# Getting Started

NIRSTAR

NIRX

ENLIGHTENING INNOVATION

GETTING STARTED WITH NIRSTAR

SETTING UP THE SYSTEM

1. Connect your NIRSport or NIRScout system to your laptop, PC or tablet with the provided USB cable. Wait for the USB device to be recognized.
2. If your laptop, PC or tablet has been already configured by NIRX, simply launch the NIRStar application, by clicking the NIRStar application icon.
3. If you want to install the NIRStar acquisition software on another PC, please download the latest available version from http://www.nirx.de/downloads/ or contact NIRx at support@nirx.net. Follow the installation instructions throughout the process. It might be necessary to reboot your PC several times. NIRStar runs on Windows XP, 7 and 8. For a detailed list of system requirements, please consult the *NIRStar User Guide*.
4. **For NIRScout users only**: If you are using the system for the first time, the number of available sources and detectors needs to be specified. **This is not necessary for NIRSport systems!** Open the "Configure Hardware" menu item and then the "Hardware Specification" tab. Please enter **the total number** of sources and detector cards available (**not the sources and detectors you will use within a specific experiment**). Each detector card accommodates 4 detectors . Once this number has been set, it should not be changed, unless the configuration of the system is physically changed, e.g. new sources or detector cards have been added to the system.

This is one detector card

These are 8 sources
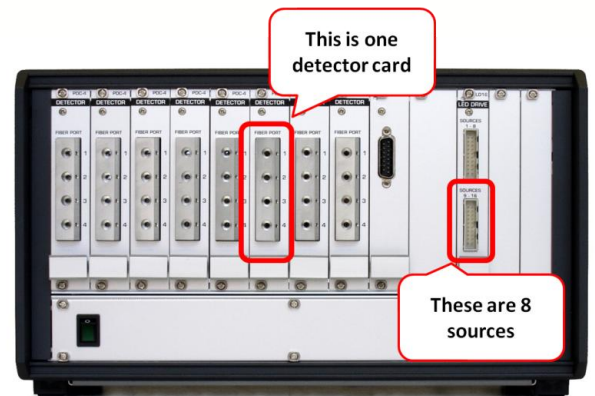
This system has 8 detector cards and 16 sources!

