BCI2000 ModularEEG Support

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1 Introduction

The *ModularEEG* is a GPL-licensed EEG-amplifier designed by Joerg Hansmann. The schematics, PCBs and design-documents were released to the OpenEEG - community in the year 2002. (see http://openeeg.sf.net) .
This document describes the use of the device and the BCI2000-compatible Source Module (ModularEEG.exe)

2 ModularEEG Hardware

The ModularEEG is a low cost EEG-system that consists of a microcontroller-based digitizer board and one, two or three analog boards. Each analog board can capture two EEG-signals. Thus, the Modular EEG can transmit two, four or six channels of EEG-data. The transmission to the host-PC or PDA is done via serial RS232-connection. USB-converters can be used, common baudrates are 56700 or 115200 bits per second. Be aware that the isolation-barrier for user safety is only 5kV, which does not meet the criteria for a medical device. The ModularEEG may not be used for clinical applications. For details and filter specifications please refer to the design documentation. (ModularEEG_design.pdf)

3 ModularEEG Source Module

The BCI2000-compatible Source Module *ModularEEG.exe* can be used instead of any other source module. In addition to standard parameters (i.e., *SampleBlockSize*, *SamplingRate*, *SoftwareCh*, *TransmitCh*, *TransmitChList*), it also contains the following parameters:

ComPort Number of the Serial Port the ModularEEG is connected to.
Protocol Transmission Protocol. There are currently 3 different Protocols for data transmission from or to the EEG-device. The oldest and most-compatible Protocol is called *P2*, it transmits all 6 channels (even in case there are only two connected) and uses unidirectional communication to the host computer. The *P2* protocol is compatible to other EEG-Applications like "Electric Guru". A *P2*-packet consists of 17 bytes. *P3* is a newer, more compact format. A 6-channel data packet has 11 bytes, the transmission of only 4 or 2 channels is possible. There are two firmware versions that are currently in experimental stage. The corresponding protocols are bi-directional and allow to send command frames to the ModularEEG.
SimulateEEG When this option is selected, sinewaves are generated instead of using real time EEG data. The amplitude and frequency of the sinewaves can be adjusted by moving the mouse.
SampleBlockSize Samples per digitized block.
SamplingRate The sampling rate for the EEG data. Currently, this is fixed to 256 Hz. New firmware versions will support adjustments of the sampling rate.
SoftwareCh The number of channels (2, 4 or 6)
TransmitCh The number of channels that are transmitted to the BCI2000
TransmitChList The list of channels that are transmitted to the BCI2000
Signal Processing module. See the BCI2000 Project Outline for further information.

3.1 Data Storage / Calibration

The ModularEEG has a 10bit-A/D-converter and transmits EEG-channel data in high byte / low byte format. The gain settings can be adjusted with potentiometers on the analog boards. A 14Hz 250uV – Calibration Signal is provided by the digital unit. When calibration is set to +/250uV, the value 0 corresponds to -250uV and the value 1024 corresponds to 250uV. BCI2000 Signal Processing or any offline analysis routine can derive, as with any other BCI2000 source module, sample values in μV by subtracting, from each stored sample, *SourceChOffset* (i.e., zero), and multiplying it with *SourceChGain* for each channel.

3.2 ModularEEG Source Screenshot