

Subject: NeurOne BCI2000 Signal Source

Date: 2016-08-02

Introduction

This is a software module for BCI2000 brain-computer-interface systems, which enables connecting to a NeurOne EEG System, and using the EEG data to control these systems.

Note: Version 2016-08-02 of NeurOne BCI2000 Signal Source is not compatible with NeurOne firmware 1.3_ALPHA - 1.3_BETA10. If you want to use this signal source, please update to a newer firmware version.

System Requirements

1. Windows computer running BCI2000, Version 3.0.5 or later (July 2012):
<http://www.bci2000.org/wiki>
2. Microsoft Visual C++ 2013 Redistributable x86 (32-bit). BCI2000 (version 3.0.5) is 32-bit software, so the 32-bit version of the Visual C++ Redistributable package is needed. The installer (vcredist_x86.exe) is bundled with the NeurOne Source and also available online:
<http://www.microsoft.com/en-us/download/details.aspx?id=40784>

Note: NeurOne PC-software (versions 1.4.x.x) use 64-bit version of Microsoft Visual C++ 2013 Redistributable, so if you use both NeurOne PC software and BCI2000 with NeurOne Source, you need to install both 32-bit and 64-bit versions.

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Installation

1. If you do not have BCI2000 installed, download it from the link above and run the installer (`BCI2000Setup_120703.exe` or similar). Choose the installation destination to be for example `D:\` (this installs the software package to `D:\BCI2000\`)

2. Copy the files `NeurOneSignalSource.exe` and `NeurOneDrvNative.dll` into `D:\BCI2000\prog\` and `.prm` files into `D:\BCI2000\parms\fragments\amplifiers`.

3. a) If you have a new BCI2000 installation create a file `BCI2000Launcher.ini` into `D:\BCI2000\prog\` with the following contents:

```
[CONFIG]
Source%20Modules\1\Name=NeurOneSignalSource
Source%20Modules\1\Selected=true
Source%20Modules\size=1
```

- b) If you had BCI2000 installed previously and `BCI2000Launcher.ini` exists, check the number of source modules previously installed from the parameter `Source%20Modules\size`, increment this by one, and append the following lines to the file:

```
Source%20Modules\size\Name=NeurOneSignalSource
Source%20Modules\size\Selected=true
```

where `size` is the new number of source modules.

4. Locate NeurOne driver data files on your computer. These are located by default in the following path, if NeurOne PC software is installed:
`C:\ProgramData\Mega Electronics Ltd\NeurOne64`

The NeurOne BCI2000 Source uses the following driver files:

- Files in HBC-folder (headbox calibration files)
- Files in NDF-folder (device filters)
- `NeurOneDrvMw.ini` (contains driver settings including active calibration files)

Use this path in NeurOne `.prm` files located in `D:\BCI2000\parms\fragments\amplifiers`

Note: if you edit the `.prm` files directly with a text editor instead of through BCI2000Launcher, you need to replace space characters with `%20` and make other replacements. For further details, see documentation in the BCI2000 wiki¹.

5. If you need to calibrate headboxes, you can do that in NeurOne PC software.

¹ http://www.bci2000.org/wiki/index.php/Technical_Reference:Parameter_Definition#Special_Characters



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Usage

1. Open BCI2000Launcher and check that you see NeurOneSignalSource in the left-most list of BCI Program Modules, see figure 1. Add a parameter file with the [+] button and navigate to `D:\BCI2000\parms\fragments\amplifiers`. Click Launch.