LET'S GET STARTED

1. Open the "Configure Hardware" menu item. The "Predefined Montages" tab should be selected and activated.
2. From the dropdown menu, choose the montage that best suits your target area. For each montage, the location of the sources and the detectors will be displayed conforming to 128 standard EEG positions (an extension of the international 10/20 system). Depending on the NIRScap you have chosen, all or some of the slits in the cap will already be pre-populated with optode holders, denoted by a colored label and a number. The same colors and numbers can be also recognized in the montage templates.
3. Everything has been setup to start the acquisition! You can now place the NIRScap on your subject. Place the optodes on the cap according to the chosen montage. Please refer to the *NIRScap User Guide* or the *NIRScap Getting Started Guide*.
4. **Before every acquisition, it is necessary to run a calibration**. During the calibration, NIRStar automatically assigns the most appropriate amplification level to each detector and displays an indicator of the signal quality, for each channel included in the montage. After all optodes are in place and the subject is in resting state, press the "Calibrate" button.
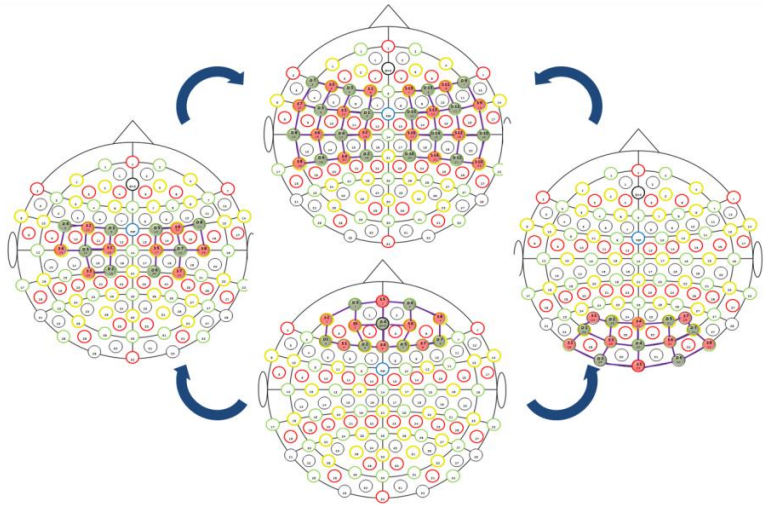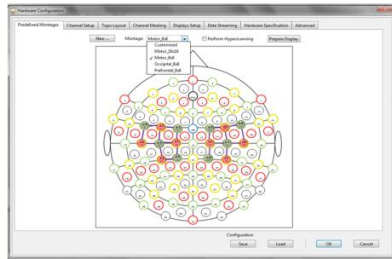
5. The signal quality depends on many factors: the identified amplification level at the photo-detectors, the mean signal level and the estimated level of noise (which in turn depend on possible environmental light interference, the stability of the optical contact between the optode and the skin, the inter-optode distance between sources and detectors etc.). NIRStar makes it easy for you to understand the signal quality of each channel by computing the quality index which takes into account the above mentioned factors. After the calibration is completed, the signal quality will be displayed to you for each channel in the chosen montage.
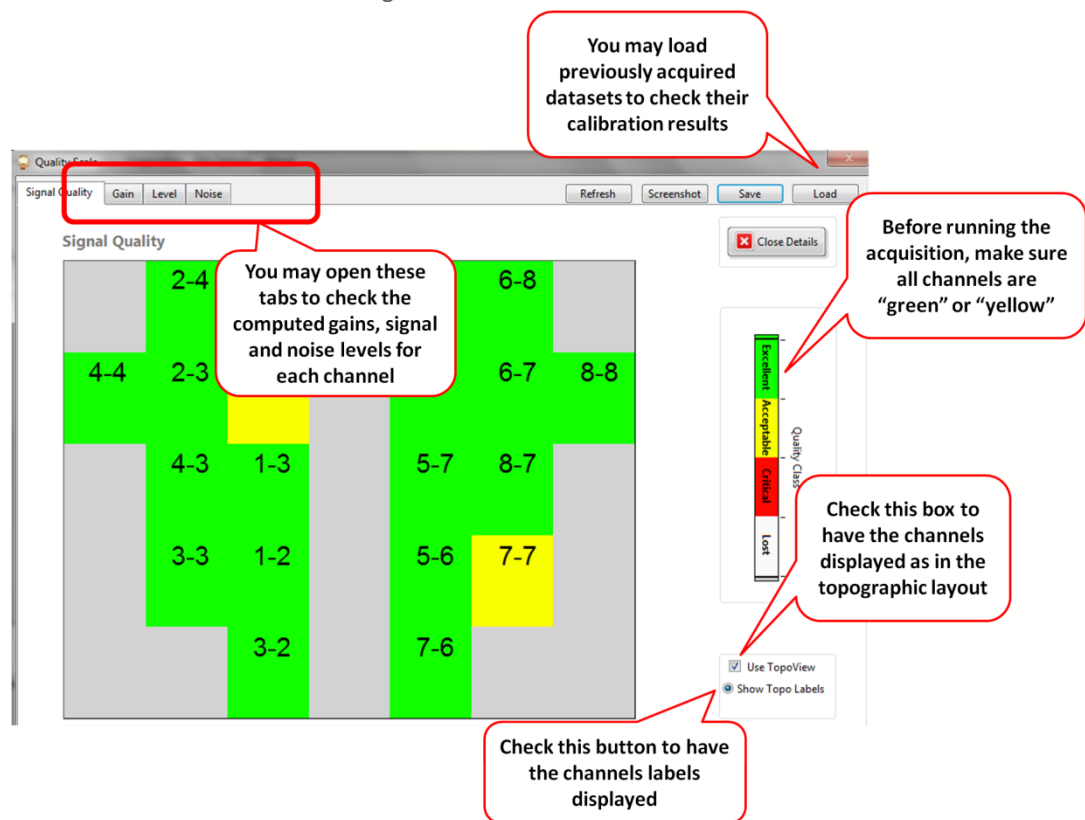
6. Please carefully examine the results displayed in the "Signal Quality" tab. If the "Use TopoView" checkbox in the bottom right corner is checked, the results should be displayed to you in the same spatial arrangement as identified by your topographic layout (for a better understanding of the NIRStar Topo Layout concept, please refer to the section *Want to add more* montages?). Make sure that the signal quality for each channel is either "excellent" or "acceptable". There are several reasons why a channel might be displayed as "critical" or "lost":

