# ASSYST

## Offline Rodent EEG Analysis System for Epileptic and Oscillatory Activity Detection

## v. 3.0

# Quick Guide

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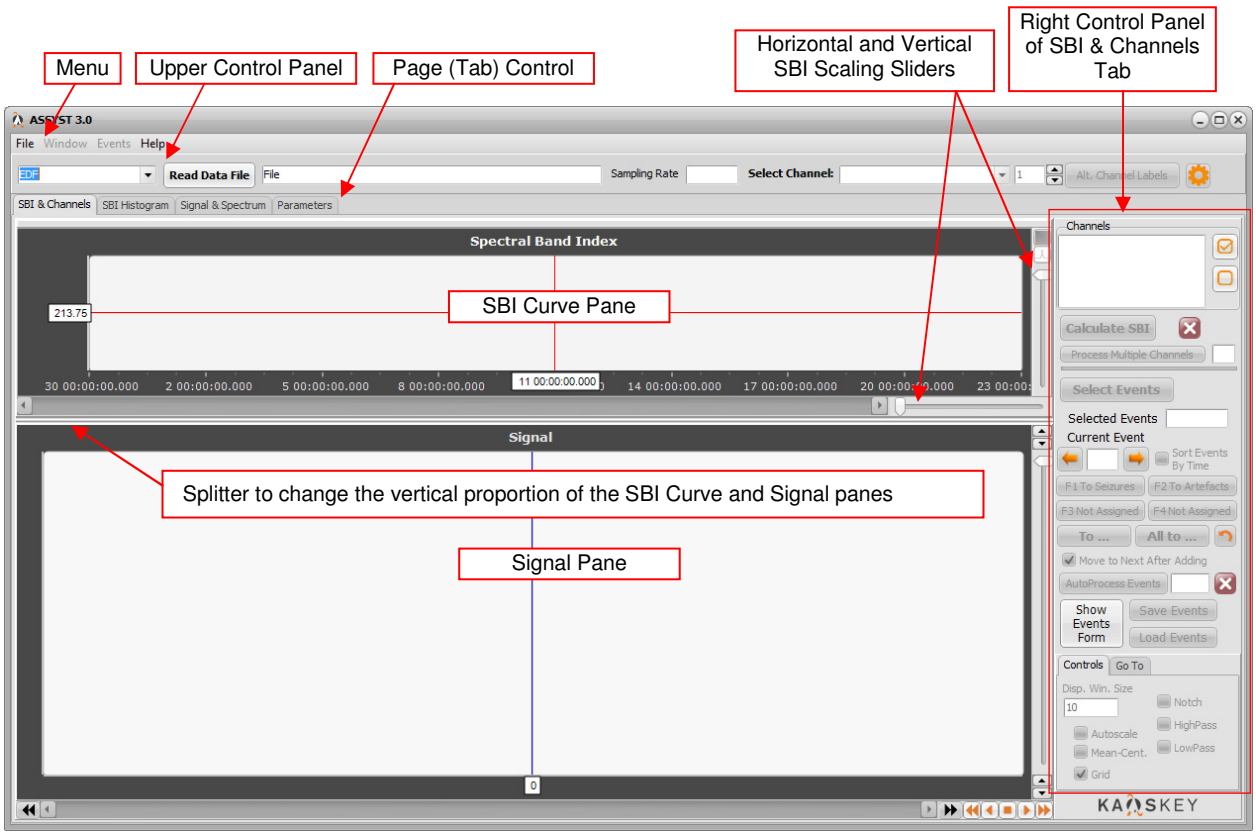
# Procedure for Processing a Single EEG Channel

## The *ASSYST* main Screen




Steps for single channel processing:

1. Load EEG data
2. Select the EEG channel for processing
3. Set parameters (Default or Custom)

   *(this step does not depend on steps 1 & 2, so can be done before 1 or 2)*
4. Calculate SBI curve
5. Readjust SBI threshold *(if needed)*
6. Specify the EEG signal processing interval *(if needed)*
7. Select Events
8. Inspect and classify the remaining events into Categories
9. Save the classified events

## 1. Loading EEG data

*ASSYST* can read and process the EEG data of following formats:

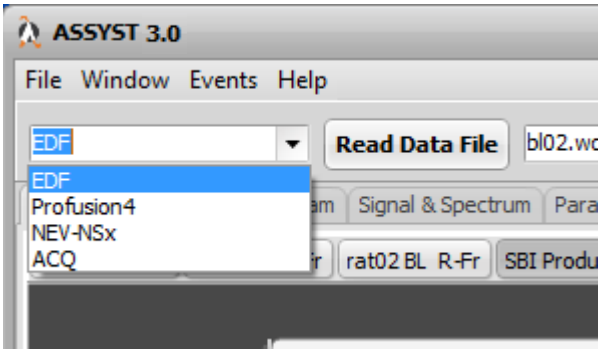
European Data Format (EDF)

Compumedics Profusion4

Ripple NSx

Acknowledge ACQ

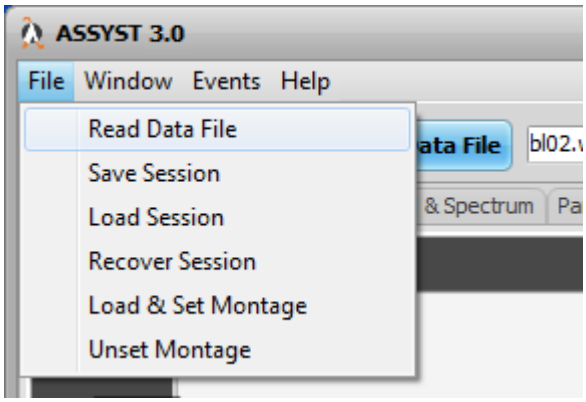
Specify the format by selecting corresponding item in the "Select Input Data Format" combo box (in the upper left corner of the Main Window). This should be done before loading the data.

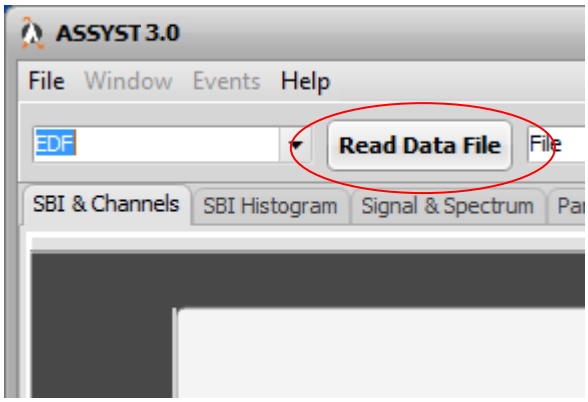



To load the data, select File → Read Data File from the main menu, or click the "Read Data File" button next to the "Select Input Data Format" combo box.