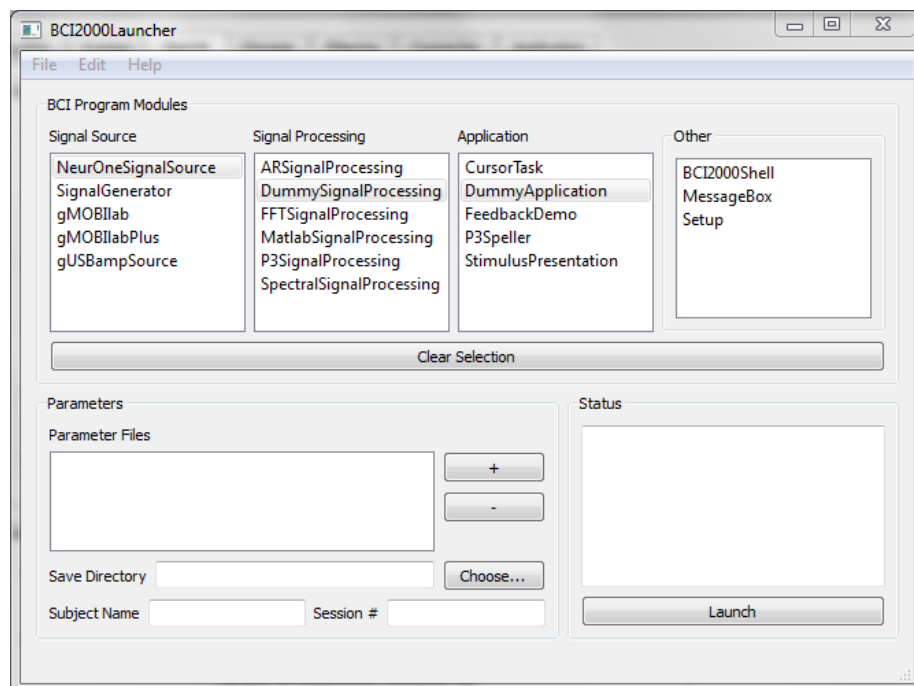


Figure 1. Initial view of BCI2000Launcher with NeurOne Signal Source installed.

2. If you see any error messages, select the “BCI2000/Operator” window (figure 2) and click “Config”. Go to “Source” tab and check that the parameter `DriverDataFolder` is your correct NeurOne Driver Data folder.

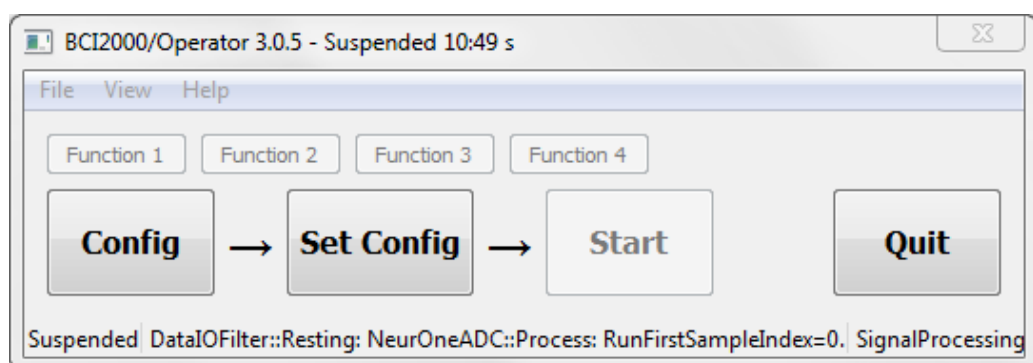


Figure 2. BCI2000/Operator window, which is a link to measurement settings configuration, starting recording and quitting the measurement session.

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3. Trigger events from NeurOne are written to BCI2000 state variables and optionally to a separate text file in the data directory, depending on the parameter `UseMarkerFile`. The trigger events are written to a total of nine state variables. One state is reserved for triggers from NeurOne SyncBox and two states for each NeurOne Main Unit connected. The maximum number of NeurOne Main Units currently supported is four, thus totalling the number of state variables to nine. The state variables are listed in table 1.

Table 1: NeurOne trigger states in BCI2000.

