



**SOFTWARE**  
myoRESEARCH®3.10

**NORAXON™**  
MOVEMENT · DATA · PEOPLE



# myoMUSCLE™ SOFTWARE USER GUIDE



# SOFTWARE

## myoMUSCLE™ MODULE

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## Section 1: Introduction

### Brief Description:

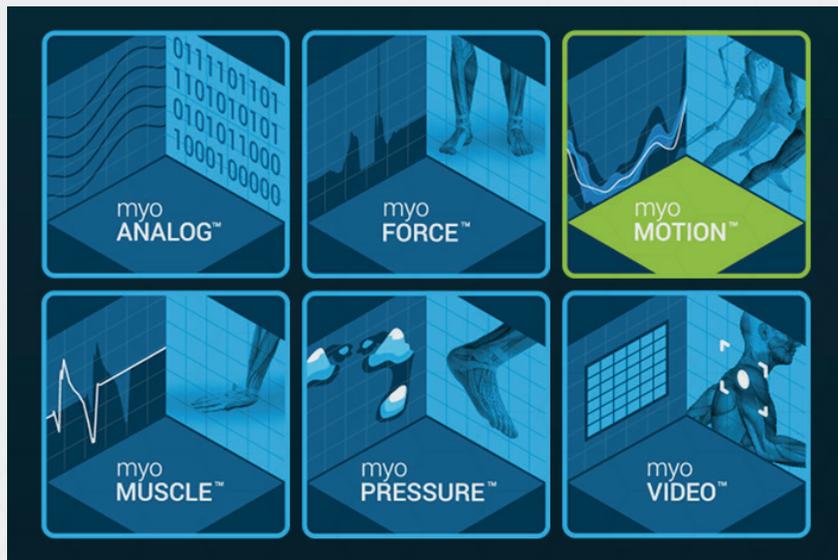
The myoMUSCLE module is primarily designed for EMG recordings, which can be taken in conjunction with other biomechanical sensors such as foot switches, goniometers, accelerometers, and many others.

myoMUSCLE is distributed into 3 major editions:

<b>Essential</b>	Provides basic recording, processing and standard analysis functions.
<b>Clinical</b>	Offers clinically oriented measurement functions, processing, and reports.
<b>Master</b>	All-inclusive package focused on research. Advanced recording, processing, and analysis functions as well as editing capability to create customized reports.

\*We strongly recommend studying the free educational booklet **ABC of EMG** available on our website, here. It introduces the theoretical and practical background of EMG recordings and many important application instructions and guidelines as well as the major analysis concepts related to surface EMG.

The myoRESEARCH software suite is fully integrated, therefore all software modules share basic menu operations which are detailed below:





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## Section 2: Set-Up

### Software Installation

**Before you launch the MR3.10 software platform:** please connect all hardware devices that you plan to use with the MR3.10 software to your computer.

1. Insert the installation USB Flash Drive or use the MR3.10 download file and start the installation with **Noraxon.mr.3.x.x.exe** (x is the latest version release number).
2. Follow the steps in the Installation Wizard menu and click Finish to close the Installation Wizard window. A new Icon will appear on your desktop:
3. Double click on the icon to start the MR3.10 software.
  - The first screen will prompt an Activation dialog box.

**Note:** the MR3.10 software platform can be started 30 times in “Demonstration Mode” without an Activation code. In Demonstration Mode, users will have access to all modules and all functions. Once MR3.10 is activated, only purchased modules will be functional.

To activate enter your license ID, press **Activate** and again press **Activate by Internet**. If no internet connection is available please contact your local distributor or Noraxon customer support at [support@noraxon.com](mailto:support@noraxon.com).



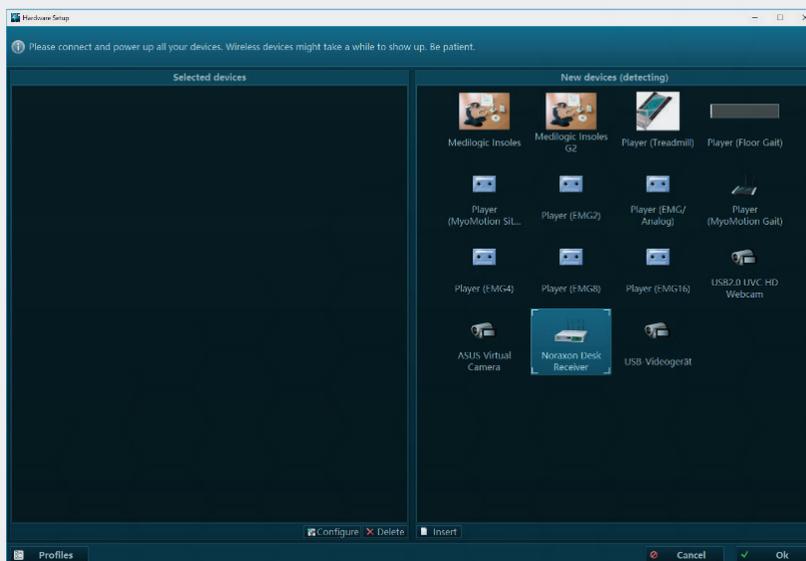
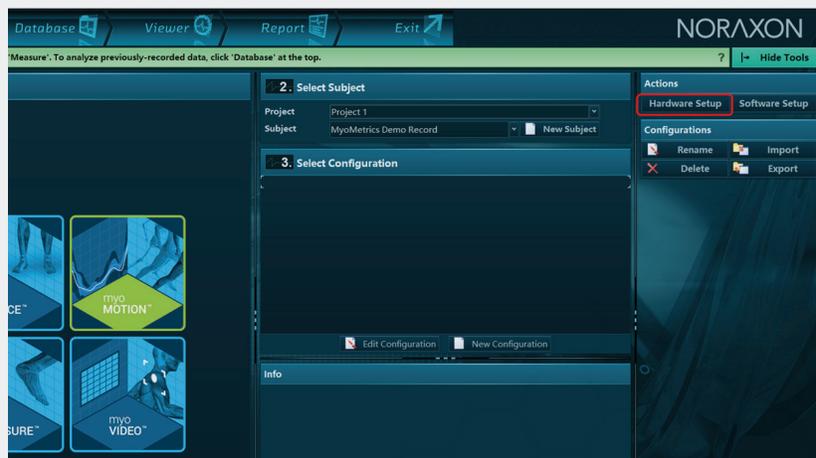
## Hardware Setup

Before the MR3 software can take and store measurements, you must configure the installed software through the Hardware and a Software setup menu. Follow these steps:

1. Connect all your measurement devices to the PC by using a USB cable. Power them on.
2. Click on the **Hardware Setup button** located in the Right Tool bar:

The Hardware menu is split into two sections:

- Selected devices (left screen)
- New devices (detecting)



Select the Hardware System or Device you plan to use (for this example, your EMG receiver).

Each device has a specific Device Configuration menu, which is detailed below. The settings will be preset to allow for normal recording. However, you may have to enter your sensors based on serial number.



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Noraxon offers a line of 5 different EMG devices:

<b>MyoTrace</b>	4 channel USB Telemetry system with onboard display
<b>Telemetry G2</b>	Belt worn WiFi telemetry with cabled inline sensors
<b>DTS Belt receiver</b>	Direct transmission EMG system with retransmission
<b>DTS Desk Receiver</b>	Direct transmission EMG system for desk tops
<b>Clinical DTS</b>	4 channel clinical RMS direct transmission system

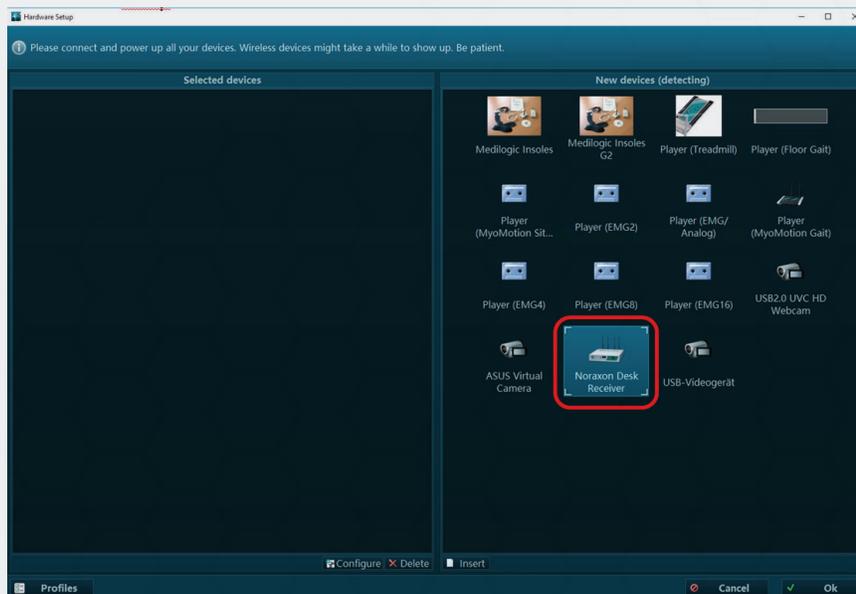
Based on the example of the DTS Desk Receiver the hardware setup of EMG is explained in the following text. The integration of other EMG devices are explained in their specific hardware manuals.

### Desktop EMG Device Configuration Settings

From the hardware set-up menu, you can configure the Desktop DTS to perform as desired with both basic and advanced options.

Basic Settings:

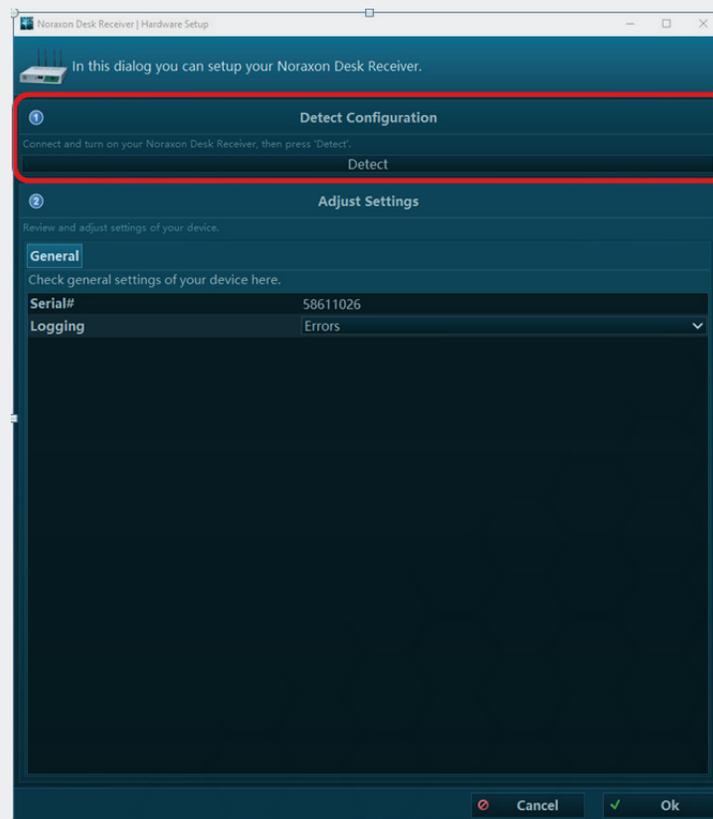
Select **Noraxon Desk Receiver** and press **Insert** to move it to left side list of **Selected devices**:



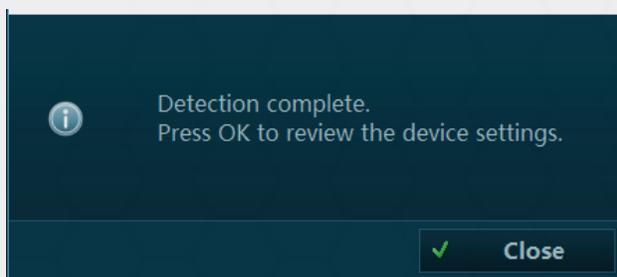


When done, a device specific configuration menu will appear, which consists of 2 steps:

- Detect Configuring
- Adjust settings



-Press Detect Configuration



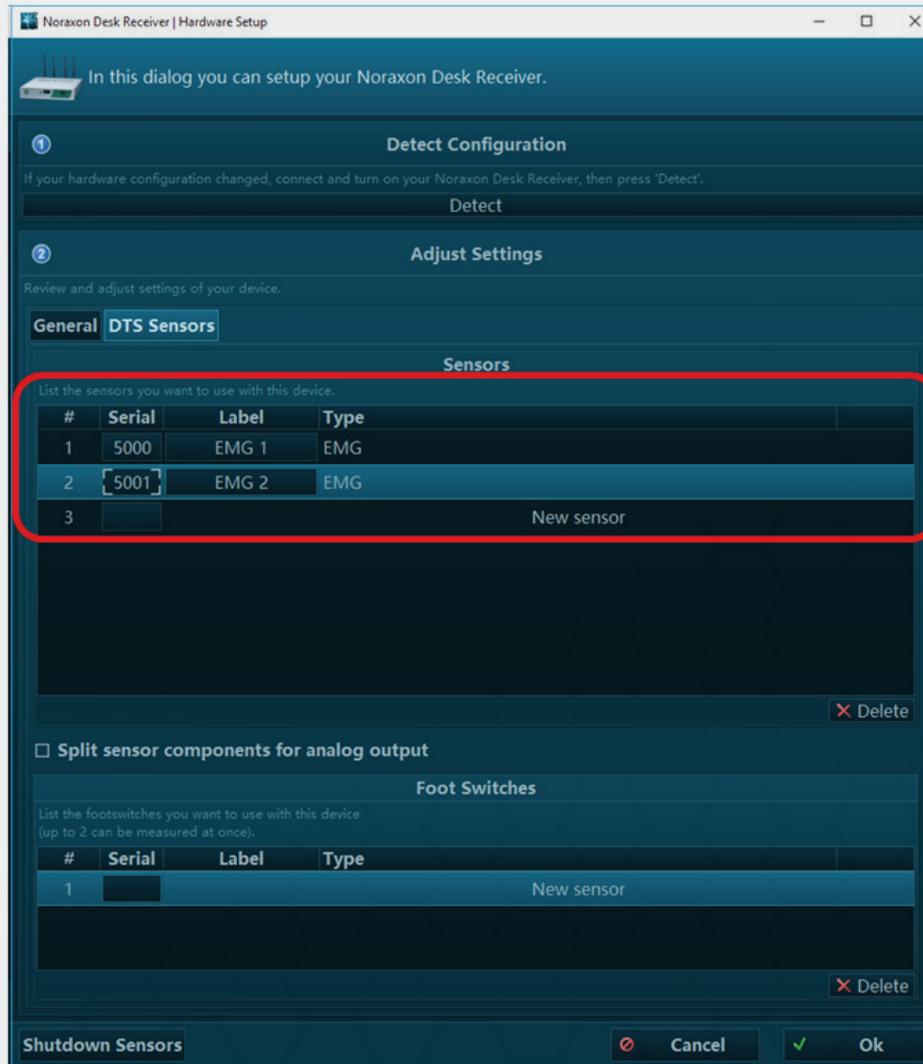
-Confirm the dialog by clicking on close:



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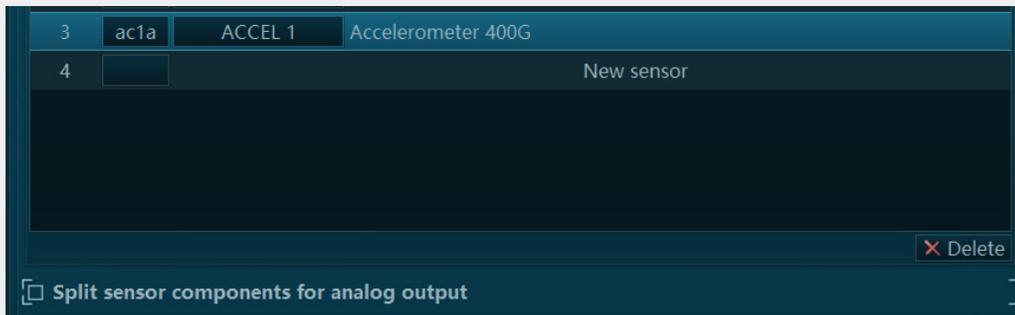
You will then see the following screen:



Section Sensors will be pre-filled based on your order! If you ordered other NON EMG sensors like goniometer or accelerometer they may be pre-filled as well. If for whatever reason they are not, simply enter the numbers found on top of the sensor in channel you desire.



Each given sensor type will automatically be identified by its serial number. For example, if you enter an accelerometer, it will be detected as such.



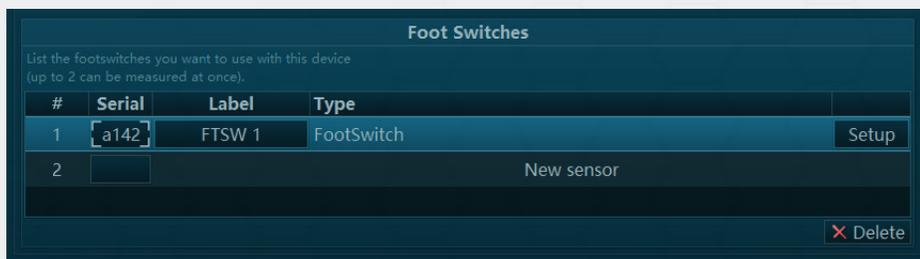
Please not the - **Split sensor components for analog output checkbox**. This function enables that each sensor dimension becomes an individual measurement channel. If not selected all dimensions of a given sensor will be grouped within the given total sampling rate:

e.g. a 3D goniometer in multiplexed mode will measure each dimension at 500 Hz , based on the total sampling rate of 1500 Hz available for each transmission channel/probe. If the split function is selected, each dimension will use its own channel.

- E.g. in an 8 channel system only 5 EMG probes (unidimensional) and one 3D accelerometer (3 dimensions) can be acquired when the split sensor component box is checked.

## Foot switches

Foot switch probe setup is found below the general setup and is very similar:



Two additional footswitches can be measured with 16 EMG probes assigned since foot switches run on an extra radio channel that does not affect the overall amount of assigned sensors.



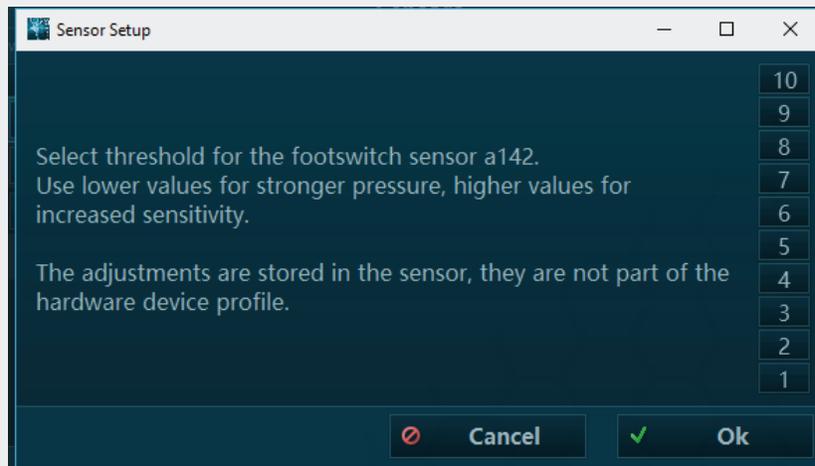
# SOFTWARE

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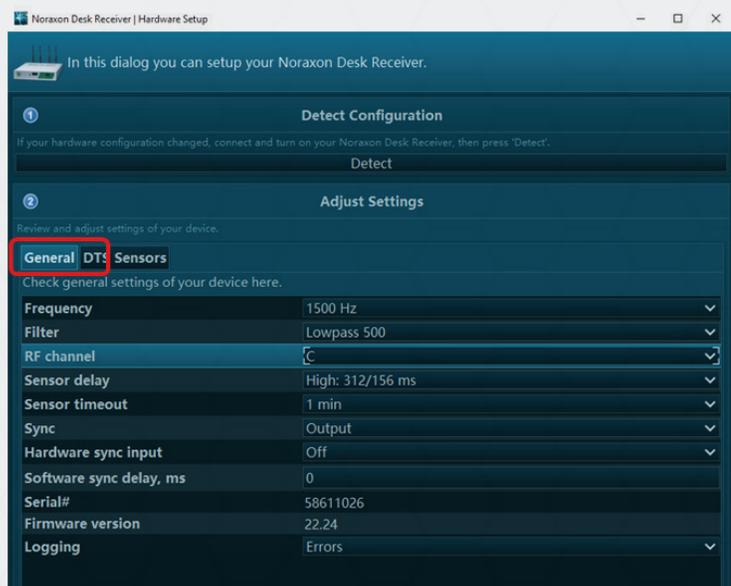
Noraxon offers two sensors for foot switch probes:

- FSR – Sensors** Force Sensing Resistor sensor
- B&L – soles** Foot switch soles with 4 contact areas

The FSR sensors can be adjusted in their sensitivity by clicking on Setup:



### General SetUp



\*Please note, this screen can differ between devices.



<b>Frequency</b>	Choose between 1500 or 3000Hz sampling rate.
<b>Filter</b>	LOW PASS filter – Can be changed from 500 to 1000 or 1500 Hz
<b>RF Channel</b>	Select the best channel for your wireless environment. Do not run multiple wireless devices on the same channel as it will cause interference and spoil measurements.
<b>Sensor delay</b>	Select the delay you would like, there are three total options, with two delays possible based on the selected sampling frequency.
<b>Sensor Timeout</b>	Defines how long a sensor can be out of range before ceasing measurement.
<b>Sync</b>	Sync pulse that can be configured to be sent to other devices or received by other devices. Options are Sync out, Sync In, MyoSync. Sync will be described in more detail later on in the manual.
<b>Hardware sync:</b>	If checked it creates an extra sync channel in the recording that can be used to check the sync timing
<b>Software sync delay:</b>	Not needed or operational for regular use of the system
<b>Serial</b>	Displays the serial number of the EMG device
<b>Firmware version</b>	Displays the installed firmware of EMG device
<b>Logging:</b>	Is set to Errors on default. Logging reports can customized to more logging detail level by changing the logging level to “Everything”. Change this setting only in case Noraxon supports is asking to do so

### Section Lower Button bar

The button Shutdown Sensors allows you to truly shut down all DTS transmission probes. This function is recommended if the sensors will not be used for longer time.



**Attention:** For regular use it is recommended to always place the sensors in the powered charger cradle, which automatically recharges the probes and manages battery condition automatically.

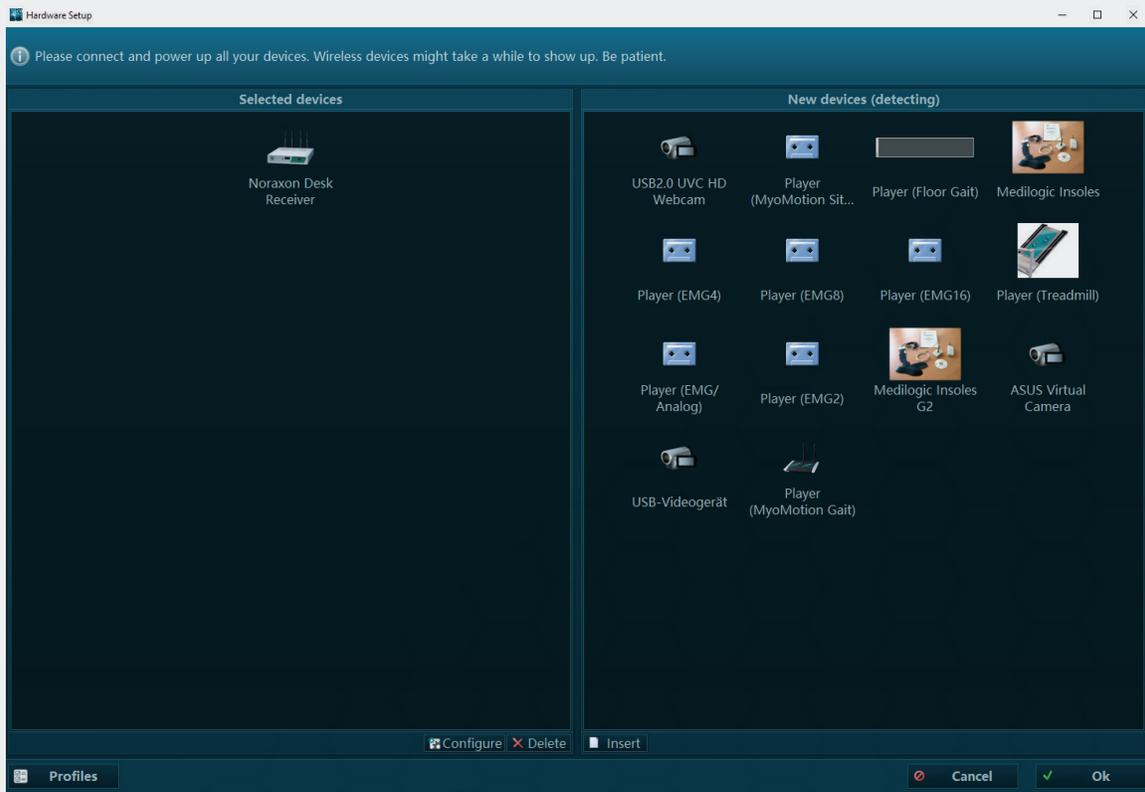


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It is recommended to fully charge sensors each second month to avoid deeper discharging and deconditioning of batteries. They are lithium batteries and behave similar to your phone or laptop.

To confirm all hardware settings click on **OK** and the Noraxon will appear in the section . You are ready for measurement.



Please note, if you need to change the sensors or device settings, click **Hardware settings** on the Actions menu in the top right corner of the home screen and double click the device to be changed, according the previous instructions.

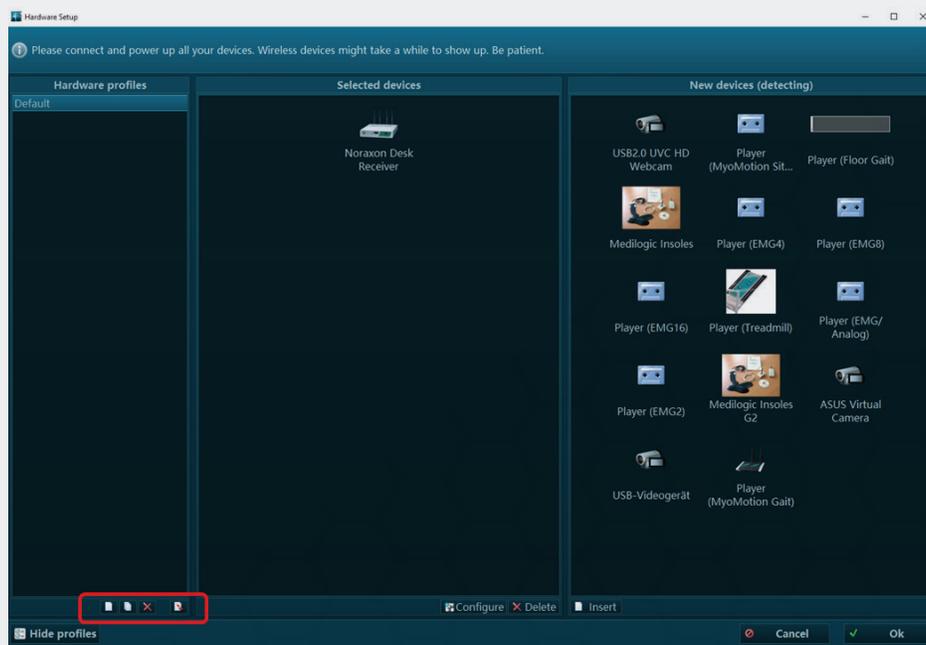


## Hardware Profiles

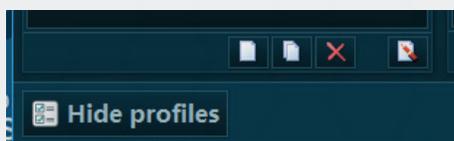
Multiple hardware profiles can be saved. This allows specific hardware setups and device configurations to be saved for later use. This is very useful if more than one EMG and biomechanical sensors are combined in certain multi-device setups.

To create Hardware Profiles:

1. click on the **Profiles** button in lower left corner of **Hardware setup screen**. A new column **Hardware profiles** will appear:



Below the list section four buttons will be presented:



Functions from left to right button:

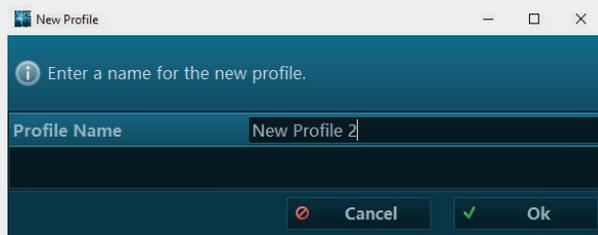
- Create a new item (Profile)
- Copy a selected item (Profile)
- Delete marked item(s)
- Rename marked item



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2. When the new item button is pressed a sub dialog is presented:



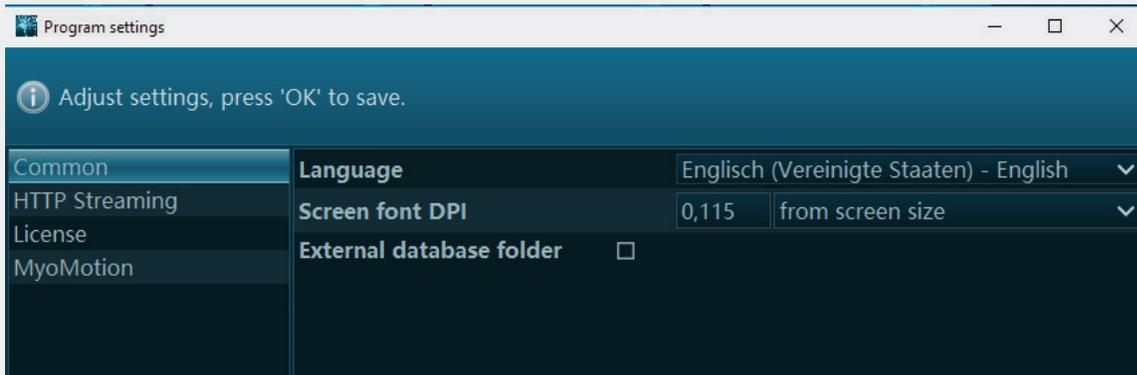
3. Enter a Profile Name and confirm it with OK.

## Software Setup

In the Software setup you can access general software settings as well as some module specific functions:



See next page for continued software setup instructions.



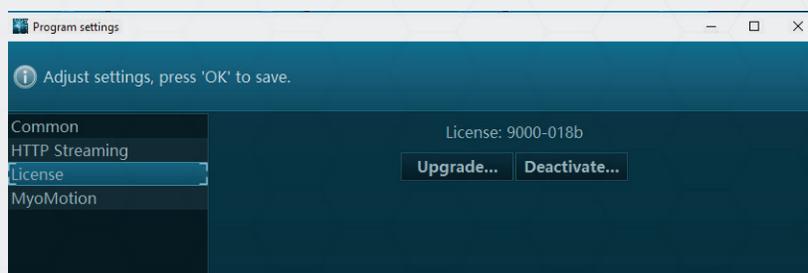
**Language** allows you to change the language. The default language is the language of your installed Windows Operating system. There are four languages currently supported by MR3: English, German, Chinese, and Japanese.

**Screen font DPI** allows you to change the font dots per inch (DPI). 3 options are available:

From screen size	Recommended setting. The resolution is scaled in proportion to screen size and auto scales if MR3 is moved to a window or if the screen size temporarily changes (i.e. when connected to a lower resolution LCD screen projector).
Fixed	This option allows you to manually select a font resolution in DPI.
From System	This option checks the general font size of operating systems and will also use it for MR3.

## License

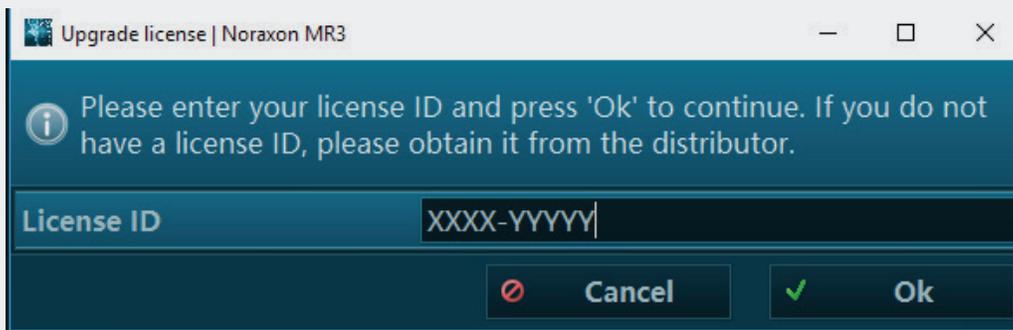
The software and each purchased module within is license protected. If you wish to upgrade your existing license with a new module (e.g. if a myoMUSCLE-only license needs to be upgraded to also include the myoVIDEO module), click Upgrade and follow the on screen instructions.



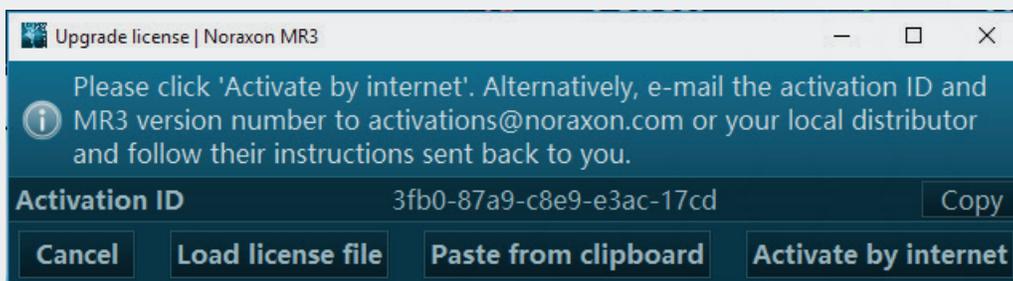


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Your license ID will be pre-filled by the initial activation when installing the software. If you need to change it, enter your new license and hit “ok.”



