



MR3 Signal Processing

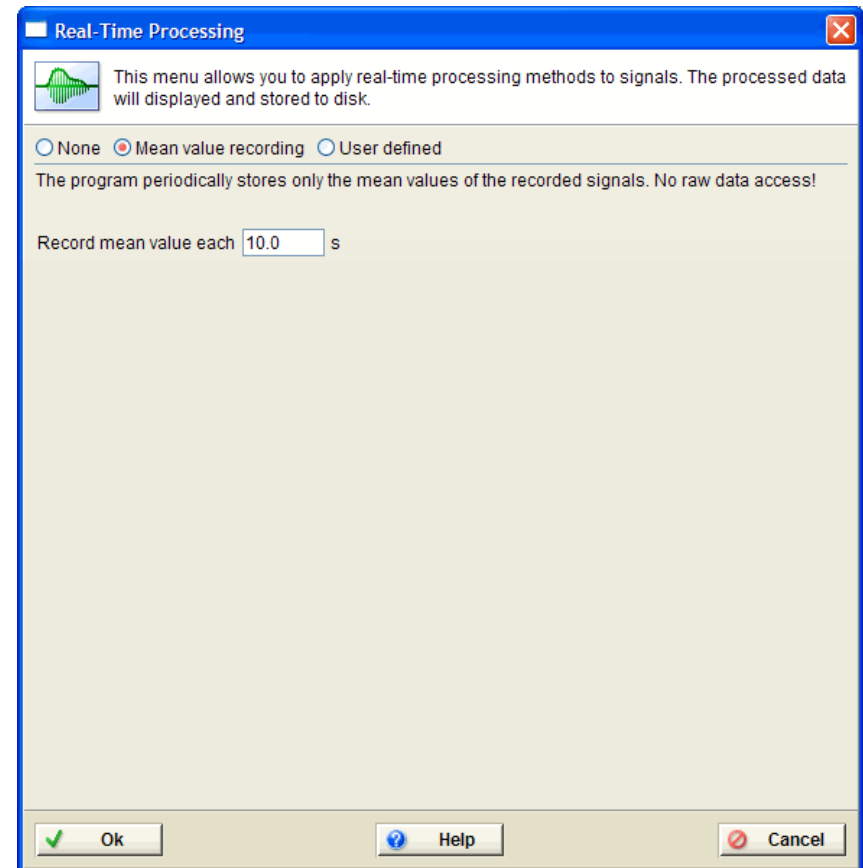
Date: 9/15/2014

NORAXON
Superior Evidence-Based Biomechanics

Real Time Processing

Mean Value Recording

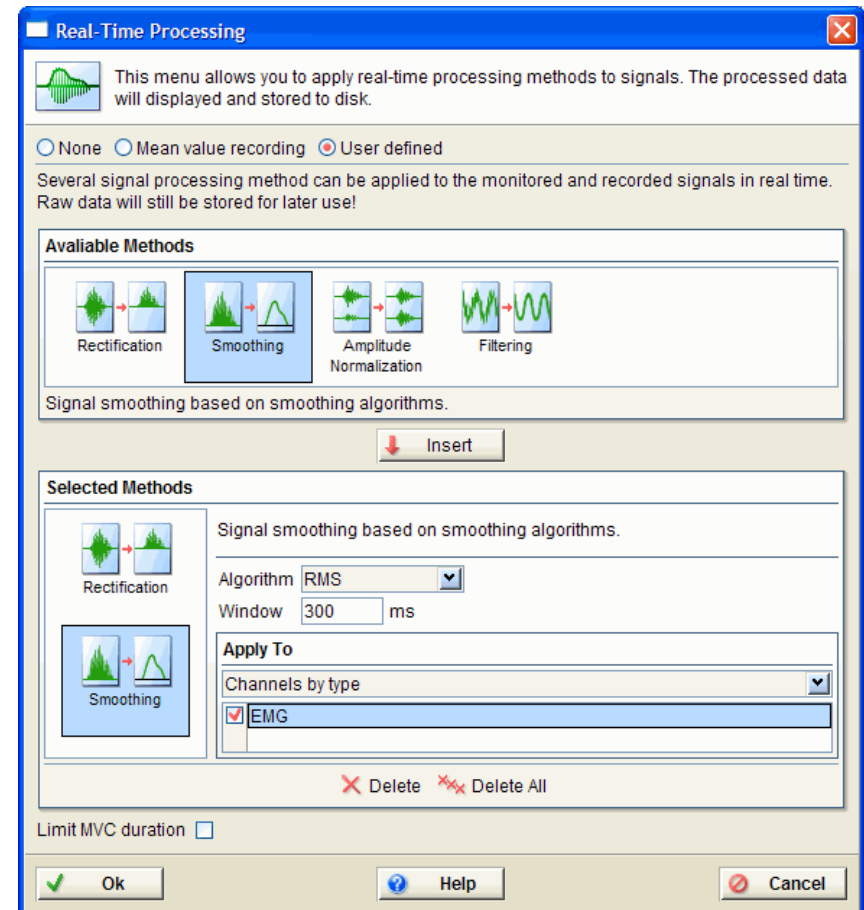
- Designed for long measurements, where any raw data recording would be too much data or processing time would be too long.
- Instead of raw data, sampled at e.g. 1000 Hz, the mean amplitude value of a user defined time period will be stored.
- Record mean value each “X” s, allows the user to define a time interval to save the averaged data.
- Benefit is, only this single amplitude mean value will be stored to the record, i.e. no raw data



