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SIMULINK
highspeed
ONLINE
processing

NIRScout Interface for Simulink

USER MANUAL V1.12.00

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Related Products

g.tec provides several biosignal analysis elements that are especially relevant to the kinds of tasks you perform with the NIRScout Interface for Simulink.

For more detailed information on any of our elements, up-dates or new extensions please visit our homepage www.gtec.at or just send us an email at office@gtec.at

g.BSanalyze	Off-line biosignal analysis package for MATLAB with EEG, ECG, classification and high resolution EEG toolboxes
g.USBamp	Multimodal biosignal amplifier for any type of electrophysiological signals like EEG, ECG, EOG, EMG, ECoG, ... and external sensors
g.MOBllab+	Portable biosignal amplifier that transmits the data via Bluetooth to a PC or notebook
g.BSamp	Stand-alone multimodal biosignal amplifier for EEG, ECG, EOG and EMG
Highspeed On-line Processing for Simulink	Allows users to perform real-time analysis under Simulink and to interface the biosignal amplifiers g.USBamp, g.MOBllab+ and g.BSamp

Installation and Configuration

Hardware Requirements

The NIRScout Interface for Simulink requires a PC running Microsoft Windows. The table below lists the minimum hardware requirements:

Hardware	Properties
CPU	Pentium working at 2000 MHz
Hard disk	20-30 gigabyte
RAM	1 gigabytes
USB 2.0 high speed port	One free USB port for the NIRScout device
USB 2.0 high speed port	One free USB port for the Hardlock Dongle
Optional:	
USB 2.0 high speed port	One free USB port for each g.USBamp
Bluetooth dongle	One Bluetooth dongle for g.MOBilab+
PCI slot	One free slot for each National Instruments board for the g.BSamp data acquisition

Software Requirements

The NIRScout Interface requires the installation of MATLAB, Simulink (The MathWorks, Inc. USA) and NIRStar (NIRx Medical Technologies LLC., USA). Make sure that the MATLAB and NIRStar installations work correctly before installing the NIRScout Interface software. Depending on your Windows operating system, administrator rights might be necessary for the installation. Additionally, one of the following packages is required to acquire biosignal data: g.USBamp, g.MOBllab+ or g.BSamp Highspeed On-line Processing for Simulink.

Software	Version
MATLAB	Release 2012a
Simulink	Release 2012a
NIRStar	10.8.3
Windows	Windows 7 Professional English Win32
Acrobat Reader	10.1.3
Optional:	
g.USBamp Highspeed On-line Processing for Simulink	Release 2012
g.MOBllab+ Highspeed On-line Processing for Simulink	Release 2012
g.BSamp Highspeed On-line Processing for Simulink	Release 2012

Installation from a CD

The installation consists of the following steps:

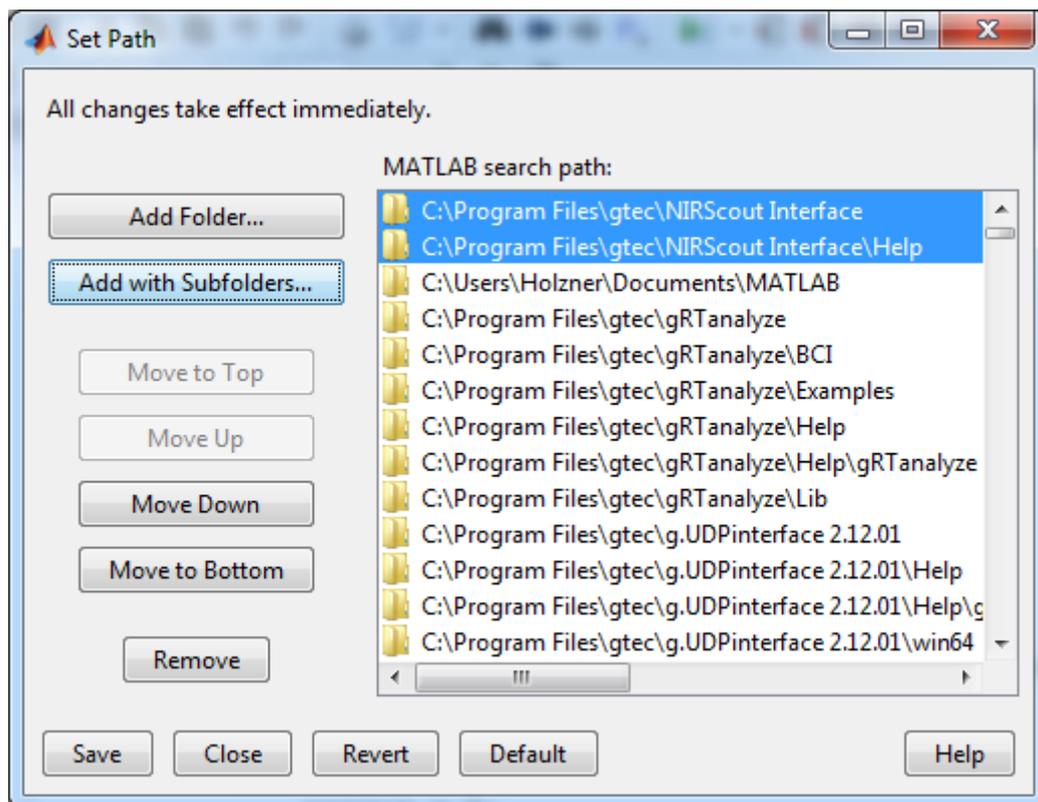
1. Make sure that you correctly installed MATLAB, Simulink and either g.USBamp, g.MOBIlab+ or g.BSamp Highspeed On-line Processing for Simulink by typing `ver` into the MATLAB command window. The correct version numbers must be reported.
2. Insert the g.tec product CD into the CD-drive and change to the root directory of your CD-drive. Then copy the directory `NIRScout Interface` to the following path:

```
C:\Program Files\gtec\NIRScout Interface
```

3. To make the path settings, start MATLAB and open the **Set Path** window from the **File** menu. Then click on the **Add with Subfolder** button and select:

```
C:\Program Files\gtec\NIRScout Interface
```

to add all subdirectories:



Click **Save** and **Close** to finish the installation.

Insert the Hardlock into a free USB slot of your PC or notebook. The light on the Hardlock will be on if the installation was successful.

Files on your Computer

NIRScout Interface for Simulink files are stored under (it is assumed that the default path setting is used):

c:\Program Files\gtec\NIRScout Interface

Help files - are stored under:

c:\Program Files\gtec\NIRScout Interface\Help

The NIRScout Block



The **NIRScout** block provides a graphical interface to the NIRStar software, which can be used under Simulink to acquire NIRs data.

Description

The **NIRScout** block provides NIRs data from a NIRx NIRScout device on the network in real-time. The data format is single. The number of channels depends on the device settings. Use a **Demux** block to demultiplex the channels.

Dialog Box

The screenshot shows a dialog box titled 'Source Block Parameters: NIRScout'. The dialog contains the following elements:

- A description: 'NIRScoutBlock (mask) (link) Performs data acquisition from a NIRx NIRScout device on the network.'
- Port descriptions:
 - > Port 1: device timestamp
 - > Port 2: data
 - > Port 3: trigger lines
- A note: 'Click the 'Help' button for a detailed description of the parameters and the output data.'
- A 'Parameters' section with the following fields:
 - IP address: '127.0.0.1'
 - Port: 45342
 - Number of channels: 32
 - Number of wavelengths: 2
 - Block sample rate [Hz]: 3
 - Receive Timeout [ms]: 1000
 - Latch
- Buttons at the bottom: OK, Cancel, Help, and Apply.

Parameters

IP address	Enter the IP address of the computer with the NIRStar software
Port	The port, which is configured at the NIRStar software
Number of channels	Number of channels to receive
Number of wavelengths	Number of wavelengths to receive
Block sample rate [Hz]	Sampling rate of the block. It must be greater than or equal to the device's sample rate
Receive Timeout [ms]	Specifies the maximum amount of time in milliseconds that the block should wait for data from the device before it reports an error. It is recommended to set this value to at least to twice the device's sample rate.
Latch	If the latch checkbox is checked, the values of the most recent sample will be hold until a new sample is available. In that case, the initial values, until the first sample is available, are zeros.