Click on OK to continue.



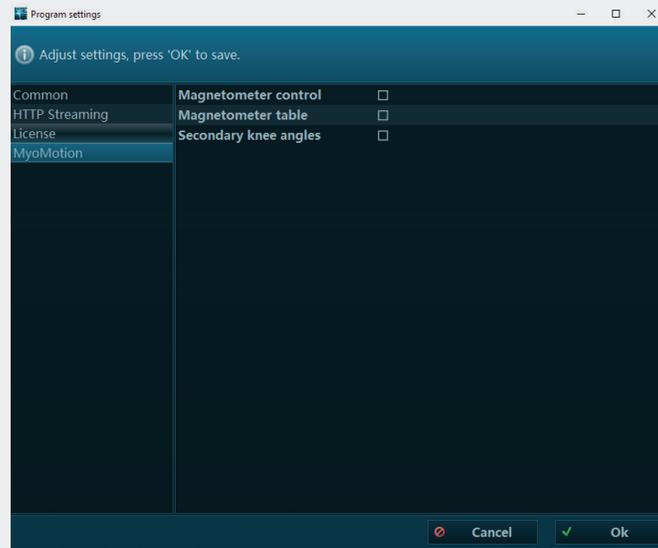
Several options are available now to activate your software.

The easiest way is to connect the PC to internet and use **Activate by internet** option. Alternatively, if you are unable to activate by internet, you may request activation via e-mail by contacting support@noraxon.com and providing them with you activation ID. They will either provide you with a text file or a large activation code. If you receive an activation code, copy it to your clipboard and select **Paste from clipboard** to load it into MR3. If you received an activation file, select **Load activation file** and choose the file provided to you.

## MyoMOTION

**This section is only operational for the MyoMotion 3D inertial sensor system. Ignore it in case of using EMG only.**

**NOTE:** All 3 of the following functions are meant to be used by inertial sensor specialists only! They require a deeper knowledge of inertial sensor technology and kinematic application techniques. Please contact Noraxon support before using these features



<b>Magnetometer control</b>	when checked, the right tool bar menu of the measurement screen will receive a new button: Magnetometer On/Off. It allows you to manually control the magnetometers of all inertial sensors.
<b>Magnetometer table</b>	when checked, a table will be shown in right tool bar of myoMOTION measurement screen. These data show the magnetometer vector magnitude and dip angle with their delta values related to the given overall weighted mean value.
<b>Secondary knee angle</b>	this option allows you to switch the knee joint from 1D (Flexion – Extension) when unchecked, to 3D (plus rotation and varus/valgus) when checked.

**Note:** the latter two angles are heavily influenced by sensor fixation techniques and temporary soft tissue motions with a given activity.



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## Section 3: Software Navigation Overview

### The Main Navigation Bar

The software navigation bar that visualizes the work flow of a typical recording from the Home screen (start) to Report (analysis) is at the very top of the MR3 screen:

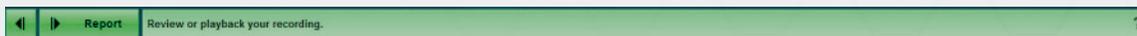


The tab/menu you are currently operating in is highlighted with an orange color and bright background. This navigation bar allows you to directly “jump” into a certain menu if needed.

**NOTE:** Some menus can only be accessed from the previous one in work flow, i.e. a record can only be viewed (**Viewer Tab**) if a record was selected in the previous **Database Tab**.

### Main Operation and Instruction Bar

Indicated by a green color, this bar appears at the top of the software screen underneath the navigation bar. On the left side of this bar is the main operation button in bright green. MR3 is designed so that by pressing this button you automatically operate the next logical step in the work flow. Please read the short instructional text to the right of the operation button to learn which steps or options are available or necessary to continue to the next step.



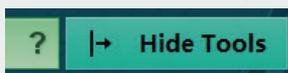
Operation button

Instructional text

Help Button

The question mark “?” to the left of the tool bar is the Help button. When this button is pressed, a pop-up dialogue box will appear with information about the currently displayed tab in the software.

### Tool Bar

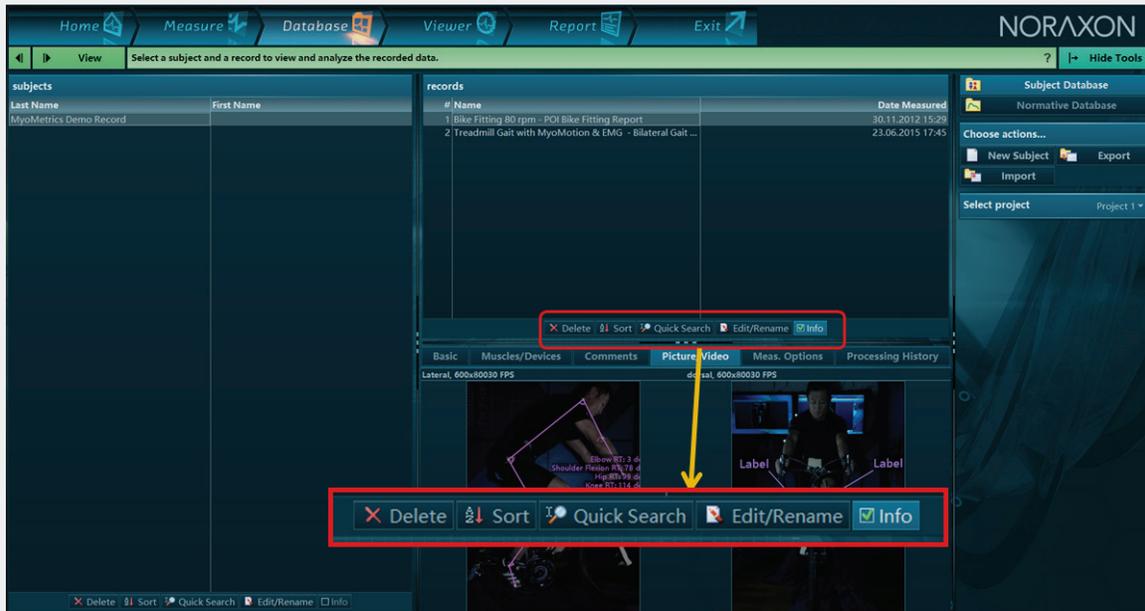


MR3 offers a set of optional tools to adjust or fine tune certain selections, operate menu specific options, or apply optional processing steps to your records. At any time the Tool Bar (located on the right side of the screen) can be opened or closed with the Hide Tools or Show Tools button on the right side of the green instruction bar.



## Local Menu Element Controls

Each menu consists of a set of menu elements, which are equipped with a set of local control tools. You can use these local tools to perform element specific selections and operations as shown for the Database Menu:





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## Section 4: Home Tab

### Introduction

The Home screen menu consists of 3 sub steps that allow you to select a measurement module and select or create a subject and measurement configuration. To do this, perform steps 1 through 3 on the Home screen:

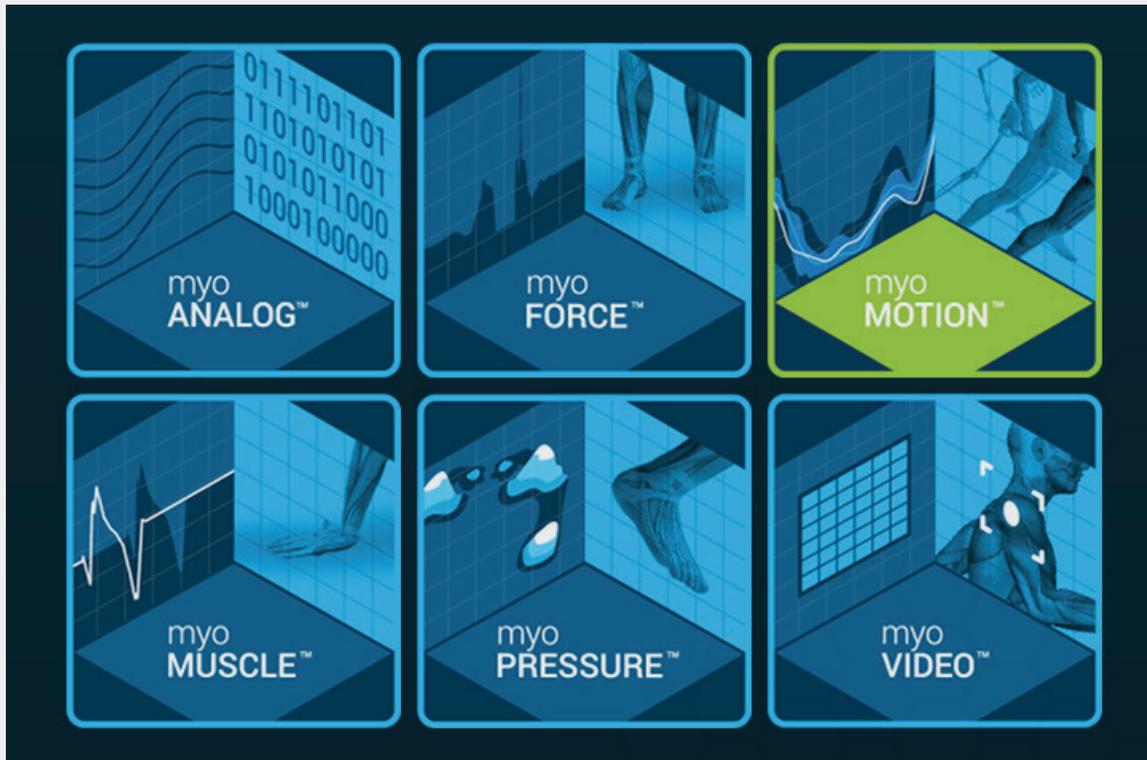


### Select a Module

MR3 is multi-functional software that can operate numerous sensors and devices. Each of these can function as a stand-alone device or module or be used in combination with each other. Step 1 allows you to select the module you would like to use for the measurement. The Modules include myoMUSCLE, for EMG recording; myoMOTION, for 3D motion analysis; myoPRESSURE, for integrated foot pressure analysis; myoVIDEO, for 2D motion capture, myoForce for 3D force plates/jump testing and myoAnalog for general use of Noraxon's AIS AD board. Modules become available once they are purchased and unlocked by the user.

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For this section select myoMuscle as the measurement module.

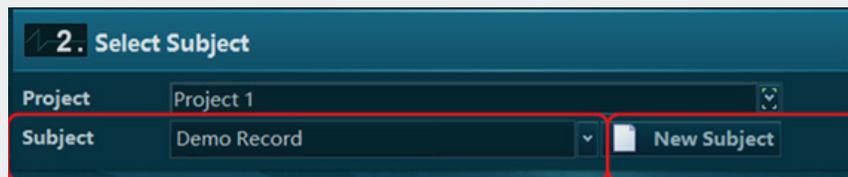


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### Select or Create a Subject

Each record will be saved under the subject. There are an unlimited number of subjects that may be saved to the MR3 database. Subjects may be selected from the drop down menu in step 2. Next to the drop down menu is also the button to create a new subject.



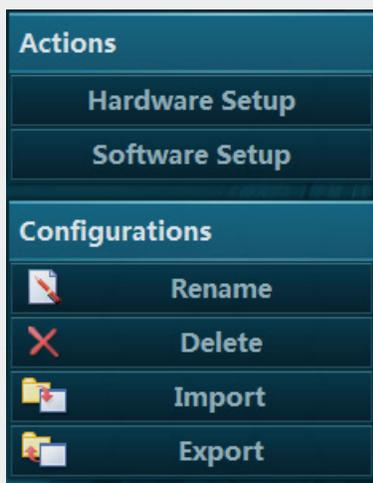
**Note:** Subjects are saved under Projects. A Project may be selected using the down arrow. Projects can be created, renamed, or delete under the Database menu.

### Select or Create a Configuration

Next the user will select, edit, or create a new configuration.

### Right Side Tool Bar

Each tab will have different tools available in the tool bar. For the Home tab, the tools are described below.



### Actions

This section includes the **Hardware** and the **Software Setup** menus as explained in the previous chapters.

### Configurations

<b>Rename</b>	Allows the user to rename the highlighted software configuration.
<b>Delete</b>	This will delete the highlighted configuration.
<b>Import</b>	Use this function to import external configurations to the existing version.
<b>Export</b>	Use this function to export configurations to external locations.



## Section 5: Create a New myoMuscle Measurement Configuration

### Introduction

1. Click on the myoMuscle module icon.
2. Select an existing subject from the database list (use the small pull-down arrow to see full subject list) or create a **New Subject**.
3. Select an existing configuration or click Edit Configuration or New Configuration.

**NOTE:** Clicking New Configuration will bring users to the measurement setup menu. New measurement configurations are stored under the selected module and will be listed under the configuration menu.



Clicking **Edit Configurations** allows already existing configurations to be modified.

MyoMuscle is shipped with some predefined measurement configurations that can be used to check different scenarios on how to setup a measurement by using different setup options.



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They are:

Biofeedback: example on how to use Biofeedback bars for one EMG channel

EMG MVC recording 1 channel: example on how to use online processing to create real time MVC normalized EMG recordings

Incontinence Test sequence: example on how to use multi-activity recording for incontinence testing

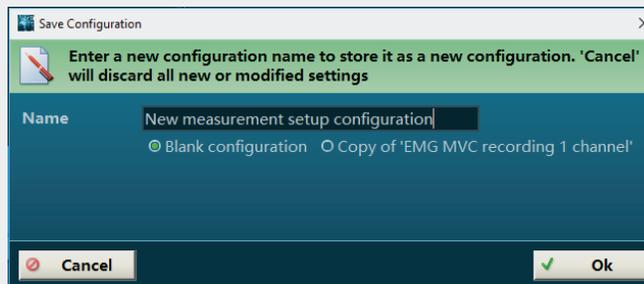
Low Back Test Sequence: example on how to use multi-activity recording for a low back test sequence

4) Click on the green  button once the correct module, subject, and configuration have been chosen.



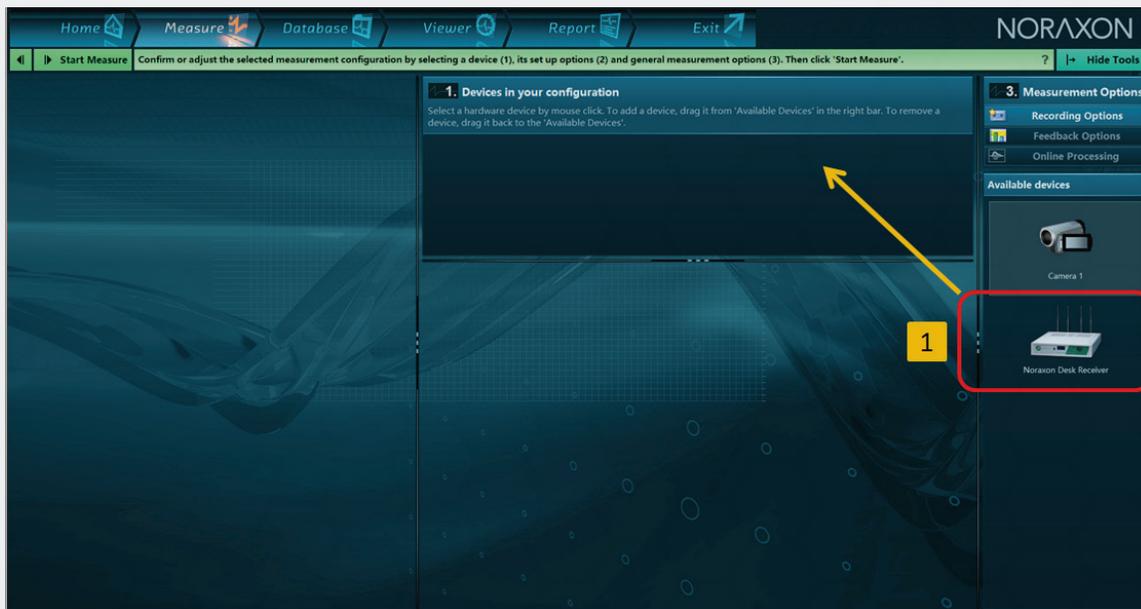
## Create or edit a measurement configuration

After clicking **New Configuration** a small dialog will appear prompting you to enter a name for the new measurement configuration:



Enter any suitable file name and confirm it with Ok.

The measurement setup screen will appear:

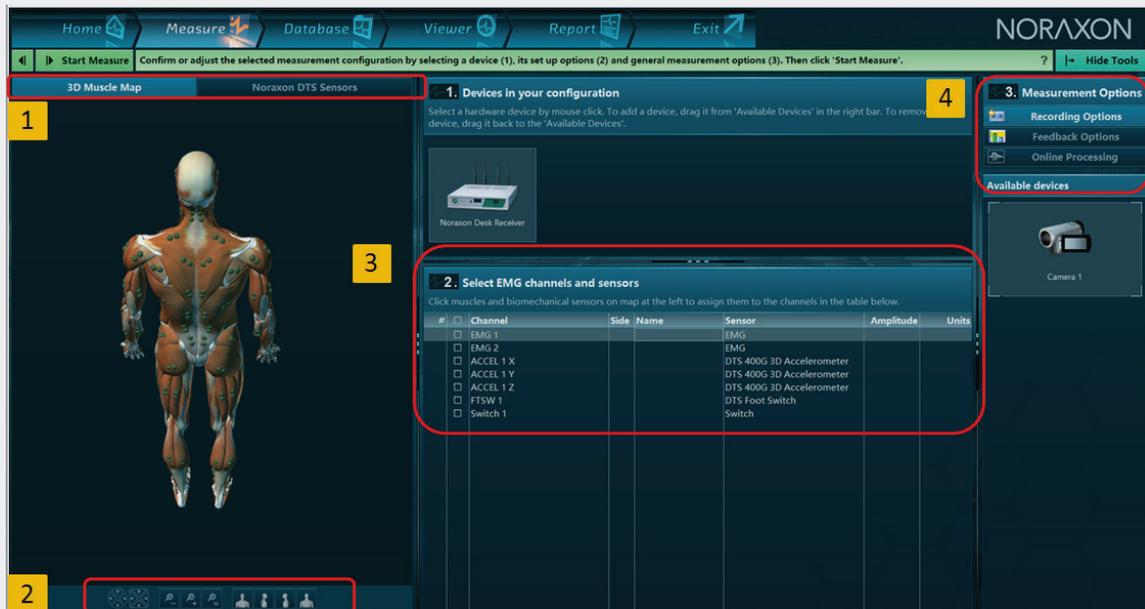


All measurement/recording devices that were inserted in the initial **Hardware Setup** dialog menu are listed on the right hand side in **Available Devices**. Click and drag the EMG system icon to the section **1. Devices in your configuration**. When done, the myoMUSCLE sensor selection screen will appear.



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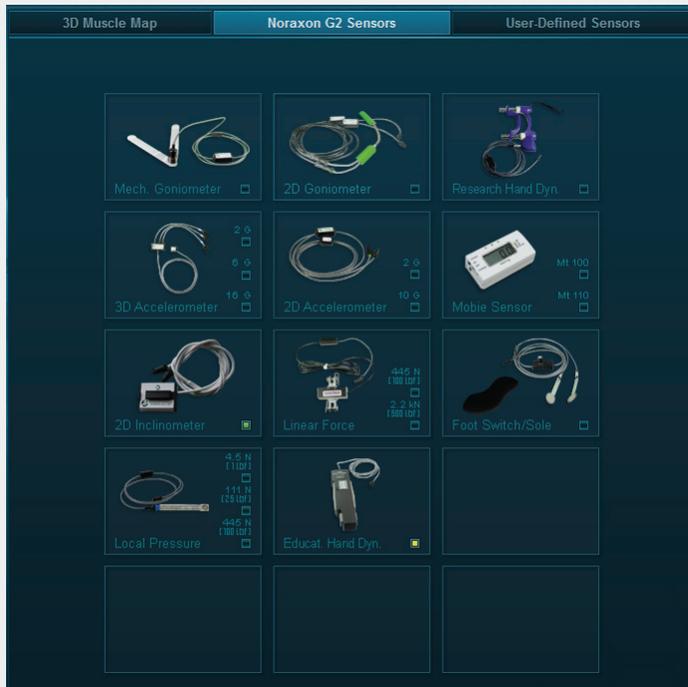
When finished inserting an EMG device, the screen above will appear.

- 1) 3D-Muscle Map and Sensor Map – click on the muscle sites you would like to measure in numerical order, e.g. EMG 1, EMG 2, EMG 3... You select the muscles by hovering the mouse over the two green dots and then clicking. You may also name the muscles yourself.
- 2) Map rotation tools – use these tools to rotate, zoom, and move the 3D animated avatar.
- 3) Channel selection list – each selected sensor will automatically be inserted to the list of selected sensors. This list supports more edit functions for individual naming (**Column Sensors**), side selection (**Side**), and amplitude scaling range (**Amplitude**)
- 4) Measurement Options – these options are related to real-time recording and are explained in section 6.



## Sensor Map

The sensor map manages all NON-EMG sensors such as acceleration, goniometer, or heat rate and appears in two modes:



### A) G2 Mode

All Noraxon systems that work with cabled inline sensors (Myotrace, Myosystem, Telemyo G2) are operated via the **Noraxon G2 Sensors** map. If the Noraxon G2 Sensors tab is selected, a list of sensors from the Noraxon sensor line is displayed:

For example, if a 2D Inclinometer is purchased and physically connected to the selected EMG amplifier (G2 TELEMyo, MT400, or MyoSystem 1400) at channel No. 3, it can now be moved via mouse from the sensor selection map and dropped to channel list position 3.



**Note:** Any combination of available sensors can be chosen, i.e. a 4 channel EMG system can be operated with 4 EMG sensors or with 2 EMG and 2 other available biomechanical sensors.



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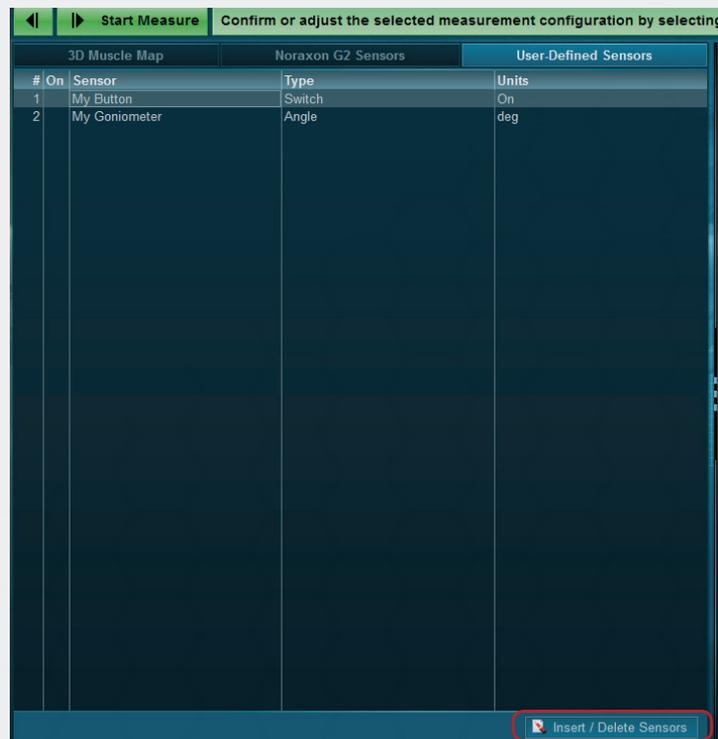
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Experts can create **User Defined Sensor** settings in the neighboring map, where units of measurement can be changed:

3D Muscle Map		Noraxon G2 Sensors	User-Defined Sensors	
#	On	Sensor	Type	Units
1		My Button	Switch	On
2		My Goniometer	Angle	deg

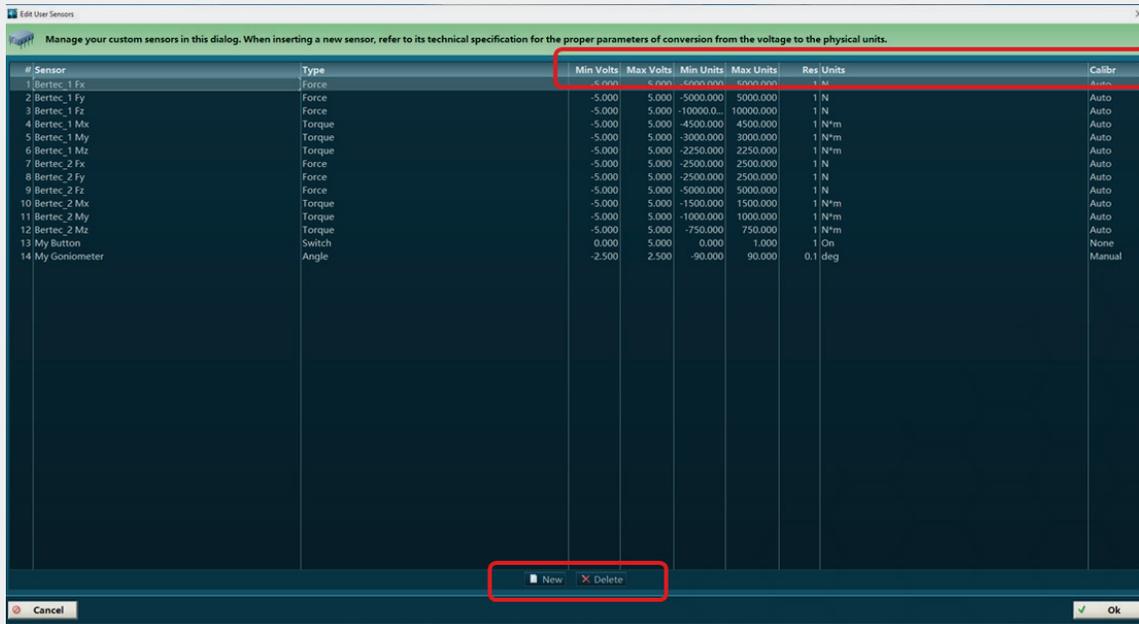
If you plan to connect a third party sensor via Noraxon AIS analog input board or DTS analog input probe, make sure that signal range and PIN connection settings are compatible with Noraxon's sensor input selection. Please refer to the hardware manual of your device for more information.

To insert a new sensor click on **Insert/Delete Sensor** on bottom of screen:





In the **Edit User Sensors** screen click on **New** and enter a name, sensor type, calibration and scale settings:



## Item description:

- Sensor** Sensor name entered here.
- Type** The name of the channel type, related to its physical measurement unit (e.g. force for physical force dimensions). EMG and IEMG are reserved for EMG signals.
- Calibr** The offset correction of the input signal. This can be toggled between Manual (signals are zero corrected by manually pressing the Zero Offset button on the Measurement Monitor), None (no correction), or Automatic (the first 30 data points are used to define and correct the zero offset at each measurement start).
- Res** Defines the number of digits after the decimal point to display on the current amplitude value.
- Units** Defines the measurement units of the device.

## Min Units, Max Units, Min Volts, Max Volts

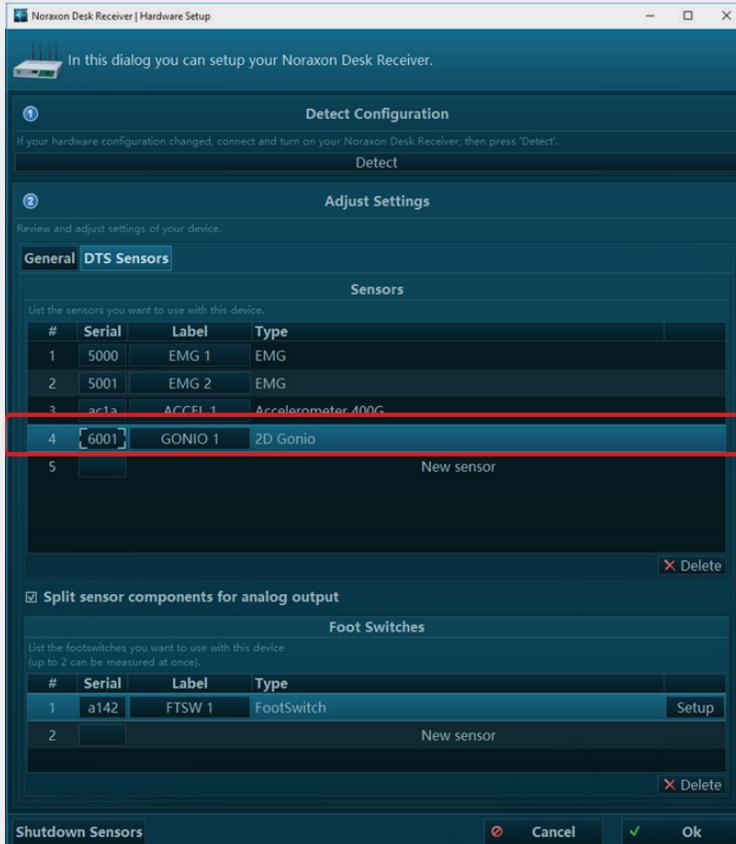
Use these values to define the parameters of conversion from the A/D input voltage to physical units of the device.



# SOFTWARE

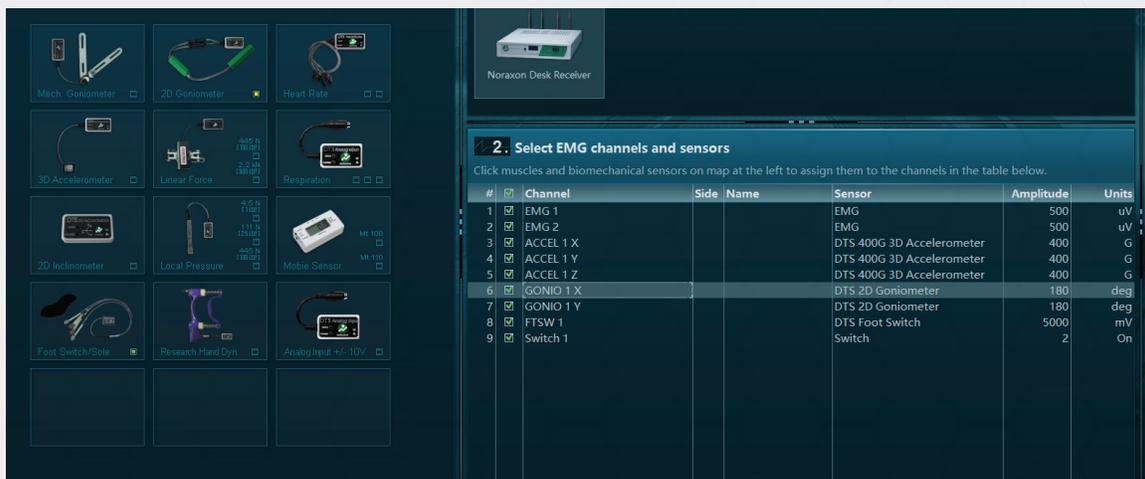
## myoMUSCLE™ MODULE

### B) DTS Sensor Map



For Noraxon DTS System there is a sensor map as well. However, it can only be utilized if the non-EMG sensor is assigned to a certain channel during the hardware setup of the given DTS device. This can be done by entering the serial number of the sensor during hardware setup.

For example, if a 2D goniometer sensor is assigned to channel No. 3 in the hardware setup menu by entering its serial number, it will automatically be detected and listed as a goniometer sensor in the channel selection list (bottom right). It can now be activated (each of the dimensions separately) by the red check mark or the sensor mouse drag operation:





**Note:** Some sensors have 2 or more dimensions (e.g. X, Y, Z), which are listed separately in the channel selection list.

Once the EMG muscle and biomechanical sensor selection is complete the user is ready to proceed to the measurement screen. Make sure the EMG system is turned on, all DTS sensors are taken out of the charger cradle, and that they show a slow blinking green LED status light

## Section 6: Measure Menu

Click on the green **Start Measure** button to continue to the measurement screen.



Incoming EMG and Sensor data are visualized on screen as traces separated into signal sub screens:



**Note:** The Clinical DTS system transmits preprocessed smoothed and rectified EMG data (100ms RMS), which are shown as unipolar positive signals, not bipolar “raw” EMG signals like the other EMG systems.



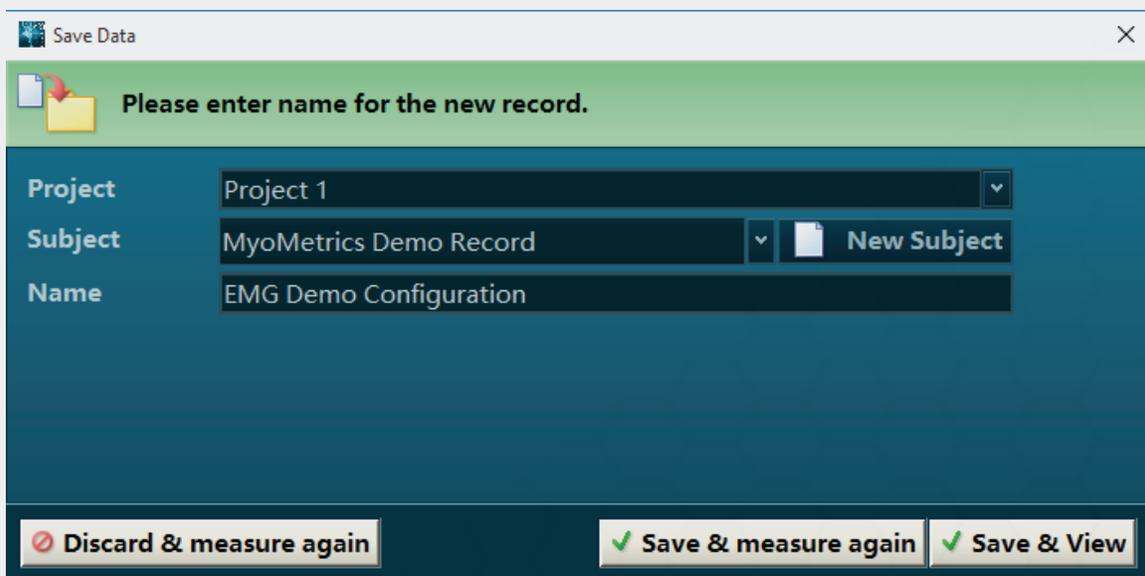
# SOFTWARE

## myoMUSCLE™ MODULE

To start a recording press **Record**, perform the desired activity, and press **Stop**:



The **Save Data** dialog box will now appear and a Name can be entered in the first line.