- The optical contact between the skin and the optode tip might not be good enough. Please remove the corresponding optode or optodes and try to improve the contact, as described in the *NIRScap User Guide*. Tip: After checking the "Show Topo Labels" radio button, it will be much easier to identify the channels and their position on the head. In the denomination x-y displayed for each channel, the first number identifies the source, the second identifies the detector.
- If you still see some "critical" or "lost" channels, it might be that sources and detectors have not been placed correctly, as suggested by the chosen montage. Please make sure that the number of each source and each detector matches the corresponding number in the chosen montage.
- Have you made sure that the inter-optode distance between the source and the detector of each channel which is denoted as "critical" or "lost" is not greater than 3 cm?
- If all your channels are "lost" there might be something wrong with the connection. Please make sure that both sources and detectors are properly plugged into the device.
- For a more comprehensive review on signal quality and how to improve it, please consult the NIRx brief tutorial on signal quality.

7. Everything is now ready to start recording. Before recording, you may preview your data to visually inspect the signal quality by clicking the "Preview" button.

8. After clicking the "Record" button all data will be saved in the folder specified under "File Options". Make sure to set the desired output directory before recording. The default output directory is always C:\NIRx\Data.

9. To finish recording, click the "Stop" button.
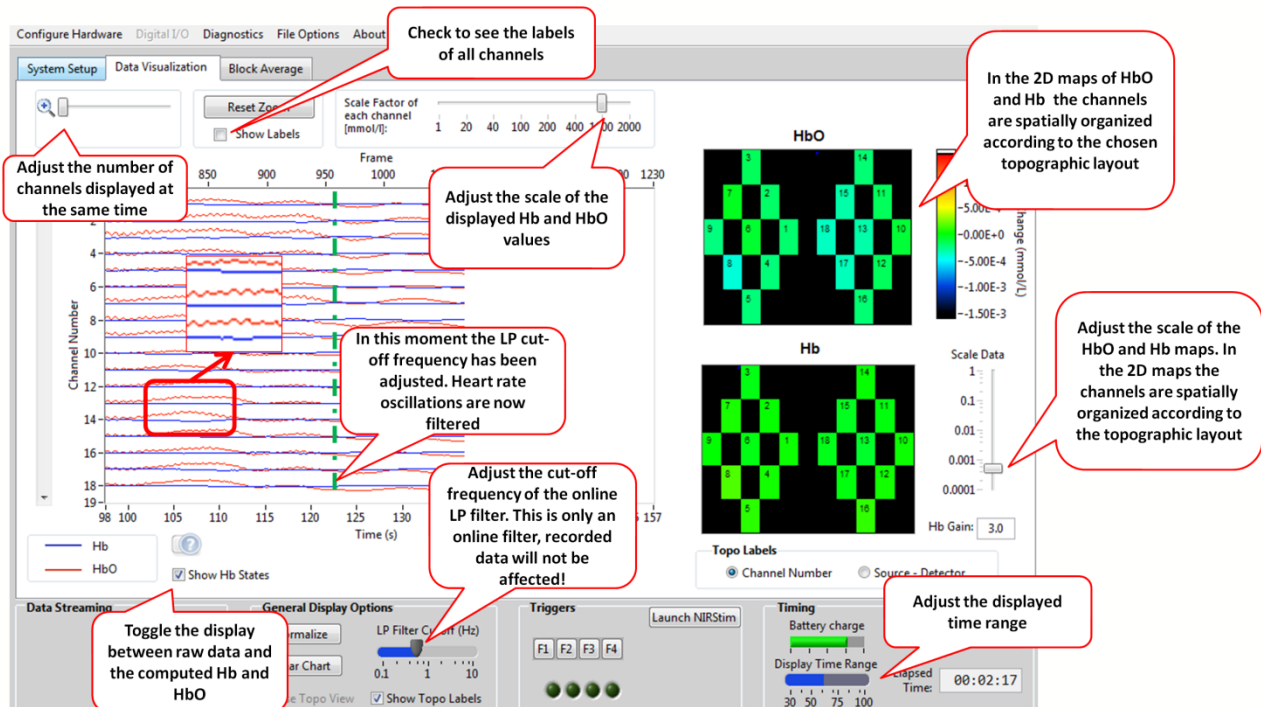
NIRStar

WANT TO ADD MORE MONTAGES?

The NIRStar 14.1 comes with a set of ready to use montages, but it also offers you the possibility to create your own, according to your specific application and the number of sources and detectors available. To add a new montage, start by creating a new topo layout.

NIRx devices adopt the unique measurement strategy where every possible combination of sources and detectors forms a measurement channel. However, only channels formed by pairs of sources and detectors which have an interoptode distance equal to or lower than 3 cm, will have a sufficient signal to noise ratio. These channels consist of sources and detectors which are the nearest neighbors. The spatial arrangement of these channels is what constitutes a topographic layout.

Before building a topographic layout in NIRStar, you may use the *NIRx Montage Editor* to design your montage, by placing sources and detectors into the available positions, according to the target area. The *NIRx Montage Editor* let's you design your montage by choosing any of 128 positions available in your NIRScap.

1. Open the "Channel Setup" tab in the "Configure Hardware" window and specify the number of sources and detectors that will be used in your montage. Please note that here you need to specify the number of detectors that will be used, and not the number of total detector cards available in the system, as in the "Hardware Specification" tab.
2. Open the "Topo Layout " tab.
3. To understand how to fill the table, start from the montage you created in the *NIRx Montage Editor*:
   - Starting from the planned arrangement of the sources and detectors on the head, connect each source with the nearest neighboring detectors.
   - Place a mark in the middle of each segment. Each mark represents a channel. To identify the numbers of rows and columns that you need to specify, count the number of marks in the vertical and horizontal direction.
   - Name every mark. Channels are named by the number of the corresponding source and detector, e.g. m-n, where m is always the source and n the detector.
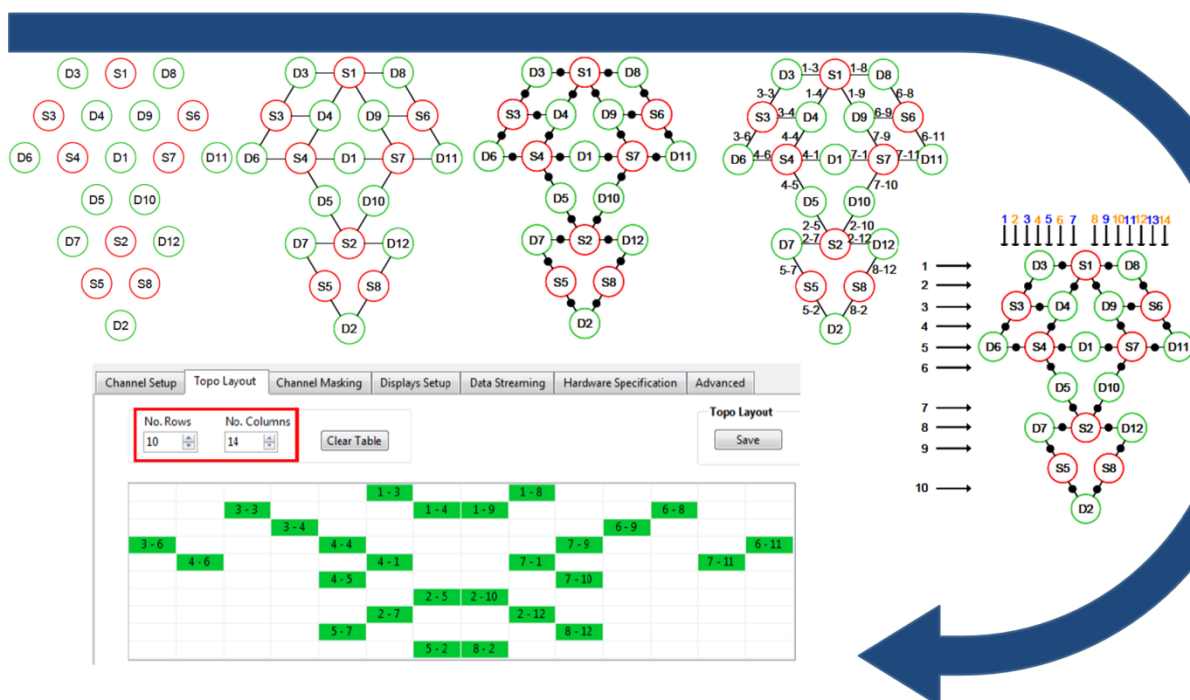
4. In the "Topo Layout" tab, specify the number of rows and columns as defined above. The grid size should be updated accordingly.

5. Fill in the cells according to the channels positions and names as identified above.

6. Save your layout by clicking the "Save" button. You will be prompted to chose a filename and a file location. Please remind that you will need to locate this file when creating a new montage.

7. Open the "Predefined Montages " tab and click the "New" button. You will be prompted to enter a name for the new montage and the number of sources and detectors. Here you may chose to add optional files, including a graphical sketch of your montage that you may create from the *NIRx Montage Editor*. For a detailed explanation on the meaning and the structure of the optional files, please consult the *NIRStar User Guide*.

8. After clicking the "OK" button, you will be prompted to locate the topographic layout file that you created in a previous step. After confirming its location, your montage should be created.

Please remind that a montage is not necessary to start a recording, but a topographic layout is. After having created a topo layout or loaded a previously created one, you may simply proceed with the calibration and recording, without choosing a montage. NIRStar always stores the last applied settings, so if you always use the same montage or the same topographic layout you do not need to make any changes in the "Configure Hardware" every time you launch NIRStar.

The advantage of using a montage with respect to using only a topographic layout, which can be part of a montage, is that its structure is more complex. While topographic layouts only define the channels consisting of neighboring sources and detectors included in the measurement, the montages may also include information about their location with respect to the head anatomy, making the analysis of your data in nirsLAB straightforward. However, this information is not necessary for the recording and can be added at any time later on.

GETTING MORE ADVANCED

When using presentation software or other recording or stimulation devices, it is important that all acquisitions are synchronized. All NIRx imagers provide trigger inputs, which make this synchronization possible. Please follow these steps to make sure trigger markers are correctly recognized and saved by NIRStar.

All NIRx imagers are provided with trigger inputs. The NIRSport and the NIRScout systems provide four parallel, positive-edge triggered digital TTL input lines, through a 10 pin IDC connector. Both instruments are provided with a cable that connects the IDC trigger input to a standard PC parallel port (25-pin sub-D female connector). The NIRScout Extended systems provide eight parallel digital inputs (TTL level, positive edge triggered), through a digital male 15-pin, D-Sub connector. The instrument is supplied with a 3-m long, 15-lead flat ribbon cable which may be used to connect the trigger input to a standard PC parallel (LPT) port, mapping LPT output lines (bits) 0..7 to trigger inputs 1..8. For more information on the trigger input ports and safety issues, please consult the NIRSport or NIRScout user guides.

To ensure proper communication between your presentation PC or another device (a stimulator for example), this needs to be connected to the NIRx imager trigger input. Please make sure that the pinning of the trigger output is compatible with the pinning of the trigger cable provided by NIRx.

If the trigger cable has been setup properly, trigger markers should be visible in NIRStar, as dotted vertical lines, in both preview and recording mode.