If the data format is "EDF", "NEV-NSx" or "ACQ", this will open a standard "Open File" dialog, allowing browsing and selecting an EDF file.

If the selected file format is "Profusion4", a standard "Select Directory" dialog will appear, allowing selecting a folder containing the Profusion4 data (this is because Profusion4 data are stored in several files).



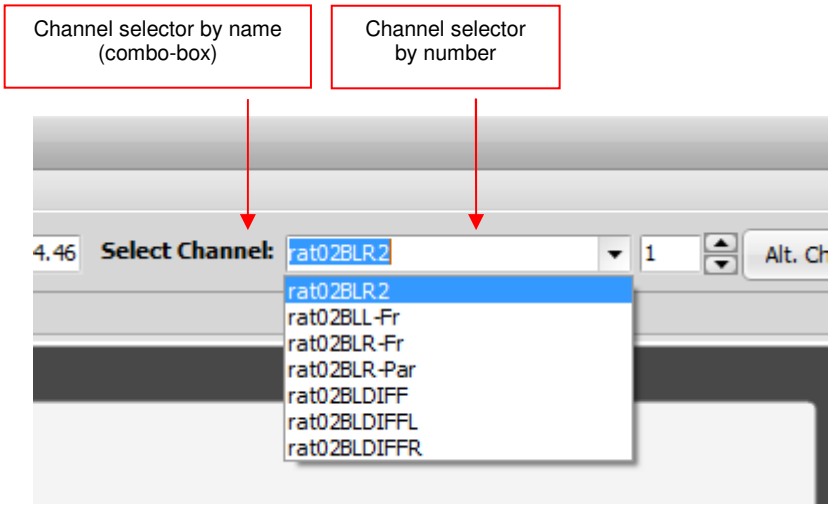
Note: The program remembers the last opened folder and sets this as initial folder in the "Open File" or "Select Directory" dialogs.

The program then loads the data, fills the "Select channels" combo box on the upper control panel and the "Channels" list on the right control panel of the "SBI & Channels" tab with the channels' labels, selects the first channel, and displays the first fragment of the first channel in the Signal pane of the "SBI & Channels" tab.

## 2. Selecting the Channel for Processing

In the "Select channels" combo box, select the name (label) of the desired channel to be processed. Alternatively, use the spin control next to the combo box to select the channel by its number (use the buttons or type in the desired number directly).

The "Select channels" combo box and the spin control are interconnected: changing the value in one automatically updates the value in the other.



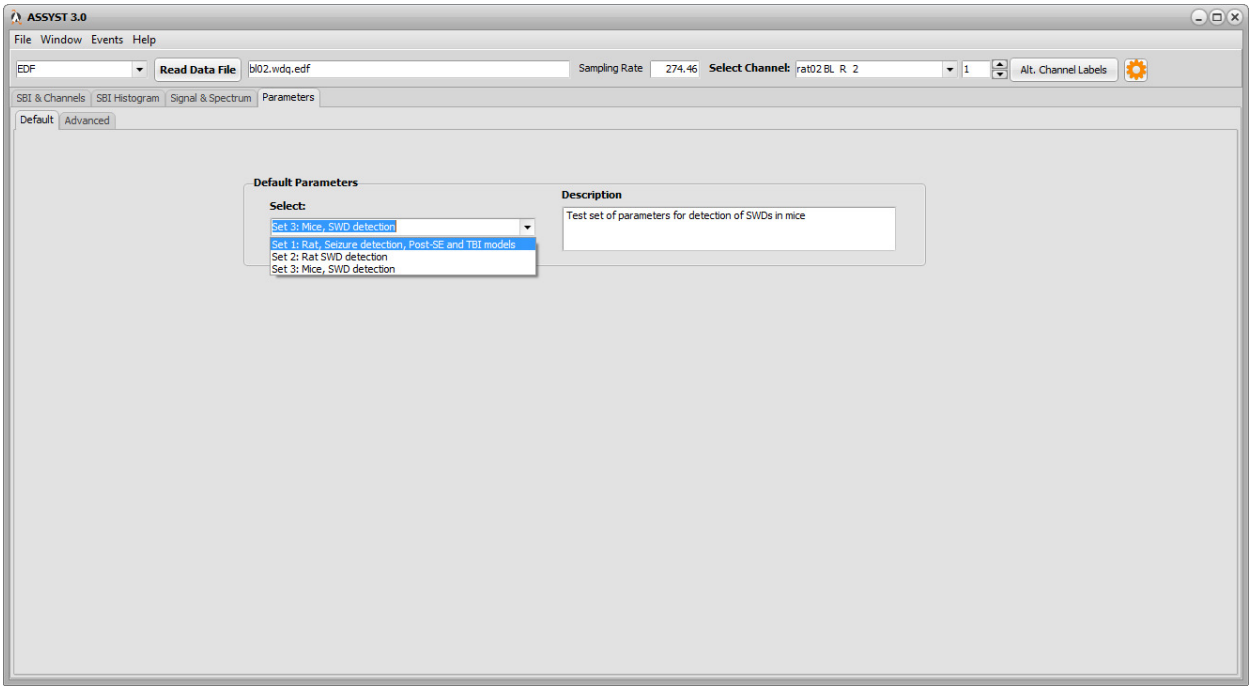

The selected channel will be automatically checked in the "Channels" list on the right control panel and its EEG will be displayed in the Signal pane. The channel that was selected previously will remain checked in the "Channels" list and its EEG will still be displayed in the Signal pane.

To hide the previously selected channel, uncheck the corresponding checkbox in the "Channels" list on the right control panel. Note that the checkbox of the currently selected (active) channel in the "Channels" list is disabled and cannot be unchecked.

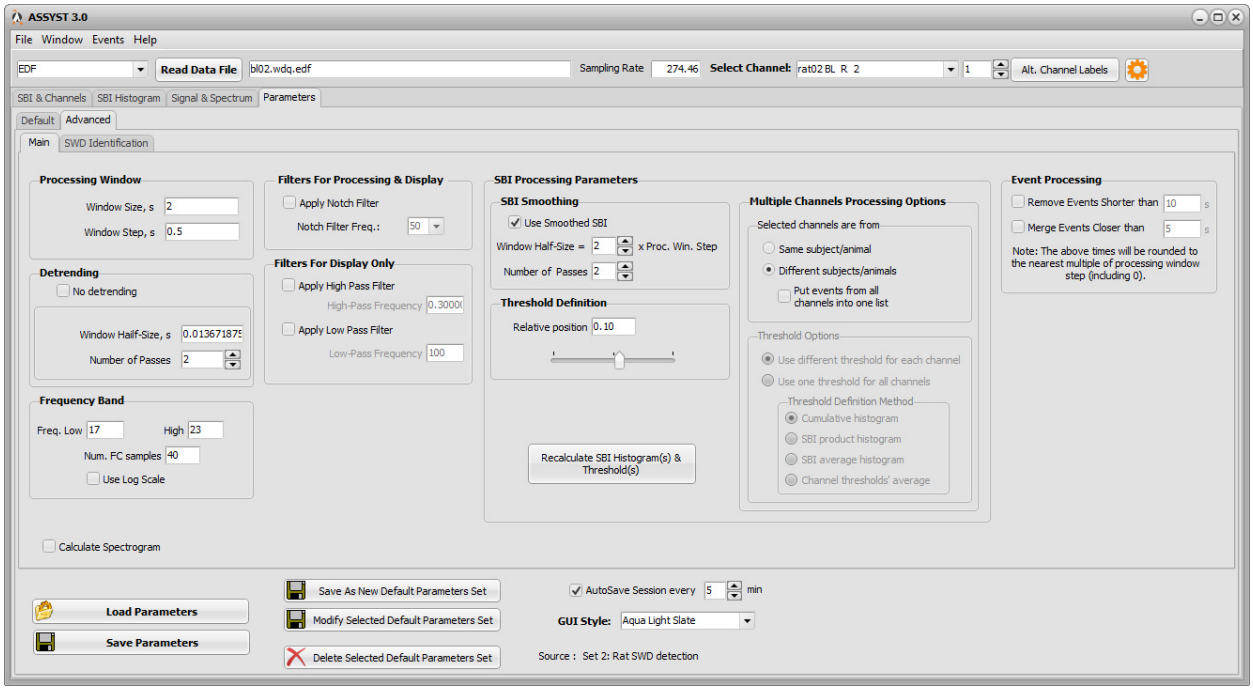
## 3. Setting the Processing Parameters

Before processing, set the desired processing parameters on the “Parameters” tab.

Go to the “Parameters” tab of the main window. If you wish to use default parameters, select the appropriate set of default parameters using the “Select” combo box on the “Default” sub-tab. You can examine the values of particular parameters of the selected default set by switching to “Advanced” sub-tab.




If you wish to use custom parameters, then switch directly to the “Advanced” sub-tab (or you can first select the closest default parameter set on the “Default” sub-tab and then switch to “Advanced” sub-tab to modify the values) and enter the desired parameter values, or load previously saved values from a parameters file using the “Load parameters” button.




The program checks the parameter values at the moment of switching from the "parameters" tab to a different tab of the main window.

If the new parameter values are not within the allowed limits or syntactically incorrect (e.g., a non-numeric value where a numeric value is expected), then the program gives a corresponding error message, stating which parameter is incorrect, and stays on the "Parameters" tab.

Moving away from the "Parameters" tab will be possible when all parameters have allowable values.

### *Saving Custom Parameters*

The modified parameter values can be saved into special parameters file(s) for further use.

To save the parameters, press the "Save Parameters' button on the "Advanced" sub-tab. The program will check the values. If any of the parameter values is not within the allowed limits or syntactically incorrect (e.g., a non-numeric value where a numeric value is expected), then the program will give a corresponding error message, stating which parameter is incorrect. If all parameter values are correct, a standard "Save file" dialog will appear allowing to select a location and a name for the parameter file. The parameter file will have extension ".sbitpar". You can create arbitrary number of such parameter files and place them in arbitrary locations.

### *Loading Custom Parameters*

Press the "Load Parameters" button on the "Advanced" sub-tab. A standard Open file dialog will appear. Choose the desired parameter file (these files have extension ".sbitpar") and press "Open". The values of he parameters on the "Advanced" sub-tab will be replaced by the values read from the selected parameter file.

### *Creating new Default Parameter set*

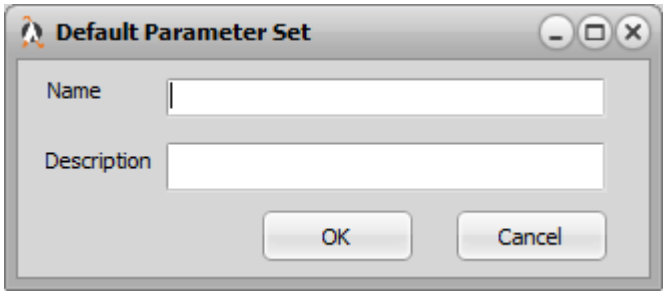
You can create and save a new named set of default parameters which is then added to the list of default parameter sets and, accordingly, to the "Select" combo box on the "Default" tab. For this:

- Enter the desired parameter values in the corresponding fields on the "Advanced" sub-tab.

- Press the "Save As New Default Parameters Set" button on the "Advanced" sub-tab.

The program will check the values. If any of the parameter values is not within the allowed limits or syntactically incorrect (e.g., a non-numeric value where a numeric value is expected), then the program will give a corresponding error message, stating which parameter is incorrect.

If all parameter values are correct, a small dialog appears asking to enter a name and a description for the new default set.




Provide a unique name for the set in the "Name" field of this dialog. The name should not repeat the names of existing sets, because the file name in which the default set is stored is generated automatically based on the set's name given by the user.

Provide a description in the "Description" field (the description is optional).

Then press the "OK" button on the dialog. The program will generate a new default parameter set file and store it in the directory where the program's executable is. The program's list of default parameter sets and the "Select" combo box on the "Default" tab will be updated accordingly.

You can create arbitrary number of additional default parameter sets with arbitrary (but non-duplicate) names.

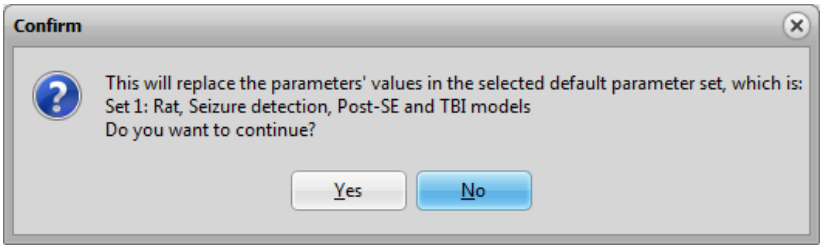
### *Modifying existing Default Parameter set*

You can change the parameter values in a default parameter set. For this:

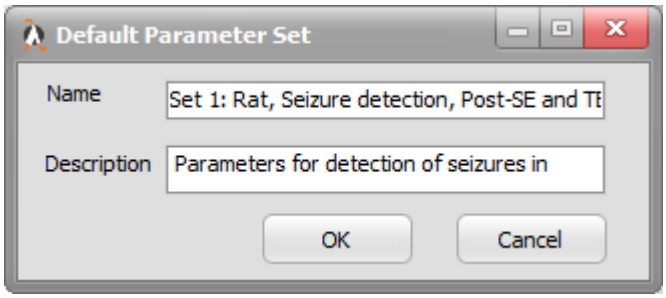
- On the "Default" sub-tab select (in the "Select" combo box) the default parameter set you want to modify.
- Go to the "Advanced" tab and modify the desired parameter values.

Press the "Modify Selected Default Parameters Set" button.

A warning message will appear asking to confirm the action (the default parameter file will actually be rewritten and the old values will be lost).




After confirmation (pressing the "Yes" button) a small dialog will appear showing the current name and description of the selected default set.



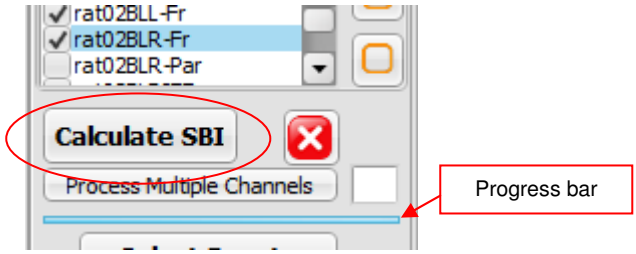

Modify the name and description, if necessary (remember that the name should be unique), and then press the "OK" button on the dialog.

The program will replace the existing default parameter set file. The program's list of default parameter sets and the "Select" combo box on the "Default" tab will be updated accordingly (with the new name and description).

## 4. Calculating the SBI Curve

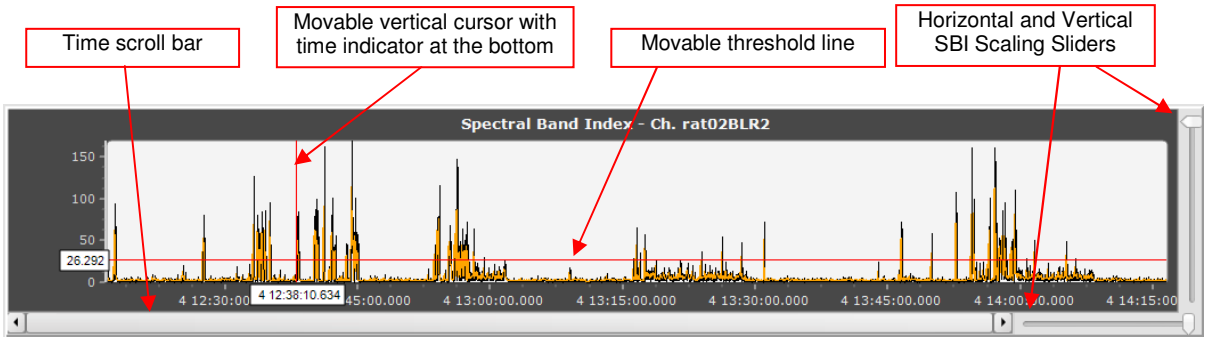
Switch to the "SBI & Channels" tab of the main window.

Press the "Calculate SBI" button on the right control panel.

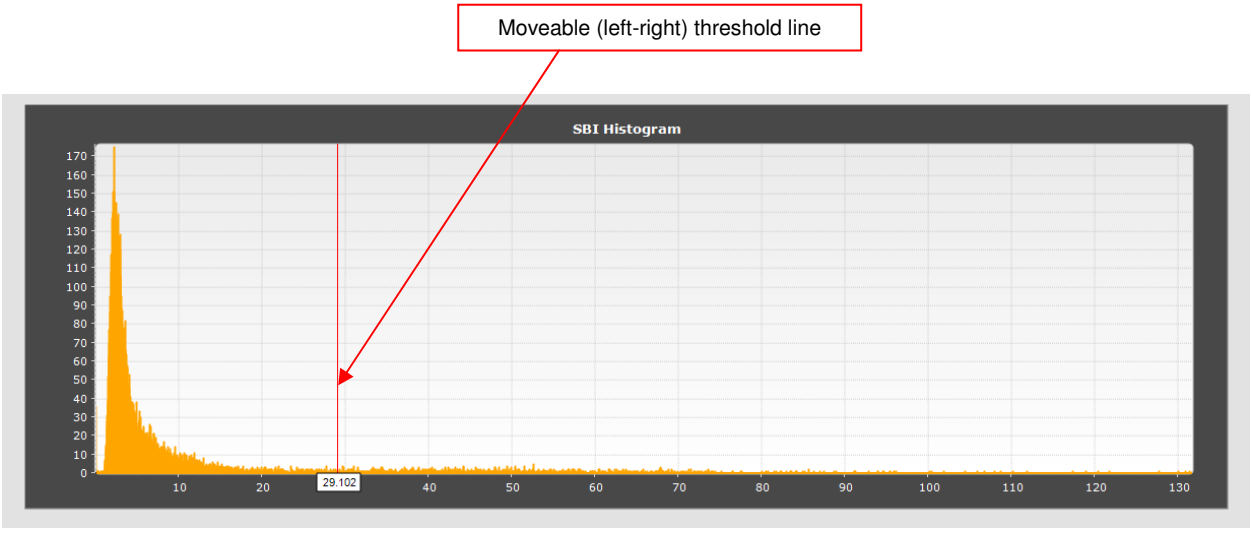



The calculation will start, and its progress will be reflected by the Progress bar on the control panel. The calculation process may be interrupted by clicking the (Stop) button.

When the calculation finishes, the program will beep and will plot the SBI curve in the SBI pane on the "SBI & Channels" tab




and the SBI distribution histogram in the "SBI Histogram" pane on the "SBI Histogram" tab.