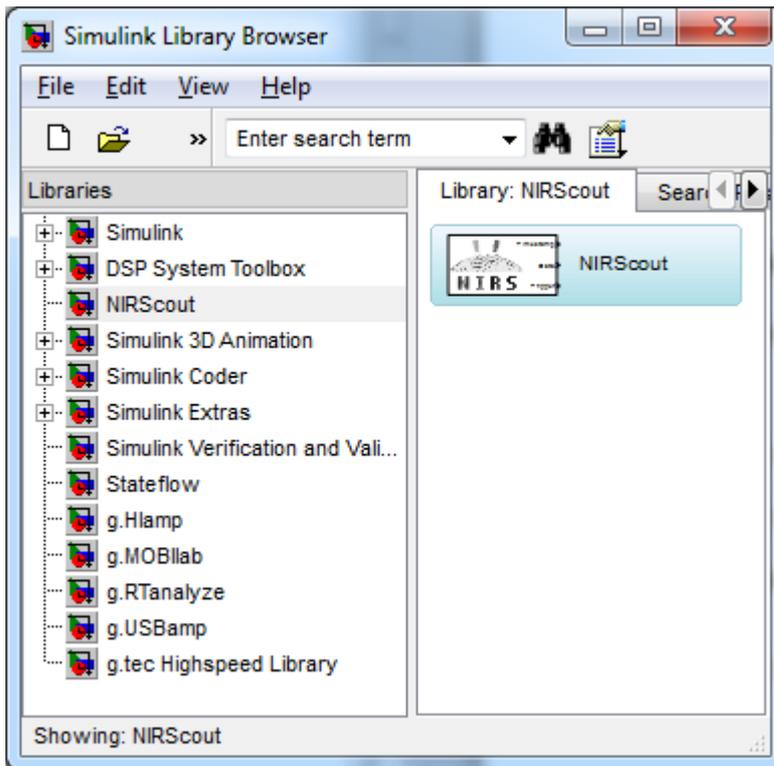
Outputs

Timestamp	Timestamp of the device
Data	Each data output sample is a one-dimensional array organized the following way (wavelength index 'w' is zero based): $\text{channel} + w * \text{number of channels}$
Trigger	The trigger lines are represented by decimal value. This value bitwise encodes the four trigger lines into an integer, where trigger line 1 is assigned to be the LSB (least significant bit) of the value's binary representation, trigger line 2 the bit following the LSB and so on.

