Design and Evaluation of Action Observation and Motor Imagery based BCIs using NIRS

Berdakh Abibullaev, Jinung An, Seung-Hyun Lee, Jeon Il Moon

PII: S0263-2241(16)30699-6
DOI: http://dx.doi.org/10.1016/j.measurement.2016.12.001
Reference: MEASUR 4463

To appear in: Measurement

Received Date: 4 August 2016
Accepted Date: 1 December 2016


This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
Design and Evaluation of Action Observation and Motor Imagery based BCIs using NIRS

Berdakh Abibullaev\textsuperscript{a}, Jinung An\textsuperscript{b}, Seung-Hyun Lee\textsuperscript{b}, Jeon Il Moon\textsuperscript{b}

\textsuperscript{a} Robotics and Mechatronics Department, School of Science and Technology, Nazarbayev University, Astana, Kazakhstan, 010000, Qabanbay Batyr Ave 53.
\textsuperscript{b} Daegu Gyeongbuk Institute of Science and Technology, Sangri 50-1, Hyojeong, Dalseong-Gun, Daegu, 711-873, South Korea.

Abstract

The integration of Brain-Computer-Interfaces (BCI) into rehabilitation research is a promising approach that may substantially impact the rehabilitation success. Yet, there is still significant challenges that needs to be addressed before the BCI technology can be fully used effectively in a clinical setting as a neural prosthesis for motor impaired users. As it is still unknown whether the conventional BCI induction strategies that use different types of stimuli and/or mental tasks induce cortical reorganization for disabled users. This paper presents a design and evaluation of a real-time Near-Infrared Spectroscopy (NIRS) based BCI protocol to control an external haptic device, and an interesting source of brain signals that may convey complementary information for inducing neuroplasticity. The protocol is based on the ideas derived from Mirror-based Therapy (MT) in which subjects not only perform literal motor imagery tasks but also combine their intents with visual action observation of a related motor imagery task. The NIRS-BCI system then commands a haptic device in real-time to move in opposing directions of leftward and rightward movement. We also compare the proposed protocol to the conventional limb motor imagery task and verify its efficacy with online decoding accuracies up to 89%. The initial validation of the experimental setup was done with seven healthy subjects. Nonetheless we contend that the design of the current NIRS-BCI method hold promise with patient populations for effective stroke rehabilitation therapy, because the beneficial effects of MT alone in post-stroke recovery has already been manifested in the literature.

Keywords: Brain-Computer Interface, Near-infrared spectroscopy, Mirror Therapy, Haptic device, PCA, Multiple Support Vector Machines, Channel Localization, BCI for Neural Rehabilitation.

1. Introduction

There is an evidence indicating the capability of a brain to remodel after stroke by forming new neural connections. The neurons in the brain may compensate for brain injury by a mechanism...
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات