MEG/EEG
Trial extractor GUI

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1. Introduction

This document is instructions for vb_trial_extractor.

vb_trial_extractor extract trials from MEG/EEG file(.meg.mat/.eeg.mat) which contains a single continuous time series data and puts extracted trials into new MEG/EEG file(Evoked MEG/EEG file)

Workflow

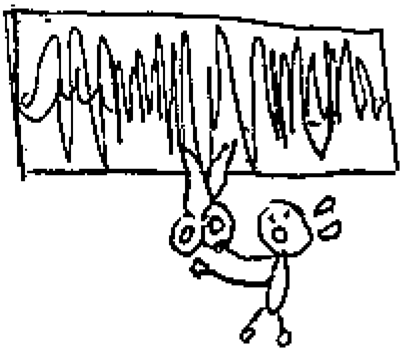
The workflow is listed below.

(1) Extract trials from contunous MEG/EEG file

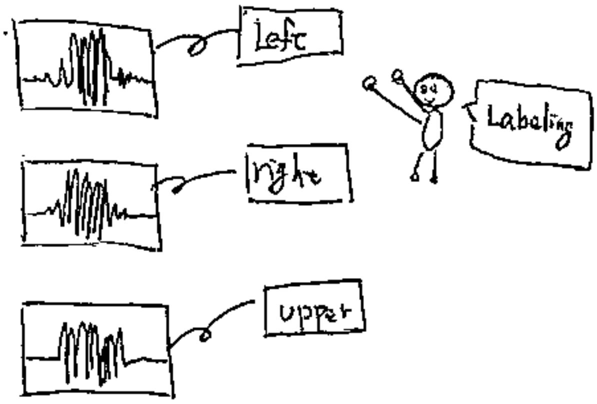
(2) Attach label to trials

(3) Put selected label into new MEG/EEG file.

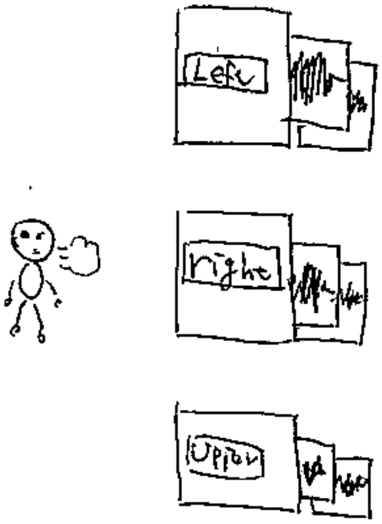
(1)Extract trial from continuous data by seeing a trigger.channel.



(2)Label trials.



(3)Put selected label into MEG/EEG file.



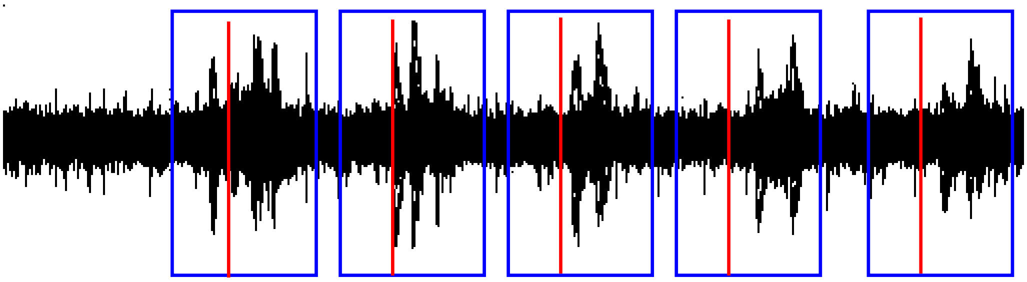
What is trial?

Timeseries data which is defined by Pretrigger/Posttrigger length and stimulus onset time.

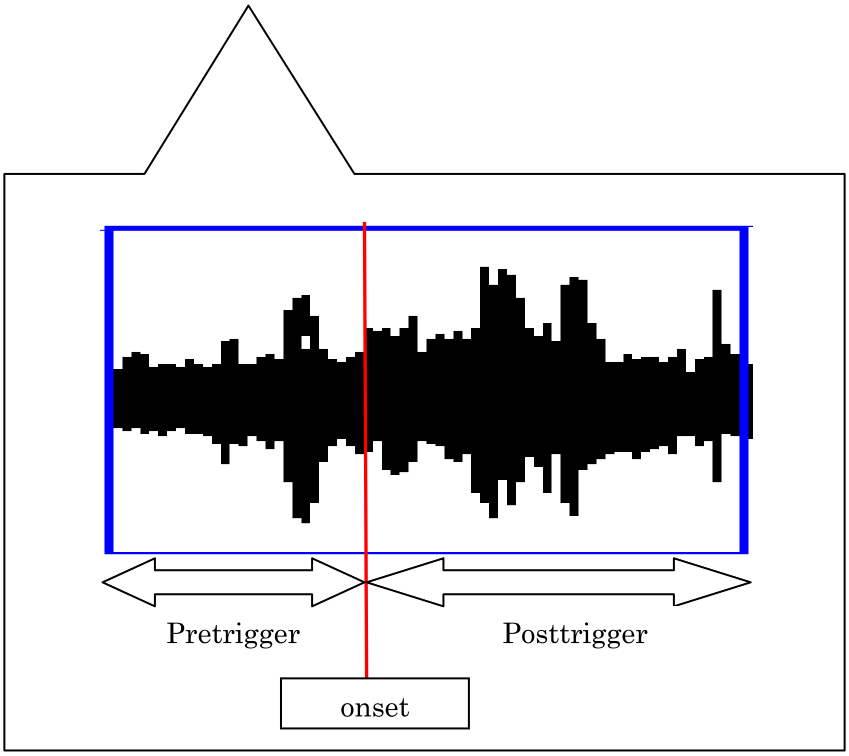
The requirements for trial extraction

To extract trials, you have to measure trigger data as an extra channel data. vb_trial extractor find trials by checking the extra channel data.

Supported trigger types:please refer to the trigger parameters section.



continuous data(blue:trial, red:stimulus onset)



requirements for input file.

(a) MEG/EEG file which is imported by VBMEG. This file should contain a single continuous timeseries data.(extension:.meg.mat, .eeg.mat).
(b) It is necessary to have trigger data as an extra channel data.

! NOTE
If necessary, pre-process the data
(vb_megfile_filter_ch_data(), vb_eegfile_filter_ch_data() are available.)

Do not apply downsampling because trial extraction may be failed for the lack of the trigger data. You can specify an output sampling frequency when you create new Evoked MEG/EEG files.

* sample data
/home/cbi-data5/common/example/vbmeg10_preprocess/
Sample data file :A005a_filt.meg.mat
- Trigger channel
  436ch:Audio signal which was presented to the left ear.
  437ch:Audio signal which was presented to the right ear.

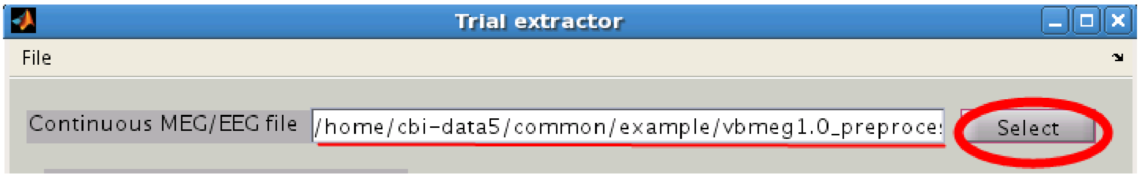
2. Trial extraction

Input filename and trigger information

1. After setting a path for VBMEG, start gui from command line.

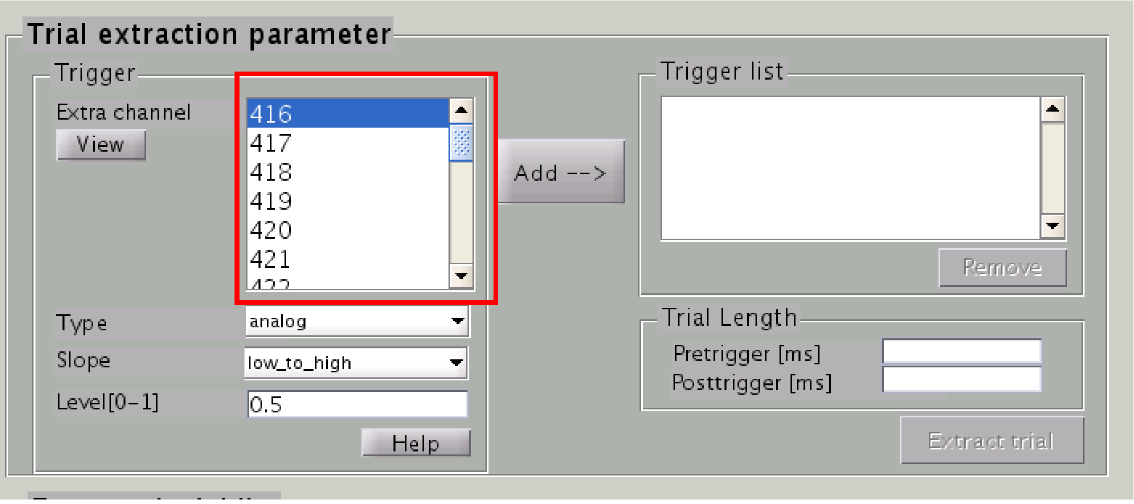
   ```
   $>vb_trial_extractor
   ```

2. Press the “Select” button and choose MEG/EEG file.



Continuous MEG/EEG file: /home/cbi-data5/common/example/vbmeg1.0_preproces

Then, extra channels are showing.



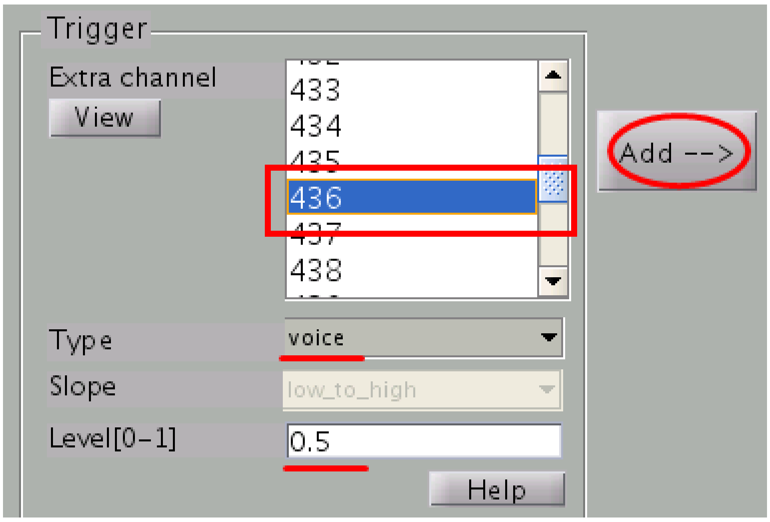
Type: analog

Slope: low_to_high

Level[0-1]: 0.5

3. Select Channel: 436 and Type:voice.

   Then click the “Add” button.

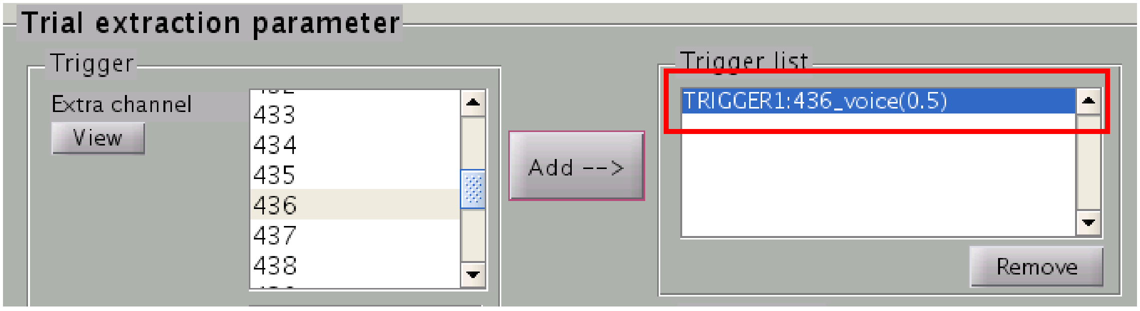


Type: voice

Slope: low_to_high

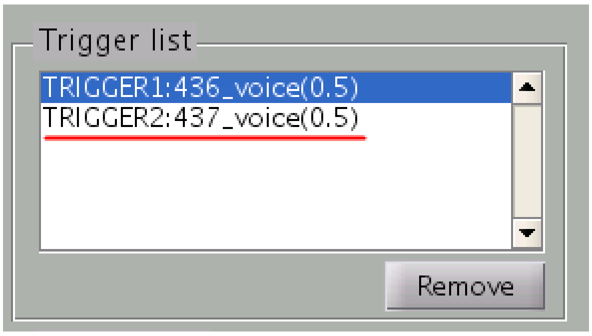
Level[0-1]: 0.5

The input trigger was added to the Trigger list.



TRIGGER1:436_voice(0.5)

4. In the same way, add trigger information for channel 437.



TRIGGER1:436_voice(0.5)
TRIGGER2:437_voice(0.5)

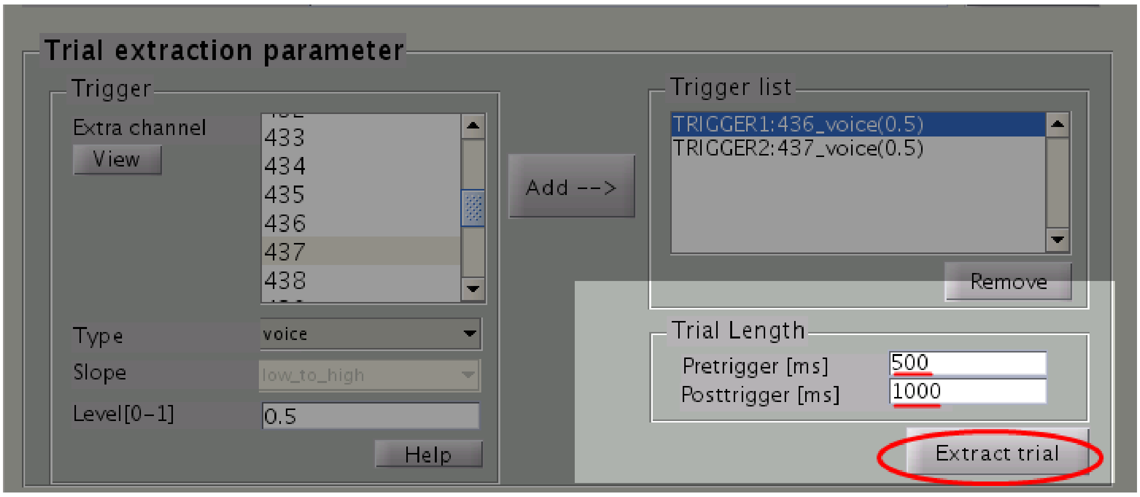
The setting of Pretrigger and Posttrigger length

Set Pretrigger and Posttrigger length in millisecond(positive integer).

Pretrigger[ms]:500

Posttrigger[ms]:1000

Press the "Extract trial" button.



TRIGGER1:436_voice(0.5)
TRIGGER2:437_voice(0.5)

Type: voice
Slope: low_to_high
Level[0-1]: 0.5
Pretrigger [ms]: 500
Posttrigger [ms]: 1000

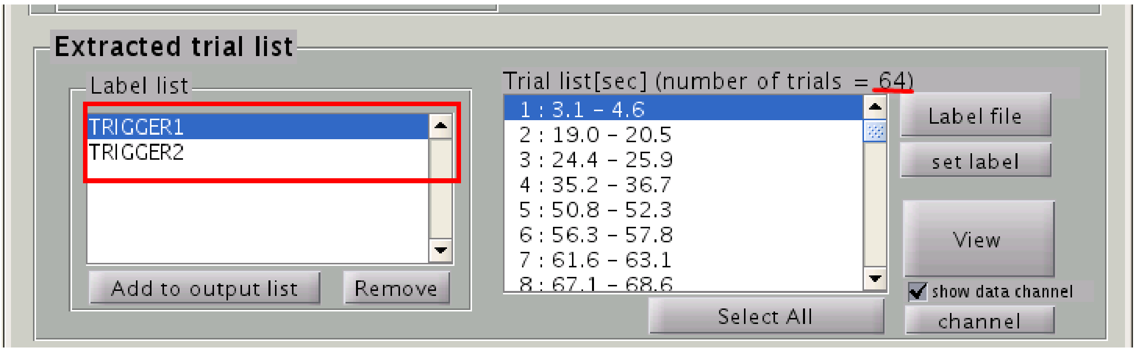
Check extracted trials

Extracted label:TRIGGER1, TRIGGER2 is showing on the Label list.