State Name	Description	Bit order	Width (bits)
N1SyncBox	SyncBox front panel trigger button and EXT Trigger port.	Lower bit: Trigger Button. Higher bit: EXT Trigger.	2
N1_1_Trig	A and B trigger input from Master Main Unit.	Lower bit: Trigger A in. Higher bit: Trigger B in.	2
N1_1_8Bit	8-bit trigger input (1-255) from Master Main Unit.	Each bit corresponds to a pin in the 8-bit trigger port.	8
N1_2_Trig	A and B trigger input from Main Unit (Slave 1).	Lower bit: Trigger A in. Higher bit: Trigger B in.	2
N1_2_8Bit	8-bit trigger input (1-255) from Main Unit (Slave 1).	Each bit corresponds to a pin in the 8-bit trigger port.	2
N1_3_Trig	A and B trigger input from Main Unit (Slave 2).	Lower bit: Trigger A in. Higher bit: Trigger B in.	8
N1_3_8Bit	8-bit trigger input (1-255) from Main Unit (Slave 2).	Each bit corresponds to a pin in the 8-bit trigger port.	2
N1_4_Trig	A and B trigger input from Main Unit (Slave 3).	Lower bit: Trigger A in. Higher bit: Trigger B in.	2
N1_4_8Bit	8-bit trigger input (1-255) from Main Unit (Slave 3).	Each bit corresponds to a pin in the 8-bit trigger port.	8

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4. The NeurOne parameter file follows the BCI2000 .prm format² and has the parameters listed in table 2.

Table 2: Parameters for NeurOne BCI2000 Source.

Parameter Name	Description	Parameter Section	Type
SourceCh	Number of digitized and stored channels.	Source:Signal Properties: DataIOFilter	int
SampleBlockSize	Number of samples transmitted in one block, per channel. For example if you have 32 channels and 1000 Hz sampling frequency, SampleBlockSize 10 results in 32x10 sized data blocks being transferred 100 times each second from NeurOne to BCI2000.	Source:Signal Properties: DataIOFilter	int
SamplingRate	Sampling rate in Hertz. Possible values are [250, 500, 1000, 2000, 5000, 10000, 20000, 40000, 80000].	Source:Signal Properties: DataIOFilter	float
SourceChOffset	Offset for channels in AD units. Should always be set to "auto".	Source:Signal Properties: DataIOFilter	floatlist
SourceChGain	Gain for each channel (AD units per physical unit). Should always be 0.001.	Source:Signal Properties: DataIOFilter	floatlist
ChannelNames	List of channel names.	Source:Signal Properties: DataIOFilter	list
DriverDataFolder	Full path to NeurOne driver data folder.	Source:NeurOne:NeurOneADC	string
DevFilterName	Name of the device filter to use. Do not add the file extension (.ndf) to this parameter.	Source:NeurOne:NeurOneADC	string
SimuFilePath	Full path to the simulation file (.sdn), if used. Using a simulation file means that no signal coming from NeurOne system is used.	Source:NeurOne:NeurOneADC	string
InputNumbers	Active input numbers (in ascending order).	Source:NeurOne:NeurOneADC	intlist
InputModes	Input modes (0 = AC, 1 = DC).	Source:NeurOne:NeurOneADC	intlist
DevChOffset	Channel offset in nanovolts (applied by device). Should always be 0.	Source:NeurOne:NeurOneADC	floatlist
DevChGain	Channel gain (applied by device). Should always be 1.	Source:NeurOne:NeurOneADC	floatlist
OnlineFlags	Online measurement flags (0 = No NeurOne SyncBox, one NeurOne Main Unit, 8 = NeurOne SyncBox, one or more NeurOne Main Units).	Source:NeurOne:NeurOneADC	int
UseMarkerFile	Write trigger events to separate file in data directory (0=disabled, 1=enabled).	Source:NeurOne:NeurOneADC	int

² http://www.bci2000.org/wiki/index.php/Technical_Reference:Parameter_Definition