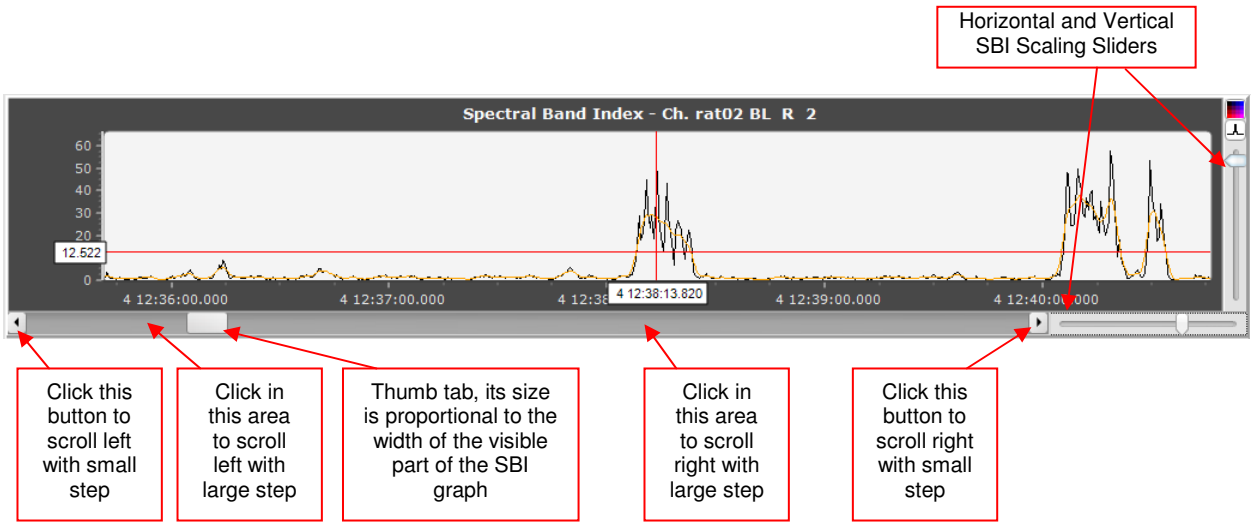



Based on the histogram, the program will also define the threshold that will be shown as a red horizontal line on the "SBI" pane and as a red vertical line on "SBI Histogram" pane.

## 5. Readjusting the SBI Threshold (if needed)

If you wish to change the automatically defined threshold before the event selection, simply drag (with mouse) up or down the horizontal threshold line on the "SBI" pane on the "SBI & Channels" tab or drag left or right the vertical threshold line on the "SBI Histogram" tab of the main window.

Recommendation: Change the horizontal and vertical scales of the SBI curve (using horizontal and vertical SBI scaling sliders) so that you can see smaller peaks. Examine several small peaks by clicking on them - the Signal pane will show the corresponding fragment of the EEG. If the small peaks are caused by events of interest (e.g., seizures or SWDs), and they are subthreshold, and then lower the threshold so that these peaks become suprathreshold to be selected by the automatic event selection procedure (step 7).




## 6. Specifying the Processing Interval (if needed)

It is possible to define a shorter time interval than the entire record duration for the analysis of the calculated SBI curve (including the histogram calculation and automatic threshold definition) and selecting the episodes of signal with excessive SBI values (the action that is performed when the "Select Events" button is pressed). This might be useful when, for example, part of the record is damaged or contaminated with strong artefacts, which would produce excessively high SBI values, which in turn would result in too high automatic threshold, so important events (e.g. seizures) will be missed. So in such cases one might want to perform the analysis only in the "healthy" part of the record.

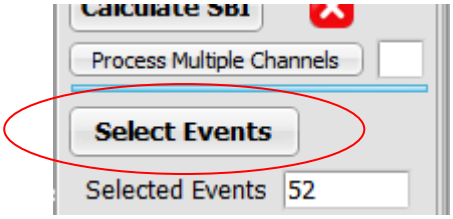
To specify a shorter processing interval:

- Right-click on the SBI pane at the position which you want to mark as the interval start. In the appearing popup menu, select the first item, "Mark Processing Interval Start".
- Right-click on the SBI pane at the position which you want to mark as the interval end. In the appearing popup menu, select the second item, "Mark Processing Interval End".

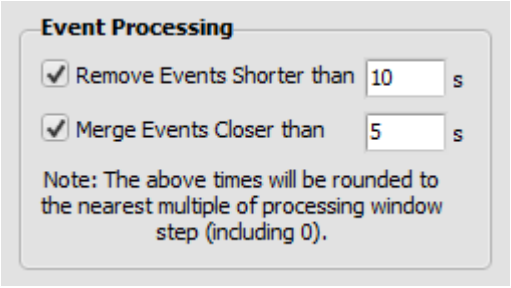
If you wish to recalculate the automatic threshold based on the selected interval only, go to the "Advanced" sub-tab of the "Parameters" tab and press the "SBI Histogram & Auto Threshold" button in the *SBI Processing Parameters* group.

## 7. Selecting the Events

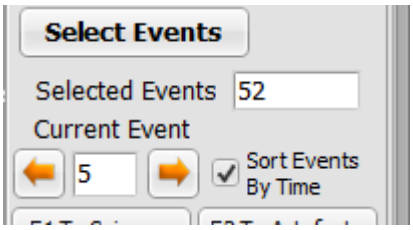
Press the "Select Events" button on the right control panel of the "SBI & Channels" tab.




The program will find the peaks of the SBI curve that are above the threshold, and store their times in a dedicated list – the preliminary event list. According to parameter settings in the *Event Processing* parameters group on the *Advanced* sub-tab of *Parameters* tab, during the selection process the short events may be ignored, and close events may be merged.




The number of selected events will be shown in the "Selected Events" field on the right control panel.




The events in the preliminary list may be sorted either according to their time of occurrence or their SBI peak value (in which case the sorting is in descending order - the first event has the highest value of SBI), depending on whether the "Sort Events by Time" checkbox is checked or not.

The first event becomes the current event, its index is displayed in the "Current Event" field and the corresponding EEG fragment is shown in the Signal pane.

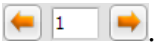
You can change the sorting any time after the event selection by checking/unchecking the "Sort Events by Time" checkbox.

## 8. Inspecting and Classifying the Events from the Preliminary List into Categories

### *8.1. Inspecting the events in the preliminary list*

After the step 7 the events in the preliminary list will be sorted either according to their time of occurrence or their SBI peak magnitude (in which case the sorting is in descending order - the first event has the highest value of SBI), depending on the current state of the "Sort Events by Time" checkbox.

You can change the sorting any time after the event selection by checking/unchecking the "Sort Events by Time" checkbox.

View the events in the Preliminary List using the Current Event group of controls on the right control panel: 

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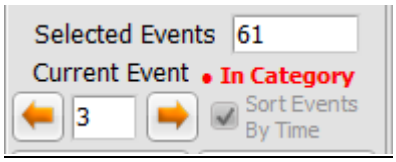
You can view the next and previous events using  and  buttons, or a particular event by entering its index number directly in the editable field.

The corresponding EEG fragment will be shown in the Signal pane. Use the "Disp. Win. Size" field to specify the desired timescale of the Signal pane.

If current event was already added to an event category (see 5.1.9.2. Adding events to Event Categories), a red text label "In Category" appears at the right side of "Current Event" text. When the user places the mouse cursor on this red text, the hint box appears indicating to which particular categories the current event was added.