Real-Time Processing

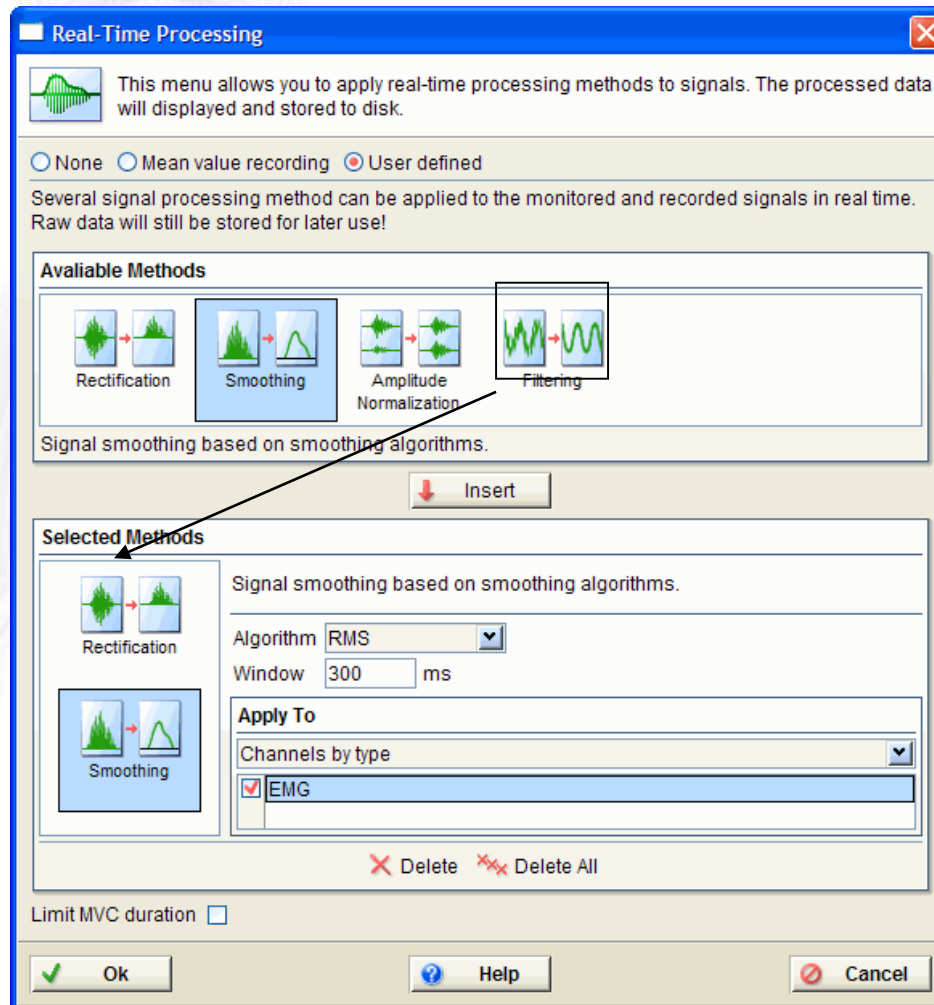
User defined

- Filtering – MUST be the first Selected Operation.
- Rectification – allows calculations e.g. mean amplitude, area under the curve etc.
- Smoothing - Raw EMG is smoothed by digital filters, RMS or moving average algorithms
- Amplitude Normalization: Real-time or post-hoc MVC-normalized EMG amplitudes



Real-Time Processing

Filtering – MUST be done FIRST!!



Filter Types

Filtering – MUST be done FIRST!!

Filter types in MRXP: FIR, IIR, Median

- FIR - Finite Impulse Response filter