NIRStar has a "Block Average" feature. In order to be able to use it properly, you need to specify the event marker codes that trigger the event-related averaging.
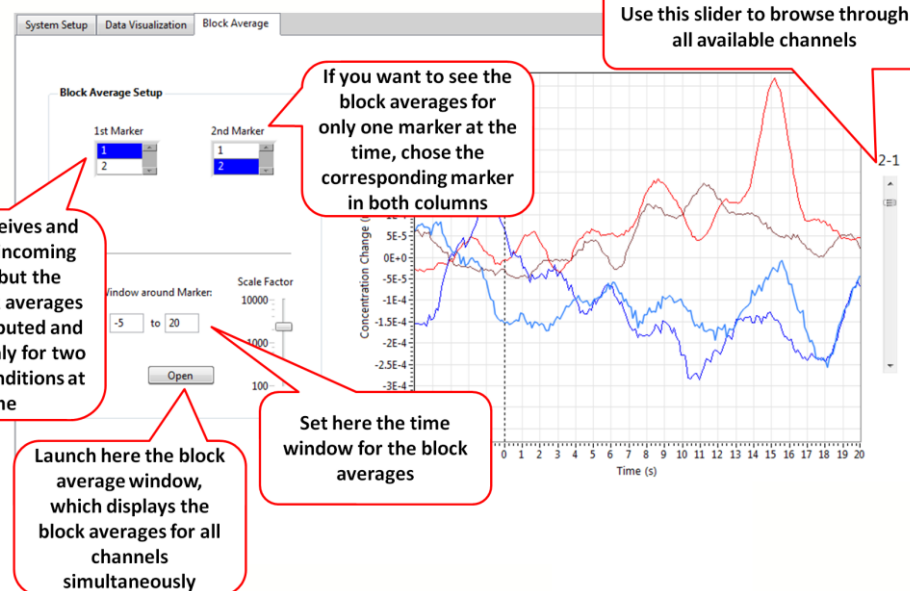
1. Before running the acquisition, open the "Configure Hardware" menu item and then open the "Display Setup" tab. The settings for the online Block Average are located in the right top corner of the window. Please specify the number and the codes of the relevant event markers (i.e. the number of conditions) that will trigger the online averaging. After having entered the number of conditions, please enter their code. As mentioned earlier,

the NIRSport and NIRScout have 4 bit trigger inputs, allowing therefore 16 different marker codes (0-15) while the NIRScout extended has an 8 bit trigger input, allowing therefore 256 different marker codes (0-255). Please keep in mind that you can you use as many marker codes as you wish. However, the online block averages can be displayed only for two markers at a time.
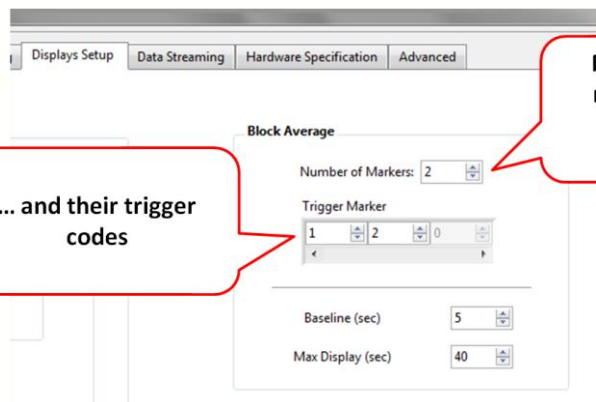
2. Please set the baseline time and the max window time in seconds. Event-related averaging is computed relative to a pre-stimulus baseline period, which has a user-specified duration between 3 and 10 seconds. The events will be displayed in the time window delimited by the entered max window time (up to 120 seconds). Confirm your settings by clicking "OK", the "Configure Hardware" window will close.

3. You can now start recording as described previously. You can access the Block Average view through the "Block Average" tab.

4. While NIRStar records all permitted incoming markers regardless of their trigger code, the block averages of only two marker events which have previously been defined in the "Displays Setup" window can be displayed simultaneously. Please select the relevant marker event codes under "1st Marker" and "2nd Marker". Please note that it is also possible to display only the averages triggered by one marker, by choosing the corresponding event code under both "1st Marker" and "2nd Marker" columns.

5. Before launching the "Block Average" window, you might want to adjust the time window and the applied scale factor for the display of the computed Hb and HbO values. The applied changes will be immediately visible in the window on the right.