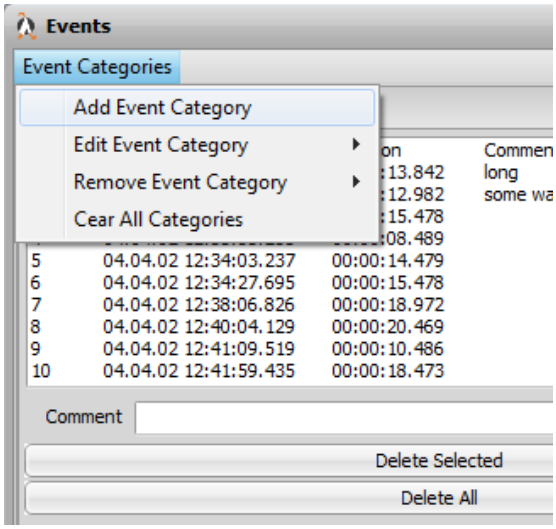



## *8.2. Adding events to Event Categories*

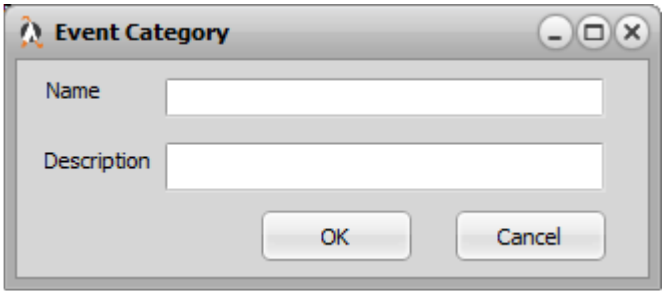
### 8.2.1. Creating additional Event Category, if necessary

If the Events form is not already showing, press the "Show Events Form" button on the right control panel. The Events Form will show.

In the Event Form's menu, select "Event Categories → Add Event Category".




The "Event Category" modal dialog will appear. Provide a name (obligatory) and description (optional) for the new category in the "Name" and "Description" fields, correspondingly. Press the "OK" button. The new category will be created and the corresponding category panel will appear on the "Events" form.

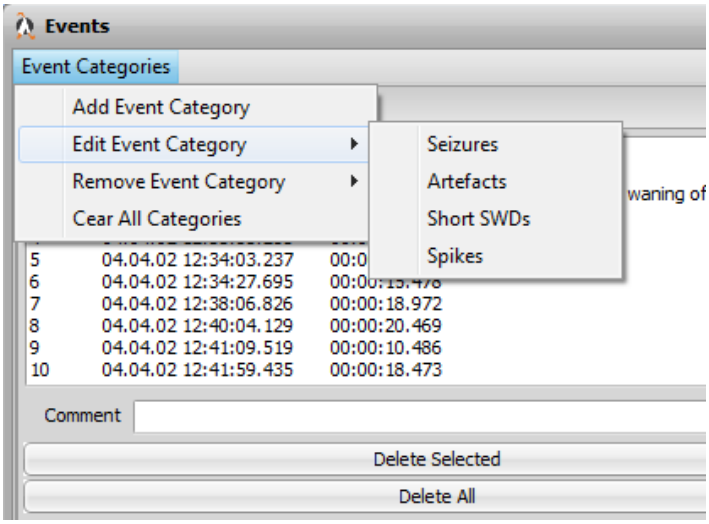


### 8.2.2. Modifying an existing Event Category

If the Events form is not already showing, press the "Show Events Form" button on the right control panel. The Events Form will show.

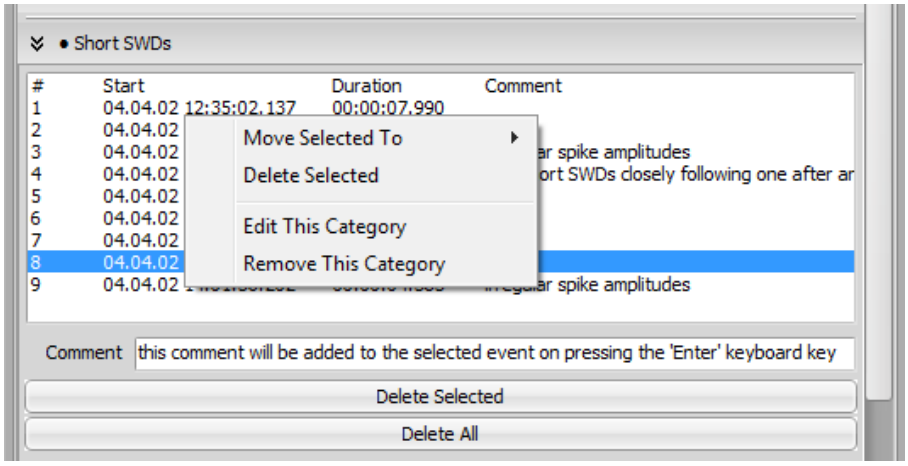
***Method 1***

In the Event Form's menu, select "Event Categories → Edit Event Category". A sub-menu will appear containing the list of existing event categories. Select the category you want to modify. The "Event Category" dialog will appear with the "Name" and "Description" fields filled with the current name and description of the selected Event Category. Edit the name and/or description as desired. Press the "OK" button - the changes will be applied.




***Method 2***

Right click in the Events list area of the Category panel you want to modify. In the appearing popup menu select "Edit This Category". The "Event Category" dialog will appear with the "Name" and "Description" fields filled with the current name and description of the selected Event Category. Edit the name and/or description as desired. Press the "OK" button - the changes will be applied.

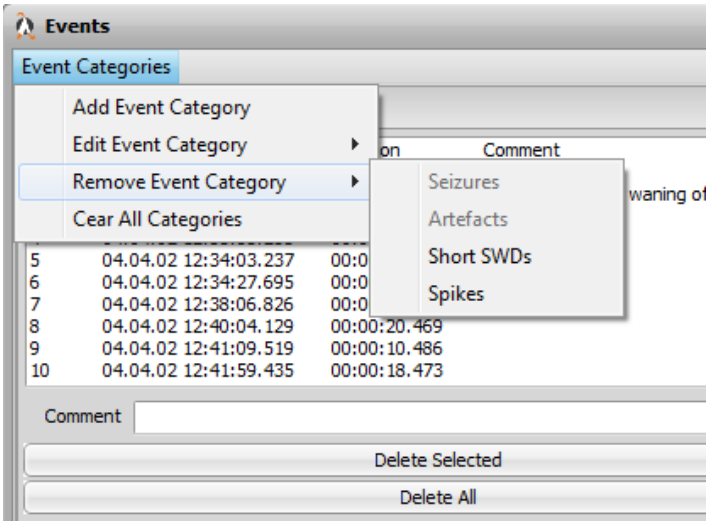



### 8.2.3. Removing an Event Category

If the Events form is not already showing, press the "Show Events Form" button on the right control panel. The Events Form will show.