Window: Number of points used to process the data. Attention: with longer windows the quality improves, but the real time processing, takes more time and creates a delay.

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

Windows (below frequency): sub type selection to define the edge fading window.

- IIR - Infinite Impulse Response-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 the filter.

- Median - Filter Window:

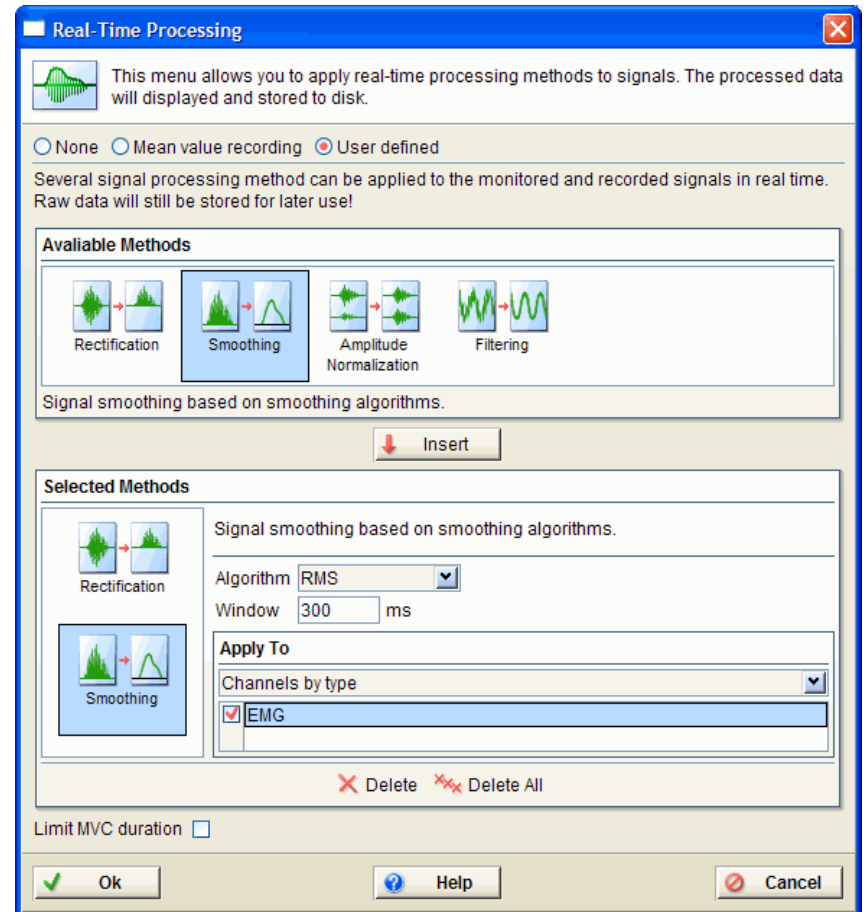
Defines the amount of data points used for the filter algorithm.