The second line, **Subject**, allows the user to change, create, or confirm the previously selected subject name. The first line, **Project**, allows you to select another project to save to. After pressing **Ok** the record can be reviewed in the record **Viewer**.

In the lower button line you will find 3 choices to continue:

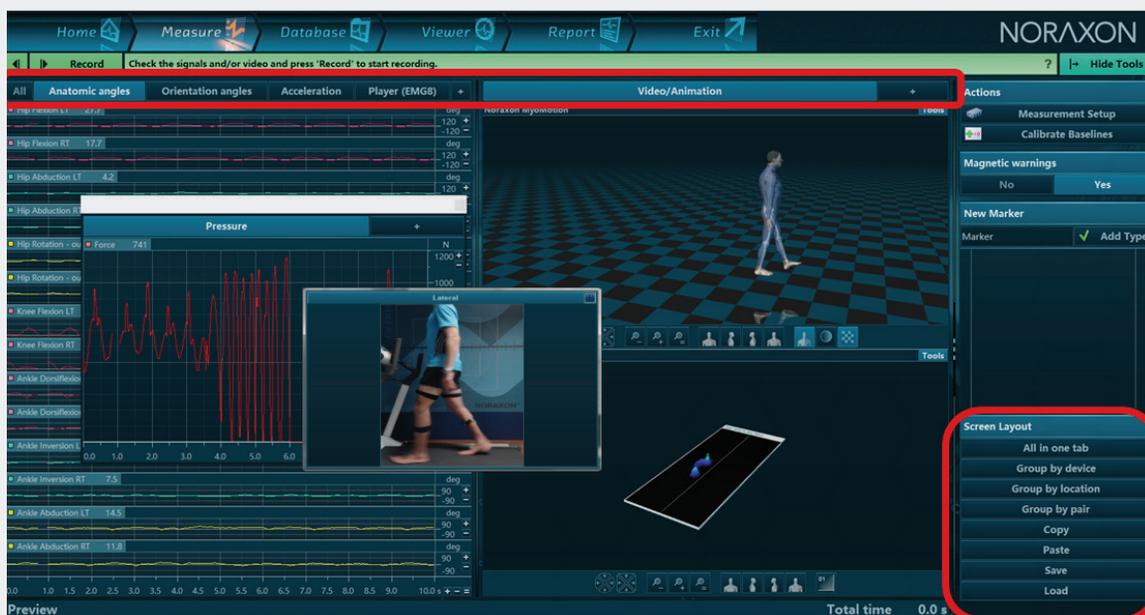
- Discard & measure again** Delete the current recording and automatically go back to measure.
- Save & measure again** Stores the current recording under entered name and automatically goes to measure.  
\*This mode skips the calibration step and allows for continuous recording trials with optional calibration in between.
- Save & View** Stores the current recording and goes back to the Record Viewer.



## Screen Layouts

For multi-device setups, it may be helpful to use the customizable screen layout system of the Measure menu. The layout system is explained by using a multi-device setup including MyoPressure, MyoMotion 3D analysis and EMG.

Generally, each device will have its own specific tab:



MyoMotion can receive up to to 3 tabs:

- Anatomical angles
- Orientation angles
- Accelerations

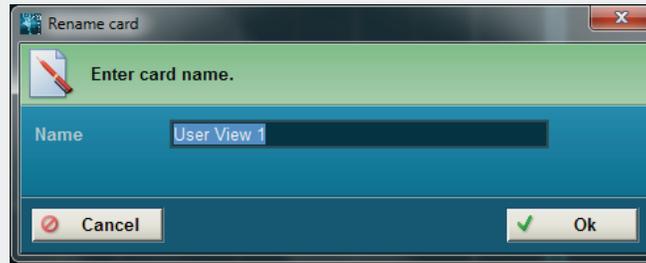
Any single signal from any signal tab section can be dragged into any other existing device tab or into the empty **“+” Tab**.



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At any time any tab can be renamed by right-clicking on the tab name. New dialog will open up:



Then enter any new/suitable name for continuous use.

This screen layout system allows the user to create as many signal selections or new user views as needed. A similar system is available for the **Video/Animation** window:

Double clicking on a given signal name moves this signal into a pop-up window:



The small red X button in the upper right corner of the window title line will close the pop-up window and move back the signal to its original tab location. Do not worry about losing the data.

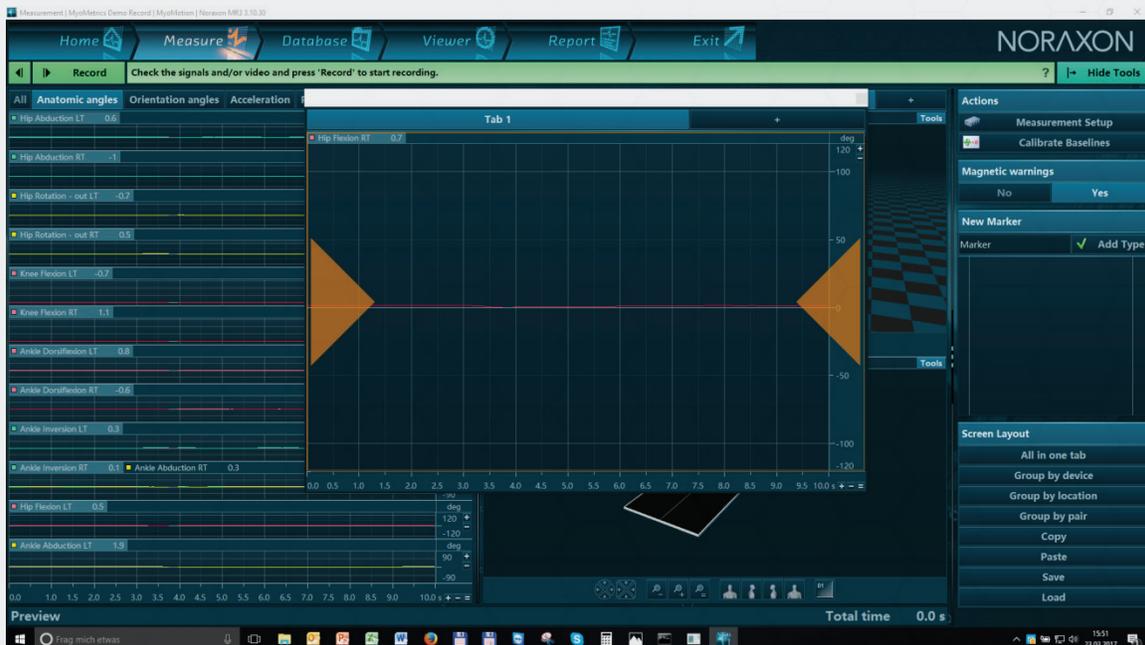
# SOFTWARE myoMUSCLE™ MODULE



If you hold the **CTRL** key and **double click** on a second channel title from the source tab you can insert more channels to the pop-up window. This can also be accomplished by simply clicking and dragging windows into the desired tab:



If you click on a channel name and drag it over another channel, orange arrow buttons will appear indicating if you overlay the dragged channel with the existing (arrow points to the middle):



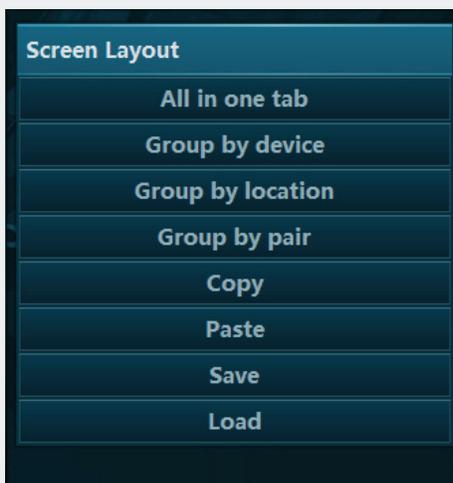


# SOFTWARE

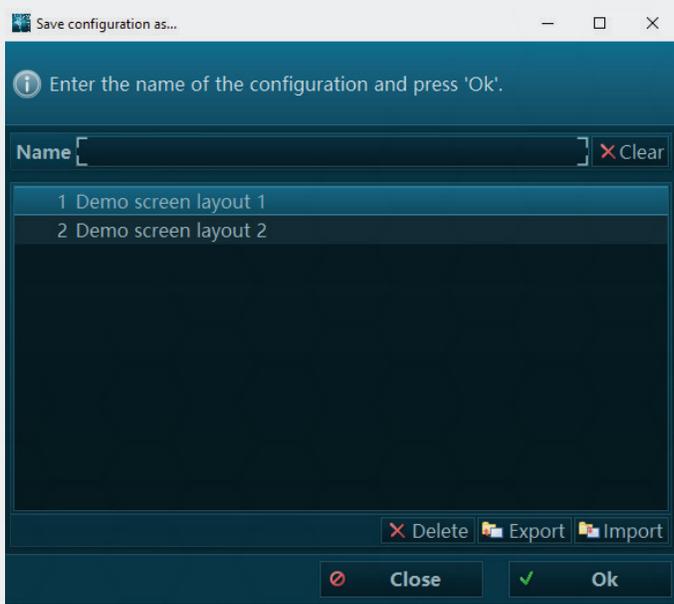
## myoMUSCLE™ MODULE

If you want to insert a channel above the existing one, move mouse up until upper arrow shows up. The same procedure works also for dragging channel below an existing channel (arrow shows down).

Whenever a certain screen/window layout arrangement is established you can **Save** it in the **Screen Layouts** section of the right tool bar.



Click on **Save** and enter a suitable name for your channel layout configuration and it will appear in empty space shown below:



To load a screen layout press the load button in right tool bar.



Other options in **Screen Layouts** are the following:

<b>All in one tab</b>	all signals from one tab will be shown (again) on one shared screen.
<b>Group by device</b>	each device and signal category is shown in separated tabs (this is the default).
<b>Group by Pair</b>	it will overlay all left and right channels from a given device
<b>Group by location</b>	will overlay all available signal dimensions of a given sensor, e.g. all 3 acceleration signals from the right side Thigh sensor
<b>Copy</b>	will copy a layout to clipboard
<b>Paste</b>	will paste it when needed

**NOTE:** The channel layout which was setup in the Measurement menu will be the same in the Viewer menu. However, all layout and channel arrangement functions are still available in the Viewer menu as well.

## Other Optional Measure Menu Functions

The right tool bar of the **Measurement** menu includes a section titled **Actions**. This section is only meant to be used for myoMOTION and myoMUSCLE signal screens and is not active (or needed) for pressure distribution measurements.

If EMG or 3D kinematic motion data have been added, the following optional functions are available:

**Measurement Setup** – Goes back to measurement setup (configuration) screen.

**Calibrate Baselines** - Only needed if EMG and other biomechanical sensors from the TELEmyo G2, DTS, or analog input system (AIS) were included in the recording. For such signals it may be required to correct zero line offset shifts via recalibration prior to recording.

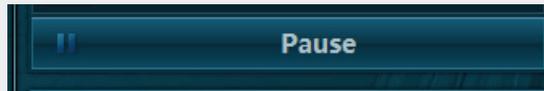




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## myoMUSCLE™ MODULE

**Record** – this button is only available in EMG device stand-alone measurements (no other device, video camera included, is measured). It toggles with a **Pause** button:



This button allows you to pause and continue the recording (press right tool bar **Record** button again) so that all recording data are recorded into one file but the pause sections are excluded. To stop the Right Tool bar Record/Pause loops press the green **Stop** button on top left corner.

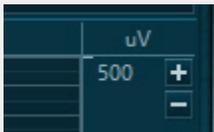
### Local amplitude zoom function

By default the amplitude scaling for EMG and other signals is predefined in the measurement setup column **Amplitude**:

2. Select EMG channels and sensors

Click muscles and biomechanical sensors on map at the left to assign them to the channels in the table below.

On	Channel	Side	Name	Sensor	Amplitude	Units
<input checked="" type="checkbox"/>	1	RT	VMO	EMG	500	uV
<input checked="" type="checkbox"/>	2	LT	VMO	EMG	500	uV



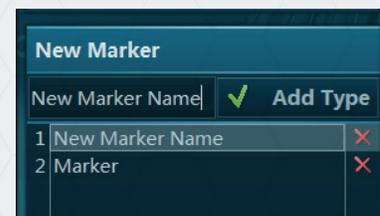
In measurement and recording the given amplitude (Y-axis) scaling can be changed by using the local zoom plus/minus buttons

If you **hold the Shift Key** on the keyboard and click on the plus/minus buttons, scaling is applied to all measured channels of the same type.

### Real Time Marker Menu

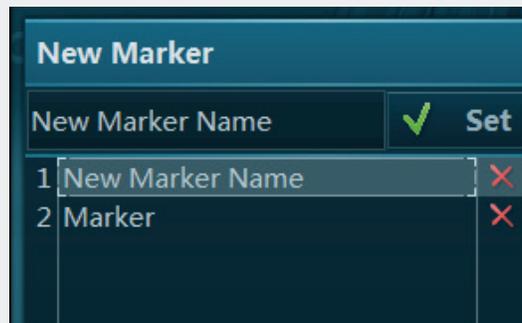
With this menu you can create marker names and manually mark or comment on events in your recording.

The default marker name is Marker. If you want to create a new marker name, **double click** on the Marker name entry box and overwrite the existing one, click the green check mark button, and this new marker name will be inserted to the list of available marker labels:





**To use** a marker name from the list **double click** on it (don't use the green Add Type button). **To delete** a marker from the marker label list, click on the red X right side to each marker name. As soon as you change measurement preview mode to recording mode (by pressing on the green Record button), the Add Type button will change to a **Set** Button:

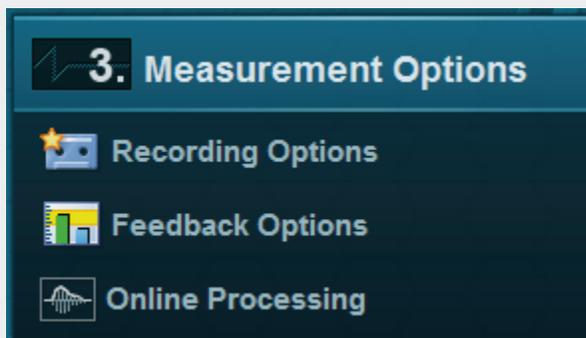


Once recording has started, clicking the **Set** button will place a marker in the record (displayed in the Viewer menu) as well as provide an audio cue. A successfully placed marker is indicated by a short tone. Alternatively the space bar can be used to place a marker in the recording.

## Measurement Setup/Configuration – Measurement Options

Some additional options to manage, control and operate a measurement are available here. For detailed explanations please look to the chapters below.

On the right side tool bar are the Measurement Options including: Recording Options, Feedback Options, and Online Processing.



### Recording Options:

After pressing this option you can select between two different recording modes:

- Standard
- Multi-activity with screen commands



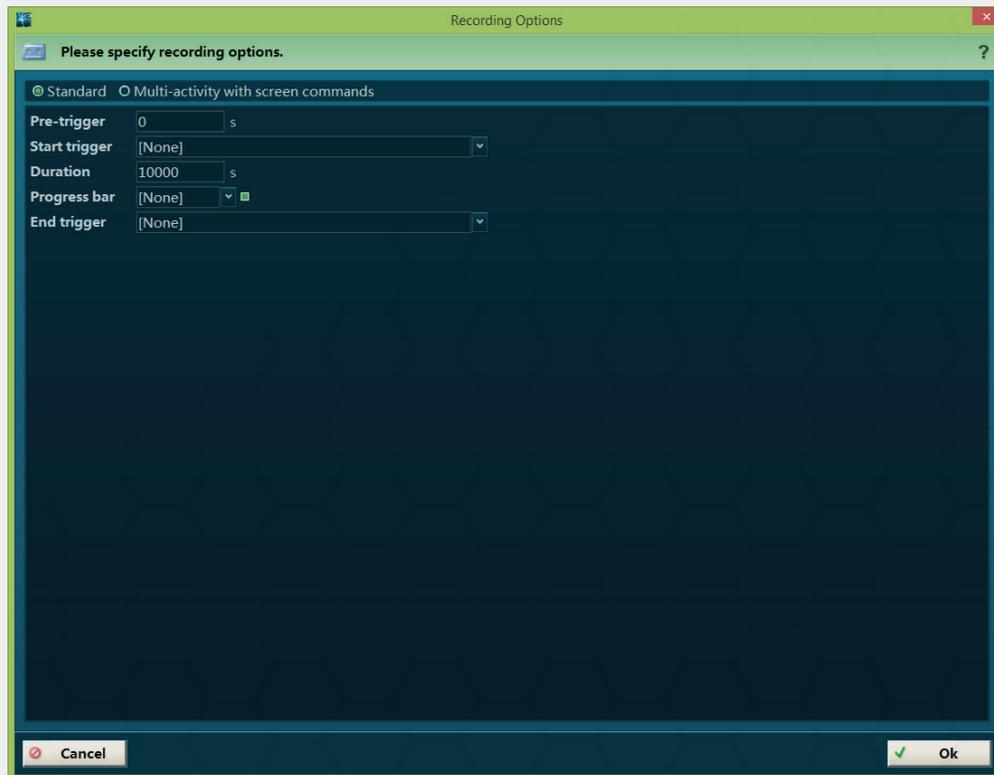
# SOFTWARE

## myoMUSCLE™ MODULE

### Standard Recording Option:

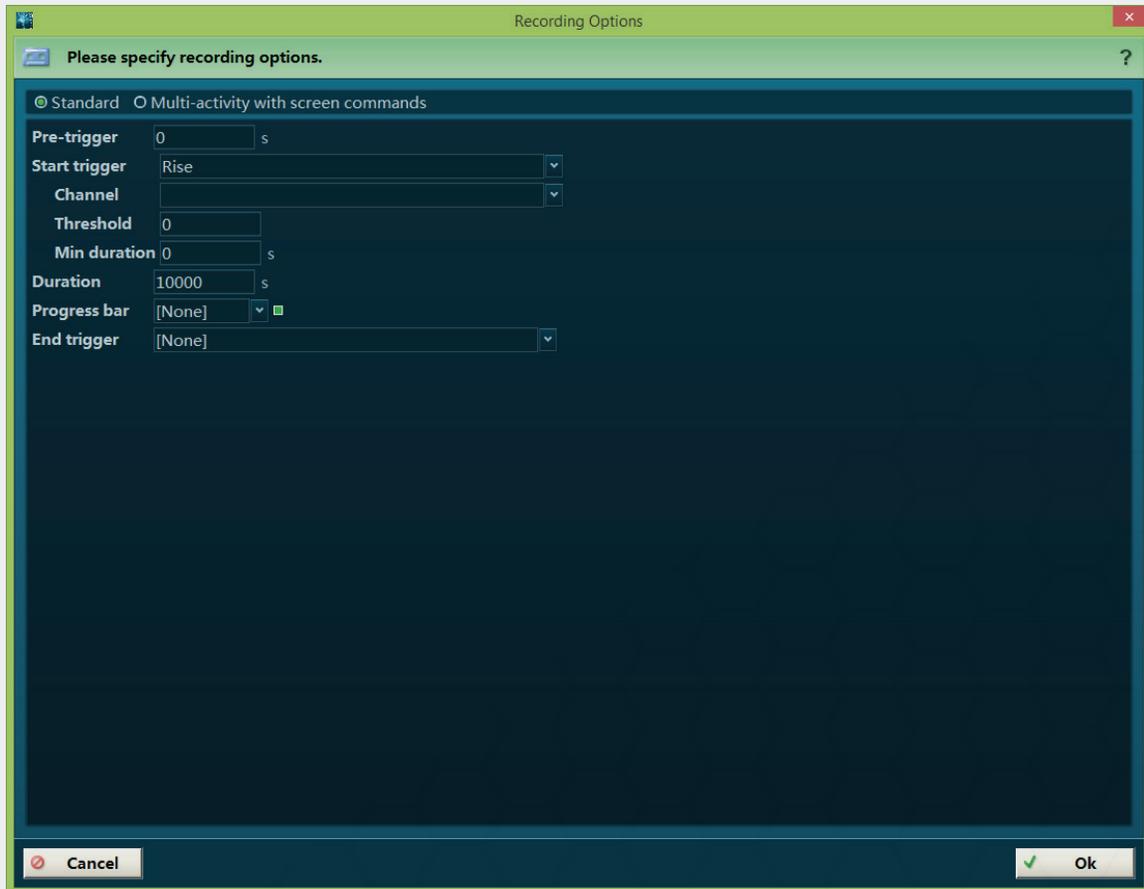
This sub menu manages Trigger start and Pre-trigger settings.

<b>Pre-trigger</b>	Specifies the recorded portion before trigger is initiated.
<b>Start Trigger</b>	Defines the TTL type: Rise or Fall.
<b>Channel</b>	Determines the trigger channel.
<b>Threshold</b>	Defines the amplitude value that must be exceeded or passed to initiate the trigger.
<b>Duration</b>	Is a predefined time for the overall recording; also works without triggered recording start.
<b>Progress Bar</b>	Activates a progress bar just below the signals screens to indicate the overall remaining time of recording.





The user can set the recording to have a starting trigger and end the recording by another trigger, or the user can record for a specified duration of time. The triggers are set according to the rise or fall of the signal on the specified channel.



Once the channel is selected, choose a threshold and a minimum duration the channel must stay above in order to activate the trigger.

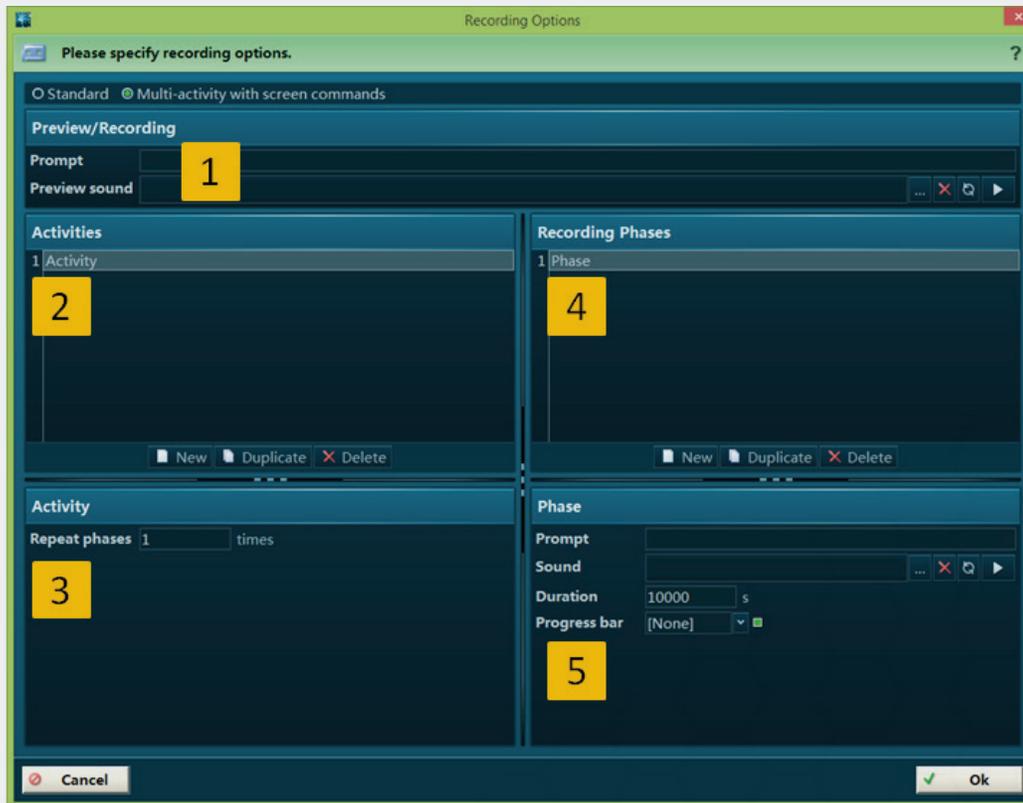
### **Multi-activity with Screen Commands**

This menu allows you to create and define screen command assisted recordings containing sequences of test activities. In addition to the screen commands, voice commands can also be integrated. This function is meant to be used for standardized test sequences with predefined activities, duration, and repetitions.



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### 1. Preview/Recording

You can create a screen **Prompt** and **Preview Sound** for the “prepare” period prior to beginning recording.

### 2. Activities

A set of activities can be created here. Each activity again consists of a sequence of motion phases like extension or flexion.

The controls **New**, **Duplicate**, and **Delete** allow you to edit phase operations.

### 3. Activity

The entry **Repeat Phases** allows you to repeat the whole activity and its motion phases a selected number of times.



#### 4. Recording Phases

In this section you can create a set of motion phases for a given activity.

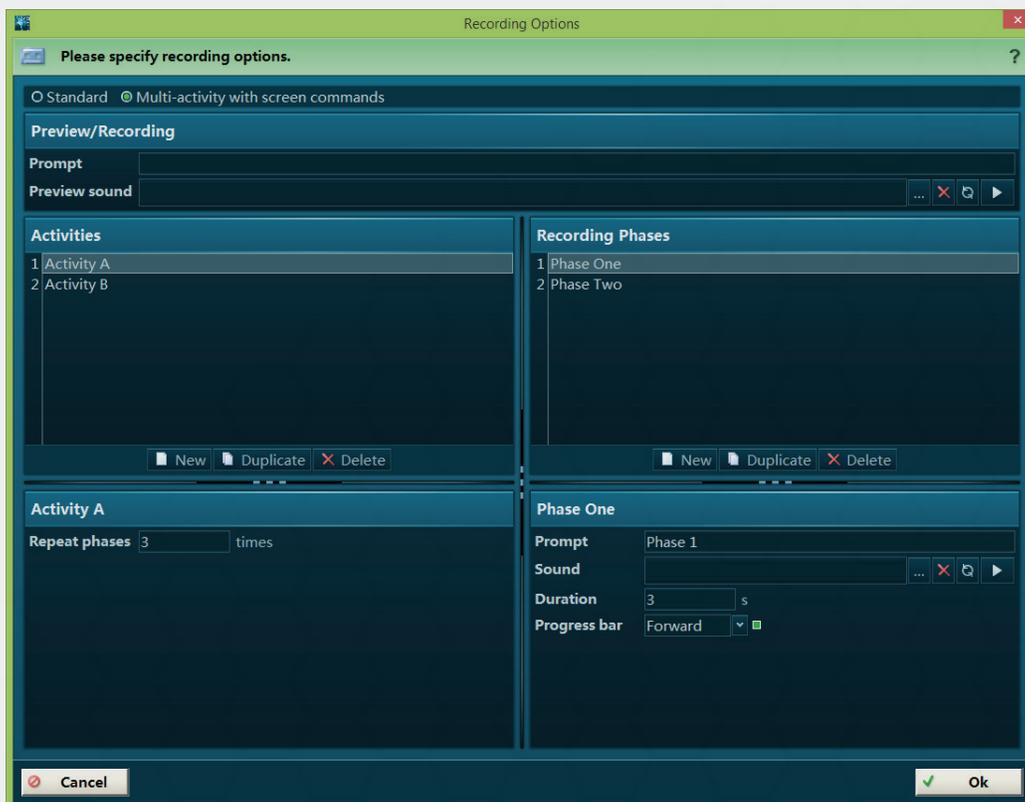
The controls **New**, **Duplicate**, and **Delete** allow you to edit phase operations.

#### 5. Phase

In this section you can define:

<b>Prompt</b>	Screen command for the given phase.
<b>Sound</b>	Sound for the given phase.
<b>Duration</b>	Duration of the given phase.
<b>Progress Bar</b>	Progress bar indicator and its direction.

Setup example:





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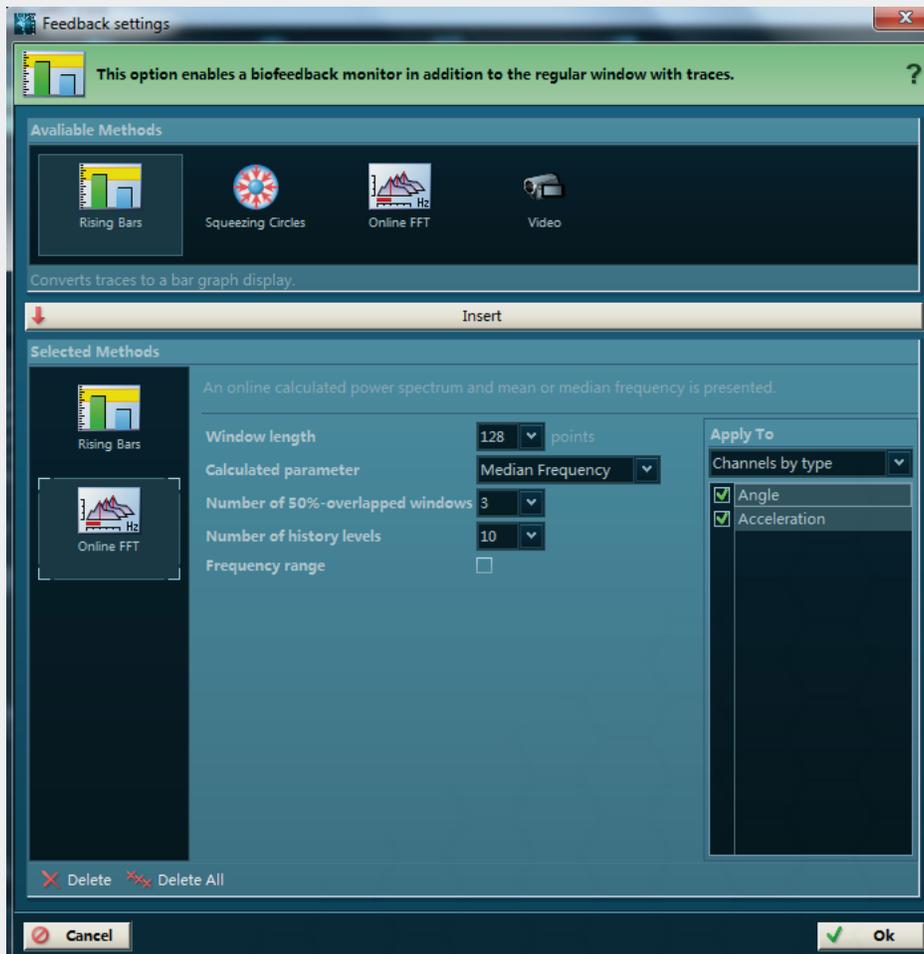
Measurement Screen example:



- 1. Phase 1** Name of the running phase in setup.
- 2. Activity A** Name of the running activity, first run of 3 (as defined in Repeat phases).
- 2. Phase One** Screen prompt of running phase (as defined in Prompt for phase).
- 3. Progress bar** Forward, as defined for this running phase.

### Feedback Options:

Feedback options will convert the signals into one of the three available signals based feedback display options. An additional fourth feedback method refers to video replay.



The signal from any sensor can be used for biofeedback via rising/falling bar graphs, shrinking cycles (designed for incontinence training), or real time FFT analysis via cascading power spectrums.

The basic idea of biofeedback is to present the signal amplitudes in easy-to-read displays and threshold ranges to provide a target for EMG activation or relaxation or joint angle movement. Currently two types of biofeedback modes are available: Rising Bars, which can be used for general purposes, and Squeezing Circles, which is a special signal presentation for pelvic floor muscle training.

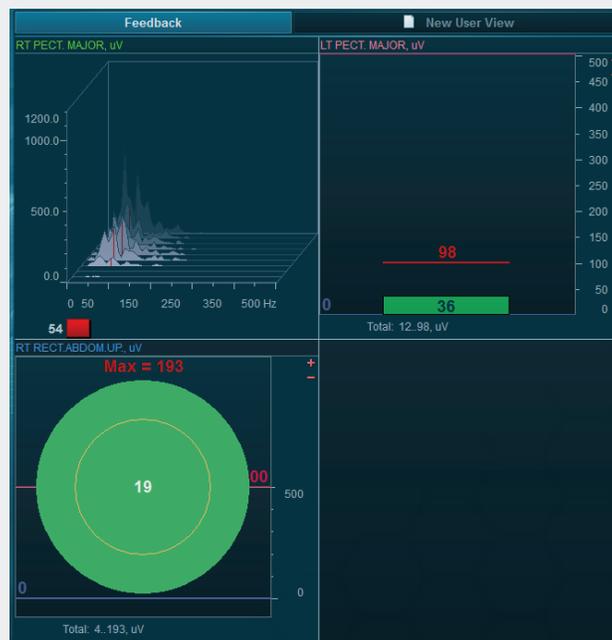


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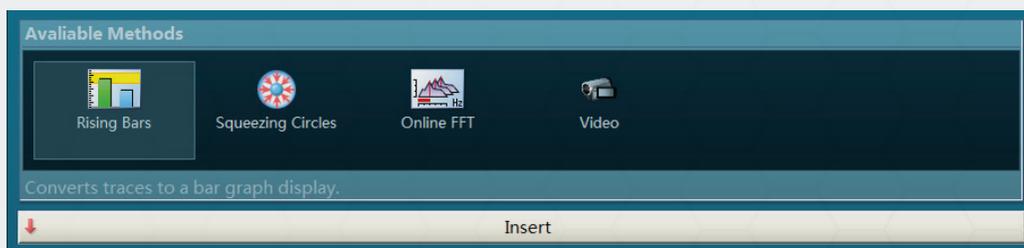
## myoMUSCLE™ MODULE

The **Online FFT** is a special form of biofeedback because it cannot be directly controlled by voluntary efforts. It displays changes in the EMG frequency during contraction.