***Method 1***

In the Event Form's menu, select "Event Categories → Remove Event Category". A sub-menu will appear containing the list of existing event categories (the first two categories cannot be removed). Select the category you want to remove.



***Method 2***

Right click in the Events list area of the Category panel you want to remove. In the appearing popup menu select "Remove This Category".

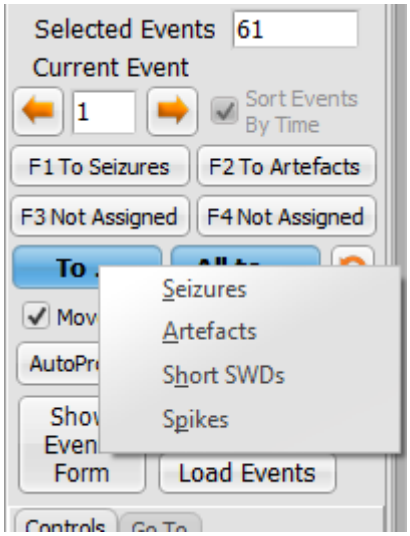
### 8.2.4. Adding the Current Event to an Event Category

***Method 1 - using the "To..." button***

Press the "To..." button on the right control panel.

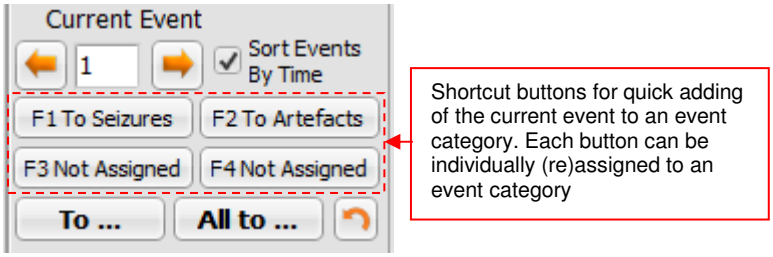
A popup menu will appear next to the button with the list of existing event categories.

Select the category to which you want to add the current event.




***Method 2 – using the shortcut buttons***

There are four shortcut buttons on the right control panel of the "SBI & Channels" tab of the main window for quick adding the current event to an event category.



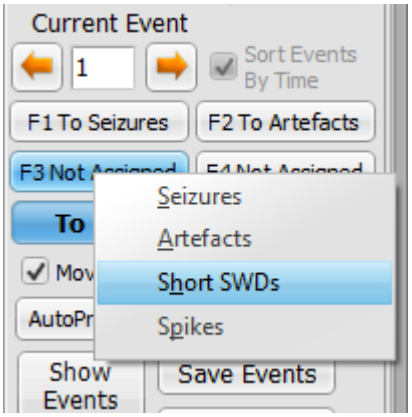

Each button can be individually (re)assigned to an event category.

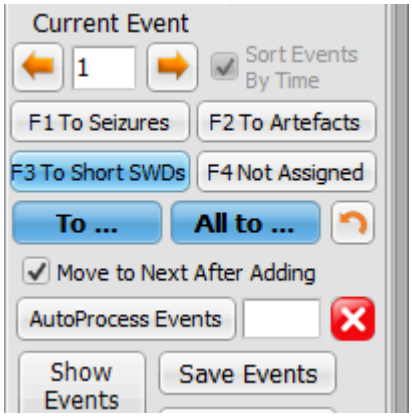
The first two buttons are by default assigned to the two default categories: Seizures and Artefacts.

The other two buttons are initially unassigned.

To assign an event category to the button, right-click on the button, then select the desired event category from the popup menu (the popup menu will contain the list of all available event categories).

After the assignment, the text on the button will change and will show the name of the assigned category: "To <*Category name*>" (note that long category names will be automatically truncated according to the button's size, so avoid long names or names with similar initial parts when creating new event categories).




Left-click on the assigned shortcut button – this will add the current event to the corresponding category.

***Method 3 – using the shortcut keys***

There are keyboard shortcuts for the four shortcut buttons - the function keys F1, F2, F3, F4, correspondingly (this is also reflected on the text on the buttons).

Press the corresponding keyboard key (F1, F2, F3 or F4) to add the current event to the corresponding category (the keys will work only if a category was assigned to the corresponding shortcut button on the right control panel of the "SBI & Channels" tab of the main window).

All the above methods are equivalent.

As a result, the current event will be added to the list of events in the selected category and will appear in the Events list of the corresponding event category panel on the Events form.

The events in the Events list of the event category panel are sorted chronologically; the newly added event will be inserted in the proper position in the list, and will be highlighted.

Simultaneously, on the Signal pane of the "SBI & Channels" tab of the main window the event will be highlighted by a pink band, the left and right edges of which correspond to the event's start and end times. These edges are movable (by mouse), so you can immediately adjust the start and end time of the event, if desired (this can be done later as well, see 8.2.6. Viewing the events in the Event categories).

When the position of left or right edge of the highlighting band is changed, the start or end time (correspondingly) of the event in the Events list of the Event Category panel on the Event form is immediately updated.

After the addition, the current event index in the "Current Event" control on the right control panel of the "SBI & Channels" tab of the main window will either remain unchanged, or the next event will become current, according to the state of the checkbox "Move To Next After Adding".

### 8.2.5. Adding arbitrary window as an event to an event category

It is possible to directly add any window as an event to an event category, irrespectively of whether it was selected into the preliminary list at step 7 or not (i.e., irrespectively of whether the SBI of this window is supra-threshold or sub-threshold).

For this:

1. Right-click on the SBI pane at the desired position (e.g. a sub-threshold peak)

2. From the popup menu, select the "Add this Event to" item. A second popup menu will appear with the list of existing Event Categories.

3. In the second popup menu, select the desired event category. The event of the size of one window will be added to the selected category, and the corresponding EEG fragment will be shown in the Signal pane, with the added window highlighted by a pink band.