(TRIGGER1 was extracted from 436ch, TRIGGER2 was extracted from 437ch)

1. If you click a label name, trials will be shown on the trial list.

   (64 trials were detected by TRIGGER1)

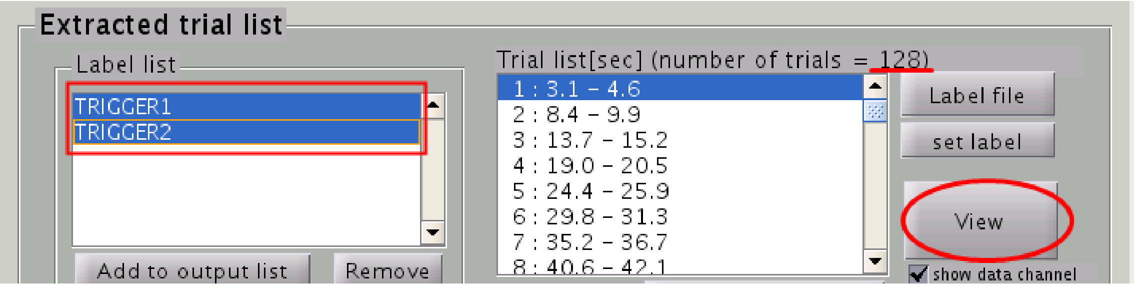


Label list:
TRIGGER1
TRIGGER2

Trial list[sec] (number of trials = 64)
1 : 3.1 - 4.6
2 : 19.0 - 20.5
3 : 24.4 - 25.9
4 : 35.2 - 36.7
5 : 50.8 - 52.3
6 : 56.3 - 57.8
7 : 61.6 - 63.1
8 : 67.1 - 68.6

☑ show data channel

2. Choose TRIGGER1 and TRIGGER2 with pushing CTRL key. Then press the "View" button.



Label list:
TRIGGER1
TRIGGER2

Trial list[sec] (number of trials = 128)
1 : 3.1 - 4.6
2 : 8.4 - 9.9
3 : 13.7 - 15.2
4 : 19.0 - 20.5
5 : 24.4 - 25.9
6 : 29.8 - 31.3
7 : 35.2 - 36.7
8 : 40.6 - 42.1

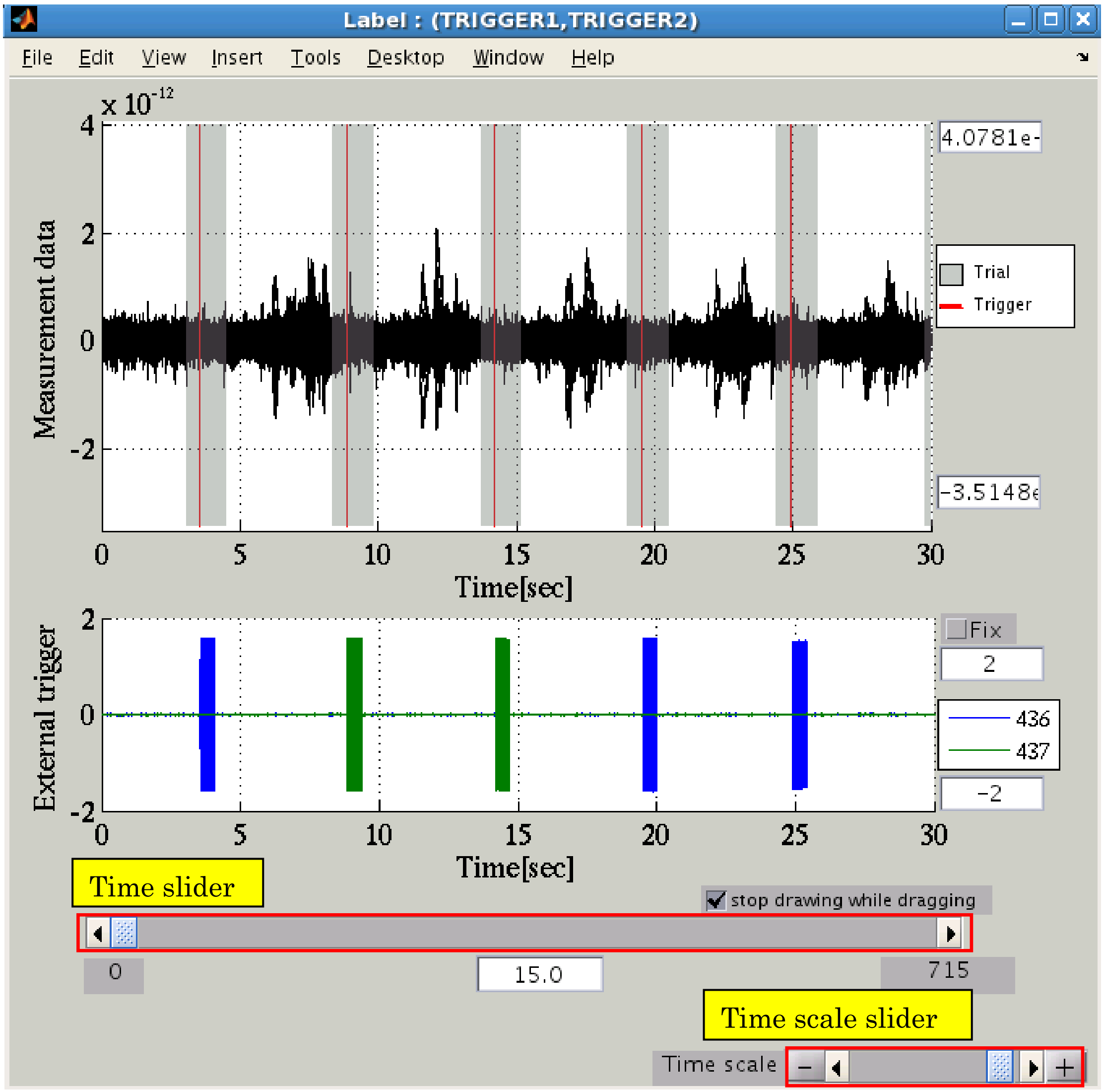
☑ show data channel

When multiple labels are selected, trials are unified and then sorted by onset time.

3. Check that the trials were extracted in the appropriate position by using time slider and time scale slider.

   Upper figure: Timeseries data + Trials(red is onset.)

   Lower figure: Trigger data(blue:436ch green:437ch)



3. Label to trials

Extracted trials has a default label, the prefix “TRIGGER”.

If you want to label to trials, there are two ways.

(a)Label to trials by label file.

(b)Label to trials by hand

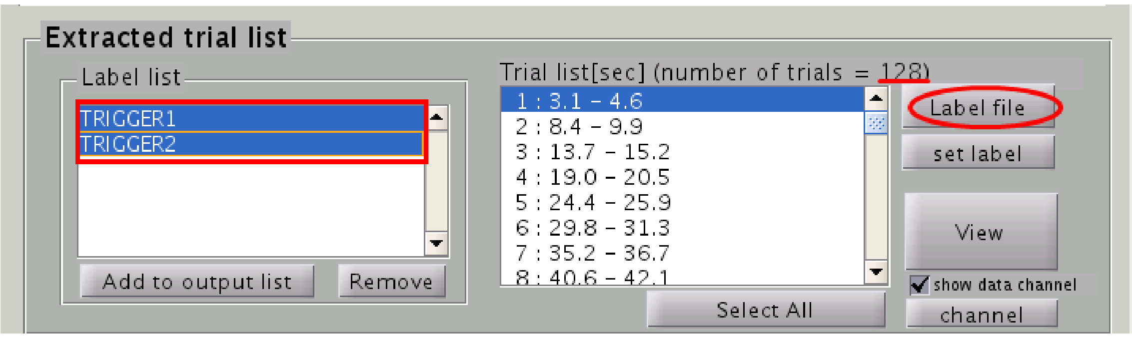
(a)Label to trials by label file.

Trials can be categorized into 4 different types.

(right_800、right_3200、left_800、left_3200：numbers denote a frequency of the tone.)

1. Select “TRIGGER1” and “TRIGGER2” with pushing CTRL key.

   Trials were unified and sorted by onset time. Then push the “Label file”.



Label list: TRIGGER1, TRIGGER2

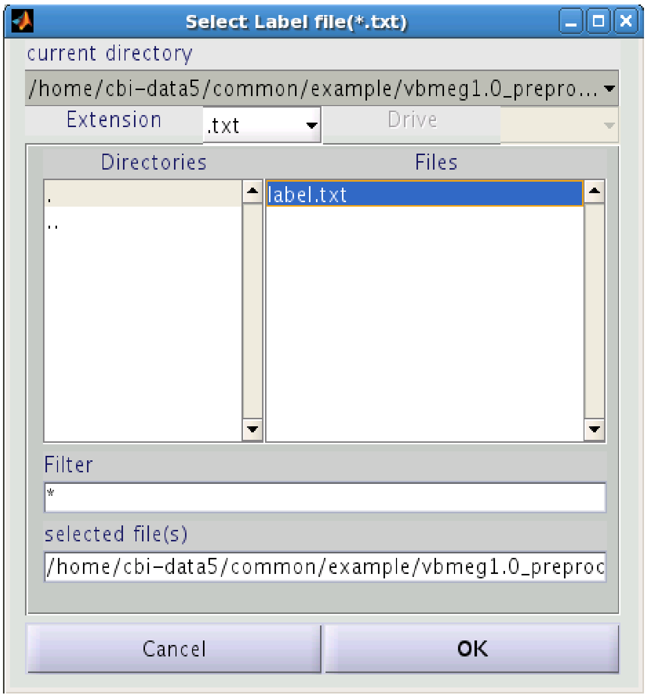
Trial list[sec] (number of trials = 128)

```
1 : 3.1 - 4.6
2 : 8.4 - 9.9
3 : 13.7 - 15.2
4 : 19.0 - 20.5
5 : 24.4 - 25.9
6 : 29.8 - 31.3
7 : 35.2 - 36.7
8 : 40.6 - 42.1
```

☑ show data channel

2. Select label file in the appearing dialog

   /home/cbi-data5/common/example/vbmeg1.0_preprocess/raw/label.txt



current directory: /home/cbi-data5/common/example/vbmeg1.0_prepro...

Extension: .txt

Directories: . ..

Files: label.txt

Filter: *

selected file(s): /home/cbi-data5/common/example/vbmeg1.0_preproc

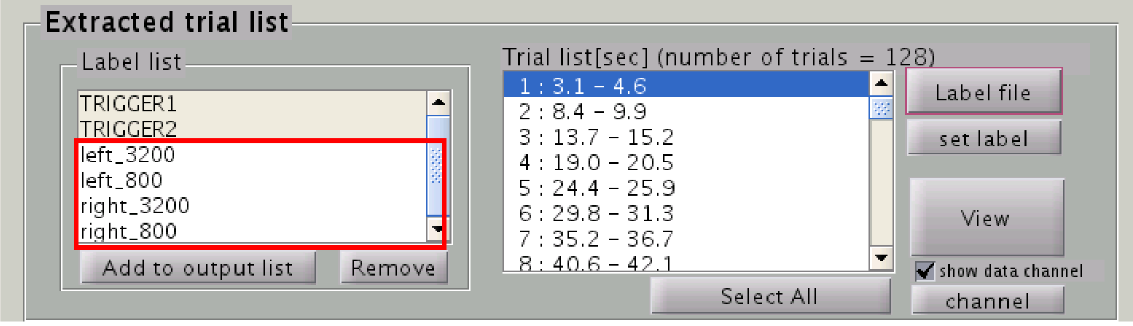
The contents of the label file is descriped on the next page.

Label file is a text file that lists for the labeling for the trial of being displayed in the Trial list.

```
left_3200
right_800
left_800
right_3200
…
```

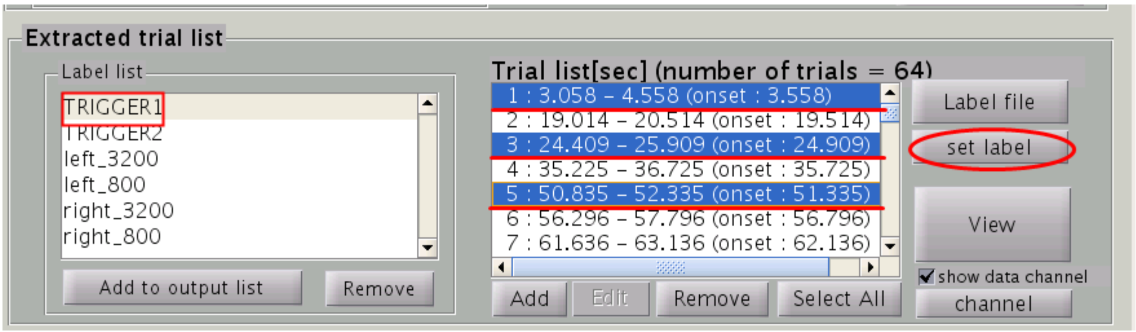
When the total number of labels in the label file and the total number of trails are different, an error occurs. In this case, it is necessary to have written 128 lines.

After finishied labeling, four new labels are added to the Label list.



(b)Label to trials by hand

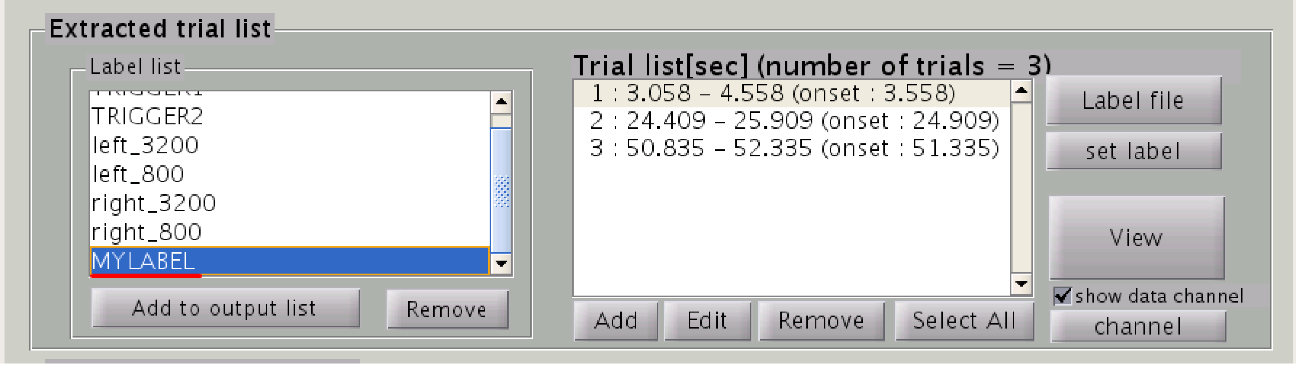
For example, when you want to create a label for trial 1,3,5 which are contained in the TRIGGER1, select the “TRIGGER1” from the Label list and then choose trial 1,3,5 from the Trial list with pushing [CTRL] key, then press the “set label” button.



The dialog to input the name of the label appears. Input label name and press the “OK” button.(Here, MYLABEL was specified.)

Input Label name : MYLABEL

MYLABEL which contains trial: 1,3,5 were created.