6. The block averages can be viewed either one by one, in the "Block Average" tab (use the slider to browse among channels) or all at once, by launching the "Block Average Display" (click "Open" in the "Block Average Setup" group, in the "Block Average" tab). In this view, the channels are spatially organized according to the chosen topographic layout.
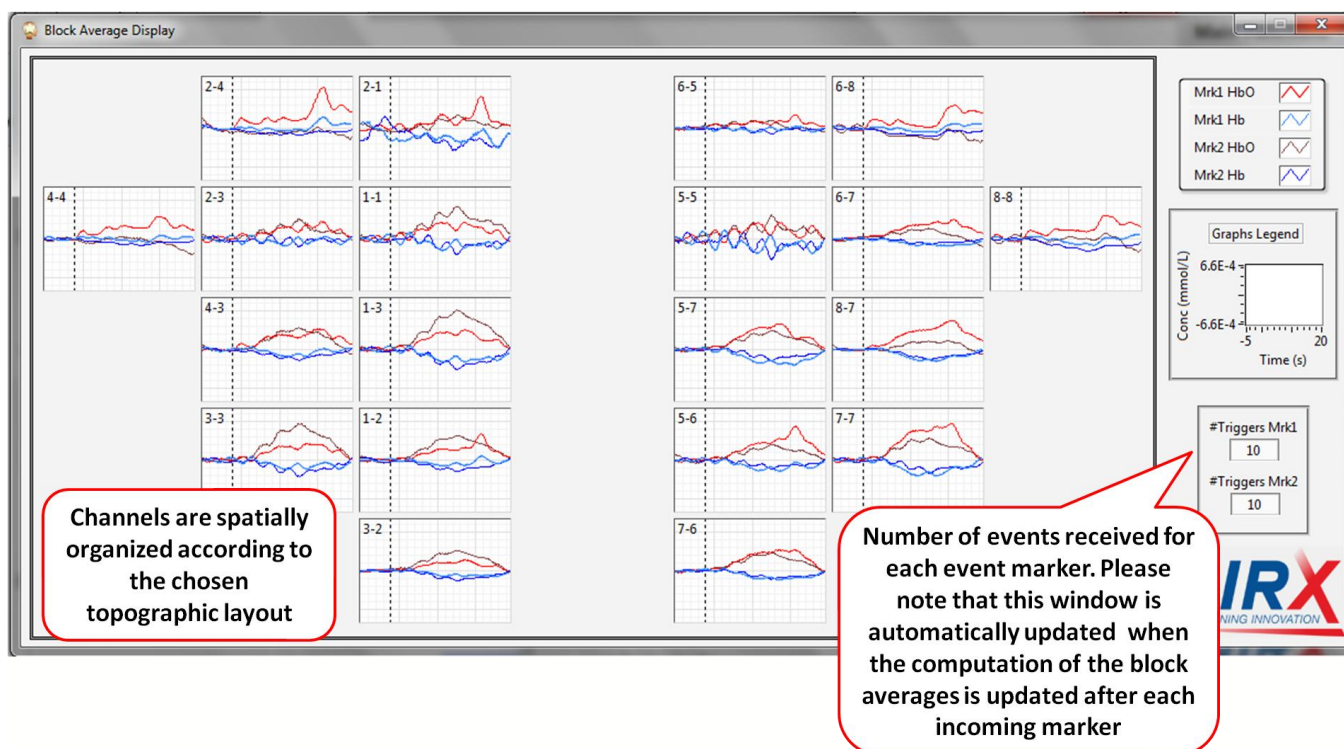
REVIEW YOUR DATA

NIRStar operates in two modes: online and offline. You can switch between the two modes with the toggle button, which at the same time indicates the currently active mode.

When in offline mode, your NIRx instrument does not need to be connected to your PC, laptop or tablet. The offline mode was introduced to let you review previously acquired data.

By clicking the "Review" data, you will be prompted to browse for the dataset you want to review. If you do not change the default settings, all data are saved to C:\NIRx\Data and organized according to the acquisition date.

You will be able to review the full calibration results, the entire duration of your recording and the block averages, should you have used this option while recording. Please remind that the data will be displayed with the same settings as applied online, i.e. if you had turned on the online LP filter, this will applied to the data under review as well, however, only for visualization purposes as the saved raw data are not affected by the online LP filter.