4. Move the highlighting band edges to properly mark the event's start and end positions.

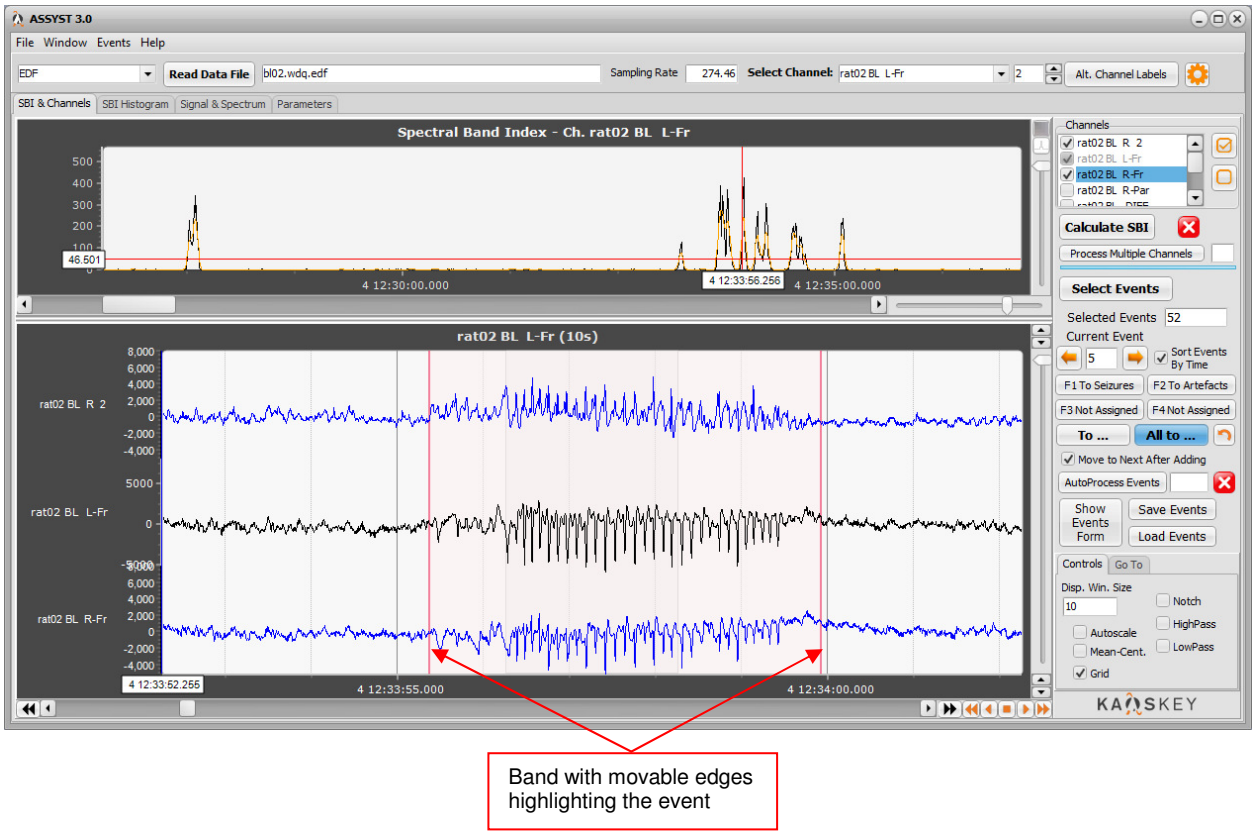
### 8.2.6. Viewing the Events in the Event Categories

You can select an event by clicking on the corresponding row of the Events list of an Event Category panel. You can also use the up or down arrow keys of the keyboard to select the previous or next event in the list, correspondingly.

When you select an event in the Events list of an Event Category panel, the corresponding EEG event fragment is automatically shown in the Signal pane of the SBI & Signal tab of the program's main window. The event is highlighted by a pink band, the left and right edges of which correspond to the event's start and end times.

The edges of the pink band are movable (by mouse), so you can properly adjust the start and end time of the event.

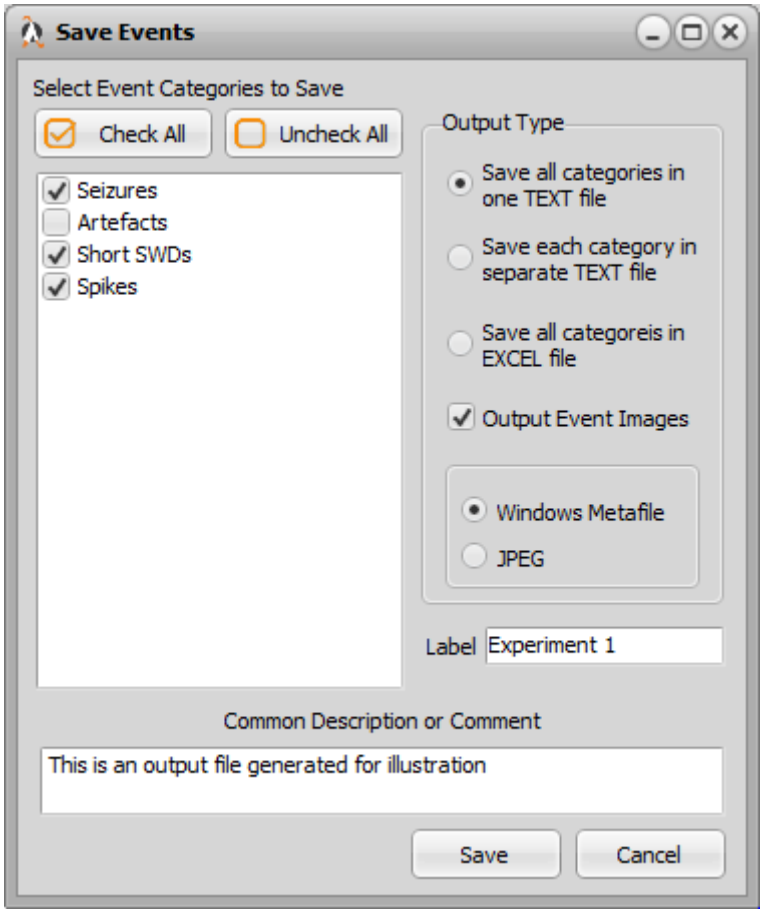
When the position of left or right edge is changed, the start or end time (correspondingly) of the event in the Events list of the Event Category panel on the Event form is immediately updated.




## 9. Saving the Classified Events

Press the "Save Events" button on the Control panel of the "SBI & Channels" tab of the program's main window. The Save Events dialog will appear.

In the "Select Event Categories to Save" list check the Event categories the events from which must be saved in the output file(s). You can use "Check All" or "Uncheck All" buttons to check/uncheck all event categories.




Select the desired output type in the “Output type” radio buttons group.

If you wish to output also the screenshots of the events (event images), check the "Output Event Images" checkbox and select the image file format (Windows Metafile or JPEG).

Provide a text string that will be added in front of the name(s) of output file(s) in the “Label” field (optional).

In the “Common Description or Comment” field enter a comment or description that will be included into the output file(s).

Press the “Save” button.

A standard file save dialog will open to select the location of the output file. The file name field of the file save dialog will show the proposed automatically generated name for the output file, which you can modify before saving (before pressing the “Save” button on the file save dialog).