Section Apply to Each filter command can be selectively applied to channel types or physical channel numbers.

Smoothing

Supported Algorithms:

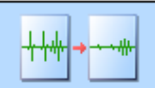
- **RMS** - Root Mean Square
- **Mean** - the moving average
- **Mean absolute** - the moving average with combined rectification
- **Window:** allows you to define the millisecond based window for each algorithm



ECG Reduction

Real-time Processing

Selected Methods



ECG Reduction

Reduces ECG interference on selected signal.

Select interval by first activity ☒

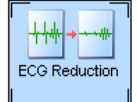
Apply To

Channels by type

☒ EMG

Post Processing

Selected Operations



ECG Reduction

Reduces ECG interference on selected signal.

Select interval by activity ☐

Select interval manually ☒

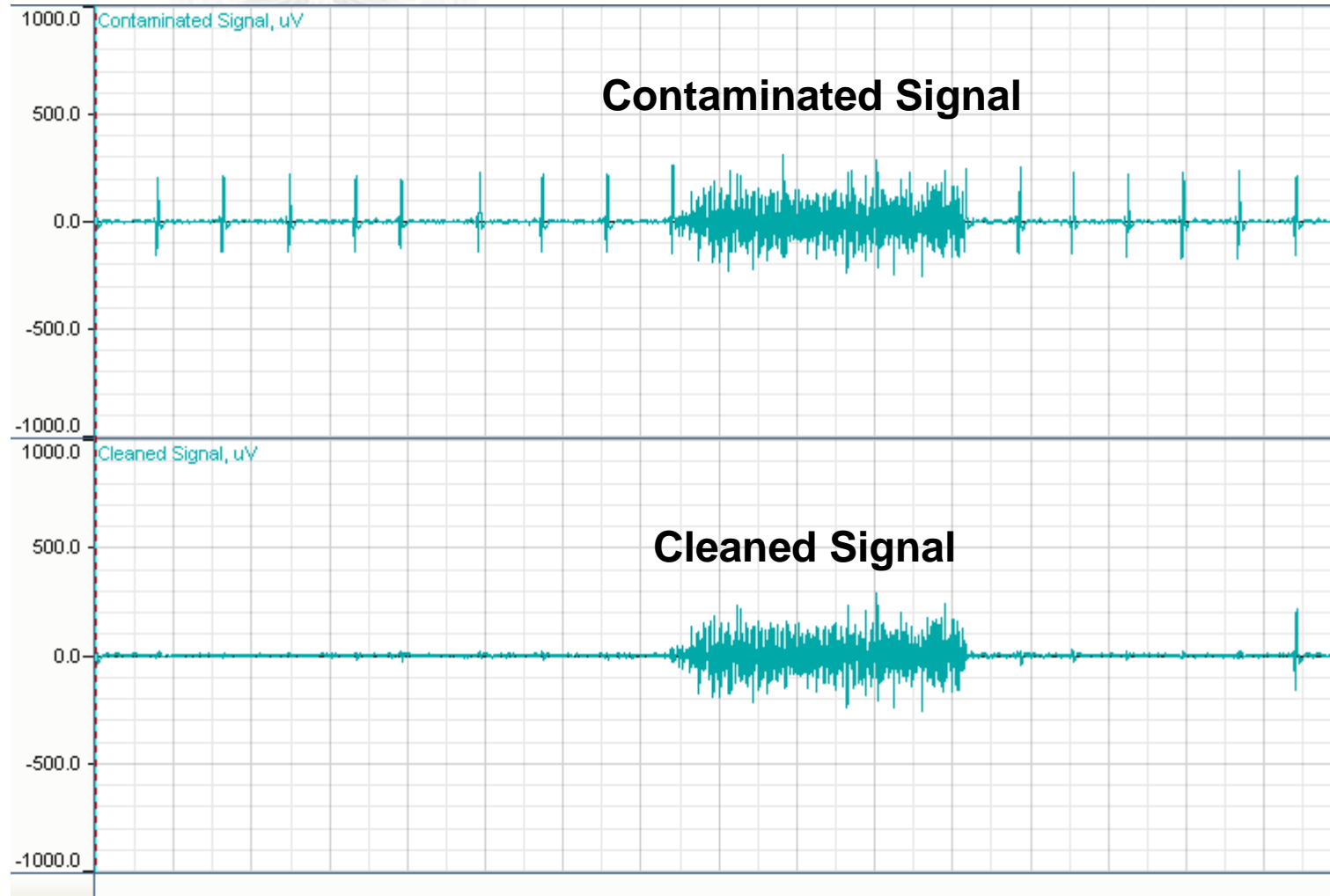
Apply To

Channels by type

☒ EMG

- ECG Reduction
 - Reduces ECG interference
 - To use: select about 3-5 pulses of ECG signal only, preferably where there is only ECG signals.
 - Click Ok. The whole record will be cleared of ECG interference.