This graph shows all three signal related biofeedback modes:



To select a feedback mode click on it and press **Insert** to load it to the list of selected operations:



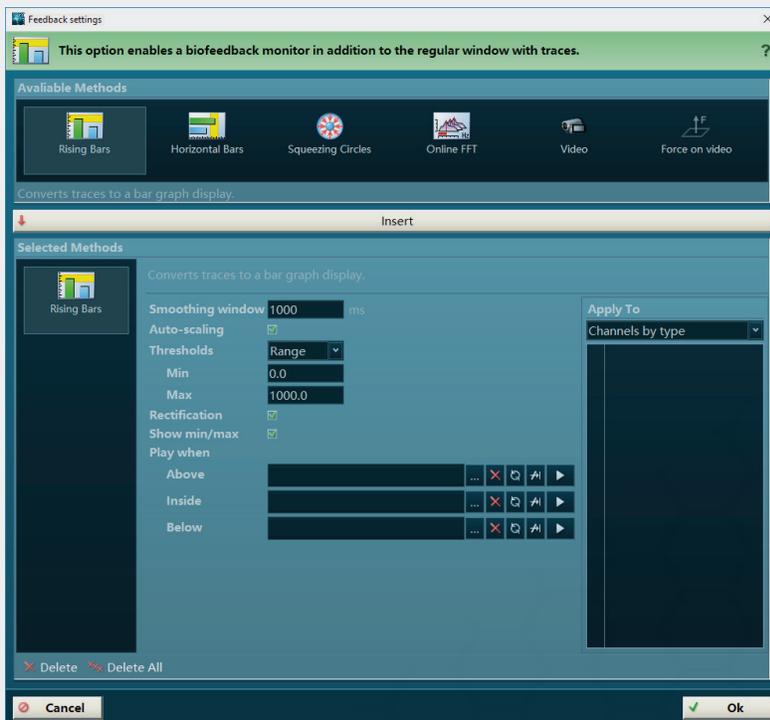
**NOTE:** Feedback methods can be loaded several times if needed.

Once a feedback option is selected, the settings for that particular feedback option will be displayed. Here, the user can change options such as smoothing, thresholds, audio cues, and choose which channels to apply the feedback signal(s) to.



## Rising/ Horizontal Bars

The basic idea of biofeedback is to present the signal amplitudes in easy-to-read displays and threshold ranges to provide eg. a target for EMG activation or relaxation, or joint angle movement. **Rising Bars** can be used for general purposes (e.g “Up” training for EMG innervation), **Horizontal Bars** can be used for e.g. left / right rotation angles of MyoMotion angles and **Squeezing Circles**, which is a special signal presentation for pelvic floor muscle training.



**Smoothing Window** – Typically, EMG signals are visually highly variable and it may be necessary to “smooth” them in both speed and amplitude.

Use the **Smoothing window** to define a time range to apply a moving average to. Factor that slows down the EMG spikes and makes it easier for the subjects to control the activation within a certain level. This smoothing is strictly a display feature for the bar graph and does not affect the recording and signal processing of the data.

**Auto scaling** – If active, the optimal amplitude scaling for the bar graph is calculated by the software and used.

**Thresholds** – Both range threshold and single line/value thresholds are supported. You can add a threshold range to the bar graph display by defining a minimum and maximum threshold range value. The threshold range is displayed as a yellow background area and typically serves as a target area for the EMG activation or amplitude level of any other selected signal type.

The “play when” feature section allows you to set an audio signal to play when the signal is above, within, or below the threshold range/value identified in the Thresholds section.



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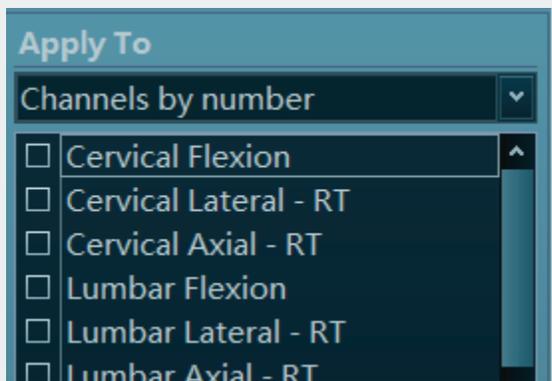
There are a number of pre-loaded sounds in the Noraxon directory. However, you may upload any sound file you wish by copying it into the “sounds.object#” folder, which can be found via the directory path shown below.

 > This PC > Local Disk (C:) > Program Files (x86) > Noraxon > MR 3.8.6 > noraxon.mr3.edition# > sounds.object#

Your sound clips must be in the \*.wav file format to be used.

### Rectification

If checked, bipolar signals and their negative portions will automatically be rectified; the bars can only rise from zero to positive values. Uncheck this control if you want to have biofeedback bars move to negative (below zero) and positive range.



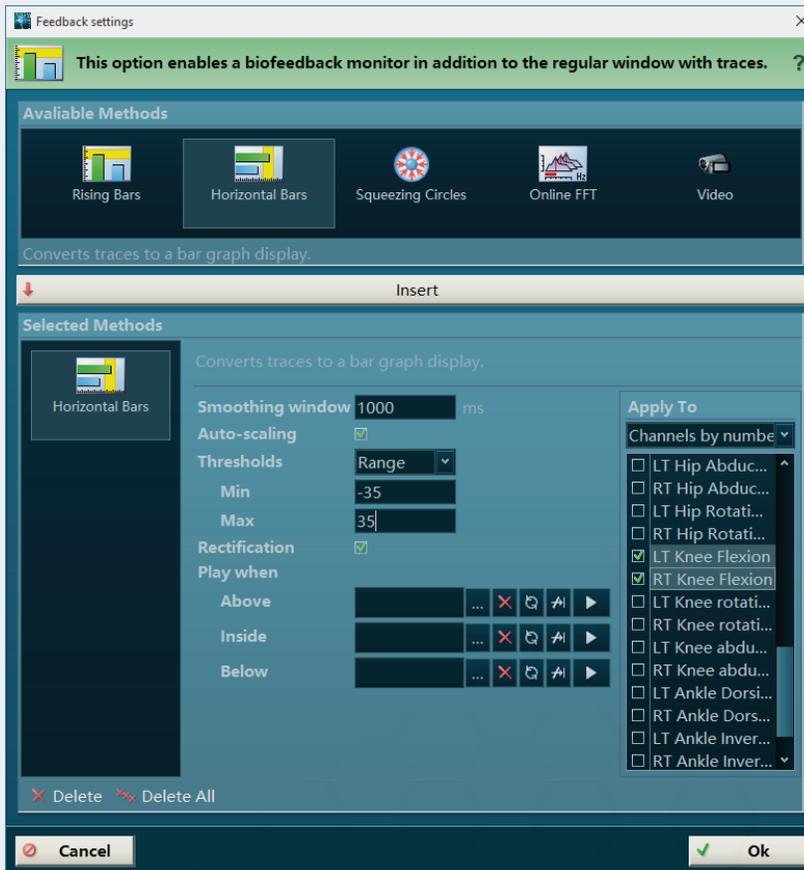
**Apply To** – This control allows you to activate (enable) the biofeedback display for a given channel type or a physical channel number. To access specific channels, use the small down arrow on the right side to change from Channels by Type to Channels by Numbers.



## Horizontal bars

For some signals, like MyoMOTION trunk lateral flexion to the left and the right side, it may be more appropriate to use a horizontal orientation of bars.

The setup menu for horizontal bars is exactly the same as for Rising bars.



## Squeezing Circles

This feedback type has the exact same functionality as the Rising Bars described above. The only difference is that any amplitude increases or decreases the diameter of the circle. This feedback style is designed for pelvic floor training, e.g. incontinence training, and should reflect the contraction of vaginal or anal muscle rings.

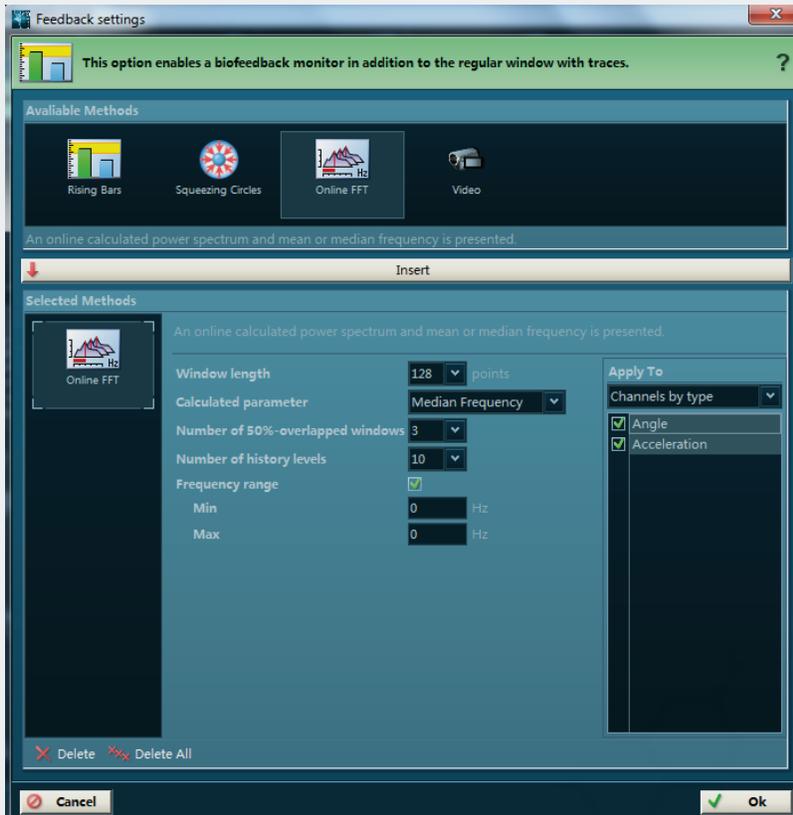
## Real Time FFT

A real time frequency analysis is performed while monitoring/recording the data. Depending on the FFT window length, there will be a short time delay for this calculation.



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**Window length** – This is determined by the number of data points used for the FFT, anywhere from 62 to 4096 data points are supported. The calculation time will increase with increasing number of data points.

**Calculated parameter** – You can choose between the mean and the median frequency. Number of 50%-overlapped windows – The amount of window overlapping can be specified here. This switch has a smoothing effect in the FFT display.

**Number of history levels** – This number defines how many power spectrums are shown in the cascading window.

**Apply to** – The real-time FFT can be applied to channel types or selected channel numbers.

### Video Feedback

With this option you can select a video clip and let it play whenever the threshold criteria is fulfilled. If the signal leaves the threshold range video play was assigned to, it stops playing and will continue as soon as the signal reaches threshold range again.

### Force on Video

Attention: not compatible with MyoMotion

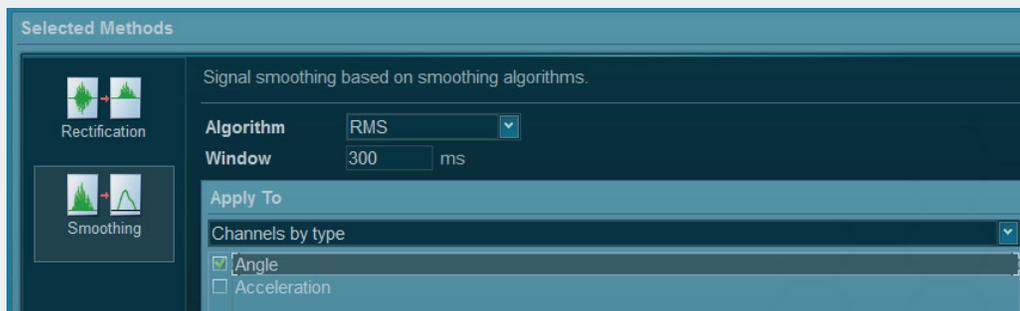
This feedback mode was designed for 3D force plates and it creates a force vector /video overlay.



### Real Time Processing:

Real time processing is identical to the Signal Processing menu in the record viewer menu. As the name indicates, all processing is operated in real time while data are recorded. This function can be very helpful in certain feedback tasks (e.g. training subjects in real time or simplifying the recording and analysis process via automated real time processing).

For more information please check the Record Viewer / Signal Processing chapter below.



### Online Processing

Real time processing is identical to the Signal Processing menu in the record viewer menu. As the name indicates, all processing is operated in real time while data are recorded. This function can be very helpful in certain feedback tasks (e.g. training subjects in real time or simplifying the recording and analysis process via automated real time processing).

For more information please check the Record Viewer / **Signal Processing** chapter below.

#### Online MVC amplitude normalized EMG recording

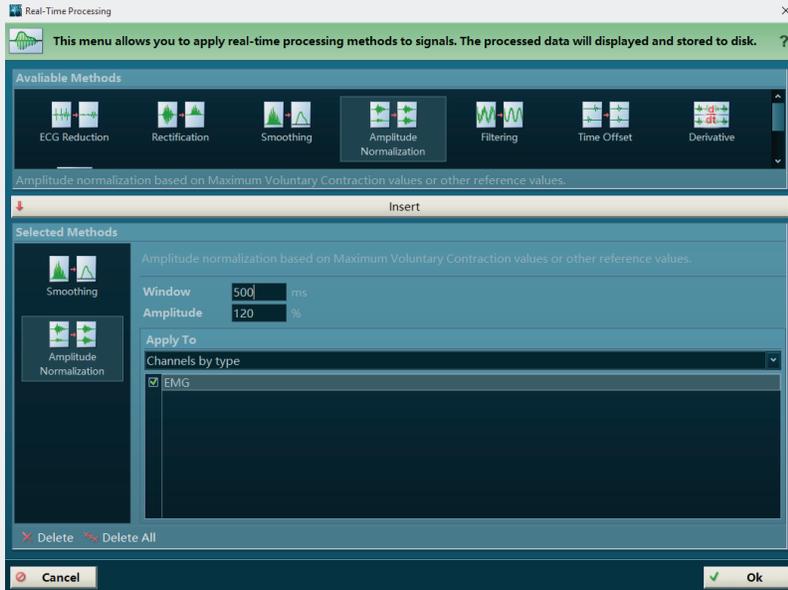
Within Online processing there is one special function that allows running real time amplitude normalized EMG recordings.



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This instruction scheme guides you through the operation steps to record MVC normalized data in real time:



1. Create a measurement configuration with at least one activated EMG channel

2. Staying in this measurement setup configuration, press **Online processing** in the right tool bar and select RMS smoothing (100ms Window) and MVC normalization with a time window of 500ms, for example (the mean EMG value within the highest signal portion of 0.5 seconds duration will be the MVC value)

3. Confirm with OK and click Measure again to enter the measurement window.





There is a new button in right tool bar called **Make MVC**.

4. Press Make MVC to start the MVC recording, which allows you to perform maximum voluntary contractions for each muscle.
5. When done with all MVC contractions, press the green Stop button in upper left corner and save the record e.g. under name "MVC record".



6. Click **Save & measure again** to continue with the first trial. The signals are now real time processed to MVC normalization to the "MVC record" just made and can be stored like a regular record.

This MVC online normalization is especially helpful in Biofeedback regimes where subjects should contract in MVC specific ranges.

Note: Online processing can be restored back to raw EMG in record viewer signal processing menu if needed. Simply click the "**Show raw signal**" button.



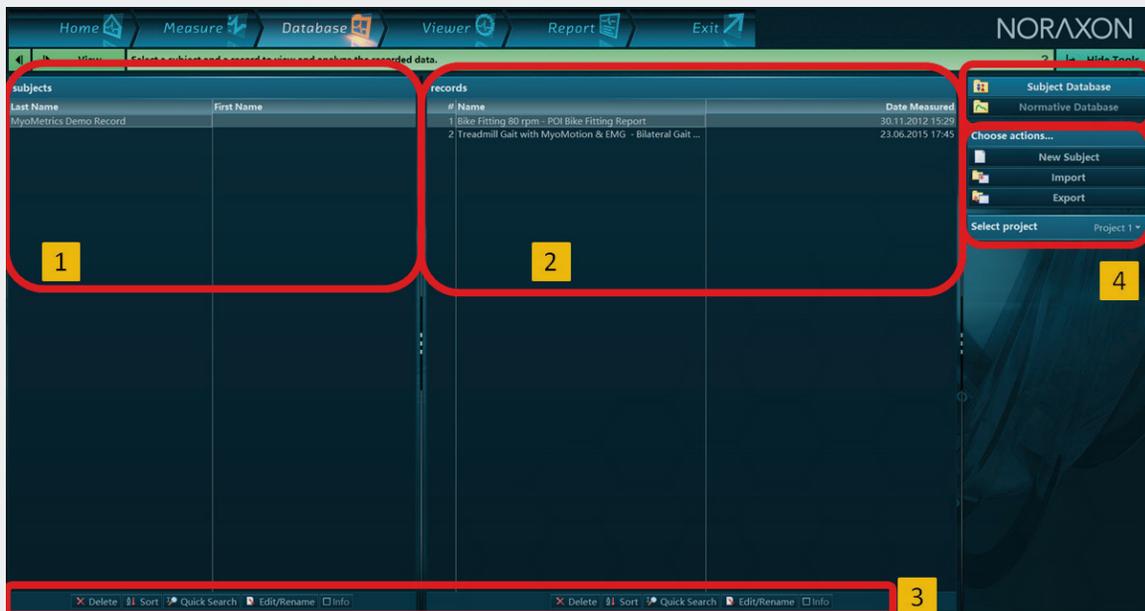
# SOFTWARE

## myoMUSCLE™ MODULE

## Section 7: Database Tab

### Introduction

As indicated by its name the **Database** tab manages all functions around data file management, like selection, editing, exporting and importing.



- 1) Lists Section Subjects
- 2) Lists Section Records
- 3) Local List Functions
- 4) Right Tool Bar Menu

### 1 & 2 – List sections

The screen is split into two sections, reflecting the organization of records into Subjects (left list section) and Records (right list section) stored under a given subject name.

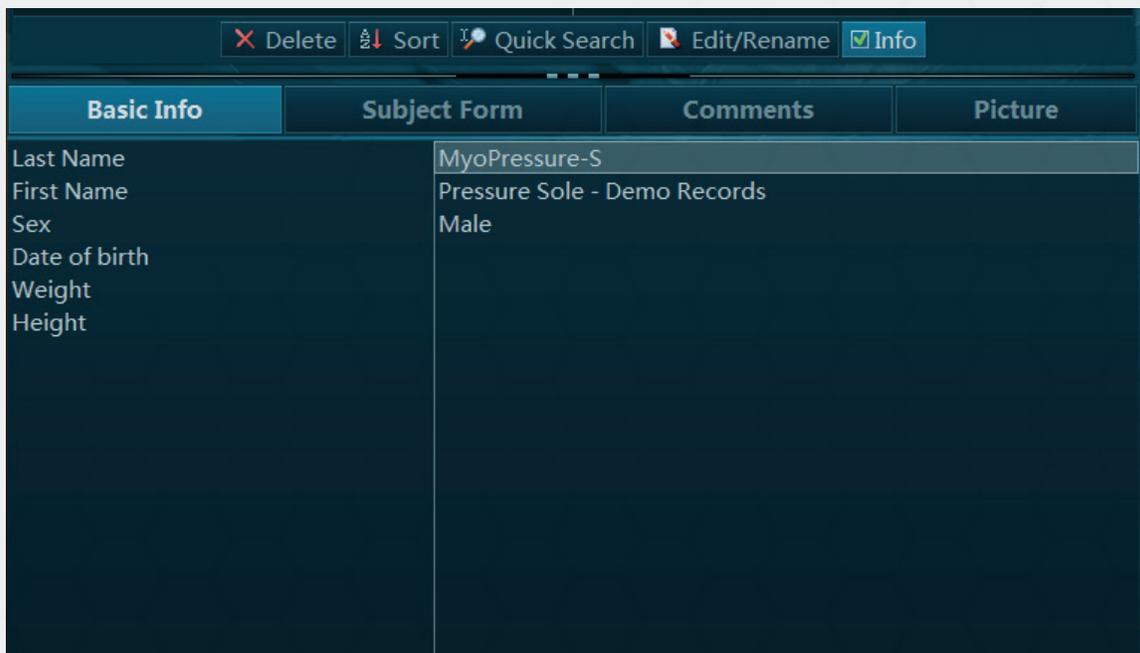
### 3 – Local List Functions

Below each list you find a set of list functions:



<b>Edit/Rename</b>	Here you can change the subject name and add additional information associated to your subject such as subject properties, comments or pictures
<b>Delete</b>	Here you can delete your subject and all records stored under this subject <b>Note:</b> deleted subject data and records cannot be restored.
<b>Quick Search</b>	If you have a very large database it may be helpful to use a search function to quickly find a certain subject
<b>Sort</b>	This entry allows you to sort your database by first or last name in ascending or descending order
<b>Info</b>	If this button is pressed/box is checked, the subject properties window with Basic info, Subject form, Comments and associated pictures is permanently visible

The info section of subjects contains a set of register cards management associated information around the Basic subject information:

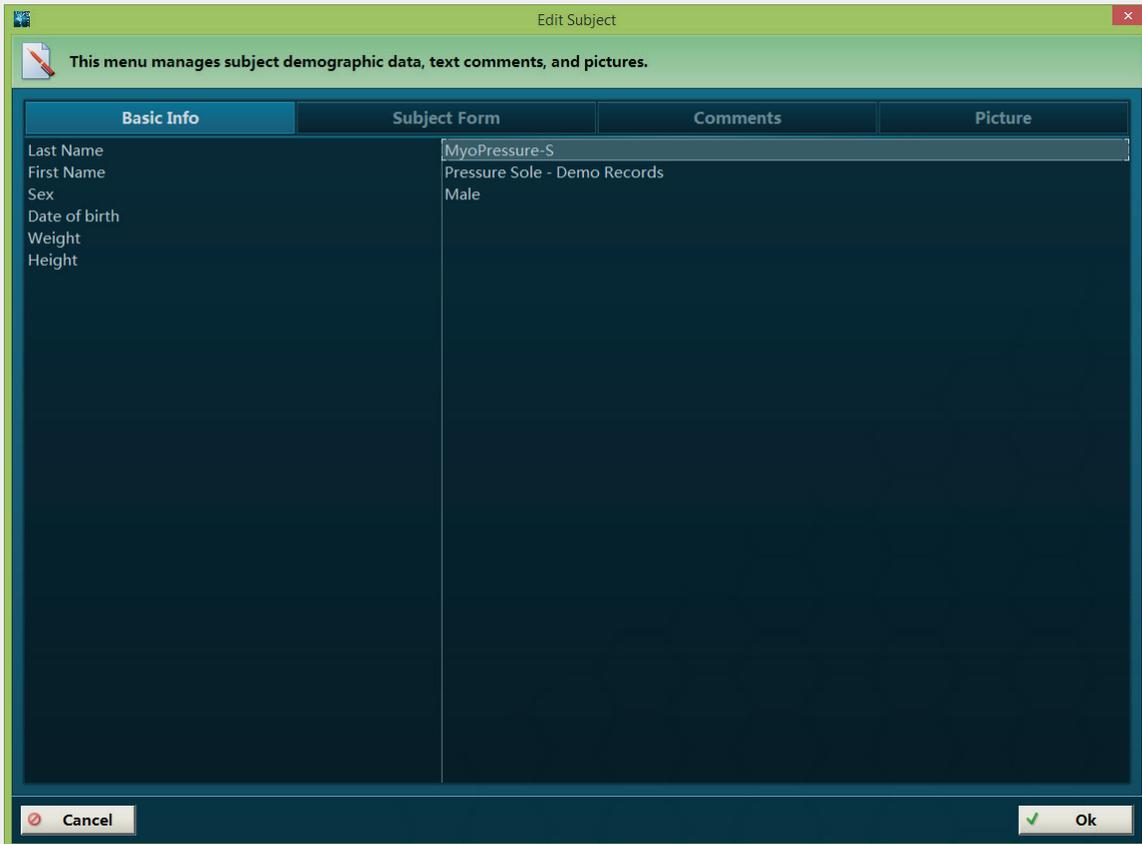




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Double click on any of them to open up a Window mode to view and edit subject properties:



<b>Basic Info</b>	This tab section contains basic subject information like Name, Sex, Birth date weight and height
<b>Subject Form</b>	This is an expanded list of patient properties and data.
<b>Comments</b>	Here you can enter or edit patient comments. It is possible to use a text clip system and/or paste text from Clipboard
<b>Picture</b>	Here you can enter a subject picture by pasting it from Clipboard or loading a picture file from the Hard disk

A similar set of list functions is available for the records list screen as well. The record **Info** button  shows important record property details:

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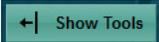
<b>Basic</b>	A summary of basic record properties like file name (editable), size, date, duration etc.
<b>Muscles/Devices</b>	Only for EMG and sensor records, shows a list of selected sensors
<b>Comments</b>	Each record can receive a record specific comment which can be created or reviewed here
<b>Picture/Video</b>	This info tab is very helpful if you have recorded data together with video. The first picture of the video is shown here to help you find and identify a record
<b>Meas. Options</b>	Not activated yet
<b>Processing History</b>	In case any signal processing was applied to your original record, all processing steps are documented here



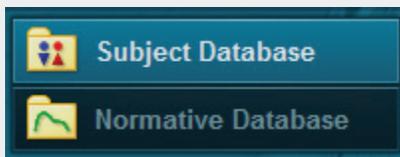
# SOFTWARE

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### 4 - Right Tool Bar Menu

If you click the  button on the right side of the green instruction bar, the Database Tool bar will show up. To remove, click .

Besides the **Subjects Database** there is another database section called **Normative Database**



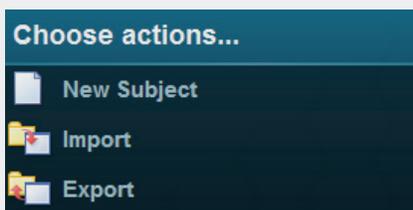
It contains all normative data records that were compiled via the “Add to Normative” function within the **Report Menu** (see chapter report).

All database functions described below are also available for normative records.

Note: The normative sample file “Natural floor gait reference curve” is not meant to be used for any medical diagnosis or similar purposes. It only serves as an educational example on how to use or operate normative data.

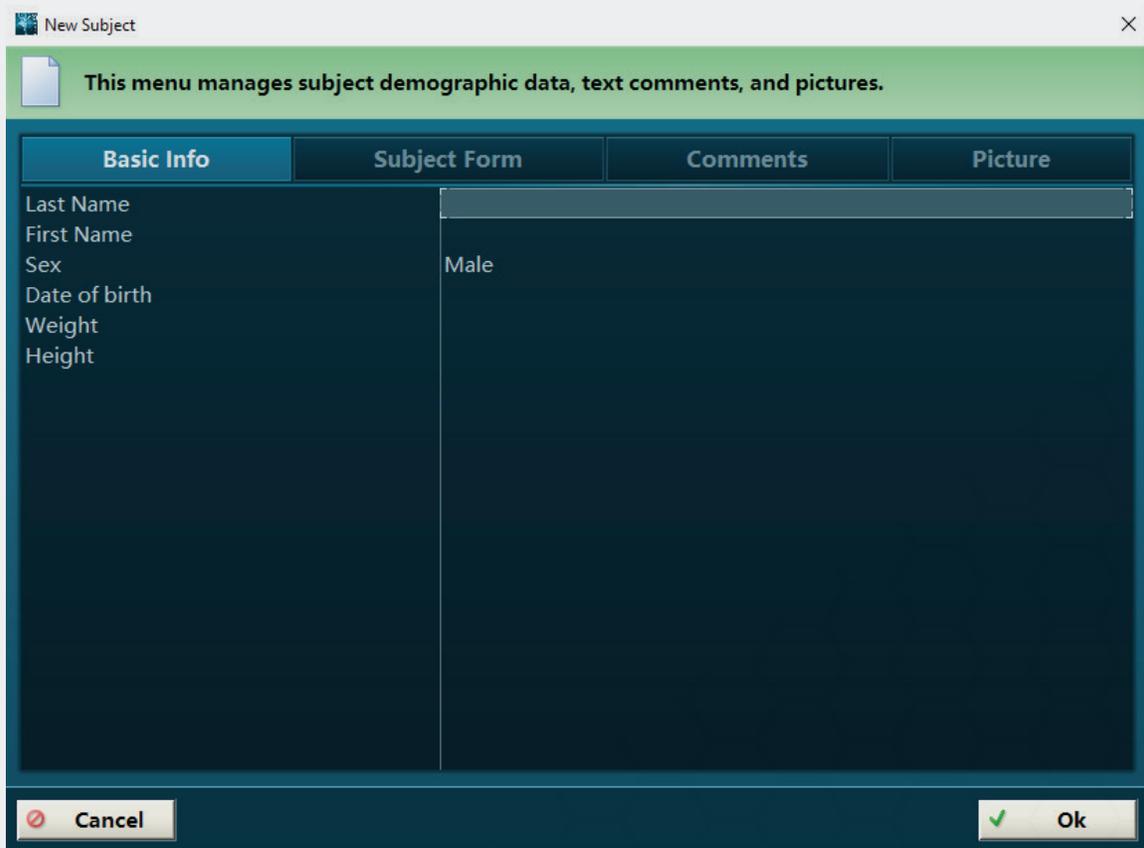
#### Choose actions

In the **Choose actions** section you can create a **New Subject** and **Import** or **Export** subjects and records.



#### ***New Subject***

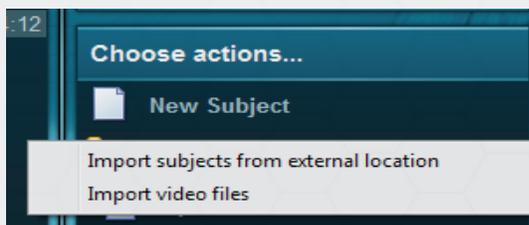
Here you can create a new subject in your database. When clicked a sub menu similar to the Subject properties / Edit screen opens up:



The minimum information to be entered is the **Last Name**, any other entry is optional. If needed Basic information, a subject form, comments or picture can be added to the subject information

## Import Records

You can import records from external locations such as a previous version on your PC, backup data from external hard drives or network folders:

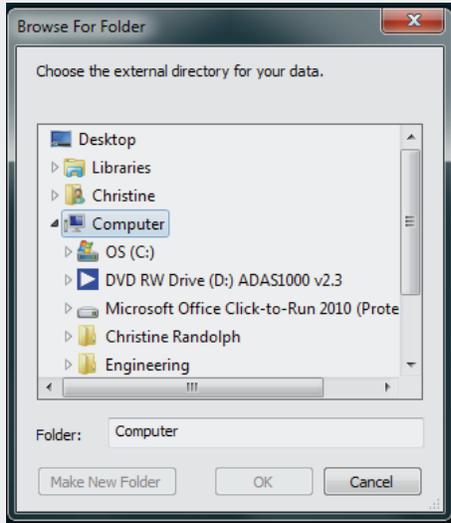


To import myoMUSCLE EMG or multi-device records select Import, then **Import subjects from external location** and set a path to the external directory (e.g. a net drive or external hard disk directory).

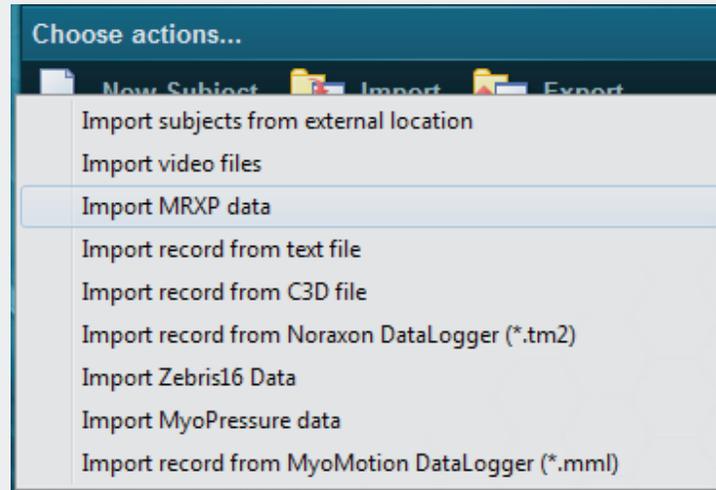


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Other import options include:



<b>Import video file</b>	Externally recorded video files in avi format can be imported
<b>Import MRXP data</b>	Import of records from the former MyoResearch XP version
<b>Import record from text file</b>	Imports Ascii or txt formatted records. Attention, only MR3s ascii data or similar arrangements are supported (see export file to ascii)
<b>Import of C3D file</b>	C3D format used by most Motion capture companies is supported and allows for import of kinematic, force and EMG data recorded there
<b>Import record from Noraxon Datalogger (*.tm2)</b>	Data logged files from the Telemyo G2 and Telemyo DTS belt receiver can be imported here
<b>Import Zebris16 Data</b>	Imports pressure data recorded with Zebris old 16Bit systems (FDM, FDMT)
<b>Import MyoPressure data</b>	Data recorded with the MyoPressure Software from Zebris can be imported here
<b>Import record from MyoMotion Datalogger (*.mml)</b>	Imports data recorded with MyoMotion inertial sensor data logger



### Export Records

You can export MR3 records in their native format to: an **External location** on your PC or to another Subject or Project within your running version:

<b>Export to external location</b>	Exports your chosen subject from MR3 to another location outside of MR3
<b>Export records to another subject</b>	Allows you to copy a record from one subject directory to another inside your myoMUSCLE version
<b>Export subjects to another project</b>	Allows you to copy a record from one project directory to another project directory inside your MR3 version

Other supported export formats are listed in this table:

<b>Export record to text file</b>	Numerical Data (signals) can be exported to ascii compatible format
<b>Export to CSV file</b>	Numerical data can be exported to Excel compatible CSV format
<b>Export record to C3D file</b>	Numerical Data (signals) can be exported to C3D format
<b>Export record to Excel (.slk) file</b>	Numerical Data (signals) can be exported to excel compatible SLK format
<b>Export record to MatLab file</b>	Numerical Data (signals) can be exported to Matlab format
<b>Export pressure data to XML</b>	Export of pressure data to XML (access to all single cell data of each step)
<b>Export MyoMotion data to Biovision BHV</b>	Export of MyoMotion data (full body required) to BHV
<b>Export Medilogic data to CSV</b>	Export of Medilogic foot print data to CSV

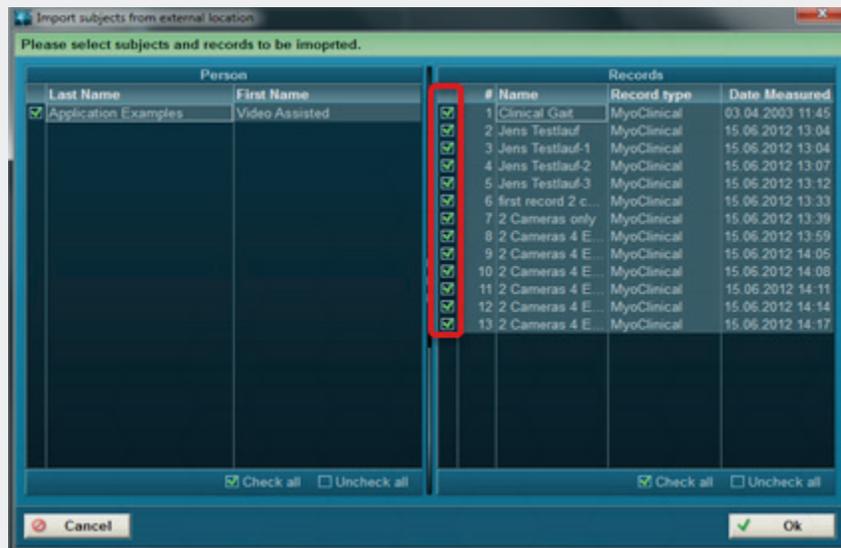


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The following menu dialog allows you to select subjects and records:



Just use the check or uncheck controls to select the desired subjects and records shown in the list and click .

**Attention:** Don't use the Windows Explorer to move or send MR3 data files directly from their data directory on hard disk: you will lose important index files and data may become unreadable. To copy data always use the **Export to external location** function of the database/right tool bar!

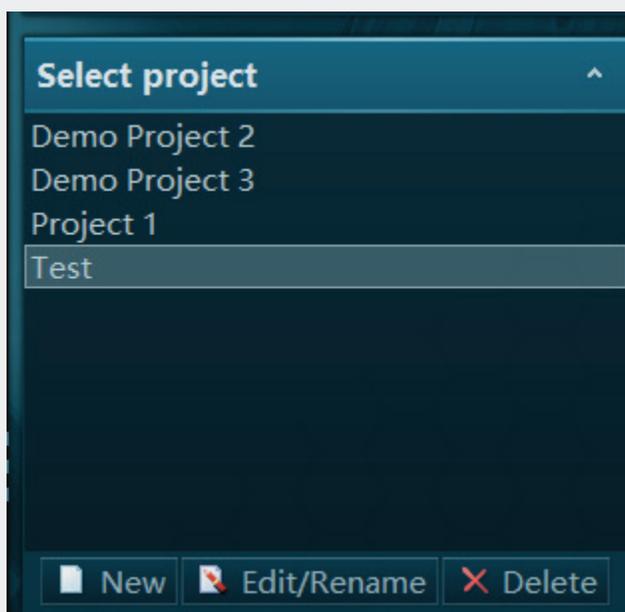


## Select Projects

MR3's database system is organized in hierarchy levels:

- Projects
- Subjects
- Records

**Projects** is the highest database level. Projects can include an unlimited number of Subjects, which can include an unlimited number of records.



The drop down arrow to the right of the project name allows you to switch to another project. If you want to create a new project, or rename or delete an existing project, click on **More**.

**New** – creates a new project

**Edit/Rename** – renames a project

**Delete** – deletes all project data, subjects inside a project with all recordings

**Attention:** Carefully use the Delete function. Projects that are deleted cannot be restored



# SOFTWARE myoMUSCLE™ MODULE

## Section 8: Viewer Tab



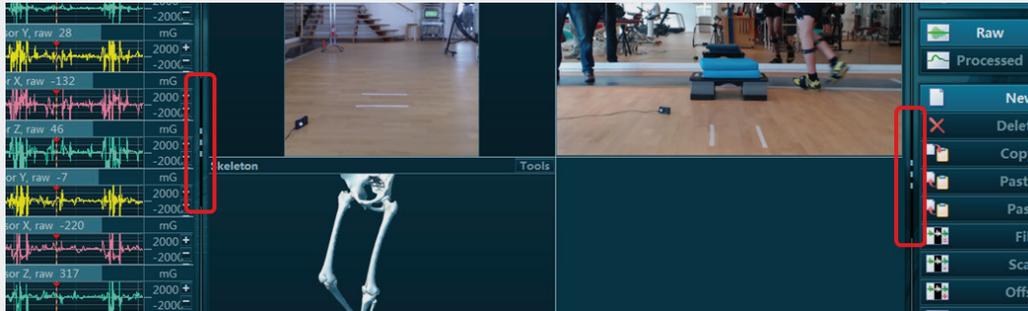
### Introduction

Each successfully stored recording will automatically be loaded to the record **Viewer**. Data will be presented in the same channel layout scheme that was used for recording. The main goal of the Viewer menu is to inspect the quality and details of a record, apply signal processing, place markers (for analysis period definition) and prepare the record for further analysis (=> Report).

Dependent on the multi-device setup used in measurement the record viewer will show curves and elements from all selected modules:

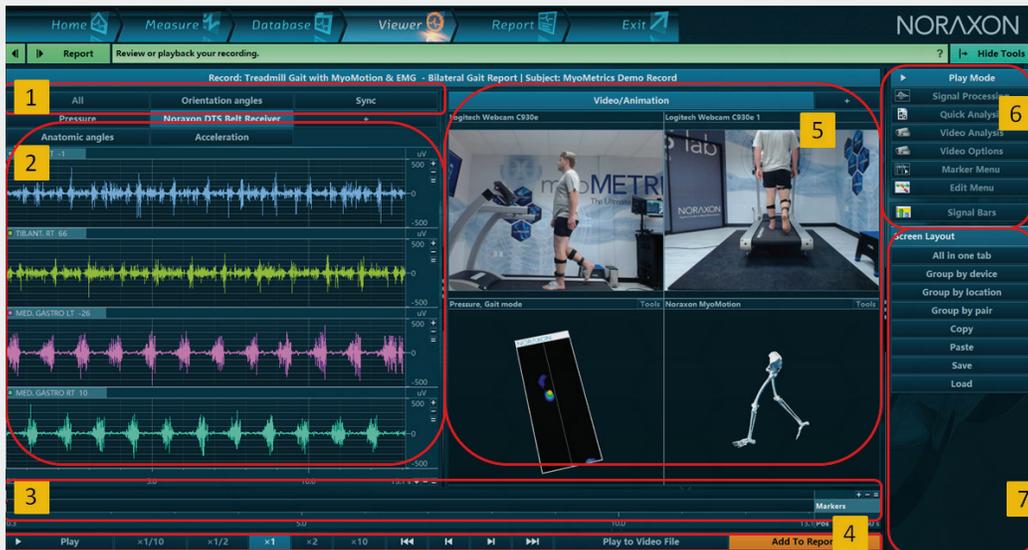


A very important display tool of the Viewer menu are the splitter lines that separate the screens sections within the viewer screen:



These lines can be drag with left pressed mouse button and allow to resize the given screen element.

As an overview the following menu elements are potentially available



Channels and view functions:

1. Register Tab system to separate/sort devices
2. Channel and View Functions
3. Time line
4. Video control/replay and POI Analysis
5. Video and animation windows
6. Tool bar menus
7. Screen layout section



# SOFTWARE

## myoMUSCLE™ MODULE

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**Note:** In the example above a raw EMG record is shown. With multi-device setups the record **Viewer** can show signals from all measured devices plus video, pressure and motion animation avatars, dependent on which Device tab (1) is selected. The addition of multi-device modules also adds functions to the right side tool bar, e.g. myoVIDEO based video recording adds two more sub menus; Video analysis and Video Options

### 1) Device register card system

By default the measurement signals of all connected devices are grouped by the given device. Click on the desired Device tab to see the measurement signals. Per mouse drag to the channel name or tab name signals/tabs can be moved into other tabs or new tabs.

The Viewer menu presents all recorded data exactly in the same screen layout arrangements as they were measured. Because of the multi-device nature of MR3, numerous signal, animation video and biofeedback screens can occur which require a sophisticated screen element management. As described in the measurement menu/section screen layouts, in the case of multi-device setups each device will be shown in its own tab section.

The following channel display, zoom and overlay functions are available:

- Local X and Y axis +/-, = buttons allow for zooming operations of amplitude and time
  - Double click on channel name maximizes a channel to a pop-up window
  - CTRL – Double click adds a second or third (...) channel to the pop-up window
  - Pop-Up windows can be moved to a second monitor
  - Left mouse drag of the channel name to another signal creates an overlay of both signals
  - Any amount of signals can be mouse dragged to a new tab
  - Any given screen layout arrangement can be stored as a configuration available in the right tool bar
- (See the Measurement chapter for more detailed descriptions and examples)

### Mouse based channel view functions:

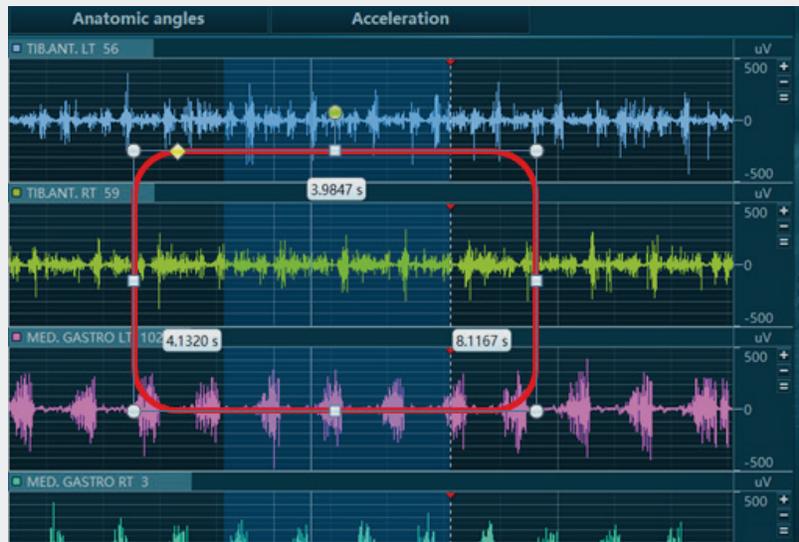
#### Left mouse button

Double click on signal screen places a marker

Click and hold left mouse button marks an area (for zooming, for period definition in report)



While dragging an interval with left mouse button, three small fly-out windows will appear indicating the time point of interval begin and end (lower values) and duration (upper value):



### Middle mouse wheel & button:

If a certain signal portion is zoomed in time (click on the plus sign in time line or turn mouse wheel) and middle mouse wheel button is pressed, mouse movement to left and right pans the signal through time

If middle mouse (wheel) button and Shift key is pressed, the mouse movement up / down pans the amplitude/zeroline position.

If mouse wheel is scrolled up the signals are zoom out, if wheel is scrolled down the signal is zoomed in.

If mouse wheel is turned with pressed CTRL button is pressed, the amplitude of the channel below mouse arrow is zoomed in or out

### Right mouse button

If right mouse button is pressed, context sensitive commands are available (in development). At the moment the function **Delete markers** is supported.



# SOFTWARE

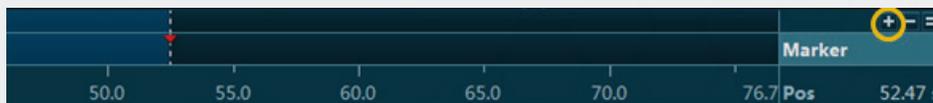
## myoMUSCLE™ MODULE

### 3) Time Line

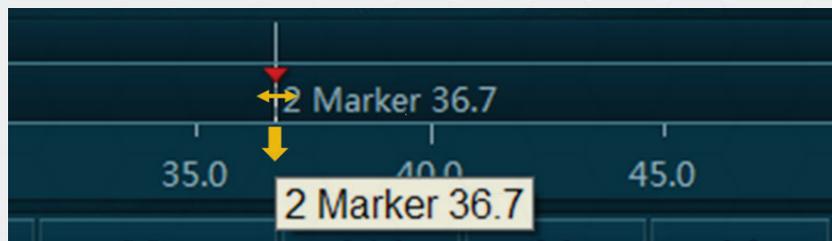
The time line indicates the cursor and marker time positions, marker labels and the location of the analysis periods (see the Report chapter for details). The time line can be used to mark areas within the record and zoom them up with the plus button on right side of time line:



The marked area is high-lighted (colored in lighter blue color) both in time line and in the signal screen. Alternatively to time line the area can be marked directly in the signal screen. The plus/minus and equal sign screen icons can be used to zoom in and out the period selection and to show the full recording:



A left mouse double click places a marker to the record. In case a marker is placed its position is shown both in the signal screen and the time line. With pressed left mouse button you can move marker to the left or right side or drag it down to the next line to delete it:



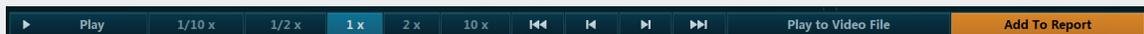
The upper area of the time line can be used to step (view) through a recording with a predefined interval length. To do so, first mouse mark an interval in the timeline or signal screen, then zoom in by clicking the plus zoom but on right side.



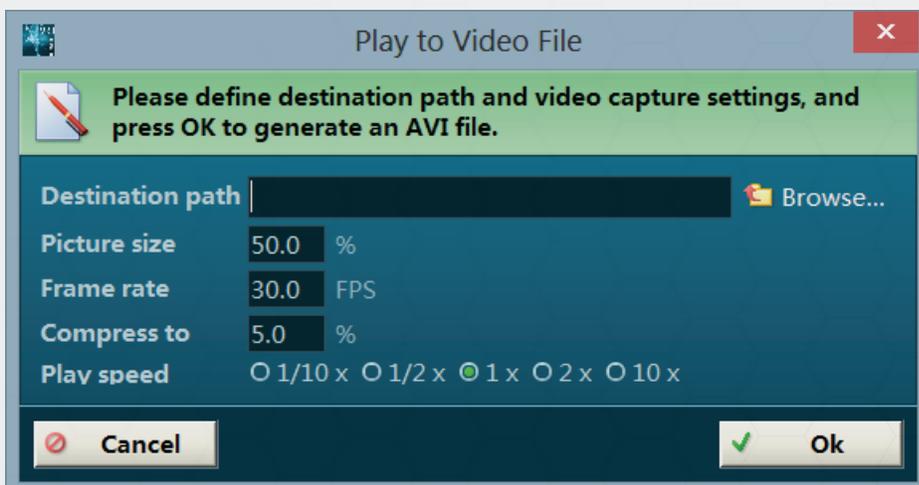
Now you can use the page up/down buttons to scroll through the measurement with the selected interval length or drag it with pressed left mouse button.

#### 4) Video control/replay and POI Analysis

At any time you can replay a video and all available animations (like skeletal avatar of MyoMotion or pressure Isobards of MyoPressure) by using the video controls:



<b>Play</b>	Plays all visible videos on the screen at the same time
<b>1/10x, 1/2x, 1x, 2x, 10x</b>	Control the play speed.
<b>Arrows</b>	Their function follows standard video control functions: Go to the beginning of the video clip, go one picture back, one picture forward or go to the end of the video clip
<b>Play to Video File</b>	This is MR3s video/screen recorder function and allows you to record any video, screen animation, time synchronized measurement signals, etc. (e.g. EMG, auto-tracked angles) to an .avi file. A small menu dialog allows you to define file destination directory, video size, frame rate and compression factor





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The screen recorder function Play to video requires to set a path (**Browse**), define the **Picture size** (selected 100% for best quality), **Frame rate** (recommend is 30 Hz), **Compression ratio** (Compress to – recommended is 5%) and **Play speed**.

**Attention:** Do not operate any other action while the screen recorder is running!

Recording intervals can be limited to a blue highlighted area in the time line (see below). To select a section within the video time line, click on the beginning of the desired recording interval, then hold down the shift key and click a second time at the end of the interval. You can also accomplish this by clicking on the beginning of the desired interval and dragging over the timeline until the end of the desired recording interval.



### Add to Report

Whenever you want to insert a video picture (with or without angle drawings) to the report, press this button. This point of interest (POI) based analysis allows you to watch a video, stop at any point of interest, analyze it (see below) and click Add to Report to mark it for the video analysis report. Any POI created by this function receives an orange Report marker label in the marker/time line shown below.



The time line shows a seconds-based time scale and a marker label line. MR3 operates a intricate system of markers related to biomechanical event triggering, manual marker labeling or POI based ("Add to report") labeling. Any created marker line is shown here and can be used to identify events, motion phases, interesting analysis sections, etc.

## 5. Video and animation window section

As already described in the measure menu, the kinematic data are animated via a skeletal avatar:





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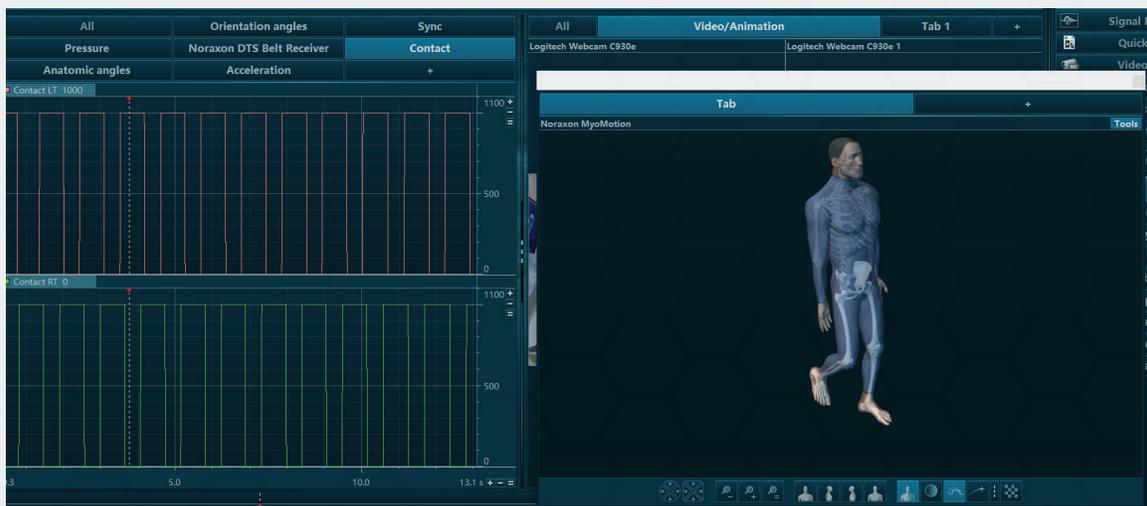
## myoMUSCLE™ MODULE

Several view and perspective buttons (left side) are available and already described in the measure menu.

In record viewer replay 3 very important new functions are available:



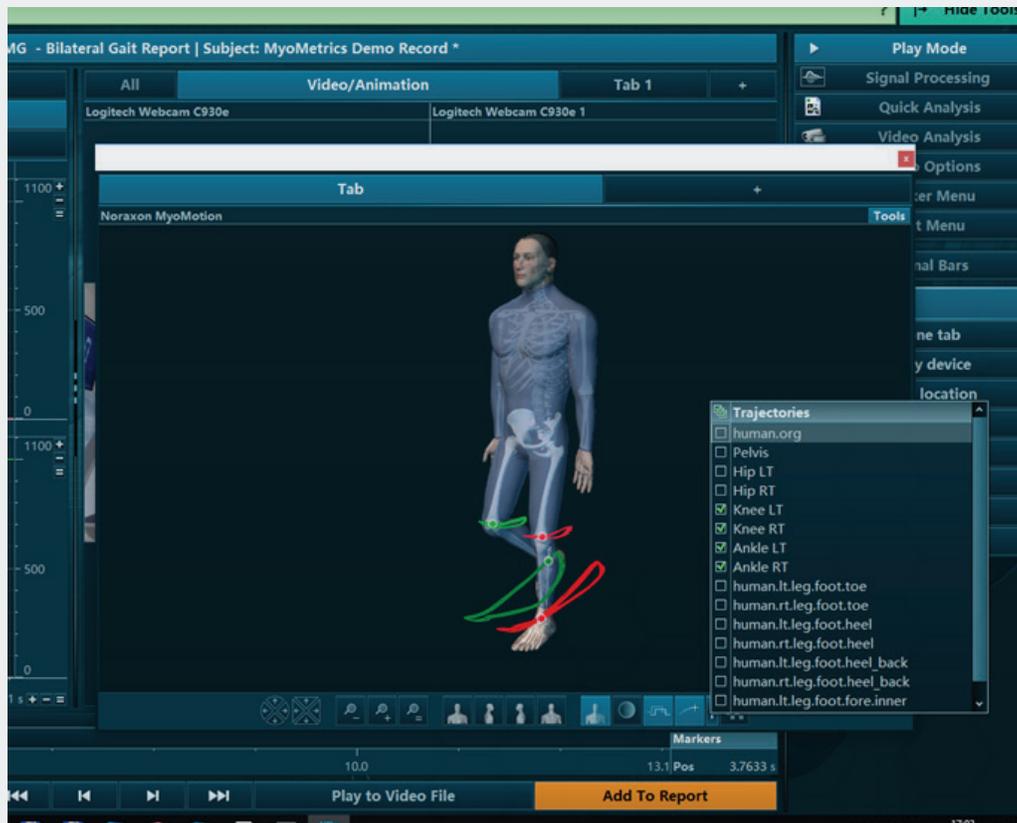
The Contacts button  will create a virtual foot contact signal for left and right side foot. This function requires that acceleration data were turned on in measurement setup and foot sensors are part of the model. Based on special algorithms utilizing the accelerations and gyro velocity of foot sensors heel strike and toe off in gait and running are estimated. Once clicked there will be a new tab in the signals screen called Contacts:



Later, in period definition of MyoMotion Foot Switch gait report these contact signals can be use as trigger signals for the gait phase definition.



The next two buttons right side to Contact button will define and turn on/off the joint trajectories:



This function can be used to nicely visualize motion patterns and motion symmetry in all kind of activities.

## 6) Right Tool Bar Options

The tool bar offers a set of optional sub menus, by default the Play mode is active. This is the standard mode to visually inspect, zoom and record. Click on the desired sub menu to activate it and use more sub menu functions.



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### Signal Processing

A collection of standard processing operations such as signal rectification, smoothing, digital filtering, amplitude normalization, etc.

### Video Analysis (requires the module MyoVIDEO)

### Video Options (optional)

Consists of a set of video adjustment tools

### Marker Menu

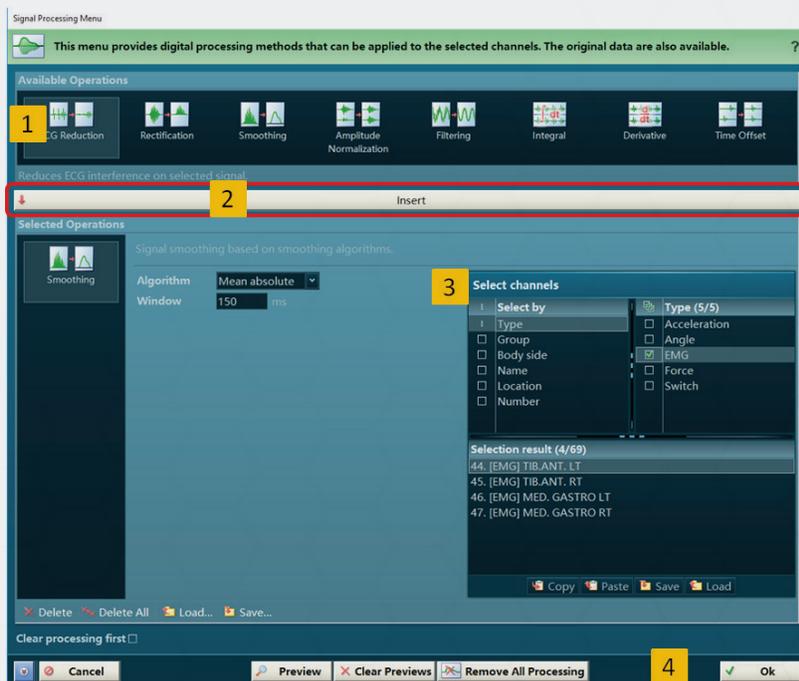
Several modes for marker labeling and auto marker settings for trigger and angle channels.

**Note:** Markers can be manually set in the signals by double clicking the left mouse button.

## Signal Processing

Signal processing is a collection of commonly used processing modes for biomedical signals. Especially bipolar raw EMG recordings require post processing prior to analysis.

The menu is operated in 3 basic steps:



1) Select a processing method

2) Click insert to add it to the processing pipeline

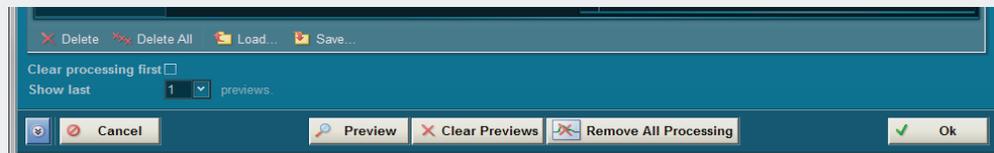
3) Apply a channel filter to select specific channels for the selected processing

4) Preview, remove processing or confirm selected processing with **OK**



## Operation Tools

Basic operation tools, independent from selected processing mode.



### Lower Red Operation Buttons (Delete, Load, Save):

- **Delete** – a method in the list of Selected Operations can be deleted from the list
- **Delete All** – deletes all selected operations from the list
- **Load/Save** – any sequence of Selected Operations can be stored and loaded for repeated use. To Save a configuration, give it a recognizable name, optionally load a picture icon for it and click Ok. Load will open a window showing all available signal processing configurations.
- **Clear processing first** – this function will remove all previously operated processing and reload the original raw data.

When preview is operated the signal processing menu is minimized to a tool bar line:



This is done to give full view to all processed signals. To maximize the signal processing menu press the arrow up

Press OK if the preview of processing shows satisfying results.

### Remove all Processing

This function will restore the raw data and remove all processing operations from the signals.



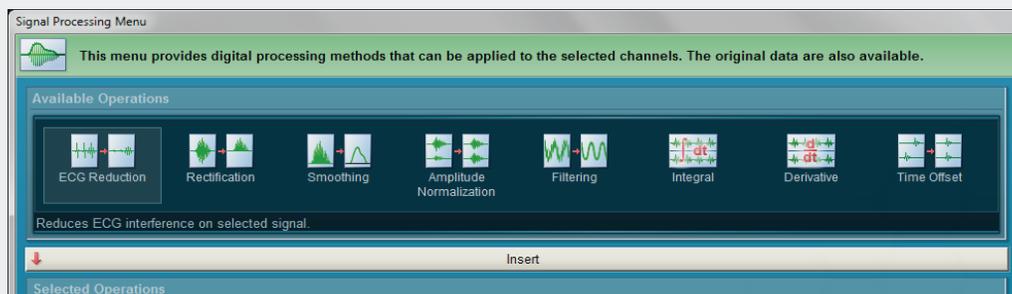
# SOFTWARE

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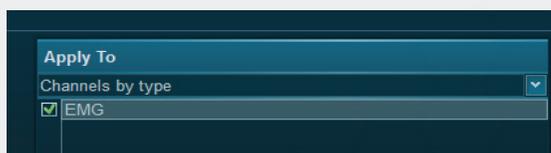
### Available Operations

Eight Signal Processing methods, listed under Available Operations, can be loaded to a sequence of processing commands (**Selected Operations**). You can easily create any sequence and/or order of processing methods and load them several times, if needed.

Click on a selected processing method and hit **Insert** to add it to the lower operation pipeline.



**Apply To** – Each processing method has an Apply To option. This allows the user to selectively apply the processing operation to specific channels. Channels can be chosen according to channel type, i.e. EMG, Anatomical Angles, etc. or by specific channel numbers.



### ECG Reduction

MR3 is equipped with a unique algorithm to detect and selectively eliminate ECG artifact spikes. The main benefit is the original EMG power is not significantly affected, only the ECG spikes are removed. The algorithm for this is a combination of pattern recognition and adaptive filtering.

- **Select interval by first activity** is currently not activated and can be discarded.
- **Select interval from beginning** < time interval > means that this recording section right after recording start is taken to determine the shape of the ECG artifact. To achieve good results, it is important that the patient is as relaxed as possible and only the spikes are visible on the EMG baseline.



The quality of this “ECG cleaning” can vary depending on the EMG recording quality and artifact conditions. This ECG removing function can be very helpful in relaxation studies, especially where ECG spikes can greatly influence the outcome results.

### ***Rectification***

This very popular processing method multiplies all amplitude values in a signal with +1, with the effect that all negative values become positive; i.e. all amplitudes below the zero line become positive amplitudes. The purpose of this operation is to achieve positive amplitude curves that allow you to calculate parameters like mean amplitude, area under the curve, etc.

### ***Smoothing***

Typically, for amplitude based calculations and analysis, the raw EMG is smoothed by digital filters, root mean square or moving average algorithms. The effect is that non-reproducible EMG spikes are eliminated and the mean trend of the EMG innervation is used. As described above, another benefit is easier reading of the EMG patterns, which is useful for clinical tests, biofeedback oriented treatments or trainings.

- **Algorithms** – the following smoothing Algorithms are supported:
  - » RMS – Root Mean Square
  - » Mean – the moving average
  - » Mean absolute – the moving average with combined rectification
- **Window** – allows you to define the window for each algorithm (in milliseconds)

Please refer to the **ABC of EMG** booklet for more information on how to use smoothing algorithms.

### ***Amplitude Normalization***

This feature allows amplitude normalize microvolts based EMG recordings. Amplitude normalization post-processing is similar to online processing offered in the Measurement Configuration setup, with a few additional options.

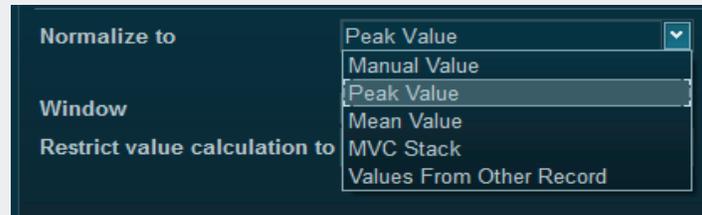


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Usually Amplitude normalization is used after rectification and smoothing of data:

**Normalize to** – normalization routines are available in the pull down list



- **Manual Value** - Here the normalization value can be entered manually. You can apply manual values per channel (see Apply to).
- **Peak value** - This is the main method of finding MVC (Maximum Voluntary Contraction) values within MVC records. The entry Window defines a window for the MVC value calculation. The mean value of this window is taken as the MVC value. An automatic algorithm calculates each selected channel separately, where the highest mean window is located in the channel and indicates the signal portion with a green color. When done, a prompt appears that asks you to Update the MVC stack. The MVC stack is an internal memory that keeps these MVC values, as long as it is filled by the next Peak value normalization operation.
  - » **Peak Normalization:** When confirmed with Yes, these MVC values are available for the next normalization routine: MVC Stack (see below).
  - » **Restrict calculation to:** Click **Pick** to use the mouse to mark a signal portion in the record with the result being the MVC calculation is done only in this marked area. This function may be helpful in measurement designs, where an MVC recording period is part of a given record, e.g. at its very beginning. Click **Clear** to clear any previously selected areas.
- **Mean Value** – In this normalization method the amplitude mean value is calculated for each channel and taken as a reference value for the normalization. This type of normalization is often used in gait analysis where time normalized EMG patterns are amplitude normalized again, each to its own mean value.
- **MVC-Stack** – This method loads the current MVC values from the stack. This can be repeated as many times as needed, e.g. to normalized records and trials done after the MVC record of a subject. The MVC values remain in the stack, even if the computer is shut down.



In summary, normalizing to Peak value creates MVC values, normalizing to MVC Stack loads MVC values for the normalization of other records (of the same subject).

When amplitude based normalization is loaded to the signal processing pipeline the storing dialog after processing will prompt you to save MVC data to the MVC stack (**Update MVC stack**). Confirm this dialog with Yes to make these MVC values available for the trial records and the amplitude normalization mode normalized **“To MVC Stack”**.

- **Values from other records** – This method accesses normalization values found or applied from this “other” record. Only records for the same subject are listed (Normalization to another subject’s muscle activation would not make sense). Please verify (see processing history in the Database Record Info Section) that the proper normalization routine was performed on this “other” record. Typically this is the MVC trial of one subject, which is used to calculate/find the MVC values within the maximum contraction series. If you choose a record that was not normalized by any method, this operation cannot be performed.

**Restrict value calculation to** – allows the user to pick a section of the record to apply amplitude normalization by highlighting the section of the record using the mouse.

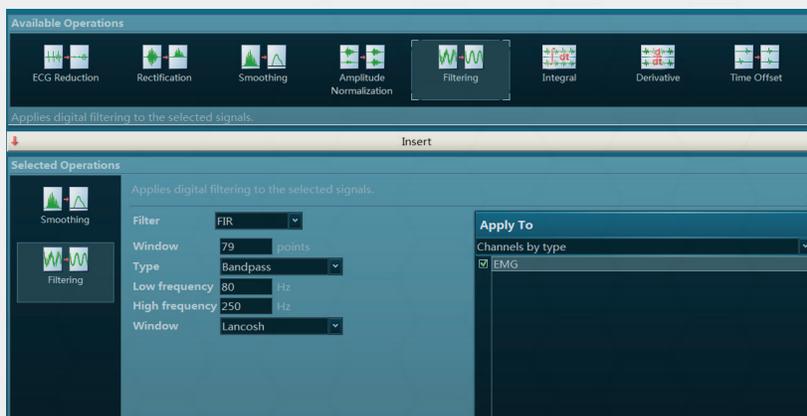
## Filtering

A set of commonly used digital filters is available in this processing method:

**Filter:** Selects the filter type: FIR, IIR, Median

### FIR - Finite Impulse Response filter

**Window:** Number of points used to process the data. With longer windows the quality improves. Recommended default values is 79.



**Type:** The filter can act as a low, high, band pass or rejecter filter. Use the **Low/High frequency:** controls to specify the filter range.

