratio of the signal power in the mu-rhythm band against the broadband power, or alternatively the convolution between the actual data and a canonical mu-rhythm template matched filter, is the control signal.
Four different hand actions were employed: both hands squeezing simultaneously, left or right hand squeezing alone, or neither hand squeezing. Using MatLab, these signals were examined using discrimination analysis to determine the optimal linear combination of electrodes C3 and C4 for discriminating left from right performance. Once we were able to quantify these differences, the amplified signals could be sent directly to a laptop computer, positioned beneath the seat of the wheel chair, where they were processed in LabVIEW. The control features are sent to a real-time controller (Compact RIO, National Instruments) which implements the linear combination of the

control features for C3 and C4 as the wheel controller algorithm.
Such a system is a general prototype for a brain machine interface for disabled subjects to control a variety of devices.

Disclosures: **N.S. Dias**, Portugese Foundation for Science and Technology, B. Research Grant (principal investigator, collaborator or consultant and pending grants as well as grants already received) ; **D. Klayton**, None; **M. Liu**, None; **V. Nguyen**, None; **D. Wu**, None; **W.X. Yan**, None; **M. Yen**, None; **Y. Zhao**, None; **P.M. Mendes**, None; **J.H. Correia**, None; **P.M. Cammer**, Lemmelson-MIT InvenTeams Grant, B. Research Grant (principal investigator, collaborator or consultant and pending grants as well as grants already received) ; National Instruments, C. Other Research Support (receipt of drugs, supplies, equipment or other in-kind support) ; Compumedics, C. Other Research Support (receipt of drugs, supplies, equipment or other in-kind support) ; **S.J. Schiff** , Lemmelson-MIT InvenTeams Grant, B. Research Grant (principal investigator, collaborator or consultant and pending grants as well as grants already received) ; National Instruments, C. Other Research Support (receipt of drugs, supplies, equipment or other in-kind support) ; Compumedics, C. Other Research Support (receipt of drugs, supplies, equipment or other in-kind support) .

Support: Portuguese Foundation for Science and Technology, Portuguese Foundation for Science and Technology

National Instruments, National Instruments

Compumedics, Compumedics

Lemmelson-MIT InvenTeams grant, Lemmelson-MIT InvenTeams grant

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[Authors]. [Abstract Title]. Program No. XXX.XX. 2006 Neuroscience Meeting Planner. Atlanta, GA: Society for Neuroscience, 2006. Online.

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