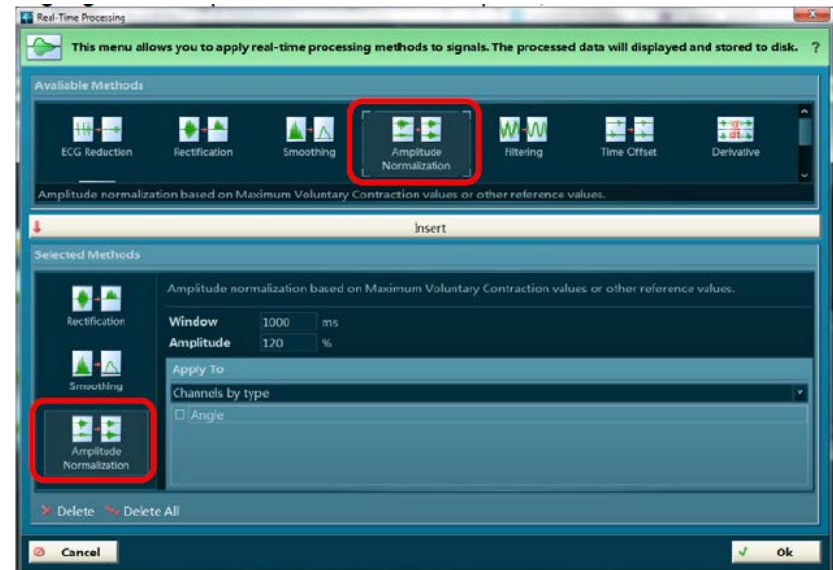
ECG Reduction



Amplitude Normalization

Real-Time MVC-normalized EMG amplitudes

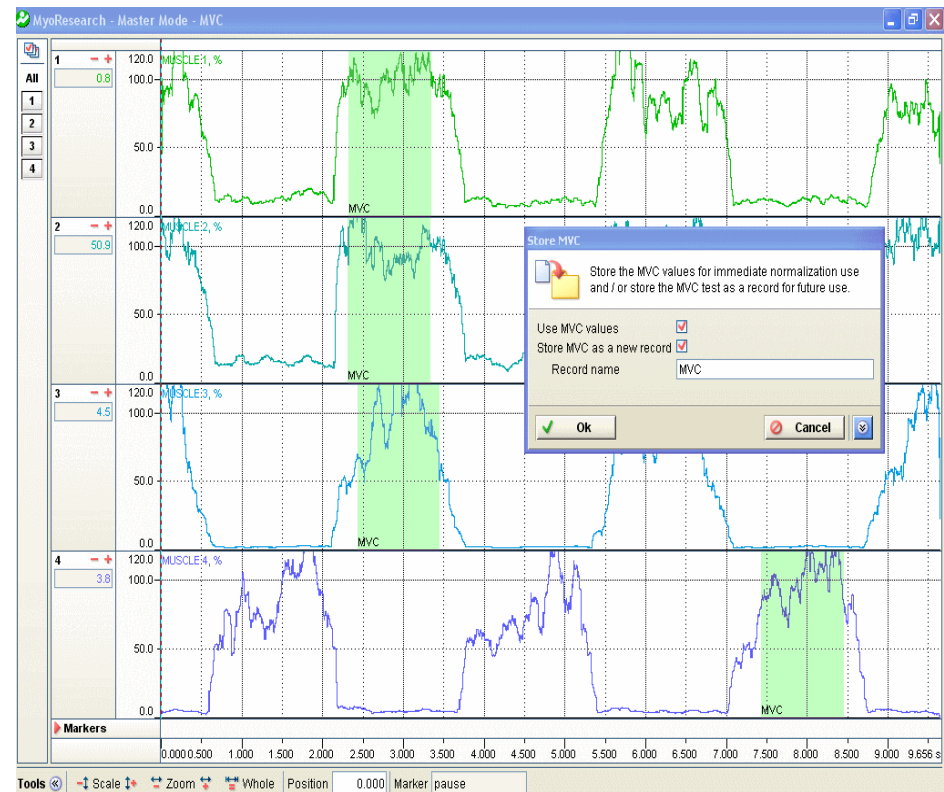
- Eliminates the influence of factors that are inherent in some studies.
- Allows comparisons over time with same patient
- Allows comparisons with other patients
- Allows comparisons with other muscles
- Also used for biofeedback purposes
- Normalization is performed using (MVC) which has to be performed prior to the test or training trials (typically, static contractions for each muscle 3-5 s, repeated 2 times).
- When activated, the real-time amplitude normalization routine adds a new button to the Main Operation Bar



Amplitude Normalization

Real-Time MVC-normalized EMG amplitudes

- First perform a MVC record that can be used to calculate MVC values for each muscle.
- The control Window defines how precisely the MVC value is defined: by entering a value in ms, the mean value of this window is taken as the MVC reference value.
- The algorithm automatically searches for the highest mean found in each channel and displays it as a green area, marked as "MVC":



Amplitude Normalization

Real-time MVC-normalized EMG amplitudes

- If checked (default and recommended) current identified MVC values are stored to internal memory (MVC Stack). All records measured with the regular Main Action Button Start will automatically be real-time normalized to the MVC values in the memory.
- MVC values remain in the memory until they are overwritten by a new MVC record.
- Store MVC as a new record: This control allows you to store the MVC trial, as a separate record to your database (default and recommended).
- Record name: Here you can enter any MVC record name