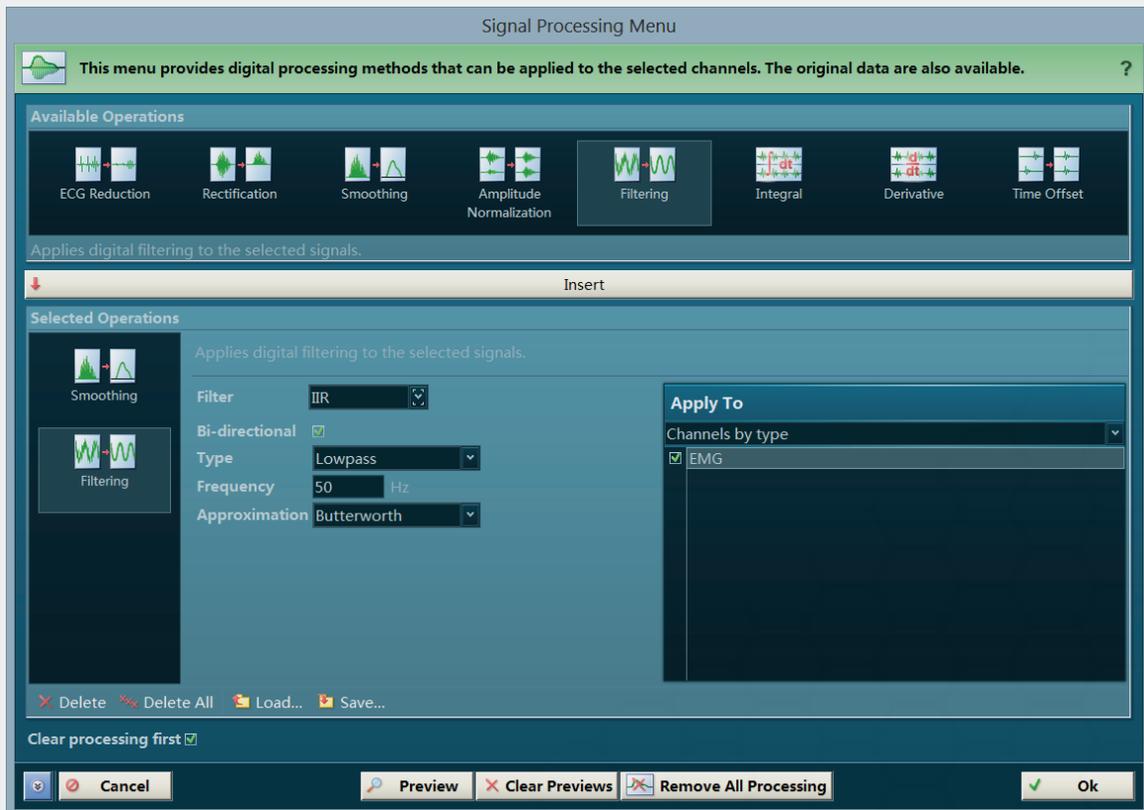
**Window** (below frequency): sub type selection, to define the window edge fading

### IIR - Infinite Impulse Response Filter



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**Bidirectional:** use this mode to avoid phase lags created by the filter.

**Type:** The filter can act as a low pass, high pass or rejecter filter

**Frequency:** The edge Frequency can be entered in Hz.

**Approximation:** Defines the sub type of filter

Median - Filter

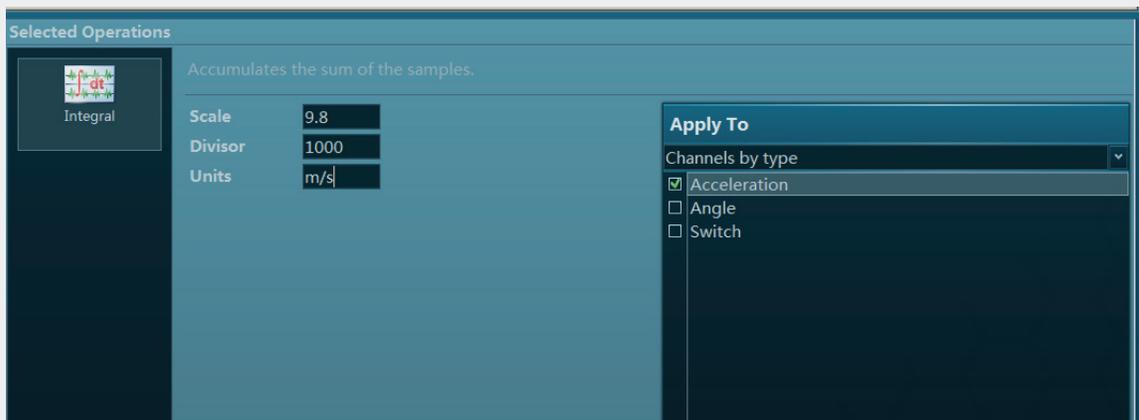
The median filter is an excellent spike cleaner for analog signals: it removes spikes from e.g. force/ angle curves without affecting the original signal shape.

**Window:** Defines the amount of data points used for the filter algorithm

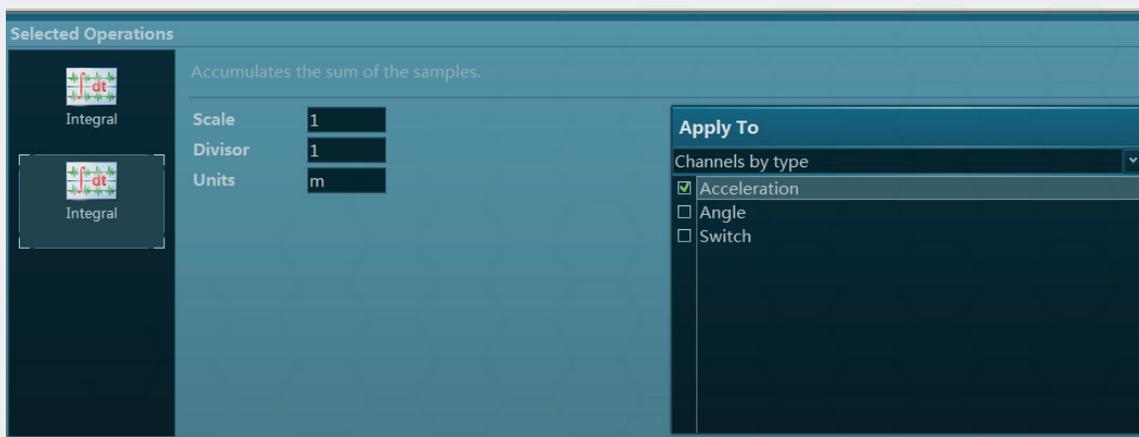


## **Integral:**

This operator calculates the integral of a given signal. E.g. if you want to calculate velocity out of a MyoMotion acceleration signal, enter these settings (source data are expressed in mG):



To operate a double integration from acceleration to distance, enter these settings in the second integral operator:





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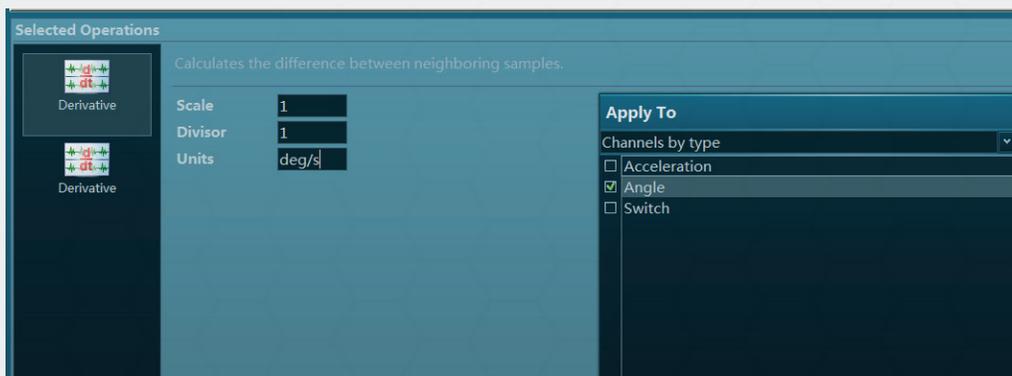
## myoMUSCLE™ MODULE

This is a preview screen of double integrated MyoMotion acceleration signal:



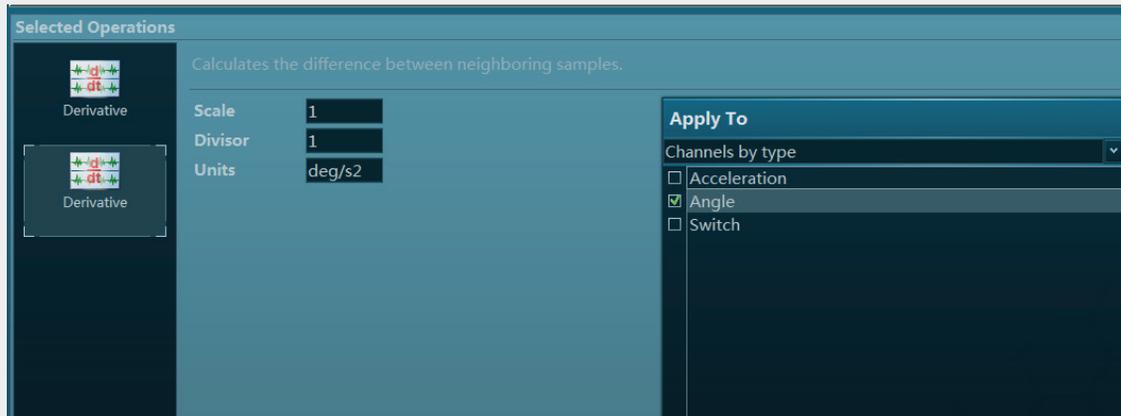
### Derivative

Alternatively, the derivative can be calculated based on an angle signal to reach angular velocity:





If operated a second time, the acceleration is derived:



Example of a double differentiated angle signal to angular acceleration:

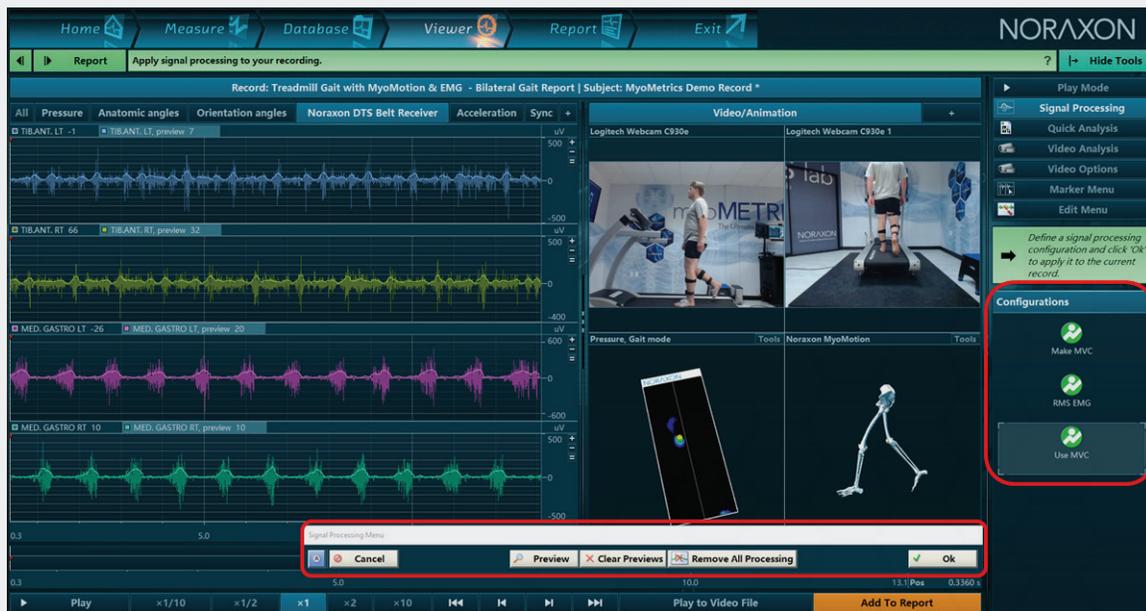




# SOFTWARE myoMUSCLE™ MODULE

## Configuration List

Any signal processing configuration saved under a user defined name will be listed here in alphabetical order. Just click on the desired configuration to automatically apply it to the displayed signals. The signal processing menu will be minimized to give free look at all previewed processes:



If the result indicated by preview is okay, confirm the processing with **OK**.

Three predefined configurations are installed by default:

- **Make MVC** - finds and stores MVC values in MVC records
- **RMS EMG** - a standard processing, that produces smoothed/rectified EMG curves, based on RMS at 100 ms
- **Use MVC** - smoothes (RMS 100 ms) and normalizes the records to the MVC values loaded to the normalization stack (see above)

## Quick Analysis

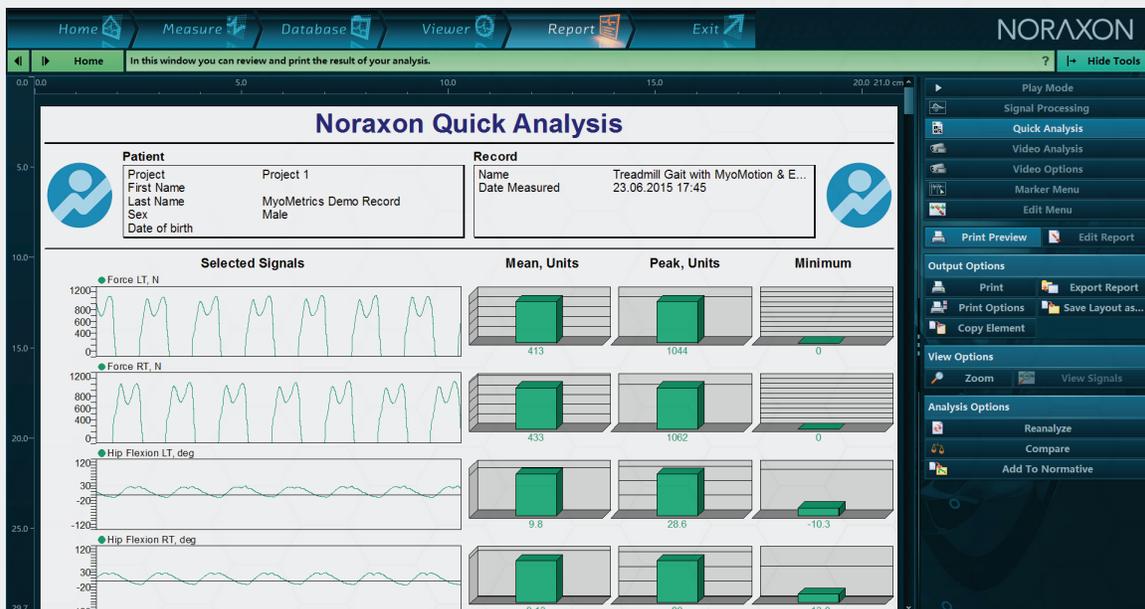
Quick analysis allows you to make an adhoc analysis of the whole record or a mouse marked area (press left mouse button to drag a selected interval).



After clicking on Quick Analysis MR3 stops at the channel selection dialog. It allows you to include or exclude certain channels from Quick Analysis:



When done and confirmed with Next in the green main command line the Quick Analysis report opens up:





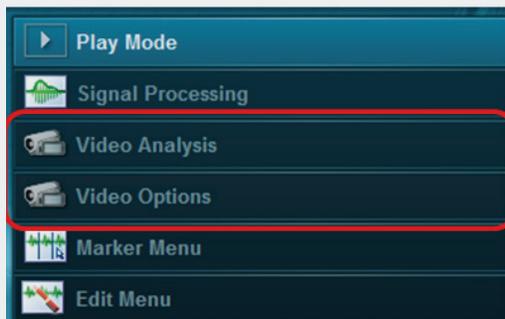
## SOFTWARE myoMUSCLE™ MODULE

It contains some basic amplitude calculations for the selected interval. Parameters can be changed by double clicking on the report analysis element and entering **Diagram Statistics**.

**More explanations on Report function are given in the local report help text.**

### Video Analysis and Video Options

These options are only displayed if you have purchased the myoVIDEO module and recorded a video. A more comprehensive description of functions is given in the local myoVideo help text which is available when you entered the Video Analysis menu.



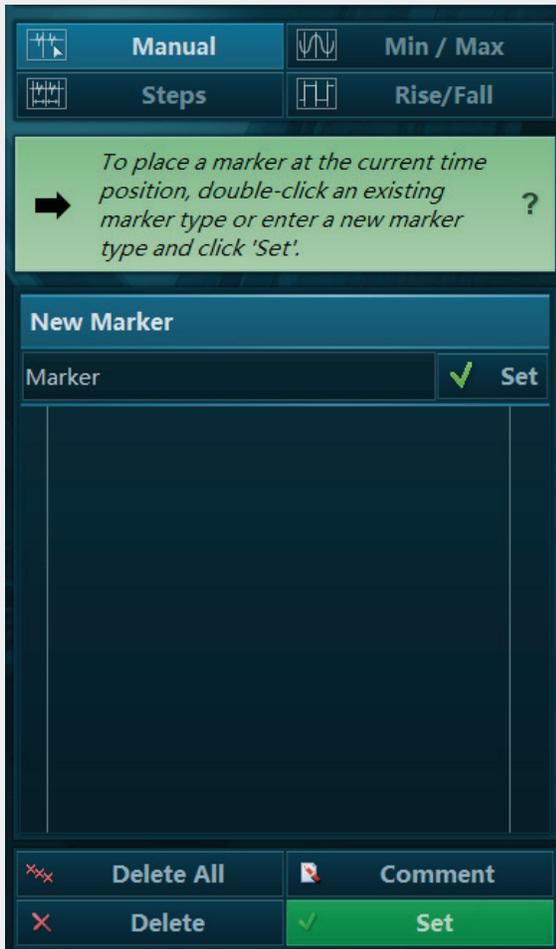
### Marker Menu

The marker menu manages all operations to place labeled markers in your recording. The main purpose of markers is to define analysis periods for reports. Markers can be placed by three major actions:

- in real time, by pressing the **Mark** button while recording
- in the **Record Viewer** by double clicking a signal portion (left mouse button)
- by using the auto-marker algorithms presented in this menu

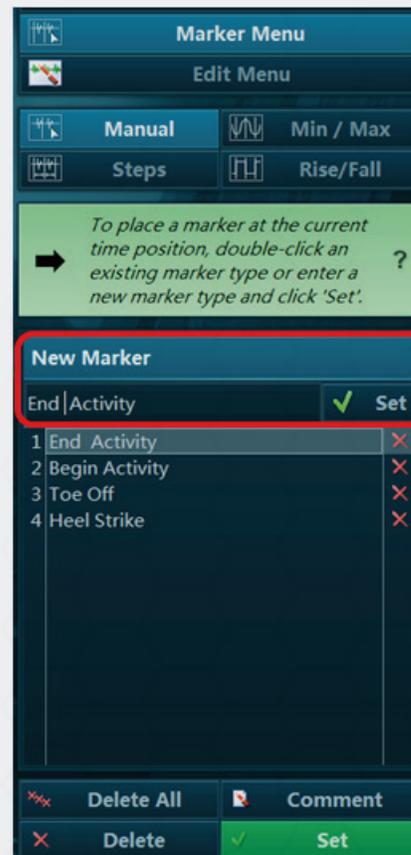
The markers and periods system is needed to fulfill the complex task of analyzing selected signal portions, TTL triggered periods, timing related onsets, or sub phases in gait analysis, just to name some examples. MR3 offers four marker methods to place markers in a record:

- Manual/Mouse
- Steps
- Min/Max by trigger channel
- Rise/Fall by trigger channel



## Manual

By default a left mouse double click on any signal portion in the channel screens will place a marker named **Marker** to the record. Alternatively you can use a list of pre-configured user-defined markers by just double clicking on the desired marker label in the list. To create a new marker label, overwrite the existing name shown in the entry box below the **New Marker** label and click the green **Set** button to apply it. When done it will automatically be placed to signal screen/timeline and also be added to the marker label list below:



If you want to delete a given marker label from the list just click on the red X to the right of each label.

Any labeled marker can become a POI marker for the POI report (see report section of help text) by just clicking on it and press **Add to Report**.



# SOFTWARE

## myoMUSCLE™ MODULE

### Steps

This method is used for continuous records or signal portions where the time domain changes of any curve parameter are analyzed in a sequence of fixed intervals (Steps). First, it is necessary to define a signal portion in your record that you would like to be marked and analyzed by the step method:

- by default the whole record is selected
- mouse marked areas are recognized and the mouse mark can be used to define the signal portion
- Selection entries within the menu box, see the example on the next page:

**Marker Menu**

**Edit Menu**

Manual Min / Max

**Steps** Rise/Fall

→ Sets markers in equal time intervals. ?

Step 1.00 s

Marker name Step

Delete old markers

**Selection**

From [ ] s

To [ ] s

Length [ ] s

Delete All Comment

Delete Set

**Step** – defines the step size in seconds.

**Marker name** – labels all step markers.

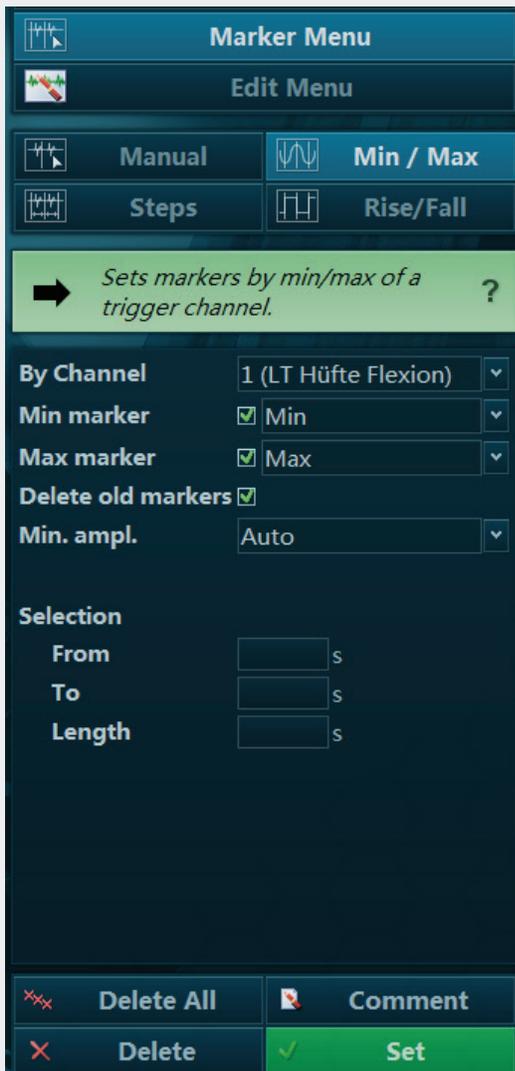
**Delete old markers** – deletes all previously placed markers.

**Selection** - allows you to enter a precise start point (From) and an end point (To), **Length** indicates the duration of the selected interval in which the auto-marker routine is operated.



## Min/Max by Trigger Channel

For records including an angle / goniometer / inclinometer signal, this special method can automatically detect the local minimums and maximums with this curve. Typically, the local events represent a start, point of return and end position within a movement sequence.



**By Channel** - defines the channel which should be used for the automarker routine.

**Min / Max Marker** – this check box allows for the user to include the local Minimum and/or Maximum value of the signal.

**Delete old marker** – removes the existing markers.

**Min. ampl.** – The default mode Auto tries to automatically check it by analyzing the highest range found within the record and accepting local ranges higher than 50% of this maximum range. In case this does not give sufficient results, a manual value for the minimum range between Min and Max can be entered that must be exceeded to identify a local Min/Max value.

**Selection** - allows you to enter a precise start point (From) and an end point (To), **Length** indicates the duration of the selected interval in which the auto-marker routine is operated.

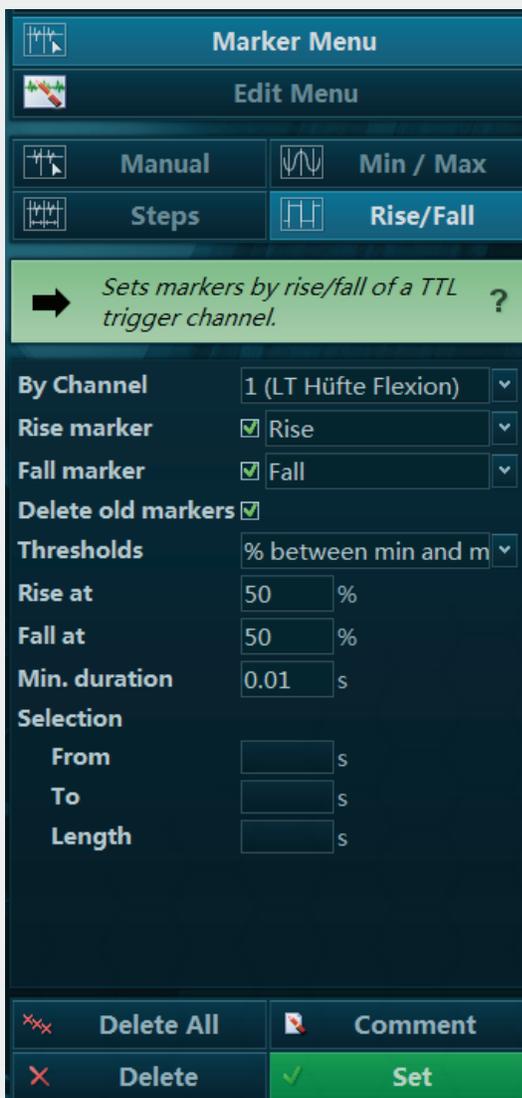


# SOFTWARE

## myoMUSCLE™ MODULE

### Rise/Fall by Trigger Channel

For records including a TTL based trigger signal (e.g. foot switches), this method is able to identify the trigger up (Rise) and down (Fall) events. There are numerous applications that use this trigger function; e.g. in gait analysis, the trigger represents the heel strike and toe off events in the gait cycle. A trigger up can be a synchronization impulse between two measurement devices (to achieve time synchronization), etc.



**By Channel** – defines the channel which should be used for the auto-marker routine.

**Rise/Fall marker** – adds the Rise and/or Fall event marker to the auto marking.

**Delete old markers** – removes the existing markers.

**Threshold** has two modes:

**% Between Min and Max** – the TTL range and places markers at a user defined percentage position between the rise and fall level. This location can be customized by the controls **Rise** at and **Fall** at < XY> % between min and max (TTL level).

**Absolute** – works in the same mechanism but uses the given channel dimension for the desired Rise and Fall event level (instead of %).

**Minimum duration** – defines the minimum duration a TTL event needs to last below or above the specified threshold level to be recognized by the algorithm. This switch can help to avoid wrong marking by artifact spikes (typically spikes of very short duration).

**Note:** For very short trigger events like jump ground contacts, this “anti-rattle” duration has to be adjusted to lower values!



**Selection** - allows you to enter a precise start point (From) and an end point (To), **Length** indicates the duration of the selected interval in which the auto-marker routine is operated.

## Lower Menu Operation Buttons

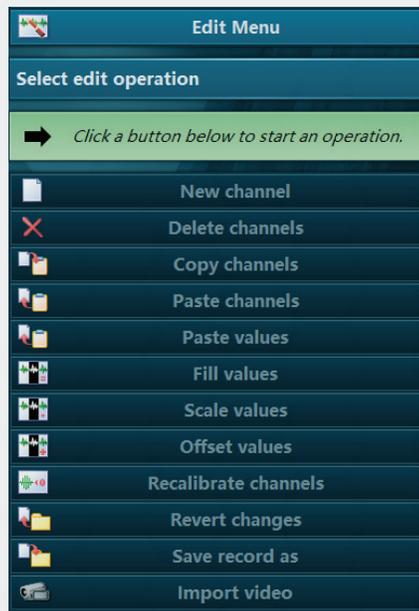
<b>Ok</b>	Executes the applied marker settings
<b>Delete</b>	Deletes the selected marker
<b>Delete All</b>	Deletes all markers in the Signals screen
<b>Set</b>	Applies the selected marker/method. Previewed in the Signals screen.

## Edit Menu

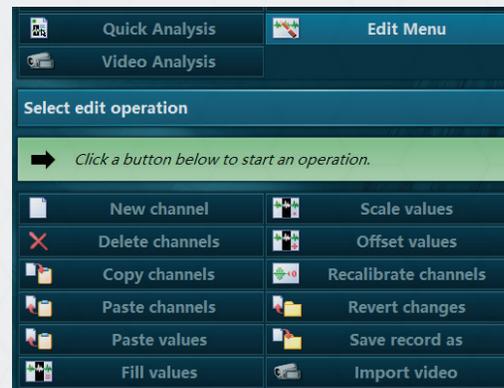
Unlike Signal Processing, all Edit operations physically change the record data set and the original recording cannot be restored. Therefore, it is generally recommended to first make a backup or a copy of your data. Alternatively, save any changes done in Edit mode with the option **Save as....**, which allows you to create a new record file (including all your edit changes) while keeping the source record in its original status.

Dependent on given screen resolution it may be needed to resize the Right Tool bar to make all functions and entry lines visible in Edit Menu:

Small arrangement:



Wide arrangement:





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## myoMUSCLE™ MODULE

At the top of the Channel Tools box there are 3 iconized View Modes of the signals:

- **Raw** – show the original unprocessed signal (signal processing is removed)
- **Processed** – show the signal only in its processed version (signal processing included)
- **Both** – show an overlay of both raw and processed

Depending on the selection done here, any channel tool operation refers to this selection. For example, to copy a raw channel to clipboard and paste it to another location the **Raw** signals mode must be used.

### New channel(s)

This function allows you to create new channel lines at any location in your record.

**Place After** – can be used to define a certain location for the insertion in the channel order.

**Name** – edits the name of the channels.

**Color** – loads a color palette to define a trace color for this channel.

**Channel type** – offers a pull down list of all available channel types to be selected for the new channel.

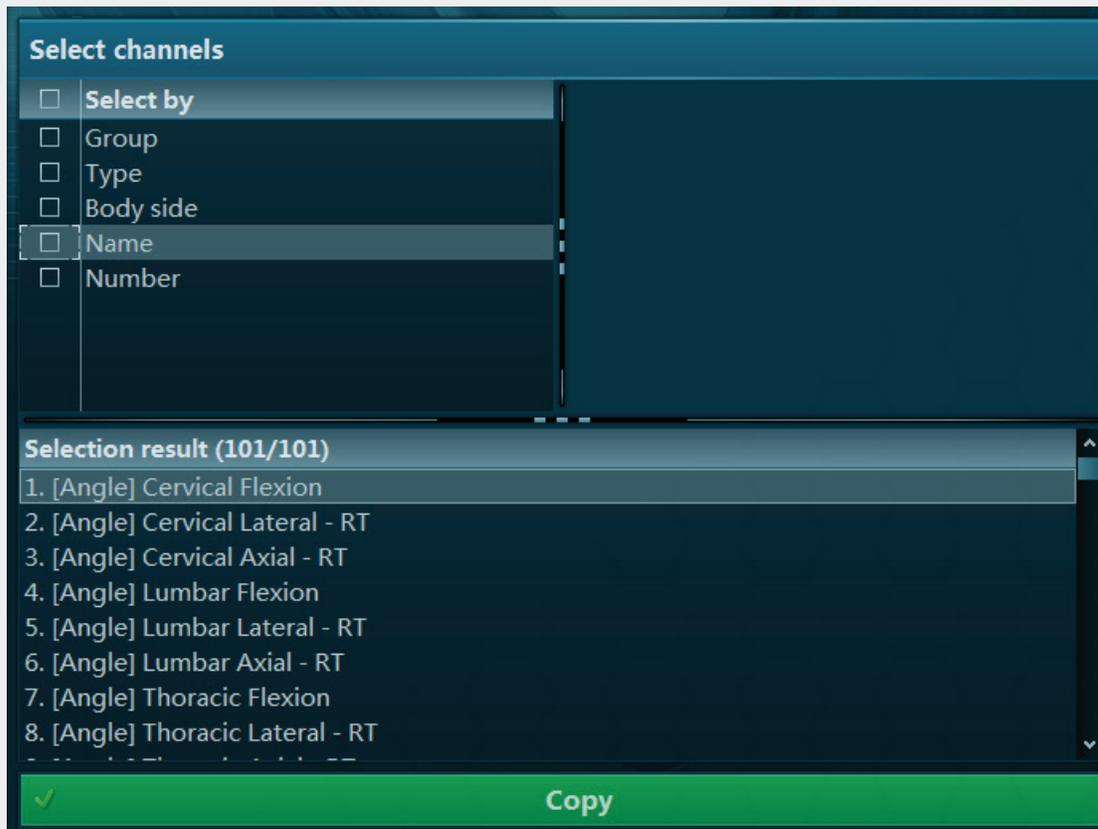
**Raw Signal** –organizes the amplitude scaling settings for the new channel.

- **Units** – define the physical channel unit.
- **# of digits** – is the decimal value when showing the actual amplitude value.
- **Bottom value/ Top value** – the lowest (Bottom) and highest (Top) amplitude scaling value for the Y-axis.



## Delete, Copy and Paste Channels

All three options have the same functionality. The selection for the given operation is done via the Select By section of this sub menu. By default all recorded channels are selected if there is no Select By method chosen:



To reduce the selection of channel for the given **Edit** operation you can use these selection modes:

Select by:

- **Group** select channels by register tab groups
- **Channel type** select channels by type, e.g. EMG, force, etc.
- **By body side** select left or right side labeled channels
- **Name** selection via muscle, segment name
- **Channel number:** select by the channel list number



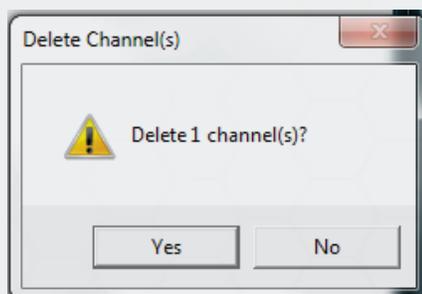
# SOFTWARE

## myoMUSCLE™ MODULE



**Note:** All 3 modes can be combined with each other.

**Delete** – physically erases a channel



**Note:** after the confirmation, which appears when leaving the record viewer menu, this channel cannot be restored!

**Copy channels** – copies the selected channel data to the clipboard

**Paste values** – fills channel data coming from the clipboard to the selected target channel

**Paste channels** – pastes channels copied to the clipboard below the last channel



## Fill Values

The **Fill Values** function is an editor for amplitude values. Based on a mouse mark signal portion, any amplitude value can be entered and will overwrite the existing values. For example, this function can be used to manually eliminate artifact spikes or other invalid data portions within a channel.