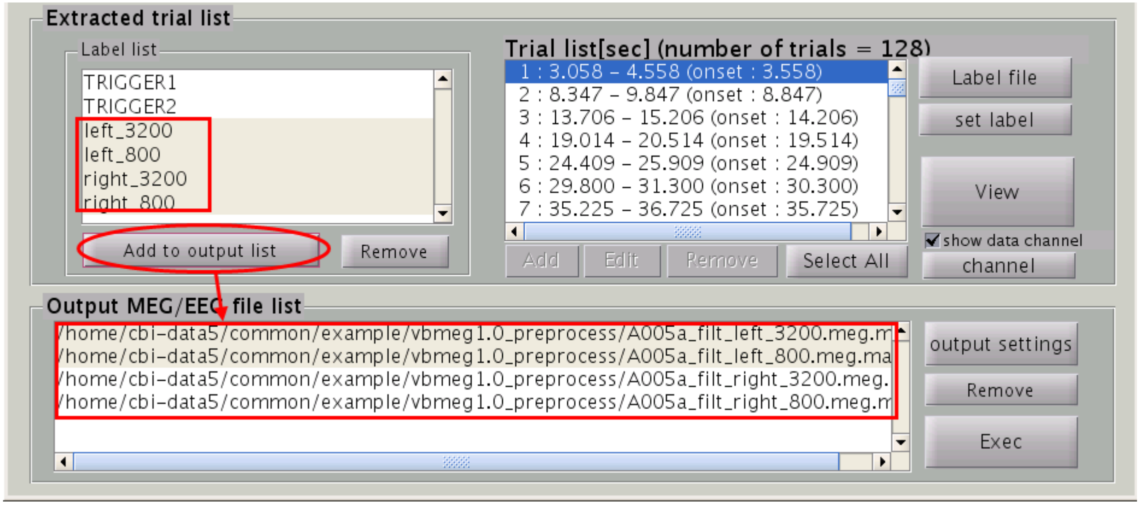
TRIGGER2
left_3200
left_800
right_3200
right_800
MYLABEL

Trial list[sec] (number of trials = 3)

```
1 : 3.058 - 4.558 (onset : 3.558)
2 : 24.409 - 25.909 (onset : 24.909)
3 : 50.835 - 52.335 (onset : 51.335)
```

4. Output Evoked MEG/EEG file

1. Select labels which you want to output and press the “Add to output list” button. Output MEG/EEG file list is updated.



Label list:
TRIGGER1
TRIGGER2
left_3200
left_800
right_3200
right_800

Trial list[sec] (number of trials = 128)
1 : 3.058 – 4.558 (onset : 3.558)
2 : 8.347 – 9.847 (onset : 8.847)
3 : 13.706 – 15.206 (onset : 14.206)
4 : 19.014 – 20.514 (onset : 19.514)
5 : 24.409 – 25.909 (onset : 24.909)
6 : 29.800 – 31.300 (onset : 30.300)
7 : 35.225 – 36.725 (onset : 35.725)

☑ show data channel

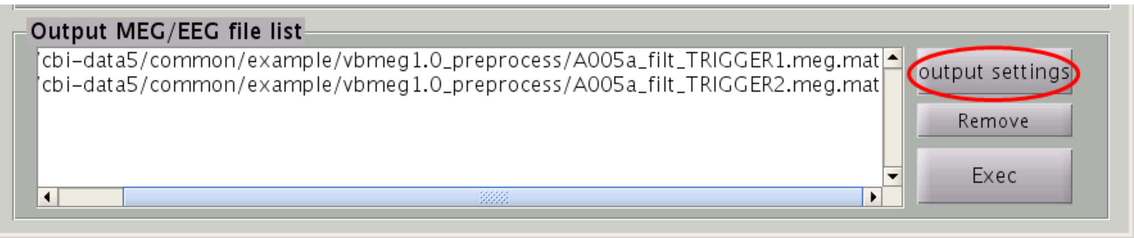
Output MEG/EEG file list:
/home/cbi-data5/common/example/vbmeg1.0_preprocess/A005a_filt_left_3200.meg.m
/home/cbi-data5/common/example/vbmeg1.0_preprocess/A005a_filt_left_800.meg.ma
/home/cbi-data5/common/example/vbmeg1.0_preprocess/A005a_filt_right_3200.meg.
/home/cbi-data5/common/example/vbmeg1.0_preprocess/A005a_filt_right_800.meg.m

2. Press “Exec” button, MEG/EEG files are created. If down sampling is necessary, please check “The setting of sampling frequency for output files”.

The setting of sampling frequency for output files

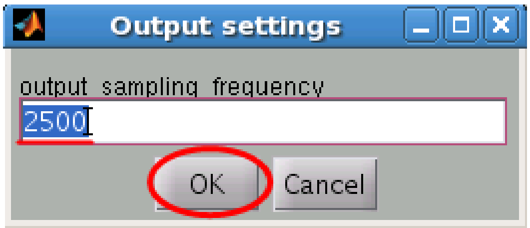
You can specify the sampling frequency for output files.

1. Press the “Output settings” button.



Output MEG/EEG file list:
cbi-data5/common/example/vbmeg1.0_preprocess/A005a_filt_TRIGGER1.meg.mat
cbi-data5/common/example/vbmeg1.0_preprocess/A005a_filt_TRIGGER2.meg.mat

2. The dialog to input the sampling frequency for output files. Input samling frequency and press the “OK” button.



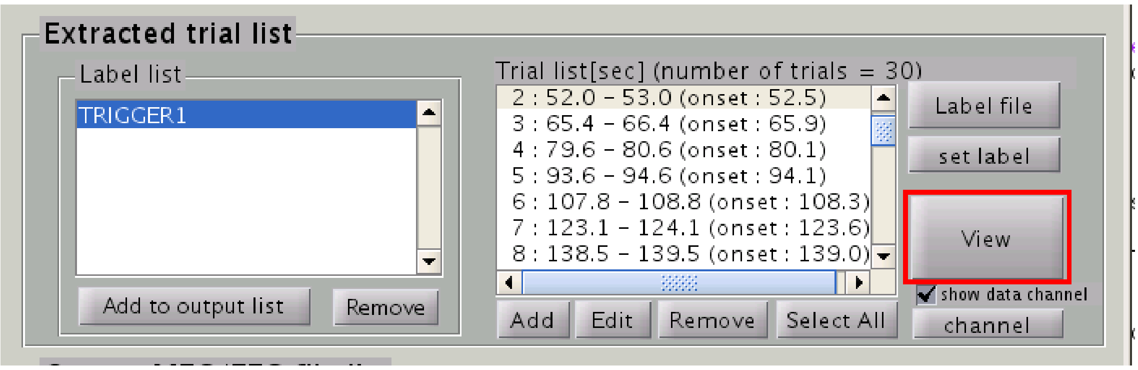
output sampling frequency: 2500

5. Manual adjustment of trial position.

Add trial

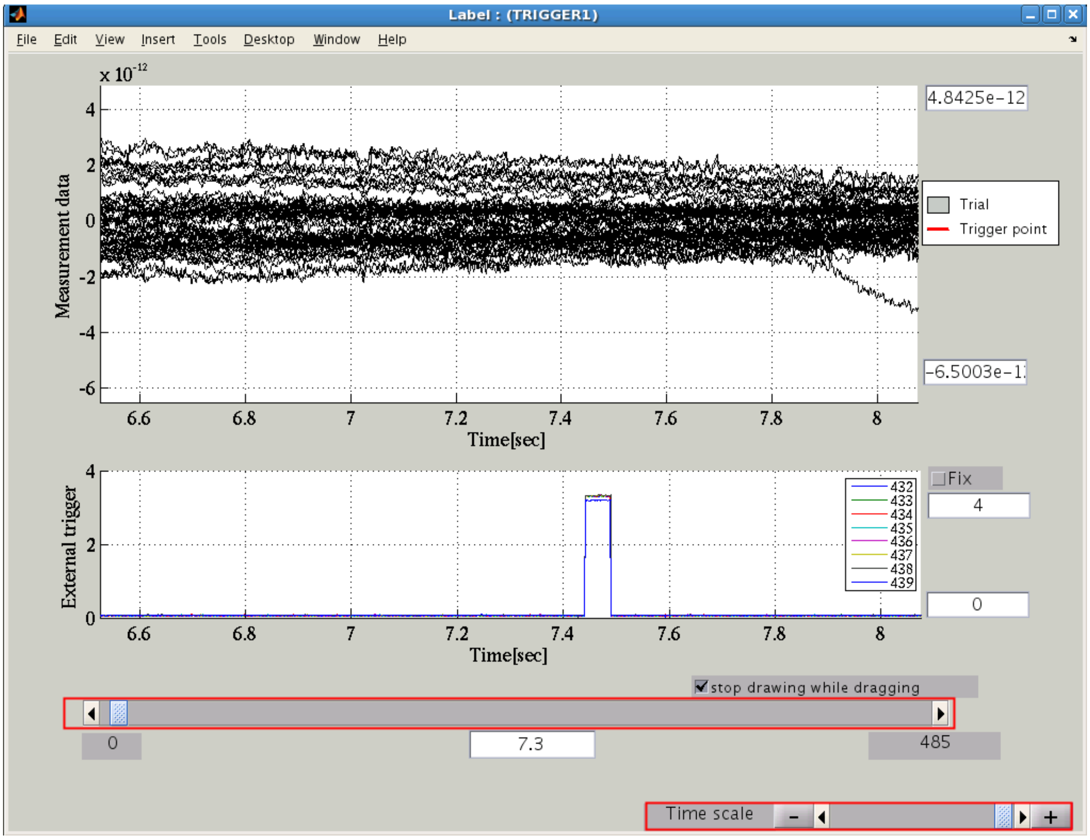
If you want to add a trial, you can add it by hand.

1. Select label from Label list.
2. Press the “View” button to launch data display screen.

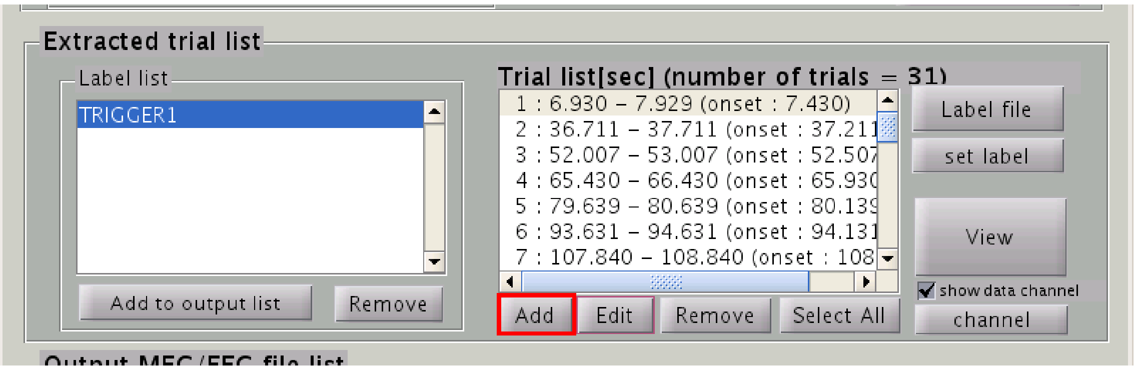


```
2 : 52.0 - 53.0 (onset : 52.5)
3 : 65.4 - 66.4 (onset : 65.9)
4 : 79.6 - 80.6 (onset : 80.1)
5 : 93.6 - 94.6 (onset : 94.1)
6 : 107.8 - 108.8 (onset : 108.3)
7 : 123.1 - 124.1 (onset : 123.6)
8 : 138.5 - 139.5 (onset : 139.0)
```

3. Show the position which you want to add a new trial by using time slider and time scale slider. In this example, there is a trigger point around 7.4 seconds. But it failed to extract as a trial.

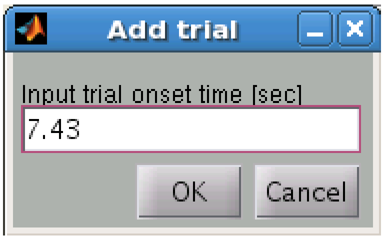


4. Press the “Add” button.



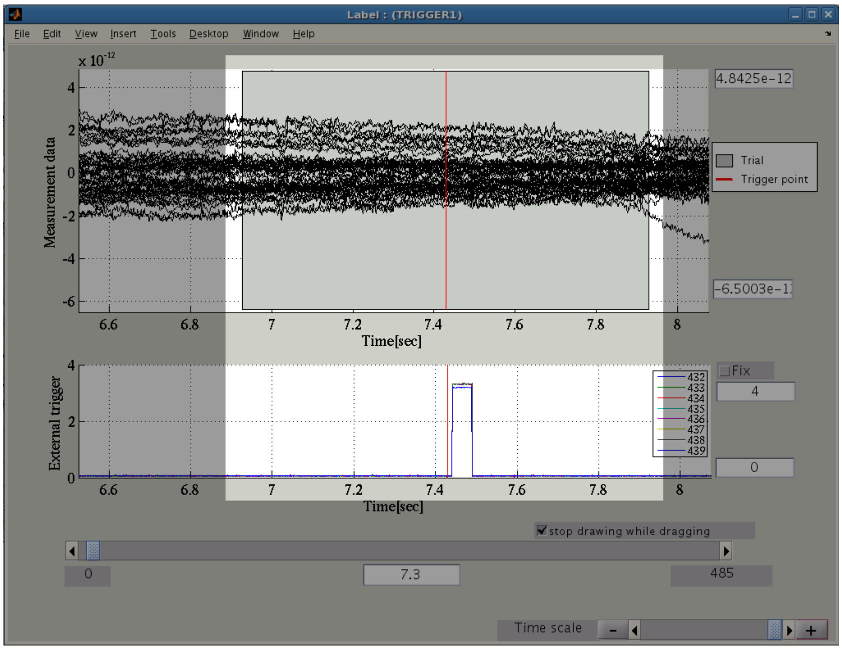
1 : 6.930 – 7.929 (onset : 7.430)
2 : 36.711 – 37.711 (onset : 37.211
3 : 52.007 – 53.007 (onset : 52.507
4 : 65.430 – 66.430 (onset : 65.930
5 : 79.639 – 80.639 (onset : 80.139
6 : 93.631 – 94.631 (onset : 94.131
7 : 107.840 – 108.840 (onset : 108

5. The dialog to input the onset time. Input 7.43 and press the “OK” button.



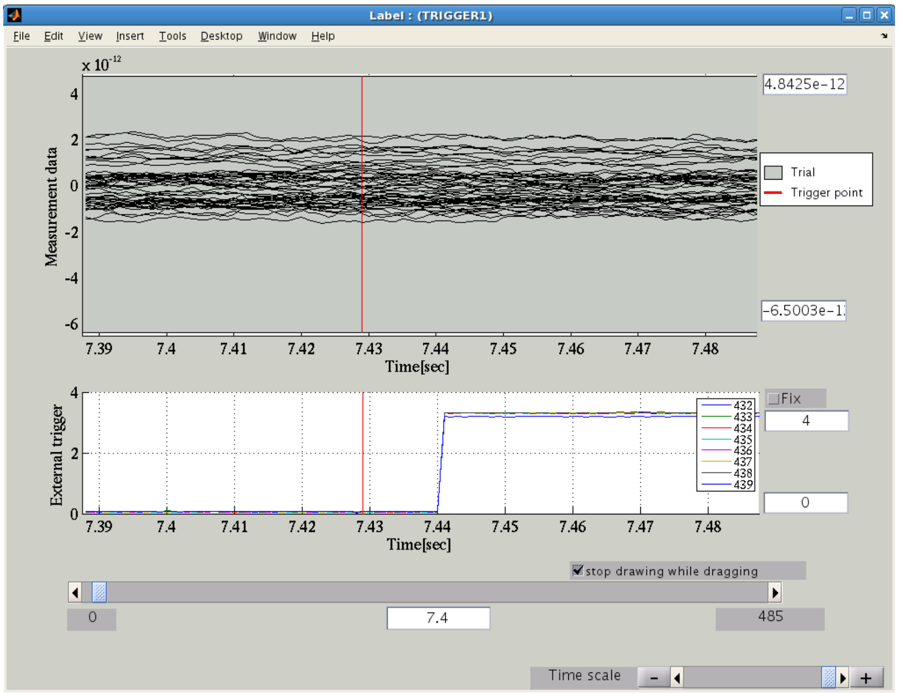
7.43

6. The trial was added as below.

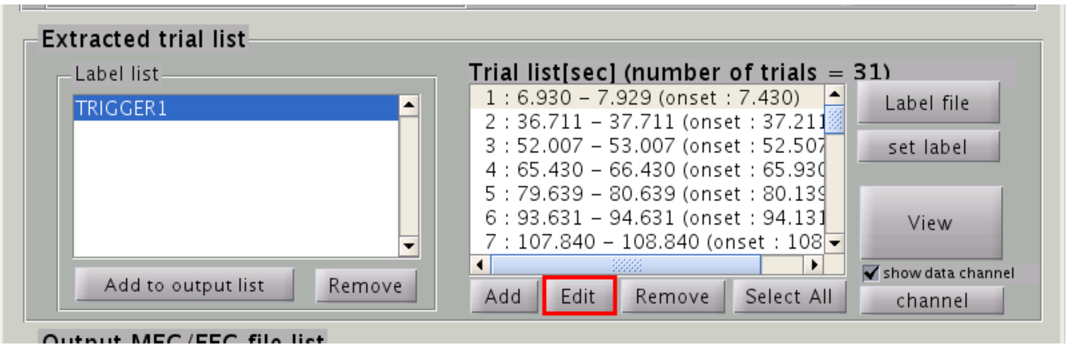


Edit trial

1. If the position of trial is shifted as below, you can correct manually.



2. Select trial number 1(6.930-7.929) from the Trial list and Press the "Edit" button.

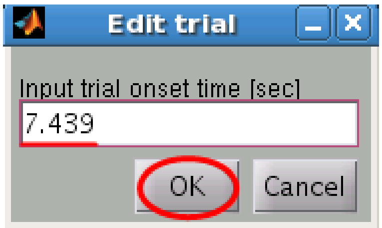


TRIGGER1

Trial list[sec] (number of trials = 31)