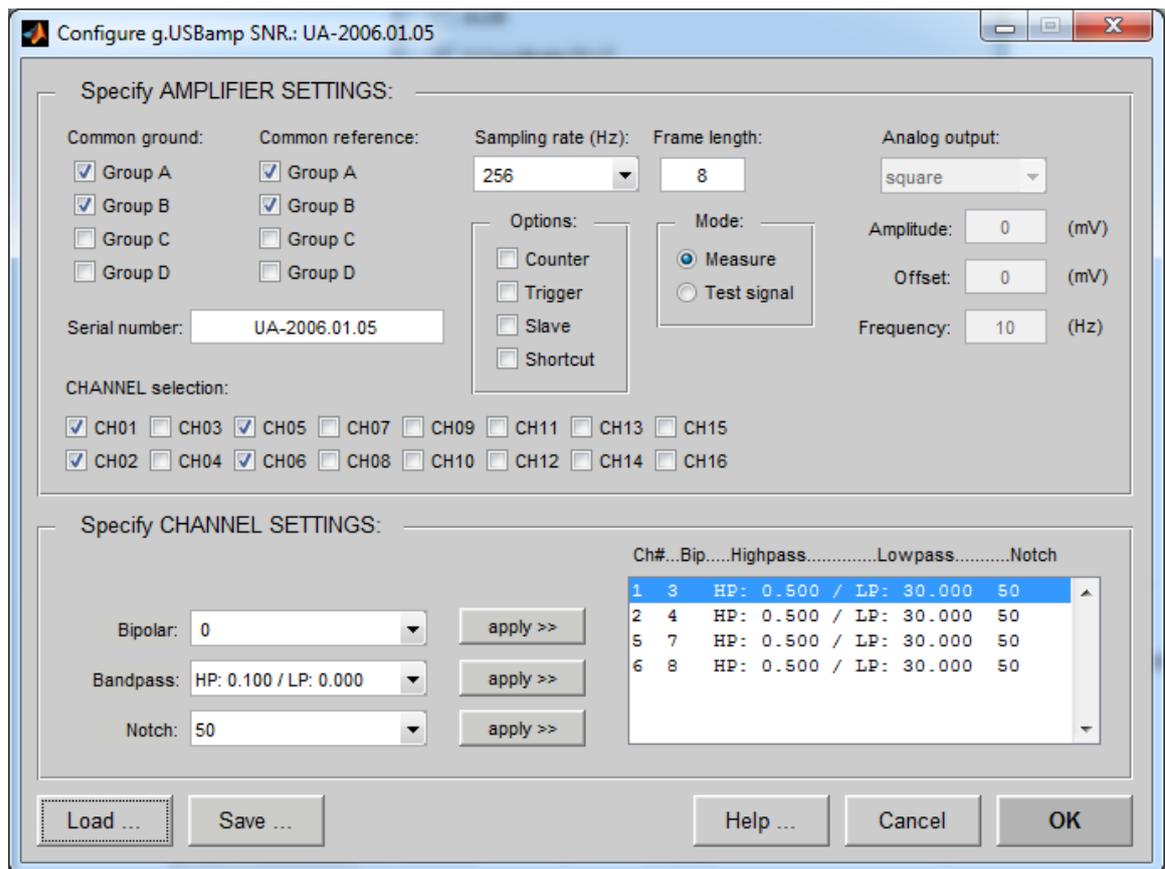
Running NIRScout Interface

To test the NIRScout Interface configuration on your system, please follow these steps:

1. Start the MATLAB command window. See your MATLAB documentation if you are not sure how to do this.
2. Open the Simulink Library Browser by typing Simulink into the MATLAB command window.



This shows the **NIRScout** block that interfaces the NIRScout with the Simulink model for real-time data analysis, visualization and storage.