**Note:** this operation will physically change the data of your source signal so back up your files to prevent the loss of raw data.



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## myoMUSCLE™ MODULE

### Offset Values

This edit function is designed for manual correction of the baseline to any desired value:

➔ *Select channels, enter the offset and click 'Offset' to apply offset to the signal values in the time range (if marked) or to value under the cursor.*

Offset by

**Select channels**

Select by	Body side (3/3)
<input type="checkbox"/> Group	<input type="checkbox"/>
<input type="checkbox"/> Type	<input checked="" type="checkbox"/> LT
<input type="checkbox"/> Name	<input type="checkbox"/> RT
<input type="checkbox"/> Number	

**Selection result (26/101)**

- 10. [Angle] LT Elbow Flexion
- 12. [Angle] LT Shoulder Total Flexion
- 14. [Angle] LT Shoulder Flexion
- 16. [Angle] LT Shoulder Abduction
- 18. [Angle] LT Shoulder Rotation - out
- 20. [Angle] LT Wrist Extension
- 22. [Angle] LT Wrist Radial
- 24. [Angle] LT Wrist Ulnar

✓ **Offset**



## Recalibrate Channels

This function corrects EMG baseline shifts by determining the amplitude mean value of a mouse selection signal portion. Because raw EMG is a bipolar signal with equal value distribution to plus and minus, its mean is typically zero.

➔ *Select channels and click 'Recalibrate' to correct the base line by the average signal value of the time range (if marked) or by value under the cursor.*

### Select channels

⋮ Select by	📄 Body side (3/3)
<input type="checkbox"/> Group	<input type="checkbox"/>
<input type="checkbox"/> Type	<input checked="" type="checkbox"/> LT
⋮ Body side	<input type="checkbox"/> RT
<input type="checkbox"/> Name	
<input type="checkbox"/> Number	

### Selection result (26/101)

- 10. [Angle] LT Elbow Flexion
- 12. [Angle] LT Shoulder Total Flexion
- 14. [Angle] LT Shoulder Flexion
- 16. [Angle] LT Shoulder Abduction
- 18. [Angle] LT Shoulder Rotation - out
- 20. [Angle] LT Wrist Extension
- 22. [Angle] LT Wrist Radial
- 24. [Angle] LT Hand Supination

✓ **Recalibrate**



# SOFTWARE

## myoMUSCLE™ MODULE

### Scale Channel(s)

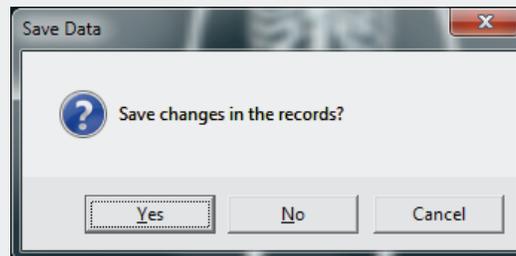
This function allows you to multiply the selected amplitude data of a given channel by any factor:



For example: This function can be used to mathematically “amplify” (scale) the signal up or scale it down to lower values.

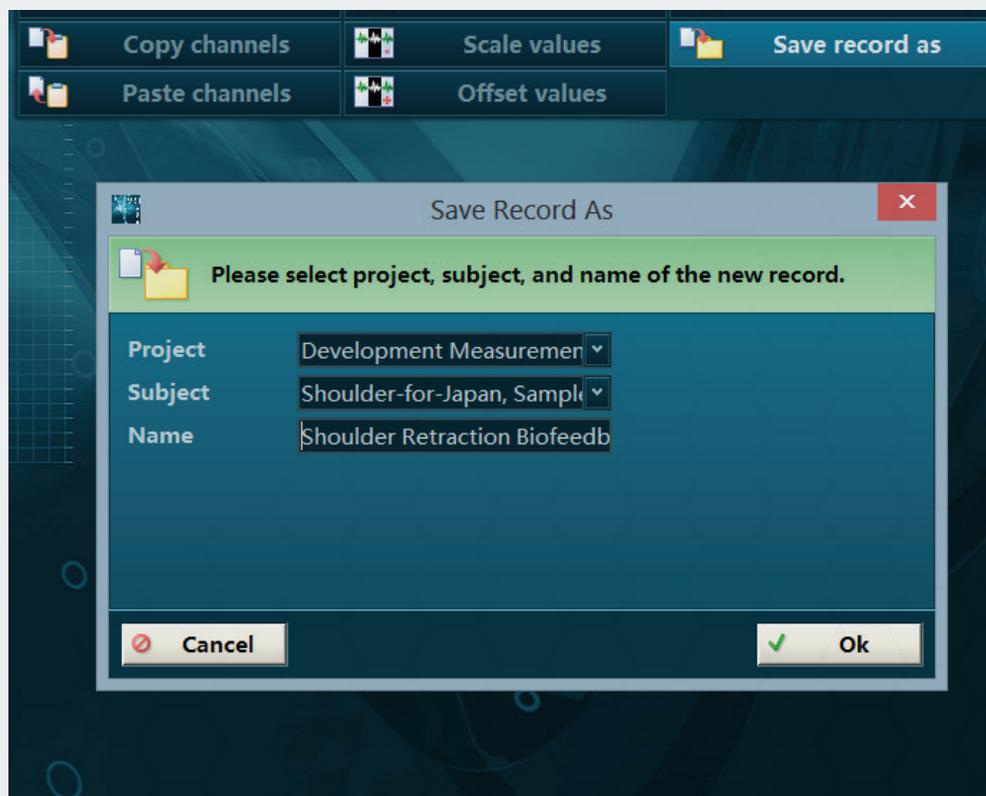
### Revert Changes

Any edit operation done thus far on the currently loaded record can be reverted to the original as long as the record is not confirmed to be changed when leaving the Edit/Viewer Menu:



## Save Record As

This function allows you to save an edited record under a new name and keep the original record as it is.



This function is highly recommended for any edited record, because editing operation cannot be restored to original version.

Function can also be used to just duplicate a given record.

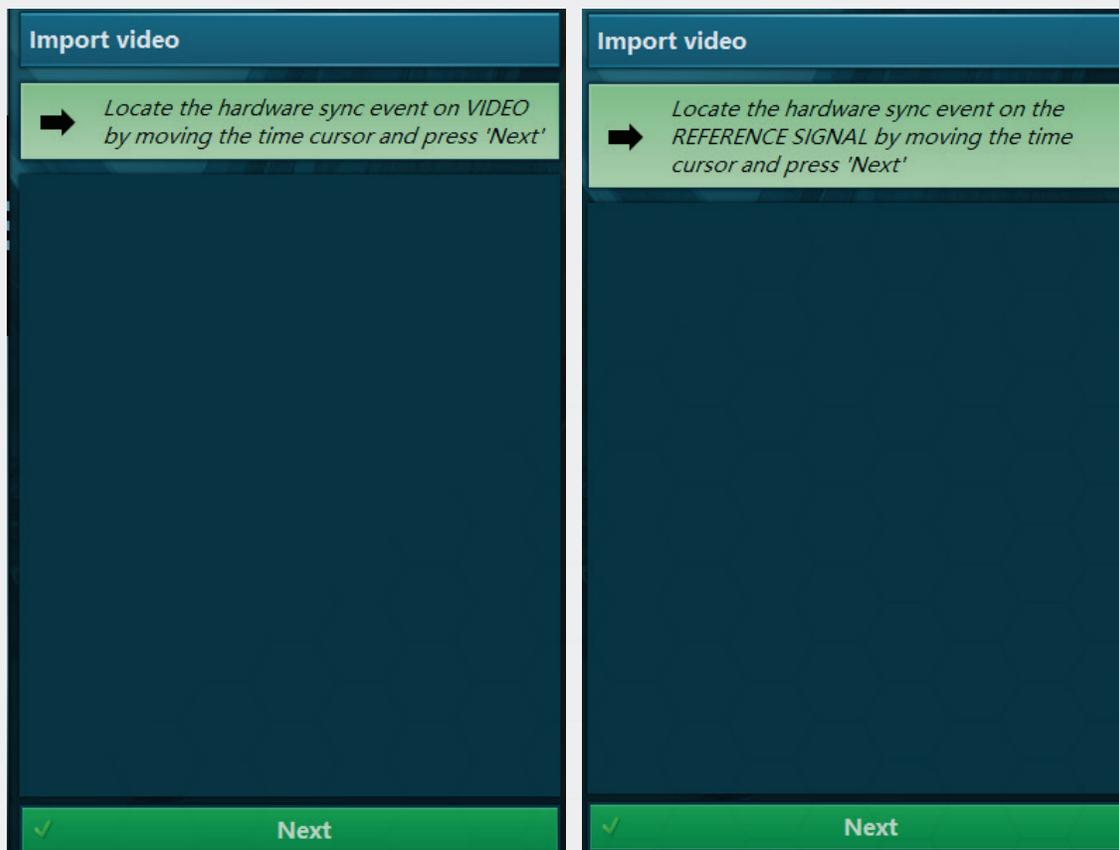


# SOFTWARE

## myoMUSCLE™ MODULE

### Import Video (only available in MyoVideo)

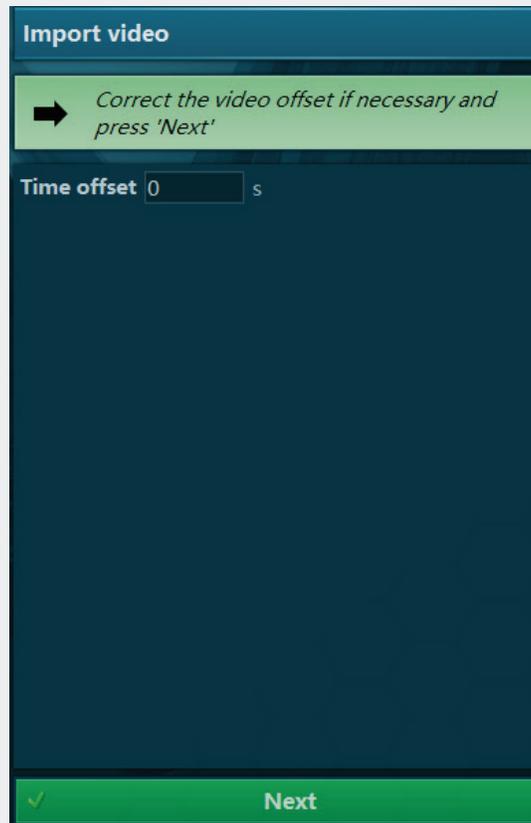
This function allows you to import externally recorded videos to an existing MR3 record. To merge the external video it is recommended that both video and MR3 record share a the same sync information. This is best arranged by connecting the LED Sync light to the MyoSync Synchronization system and record it's illumination with the external video right after recording start. It is also needed to turn on the sync channel of the given MR3 device so that it is seen as an extra channel in recording. Now external video and MR3 based recording can run independently. Later, in the merging dialog of import routine there is a two step scheme that allows you to align the external video with the internal MR3 recording:



In first dialog on left side there is a possibility to enter a hardware sync (e.g. = the illumination of the sync light) and align it in next step with the sync event shown in the Sync channel of MR3 recording.



This is shared sync scheme was not available, just skip first two dialog screens by pressing **Next** and optionally enter an offset value if known:



When done press Next to check the result in the record viewer.

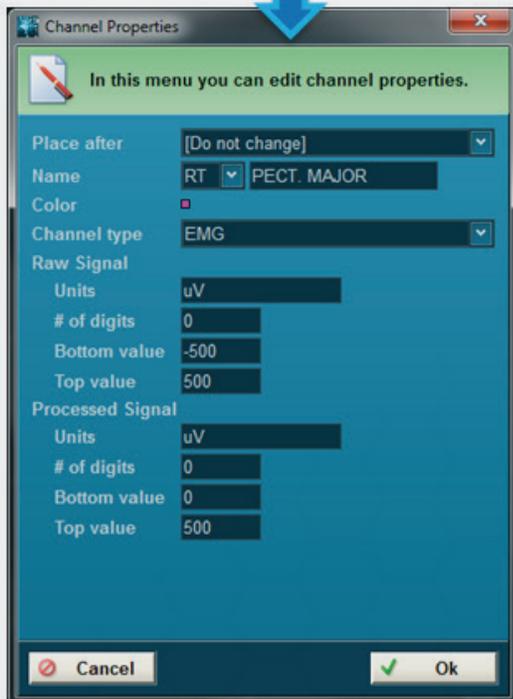
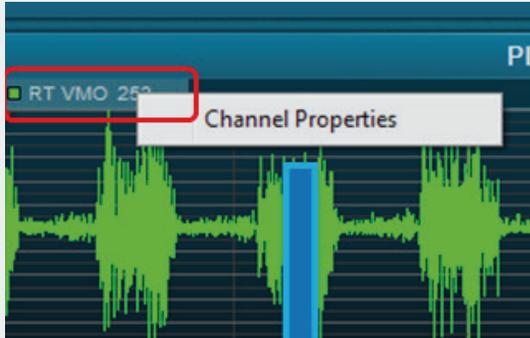


# SOFTWARE

## myoMUSCLE™ MODULE

### Edit Channel Properties

This menu can be started by right clicking on channel name in the signal screens:



**Place after** can be used to move a selected channel after another one. Use this function to re-order channels.

**Name** changes the current channel name and side indicator.

**Color** loads a color palette to define trace colors for this channel.

**Channel type** offers a pull down list of all available channel types to be selected for the new channel.

**Raw Signal / Processed Signal** section organizes the amplitude scaling settings for the selected channel.

**Units** defines the physical channel units.

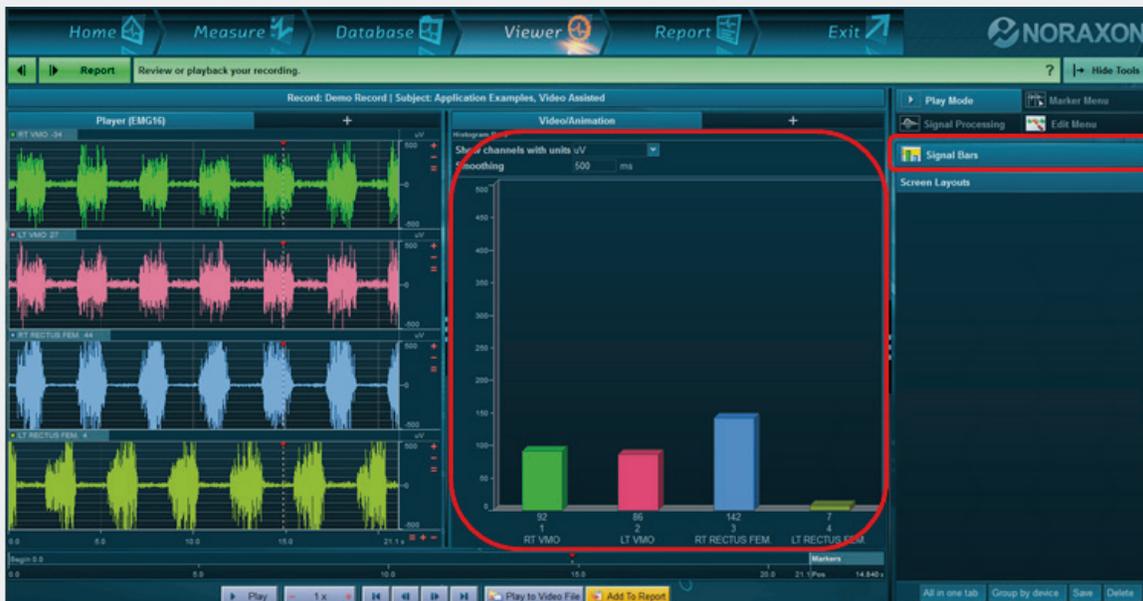
**# of digits** is the decimal value when showing the actual amplitude value.

**Bottom value** is the lowest and Top value is the highest amplitude scaling value for the Y-axis.



## Signal Bars

This button adds a new screen window showing the amplitude data at cursor position as a bar graph:



**Show channels with unit** < > – allows the user to select what type of signal/channel will be displayed as a bar graph

**Smoothing** – the value entered here defines a smoothing interval based on the mean value of this selected interval

## 7) Record Viewer Screen Layout System

The screen layout system is identical to the one already described in Measure menu. Please refer to this chapter to learn more about the possibilities to customize signal and animation screens and create, store and load different screen layouts.



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## myoMUSCLE™ MODULE

## Section 9: Report Tab

### Introduction

myoMUSCLE is designed such that it covers all major analysis concepts relevant to Kinesiological EMG and presents them in application related reports.

Depending on your myoMUSCLE edition, you may find different sets of ready to go reports from major application areas of EMG:

<b>Essential/Standard</b>	a set of standard reports is offered
<b>Clinical</b>	a set of clinical reports is offered
<b>Master</b>	a complete set of numerous application reports including the ones listed above

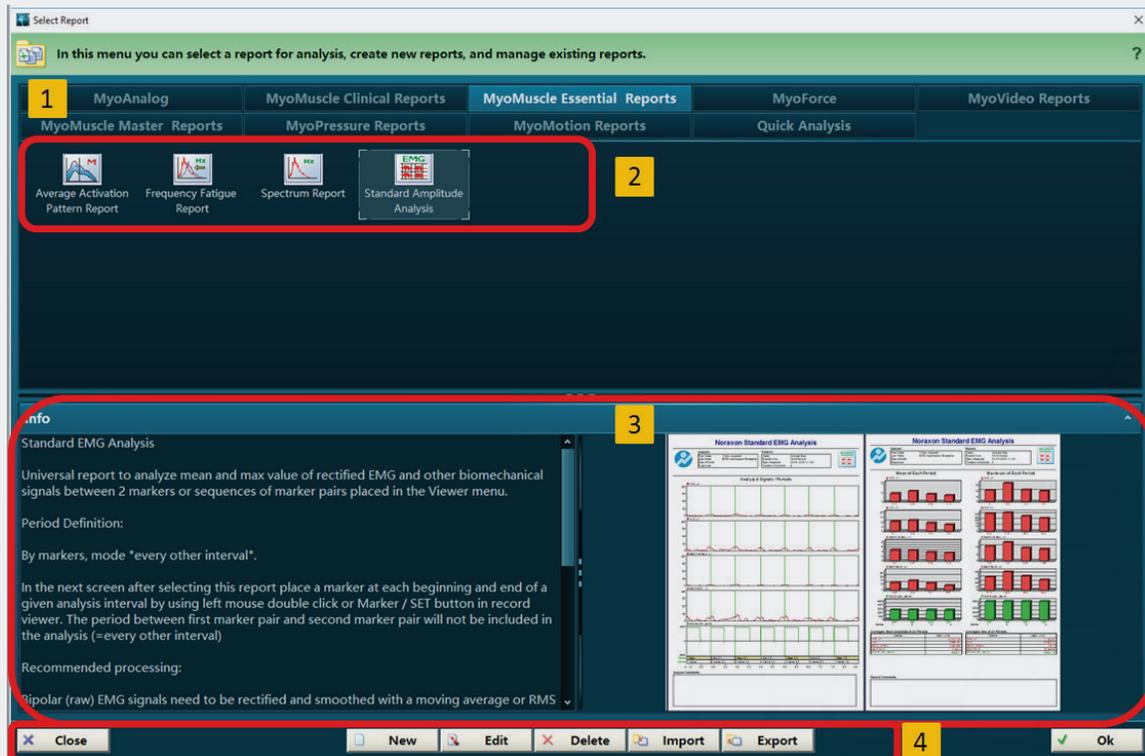
From the **Viewer** menu, click on the **Report** button in the top navigation bar or green Report button in the main action bar:



When done, the **Select Report** menu is opened. Depending on the number of installed modules, a selection of ready to go analysis reports are displayed.

### Select Report Menu

When done, the **Select Report** menu is opened. Dependent on the amount of installed modules, a selection of ready to go analysis reports are displayed.



1. Report group selection organized in module tab system
2. Selection of reports within a module group
3. Report info section with report preview
4. Report Options

## 1) Report Module Selection

Reports are sorted in seven major tab sections. The accessibility of these tabs is dependent upon the equipment and modules installed.

- **myoMUSCLE** (Essential, Clinical, Master) – for all myoMUSCLE EMG and sensor records
- **myoMOTION** – for all myoMOTION based 3D kinematic records
- **myoPRESSURE** – for all pressure related records
- **myoVIDEO** – for myoVIDEO 1 and 2 video camera records
- **myoForce** – for 3D force plate jump analysis
- **Quick Analysis** – default report for the Viewer based Quick Analysis

The list of available default reports may grow with new program updates.



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## myoMUSCLE™ MODULE

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## 2) Report Selection

myoMUSCLE reports are separated into 3 tabs:



**myoMUSCLE Master Reports** come with the **Master Edition** and contain a set of specialized application reports such as: gait, isokinetics, ergonomics, jump testing, and wavelet.



**myoMUSCLE Clinical Reports** are a set of commonly used clinical reports:



**myoMUSCLE Essential Reports** are part of the Essential Edition. Four major EMG standard analysis reports are available here:





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## myoMUSCLE™ MODULE

### 3) Report Info with Report Preview

Here you can find a short description of the selected report addressing its main purpose, the way analysis periods are defined (Period Definition), analysis elements, and typical signal processing steps.

#### Info

##### Average Activation Report

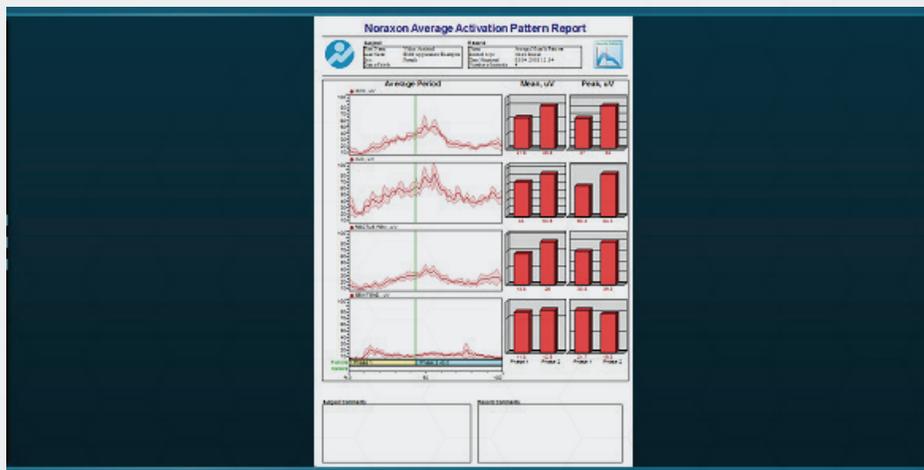
The report is designed to provide time normalized average EMG patterns for repetitive movements (e.g. extension / flexion). It displays EMG patterns averaged across repetitions (ensemble average)  $\pm 1$  SD as well as corresponding statistics (mean and peak amplitudes) for each muscle and motion phase.

Period Definition:

Mode: Interval with Event

At least three markers must be placed to run an analysis. The first marker defines the start of the first repetition. The second marker (event) is the turning point within each movement, such as toe-off in gait cycles or the highest pedal position in cycling. The third marker serves both as the end of the first repetition and the start point of the second repetition. In the Viewer graph (next screen after selecting this report) the two phases of the movement (e.g. extension/flexion) are separated by the event marker and further indicated by the horizontal yellow and blue bars on the bottom.

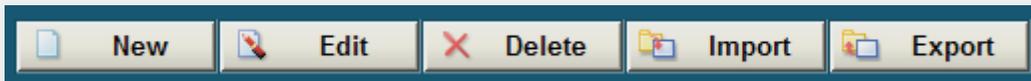
Below is a typical example of an average curves report.



**NOTE:** Please carefully study the information about the predefined period definition preselected for each report (marker based, trigger signal based, sub modes, etc.).



## 4) Select-Report Options

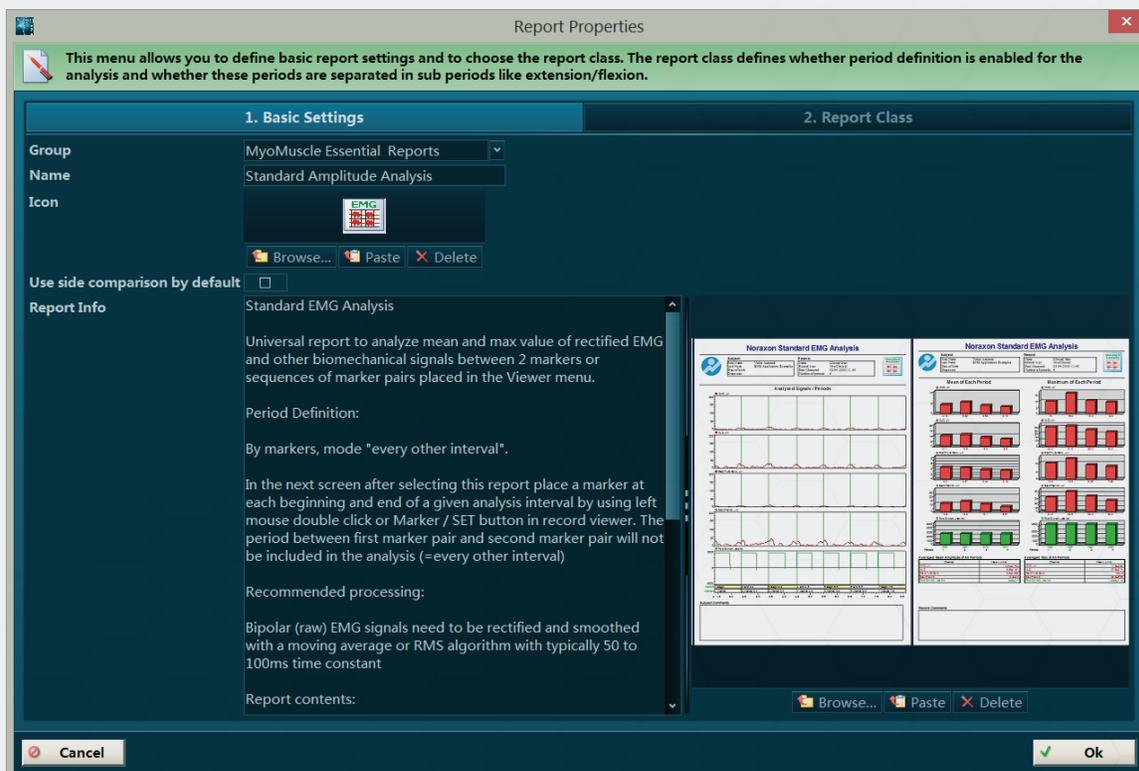


### New

You can create your own reports by selecting a report class and manually choosing analysis, layout, and info elements. A description of this Report Generator module is given in an additional document.

### Edit – Basic Settings

If needed, a report's title, tab sections, description text, and preview window can be changed with this edit menu:





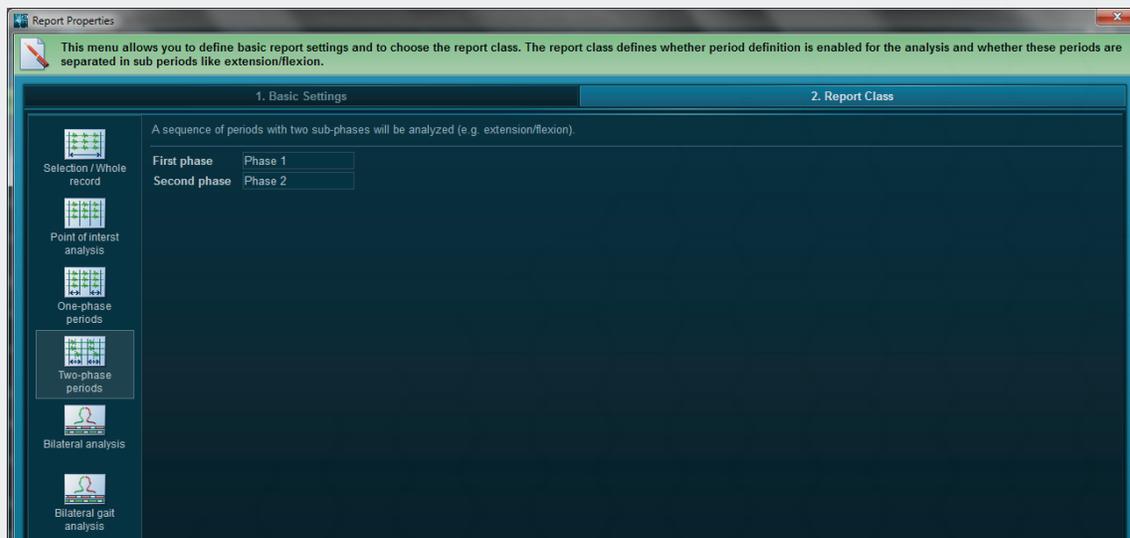
# SOFTWARE

## myoMUSCLE™ MODULE

Use side comparison by default – this option will automatically create a comparison overlay plot of left / right signals (see myoMUSCLE Clinical – Symmetry Report)

### **Edit – Report Class**

The report class editor is meant to be used for experienced report designers only. Reports can vary in complexity in terms of periods and phase definition. For example, some reports do not require any period or phase definition because the whole record or a mouse marked area is analyzed (e.g. Clinical coordination report or Spectrum report). Other reports, like Unilateral Gait in the myoMUSCLE Application Reports, need a foot switch triggered period definition with 2 phases (stance and swing phase) to properly analyze the gait cycle. Even more complex are the Bilateral gait setups which add more sub phases to the gait cycle. The current MR3 /myoMUSCLE version offers six levels of complexity to manage these differing tasks:



**Selection / Whole record** – The whole record or the mouse marked area will be analyzed.

**Point of Interest** – Only single points of interest, marked with the button Add to Report in Viewer menu, will be included in the report (designed for Video Analysis).

**One-phase periods** – A sequence of markers or event based (defined by trigger channels) periods without additional sub phases will be analyzed.

**Two-phase periods** – A sequence of periods with two sub phases will be analyzed (e.g. extension/flexion, stance/swing phase, etc.). You can freely name the first and second phase (default names are Pre and Post event).



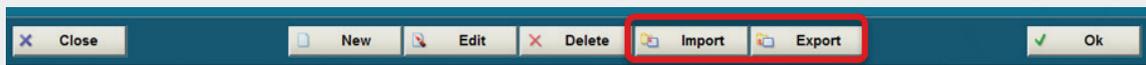
**Bilateral analysis** – This class is designed for left to right comparison analysis in bilateral gait measurements and splits the period definition into left and right side periods.

**Bilateral Gait analysis** – A sub version of Bilateral analysis and needed for myoPRESSURE recordings.

### Delete

This function will delete a record without a possibility of restoring it. Carefully use this option and consider first making a backup to an external location using the Export function.

### Export/Import



Here you can export or import reports from/to external locations such as other HDD drives, network directories, etc. An exported report is automatically stored in a container directory called **Noraxon MR3 data**. To import reports set a path to the location where this directory is located.

**NOTE:** Do not attempt to change the contents of the Noraxon MR3 data folder. If you wish to keep track of multiple projects or subjects please create folders for those projects and save the respective Noraxon MR3 data folder into the individual project folder.

### OK

This operates the selected report. Once the correct report has been selected press **OK** to continue.

After selecting a report, click **OK** to enter the next step to run a report

### Run a report

Once a report is selected, the next step is channel selection. Because of its multi-device nature, many signals may be available in the record and a selection of specific channels is required, which can be organized in the next step.



# SOFTWARE myoMUSCLE™ MODULE

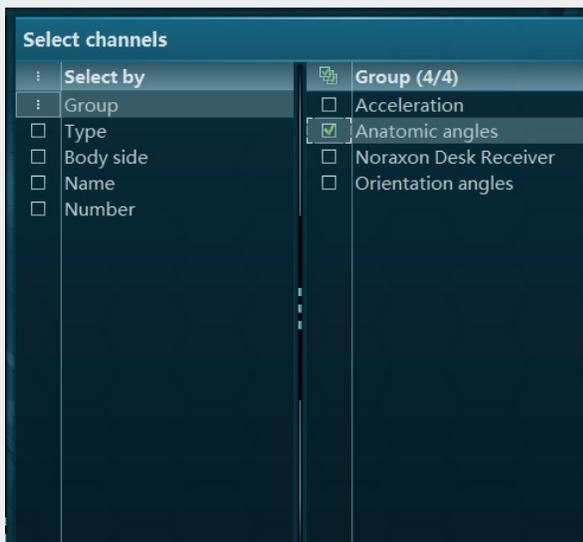
Report channel selection step

By default all channels available in a record are preselected for the analysis (see section 2):



In the above multi-device example 3 Tab groups from the myoMOTION system and another tab Group from myoMUSCLE's Desk receiver is available, which counts up to 101 possible analysis signals.

The Select channel Option allows you to specifically select Groups and Types of channels:



The following operators are available:

Select by:

**Group** -- Select channels by register tab groups.

**Channel type** -- Select channels by type, e.g. EMG, force, etc.

**By body side** -- Select left or right side labeled channels.

**Name** -- Selection via muscle, segment name.

**Channel number** -- Select by the channel list number.



When done, click **Next** in the green main action bar to continue.



## Report Period Definition Step

Before the report is shown, MR3 must define **Period Definition** (for analysis periods), operated via the Viewer Menu.

Whenever a report analyzes phases or multiple periods, these phases/periods have to be defined via manual marker, point of interest markers (video analysis), or auto period definition routines.

## Overview of main screen elements:



- 1. Instruction text** – Carefully read the instruction given here to navigate report wizard.
- 2. Period Definition Mode** -- Several methods are offered here: using markers, angles signals, or TTL/switch signals. Each Report is pre-configured to a certain period definition mode. The Period Definition for each given report is pre-filled here as defined in the explanations given in the Report Info.