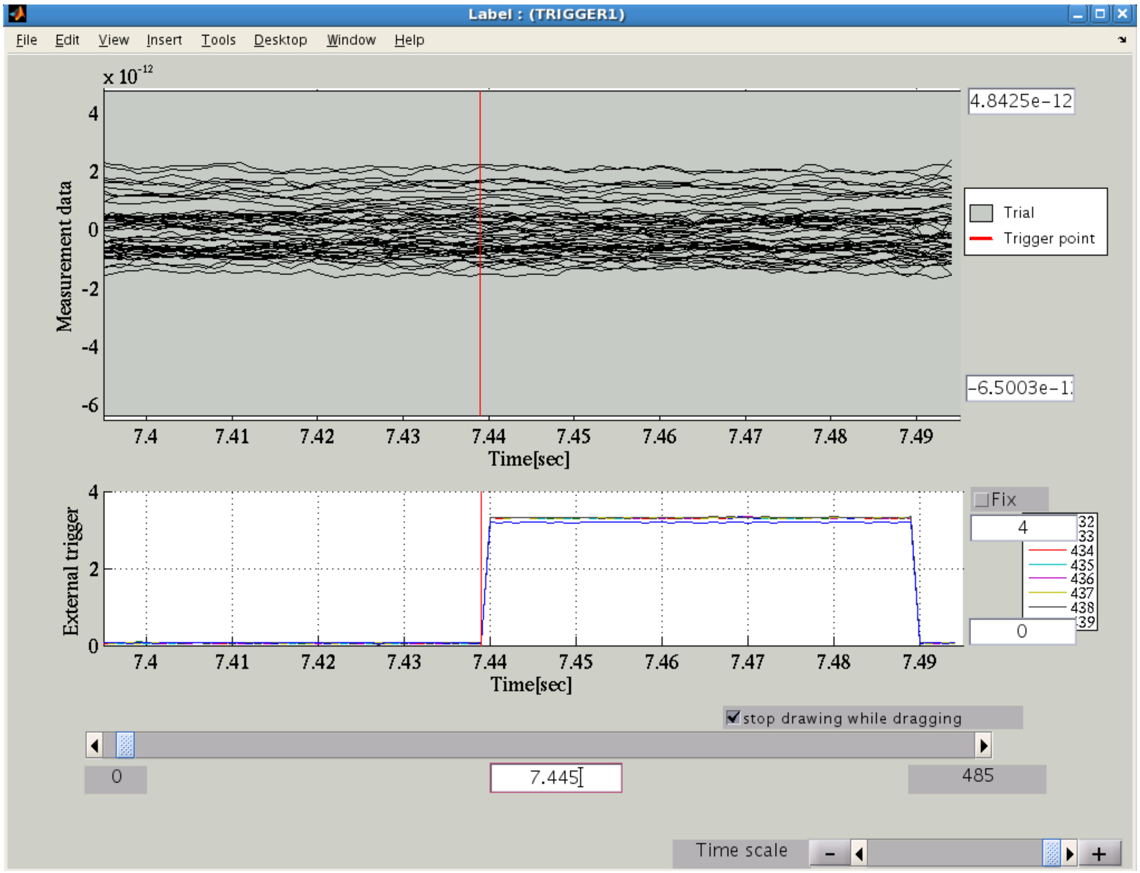
1 : 6.930 – 7.929 (onset : 7.430)
2 : 36.711 – 37.711 (onset : 37.211
3 : 52.007 – 53.007 (onset : 52.507
4 : 65.430 – 66.430 (onset : 65.930
5 : 79.639 – 80.639 (onset : 80.139
6 : 93.631 – 94.631 (onset : 94.131
7 : 107.840 – 108.840 (onset : 108

3. The dialog to input the onset time appears. Input correct onset time and press the "OK" button.



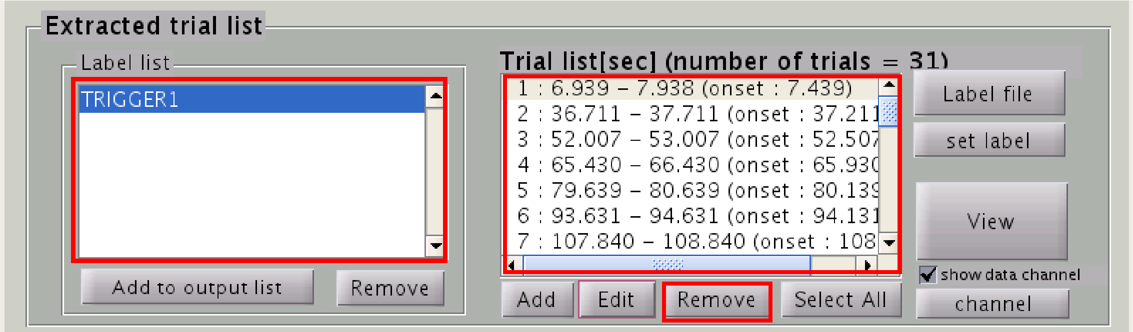
Input trial onset time [sec]
7.439

Data display screen is updated.



Remove trial

If you want to remove specified trial(s), select the label which contains the target trial(s) and choose trial(s) in the Trial list, then press the “Remove” button.



1 : 6.939 – 7.938 (onset : 7.439)
2 : 36.711 – 37.711 (onset : 37.211
3 : 52.007 – 53.007 (onset : 52.507
4 : 65.430 – 66.430 (onset : 65.93
5 : 79.639 – 80.639 (onset : 80.13
6 : 93.631 – 94.631 (onset : 94.131
7 : 107.840 – 108.840 (onset : 108

6. Reference

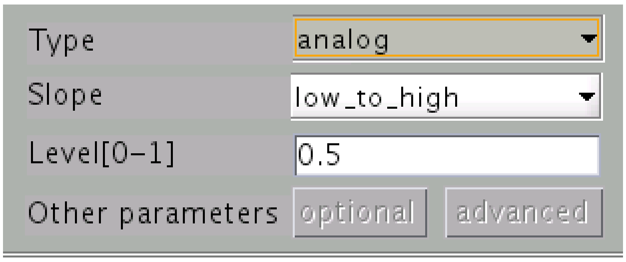
Trigger parameters

vb_trial_extractor can detect six types of triggers (analog, emg, voice, integer, bit, multi channel pattern). Please use them depending on the types of triggers that is recorded in the external channel.

analog

Find onset points using analog signal.

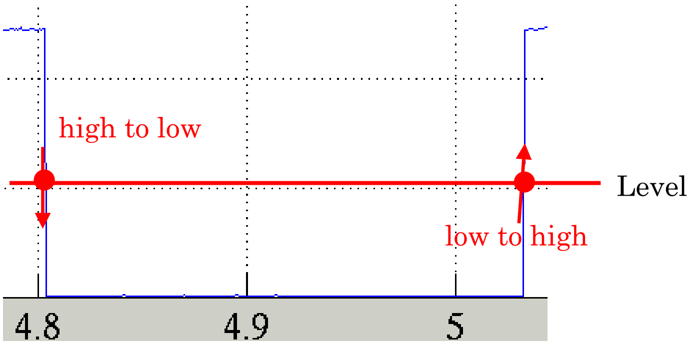
＊Basic parameter



Type analog

Slope low_to_high

Level[0–1] 0.5



Slope:

low_to_high : Find points that analog signal exceed the specified level.

high_to_low : Find points that analog signal goes under the specified level.