- When the “Store As” dialog is done, you can continue with your investigation or treatment by pressing Start: The measurement monitor will now show you the real-time normalized EMG traces.

Amplitude Normalization

Real-time MVC-normalized EMG amplitudes

To complete the description of the Amplitude Normalization setup section:

Amplitude: This value in percent defines the default scaling on all normalized channels in the Measurement Monitor

Section Apply to

The Amplitude Normalization can be applied to certain channel types (typically EMG) or physical channel numbers.

Delete and Delete all - you can delete an individual signal processing method from the iconized list of Selected methods or delete the complete list.

Limit MVC duration

In some cases it makes sense to standardize the duration of the MVC recording (e.g. when working with only one or two muscles). When checking this control, you can enter a time value in seconds to limit the MVC recording to a fixed time interval.

MVC Calculation Options

- MVC Selections
 - Channels by type: EMG or “other”
 - Channels by number
 - Restrict Calculation to: optional setting that allows the user to select a portion of the record to calculate the MVC.
 - Option for Peak or Manual Value

MVC Calculation Options

- Manual Value
 - Enter a pre-selected value
- Peak Value
 - Enter window size used to calculate peak value – default 1000ms
 - Note: The peak value is not the peak value of one single point, but the maximum value of N averaged points.
- Mean Value

MVC Storage Options

- Values from other record
 - Useful if Normalizing records after several subjects.
- MVC Stack (Last Calculated Values)
 - Use only if you are sure that the values you want are in the stack!
 - Useful if working on one subject at a time. (Collecting and Analyzing Data at the same time)

MVC Stack Illustration