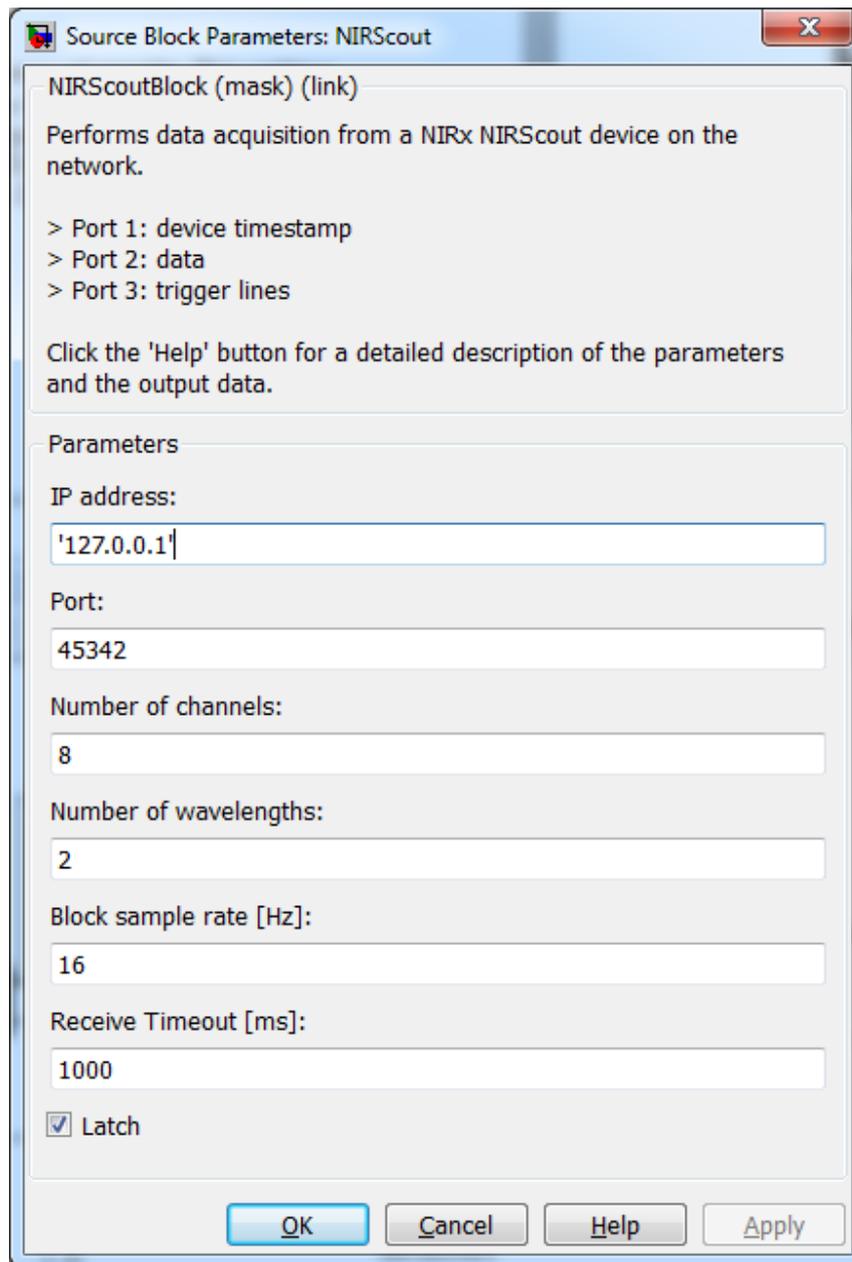
- Place the NIRs optodes over the left and right motor cortex. Place source 1 and 2 and detector 1 and 2 over the right motor cortex and source 3 and 4 and detector 3 and 4 over the left motor cortex. For further information how to place see the NIRStar manual.
- Connect your EEG electrodes to the amplifier. Place channels 1 to 4 on the right side of the brain around the NIRs optodes over the motor cortex. Channel 1 should go just in front of the ear, and channel 3 should be just behind the ear. Channel 2 should go just in front of the middle, and channel 4 should go just behind the middle. Channel 5 – 8 are mounted similarly over the left motor cortex. Channel 5 ahead near the ear and channel 7 back near the ear, channel 6 ahead near the middle and channel 8 back near the middle. The ground electrode should be fixed on the forehead and the reference to the right ear lobe.



This picture shows the placement of the optodes and electrodes over the left motor cortex. The red optodes in the middle are the sources of the NIRScout device and the white ones are the detectors. The red electrodes in front and back are EEG channels 5 – 8.

8. Start the NIRStar software and configure it correctly for measuring 8 channels over the motor cortex. Furthermore, configure the TCP connection with IP '127.0.0.1' for the local computer and port 45342. For information how to configure the NIRStar software, please read the NIRStar manual.
9. The **NIRScout** block communicates with the NIRStar software and the NIRScout device over TCP and sends data to the Simulink model in real-time. Double click on the **NIRScout** block and enter the **IP address** of the computer where the NIRStar software is installed:

'127.0.0.1'



10. Enter the **Port**, configured at the NIRStar software

45342

11. Insert the **Number of channels** measured with the NIRScout device

8

12. Enter the **Number of wavelengths** recorded with the NIRStar software

2

13. Enter the **Block sample rate [Hz]** for the block. It has to be greater than or equal to the sample rate of the NIRScout device!

16

14. Enter the **Receive Timeout [ms]**, which reflects how long the system will wait for data from the NIRStar software. It should be around twice the sample rate of the device.

1000

15. Check the **Latch** checkbox to get the most recent sample when no data are available.

16. Double click on the **To File** block and enter **Filename** `test1.mat`. The data is stored into the variable `y`.

17. Start the model by pressing the **Start** button in the Simulink model



18. To view the signals, double click on the **Scope** block. Channels 1 and 2 show the EEG from channels 2 and 4. Channel 3 shows the NIRs data.

19. Stop the model with the **Stop** button and close it





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