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### 3. Marker Type – Several marker types can be used to define the analysis periods:

- [Any Activity]
- [Any Marker or Activity]
- [Any Marker]
- Begin Activity
- End Activity
- Marker
- pause
- Sync
- Video

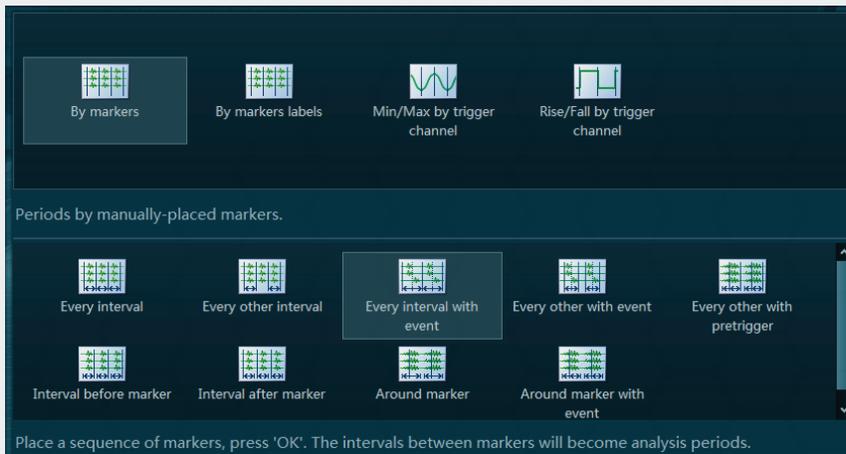
In this example **Begin Activity** and **End Activity** are customized markers, the default marker type is "**Marker**" – this marker type appears whenever you manually add a marker into the record.

When the period definition mode and marker type are selected press **Next** in the green main action bar and check the periods found in the record. They are indicated by yellow or blue yellow (for gait analysis green-right and red-left side) period bars:



A given colored period can be mouse dragged to the bottom of screen to remove it from the selection sequence. This function is important in gait analysis and foot switch based period definition when some invalid steps that should not be analyzed need removed.

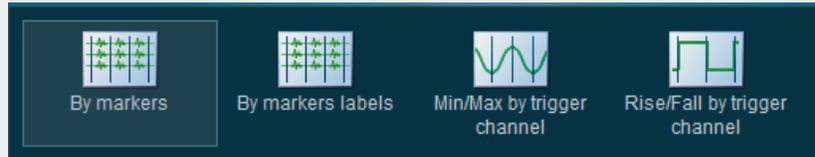
### Create a new or change an existing period definition



A comprehensive set of period definition modes is presented that allows for the selection of alternative period definition modes and sub-modes. Some reports don't offer the option to change period definition because they are assigned to the mode "Selection/Whole record" by their report class definition in the report selection/properties menu. For this report class only the mouse marked area can be changed.



MR3 supports 4 major period definition methods



## By Markers

This is the default mode for most reports. Markers are set by left mouse double click or by using the Marker Menu in the Viewer menu. The default name for these is **Marker**, but the marker menu allows you to create other marker names. Individual marker names can be used with the second method, **By marker labels**.

If the report class is a **One Phase** (e.g. Standard Amplitude) or **Two Phase** (e.g. Average Activation) report, a set of sub modes are presented in the sub mode column:

### One phase reports:

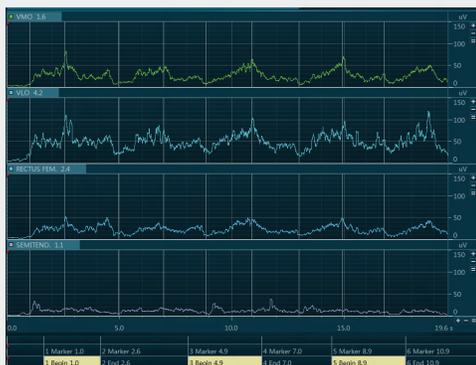


### Two phase reports:

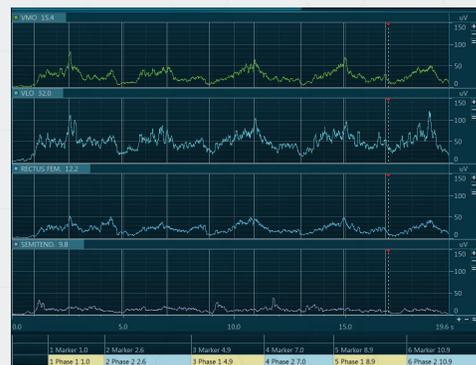


The result of any auto period definition routine is visualized by horizontal periods bar just below the signal screen:

### One phase reports:



### Two phase reports:



Selected sub mode: - Every other interval

- Every interval with event



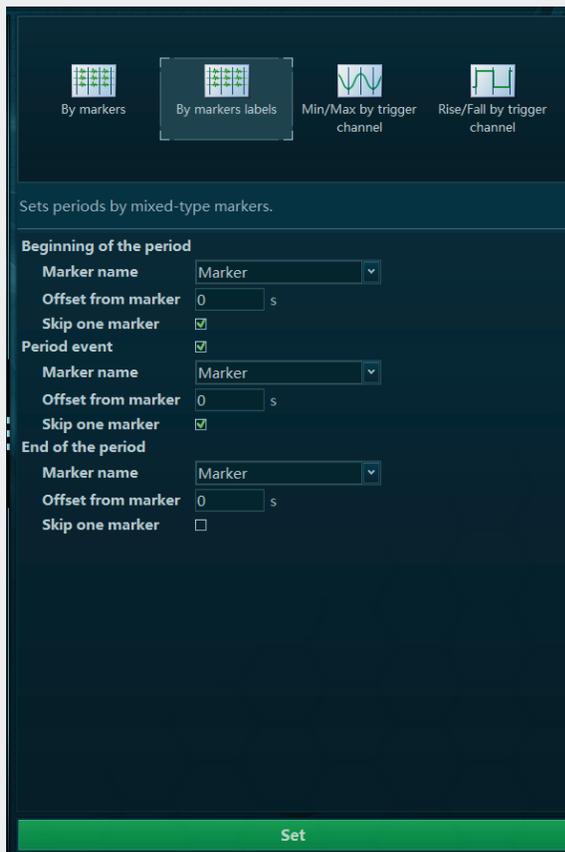
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Check if one of the offered sub modes is more suitable to your task and select it by confirming **OK**. Pressing the **Preview** button allows the user to see the periods in the signal window before selecting **OK**.

### By Marker Labels

Markers can freely be named by any label (see Viewer, Marker Menu). If special marker names were used in record viewer or in imported files (C3D gait event markers) the period definition can specifically use these marker labels for period definition. For example, all “Heel strike” markers can be used for the beginning of a 2 phase cycle (step), and all “Toe” markers as “event marker.”



Choose the marker type in the pull down list **Marker name**.

**Offsets from markers** will add a pre-marker period, a setting that is helpful for event markers in jump testing (pre-activation period before hitting the ground).

**Skip one marker** is needed in case there are undesired interruptions within un-interrupted motion cycles (e.g. gait).

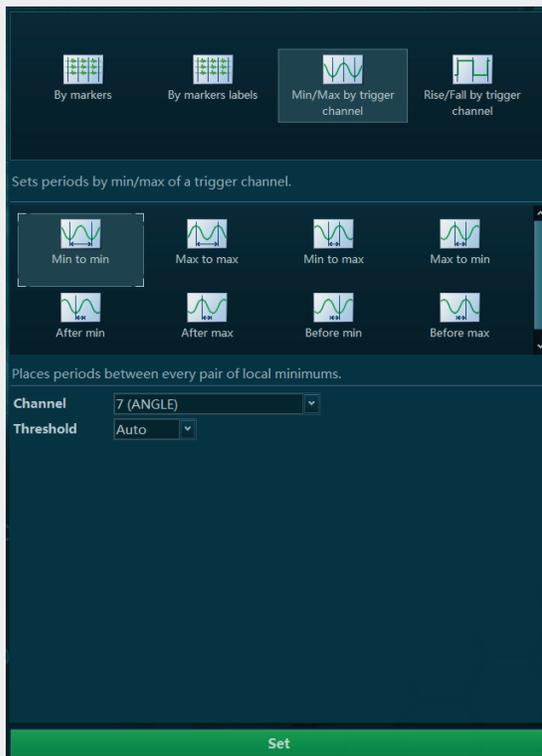
### Min/Max by trigger channel

This period definition type is designed for angle plots and similar signals that should be used as a motion trigger signal. It detects local Min and Max values in the selected trigger channel.

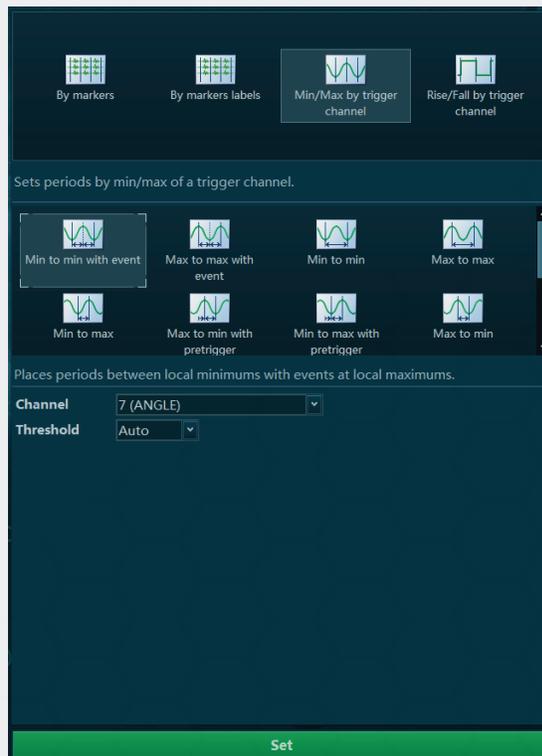


If the report class is a One Phase (e.g. Standard Amplitude) or Two Phase (e.g. Average Activation) report, a set of sub modes are presented in the vertical sub mode column:

One phase reports:



Two phase reports:



**Channel** – select the trigger channel to be used for the auto-period detection

**Threshold** – regular angle signals can be analyzed by the **Auto** mode. In special cases it may be required to select a **Manual** mode. Here you need to enter suitable value that define the minimum range that has to be found between Max and Min angle value to accept it as a local event.

Check if one of the offered sub modes is more suitable to your task and select it by confirming **OK**.



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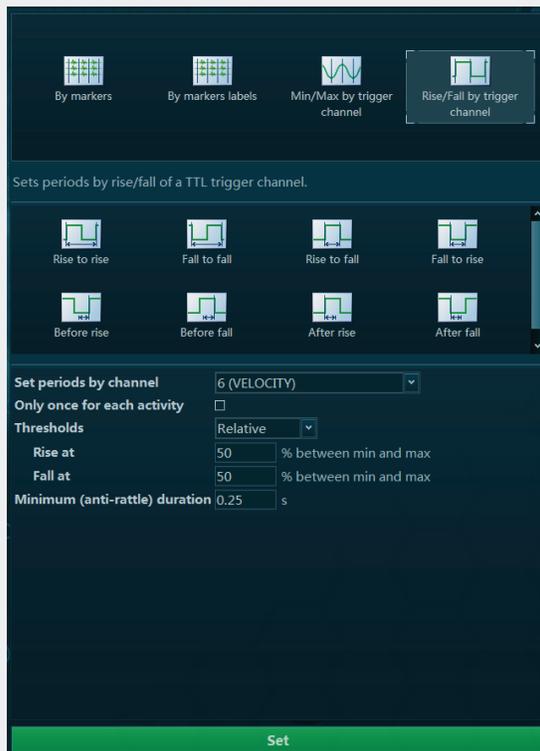
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### Rise/Fall by trigger channel

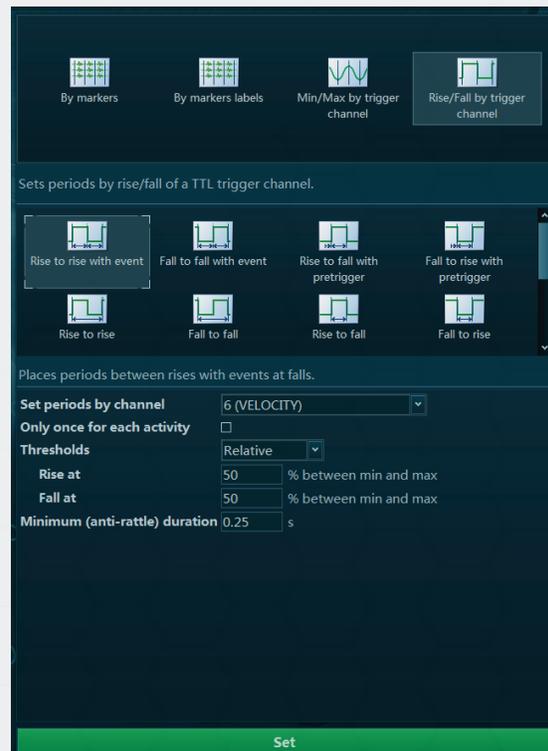
The Rise/Fall auto detection is designed for classical TTL styled signals and foot switch on/off signals with a sharp rising edge going to high TTL and sharp falling edge going back to low.

If the report class is a **One Phase** (e.g. Standard Amplitude) or **Two Phase** (e.g. Average Activation) report, a set of sub modes are presented in the vertical sub mode column:

#### One phase reports:



#### Two phase reports:



**Set period by Channel** – select the trigger channel to be used for the auto-period detection.

**Only once for each activity** – designed for multi-activity recordings which interrupt a recording via a pausing period.



**Threshold** **Relative** tries to automatically detect every **Rise** and **Fall** of the trigger signal by checking the TTL range and placing markers at the 50% position between the rise and fall level. This location can be customized by the controls **Rise at** and **Fall at** between low and high (TTL level).

**Absolute** takes the amplitude values entered in **Rise at** and **Fall at** as threshold lines and uses them for the period definition. Each time the TTL signal passes the defined threshold line, it is assumed that this event can be used to define a period

**Minimum (anti-rattle) duration** defines the minimum duration a TTL event has to last to be recognized by the algorithm. This switch can help avoid incorrect selections caused by artifact spikes (typically very short spikes).

**NOTE:** For very short trigger events like jump ground contacts, this anti-rattle duration needs to be adjusted to lower values!

Check if one of the offered sub modes is more suitable to your task and select it by confirming **OK**.

**NOTE:** We recommend choosing the basic settings pre-configured for this report and only entering the period definition tool bar menu if experiencing problems, such as noisy signals. Incorrectly selected and operated period definition will result in an inaccurate analysis of the default myoMOTION report.

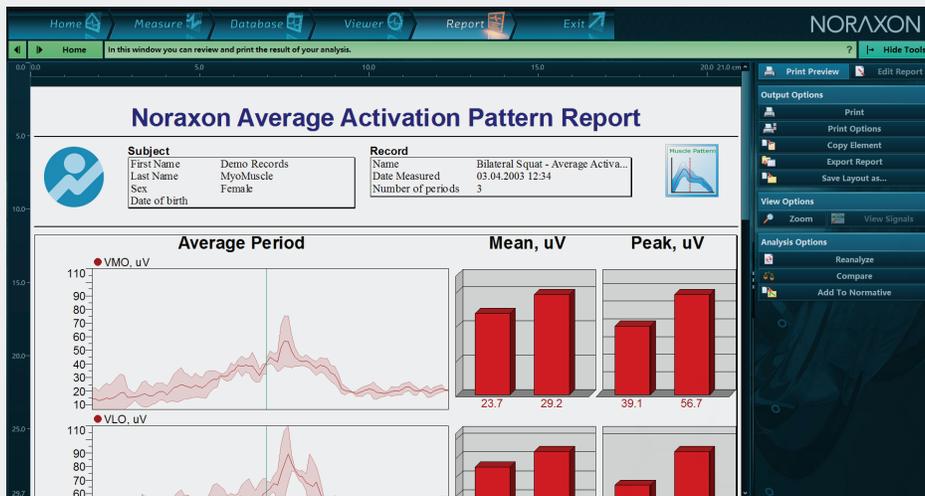


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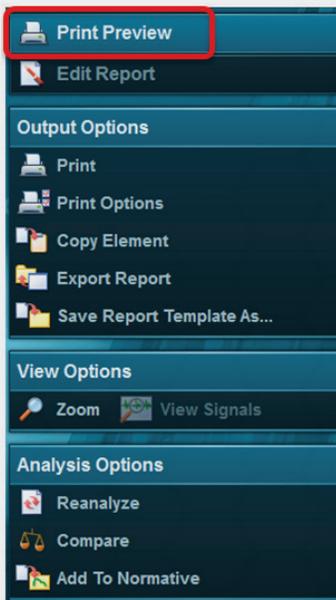
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### Report Print/Preview

Once a report is chosen and the analysis periods have been set, a preview of the report will be generated. At this point, there is also the option for printing, exporting, or further editing and analysis.



In the right side tool bar are several helpful report related options. The report options exist in two modes: **Print Preview** and **Edit Report**. The user can toggle between the two to access different report options and customize the report.



#### Print Preview

The **Print Preview** mode is has three available option groups: **Output, View, and Analysis**.

#### Output Options

- **Print/ Print Options** – print the report or format the report including which available printer to print to, page size and orientation, and margin size.
- **Copy Element** – any elements (graphs, tables, etc.) of the report can be selected by clicking on the element. Selecting Copy Element will send the element to the clipboard to allow for pasting into other programs such as word, paint, or excel.



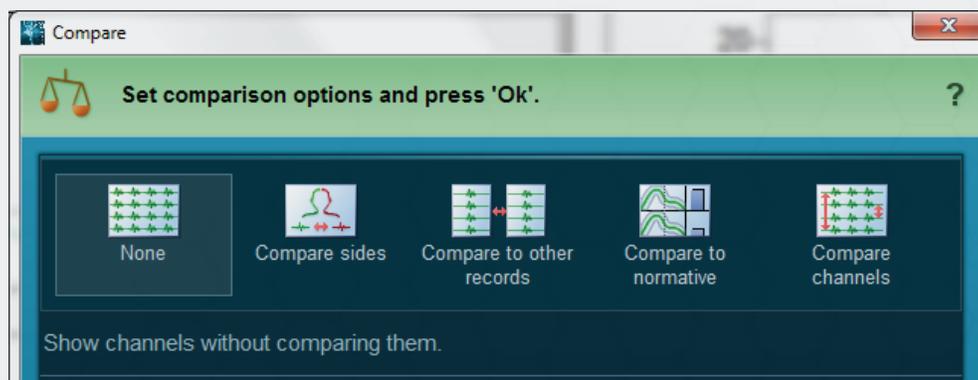
- Export Report – sends the report to clipboard or saved as an HTML, Text, or Excel file in a specified location.
- Save Layout As – the user can save customized report templates for later use. The original report/layout will stay unchanged.

### View Options

- **Zoom** – the user can zoom to a percentage of the report, size the report to fit vertically or horizontally, or choose to view the report one or two pages at a time.
- **View Signal** – the user can view the signals of a selected element. Clicking on this will display the selected element in the Viewer window. To return to the report preview, hit the back arrow button or click on the Report tab.

### Analysis Options

- **Re-analyze** – This option allows you to modify the report setup steps Channel Selection and Period definition. **Reanalyze** – will take the user back to the preview Report - Viewer menu to change the channel selection and period definition as described above.
- **Compare** – Click on Compare in the right tool bar menu to start the Comparison Menu. MR3 supports four major comparison routines for report data:



- Compare sides
- Compare to other records
- Compare to normative (if available)
- Compare channels (within the same record)



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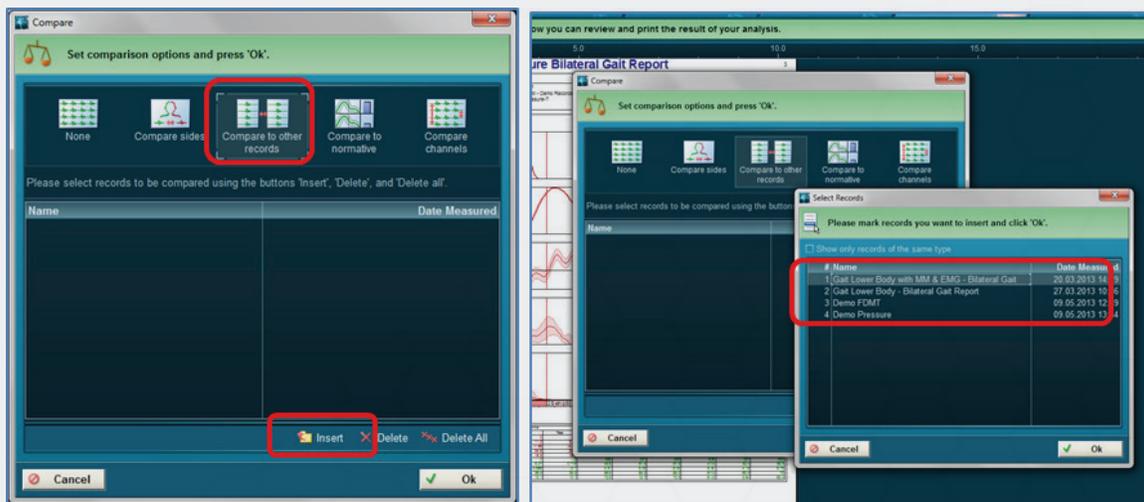
### Compare sides

In records measuring both sides of a muscle group, the Measurement Setup Menu allows each muscle group a side indicator (LT and RT, see Measurement Setup Menu). If this comparison mode is chosen, muscles/channels of the same name but with differing side indicator **RT** and **LT** are automatically compared. This function works independently of the channel numbers and arrangements, all channels of the same channel name but with LT and RT indicator are automatically compared!

### Compare to other records

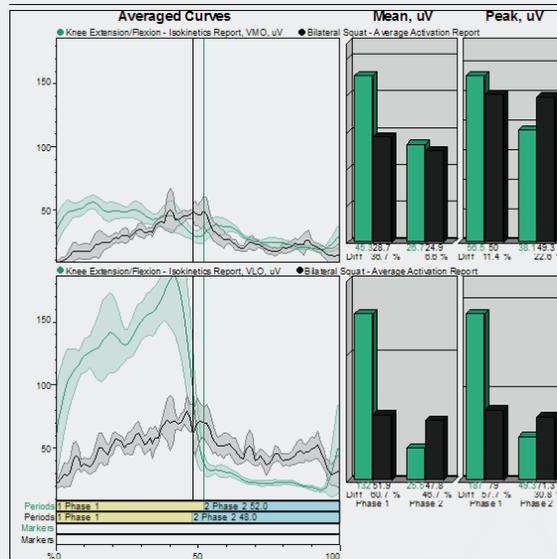
Compares the record to another record previously stored in the database and analyzed in the Report menu.

**Note:** In order to compare records, the records must have been analyzed with the same report and report setup options, especially related to period definition.





After confirming the record selection with  **Ok**, both record data will be shown side by side or as an overlaid signal in each report element:



It is possible to compare to several records at the same time.

### Compare to normative (curves)

MR3's unique normative data system can be used to compare a current record to a normative record. Normative records are usually time normalized averaged curves of single healthy subjects performing a repetitive sequence of the analyzed activity. To create a normative curve, first the single subject performs a repetitive sequence, and then each repetition period in this sequence is averaged in time normalized cycles. Finally 10 or more of these individual time normalized records are averaged again in MR3's normative database in a group or normative curve. Once done and available in the normative database, a current patient curve can be compared to this group curve to show differences, such as differences in the EMG pattern.

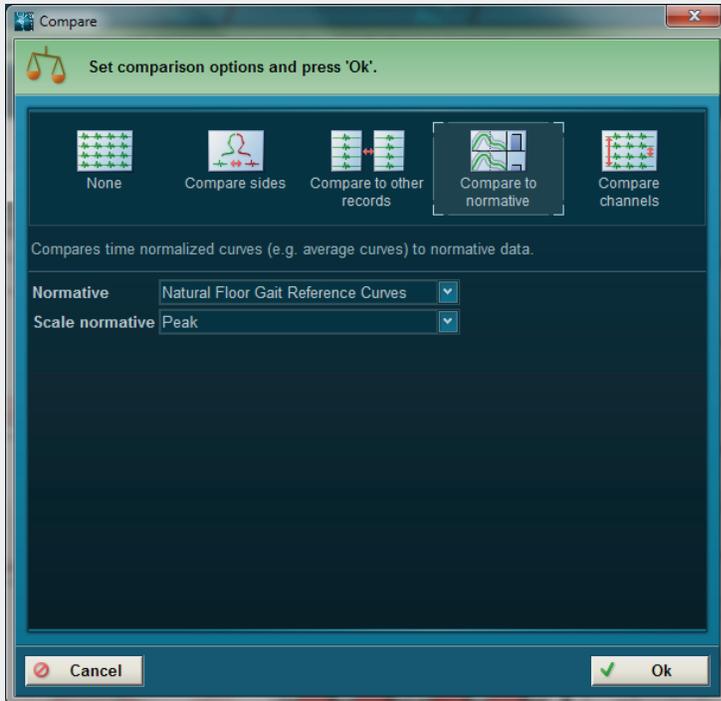
**Note:** Only records of the same type and analyzed with the same report and channel settings can be compared.

The selection box **Normative** has a pull-down list of all available normative curves available in the current project. Choose a suitable normative record from this list. All normative files that were created with the right tool bar function "Add to normative" are listed here.



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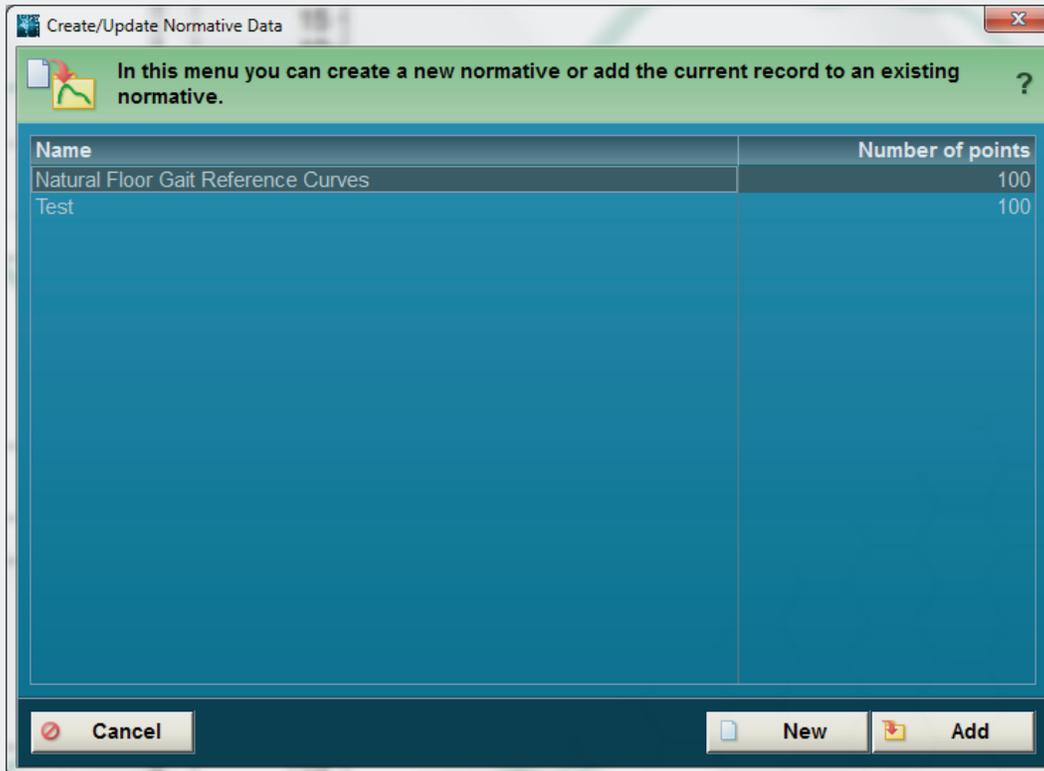


MR3 is equipped with one sample normative file for floor walking.

**Scale normative** – If EMG based normative data were not amplitude normalized via Signal processing in the **Viewer** menu, the amplitude data may heavily vary. This function allows users to amplitude normalize both the selected patient record as well as the normative file to its **Peak** or its **Mean** value. This procedure enables a better fit between curves and allows more detailed inspection of curve behavior and other characteristics.

- **Add To Normative** – adds to normatives in the database, or creates and adds to new normatives in the database.

MR3 has a powerful normative data generator. It is designed for records analyzed with averaged curves reports like Gait, Average Activation, Isokinetics, etc. All these records have a time normalized ensemble average curve with plus/minus 1 SD. The time normalization in cycle from 0 to 100% enables a standardized format for comparison files of different phase duration.



**Note:** The only normative included with the MR3 software is the Natural Floor Gait Reference Curves. It is meant to be used as demonstration data set and has no diagnostic meaning. All other normative data must be created and saved by the user. Only the time normalized averaged curves are stored to the given normative file.

Any successfully generated averaged curve can create a **New** normative file or it can be added (**Add**) to an existing one:

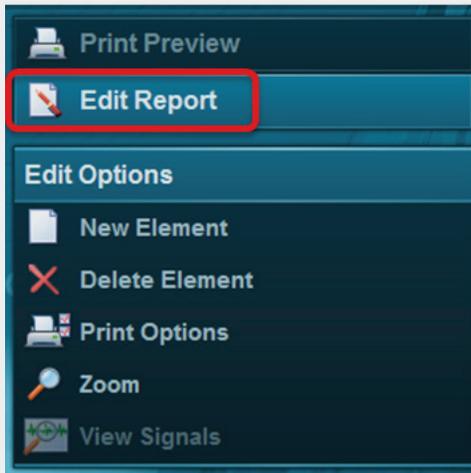
All normative files are listed in the Normative Data base section of the **Database** menu. They are also available as normative comparison files in the report **Comparison** option described above.



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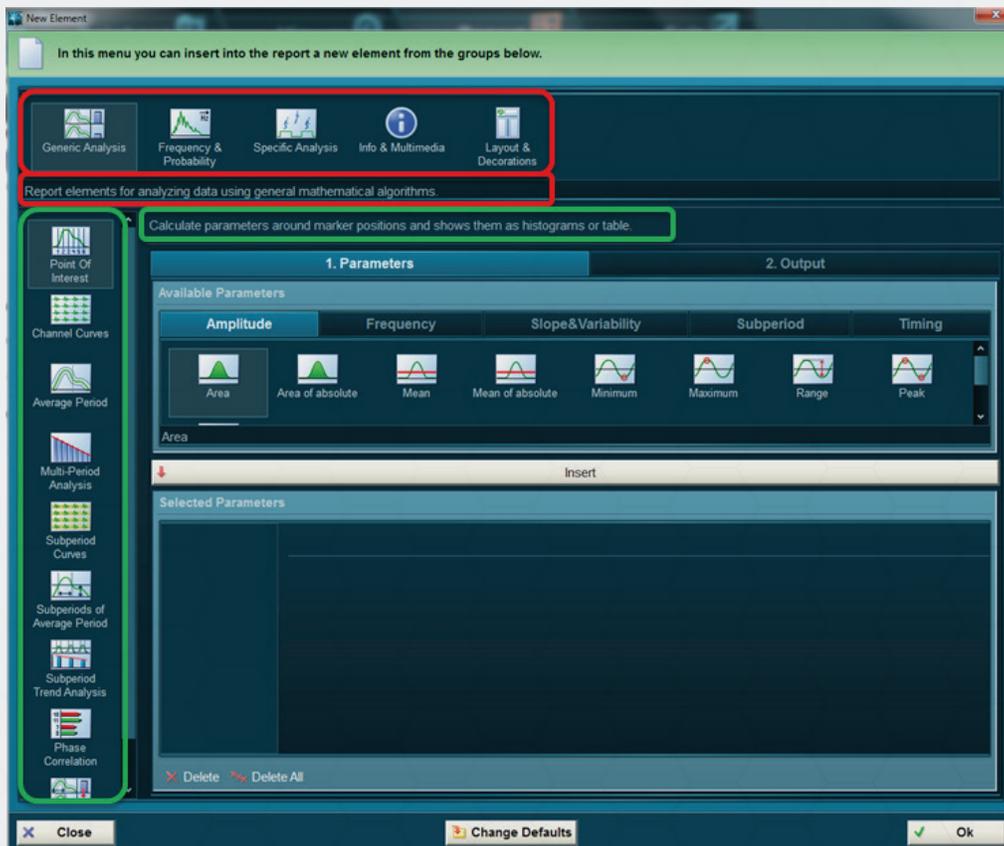
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### Edit Report



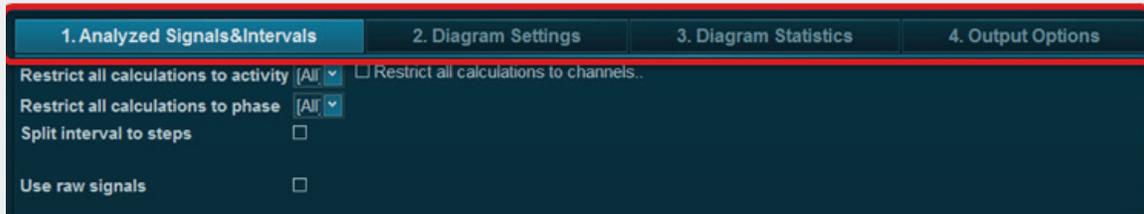
Edit Report options allow the user to customize the report by adding or deleting elements.

- **New Element** – This function creates areas for the user to insert new elements. The user must then double click within one of the dashed areas with the text “Double-click here to insert an element.” The new element box will appear:





The user can determine which element they need by reading the descriptions provided in the box. Each element will have different available parameters and output options for how the element information will be displayed, i.e. table, graph, or combination of the two.



**Note:** Any elements in the report can be edited by double clicking the element.

- **Delete Element** – To remove an element from the report, simply click on the element and select “Delete Element.” This will prompt the user with a confirmation message, and if “Yes” is selected the element will be removed from the report.



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