Level[0-1]:Threshold value (0-1). The maximum signal value is normalized to 1.

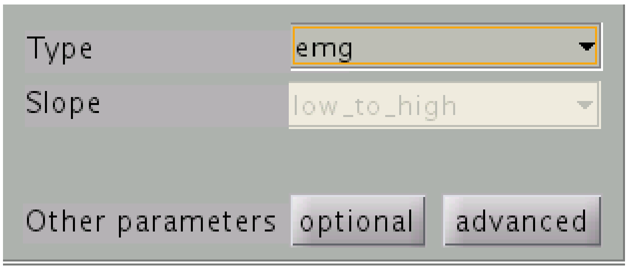
＊Optional parameter : none

＊Advanced parameter : none

emg

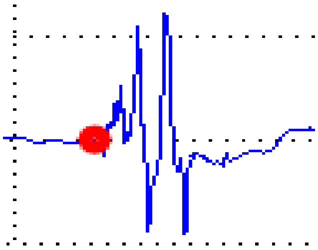
Find onset points using emg signal.

＊Basic parameter：none

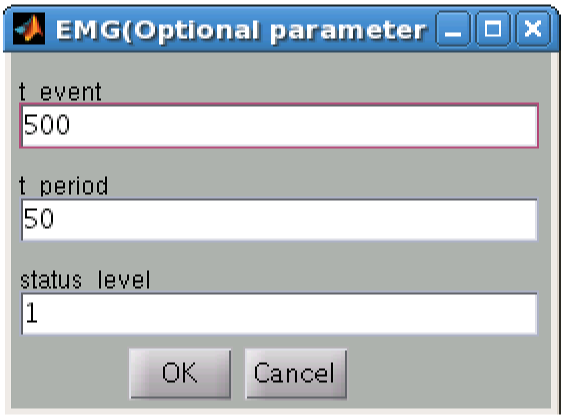


Type: emg

Slope: low_to_high



＊Optional parameter



t_event: 500

t_period: 50

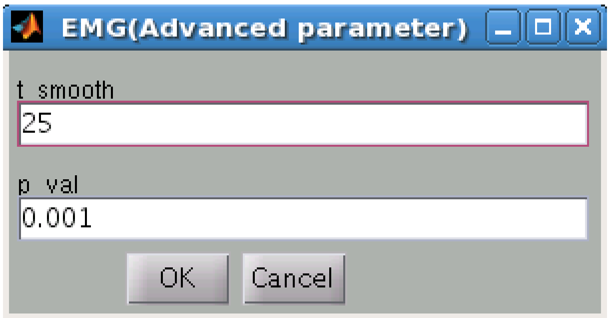
status_level: 1

t_event　　：minimum distance from previous onset event　[500 ms]

t_period　　：minimum period that Smoothed EMG > threshold [50 ms]

status_level：threshold value control rate　[1.0]

＊Advanced parameter



t_smooth: 25

p_val: 0.001

t_smooth：moving average window length　[25 ms]

p_val　：P-value corresponding to threshold value　[0.001]

If the signal exceeds the threshold,

the probability, that the signal is noise, is less than p_val.

＊Suggestion for optional parameters

(a)If too many EMG onsets are extracted, try to increase 't_event'

(b)If some of onsets are not extracted,
try smaller status_level and/or shorter 't_period'

(c)If false onsets with small peaks are extracted,
try larger status_level and/or longer 't_period'

*** Procedure**

1. Smoothed EMG is calculated by moving average of abs(EMG) with time window length of 't_smooth' (20ms)
2. Gamma distribution is fitted to the peak mode of EMG histogram
3. Default threshold value (y0) is determined from estimated gamma distribution
4. Threshold value yh = y0 * status_level
5. EMG power is calculated by TKE operator
    1) band-pass filtering at 30-300 Hz
    2) y(t) = x(t)^2 - x(t-1)x(t+1)   (TKE operator)
    3) low-pass filtering at 50 Hz
6. EMG onsets are extracted where EMG power exceed the threshold value

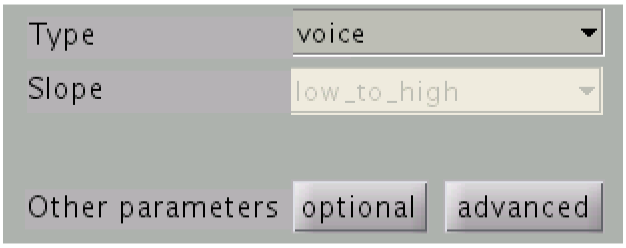
*** Condition for EMG onset (vb_get_emg_onset_time.m)**

1. Period length that EMG power exceed the threshold is larger than 't_period'
2. Distance from previous onset should be larger than 't_event'

voice

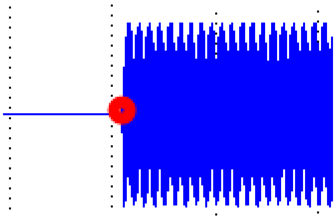
Find voice onset time that smoothed signal exceed the specified level.

＊Basic parameter：none

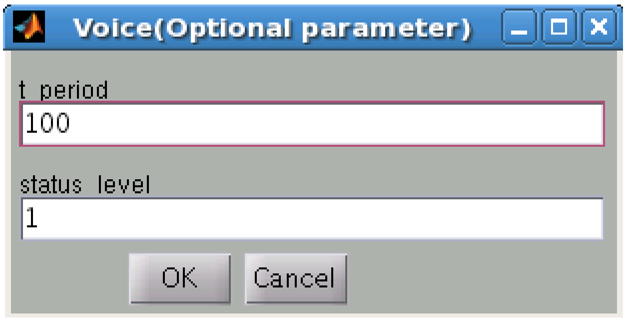


Type voice

Slope low_to_high



＊Optional parameter



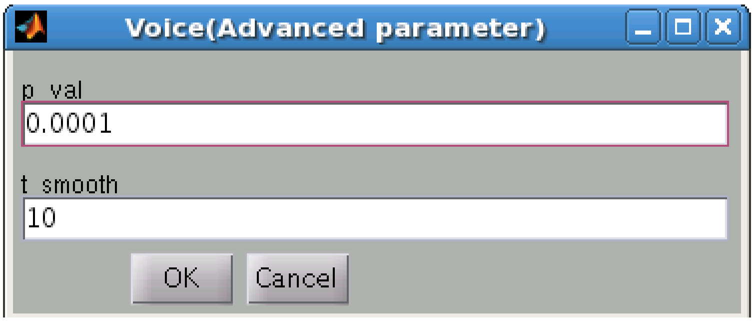
t_period
100

status_level
1

t_period　　：minimum period length that SA exceeds the threshold [100 ms]

status_level：threshold value control rate　　　　　　　　　[1.0]

＊Advanced parameter



p_val
0.0001

t_smooth
10

p_val　　：P-value corresponding to the threshold　[0.0001]

t_smooth：moving average window length　　　　　[10 ms]

＊Procedure

1. Smoothed amplitude (SA) is calculated by moving average of abs(signal)
   with time window length of t_smooth (10ms：100Hz)
2. Gamma distribution is fitted to the SA histgram
3. Default threshold value (y0) is determined from estimated gamma distribution
4. Threshold value yh = y0 * status_level

5. Voice onsets are extracted where SA exceed the threshold

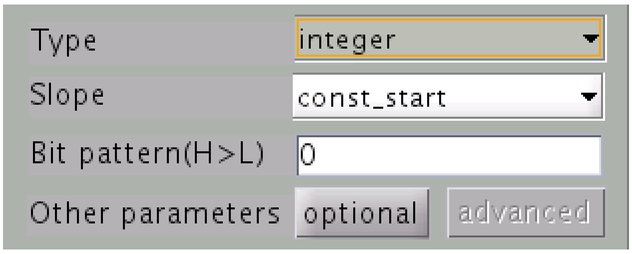
＊Condition for voice onset (vb_get_voice_onset.m)

1. Period length that SA exceed the threshold is larger than 't_period'

integer

Find onset points using bit pattern.

＊Basic parameter

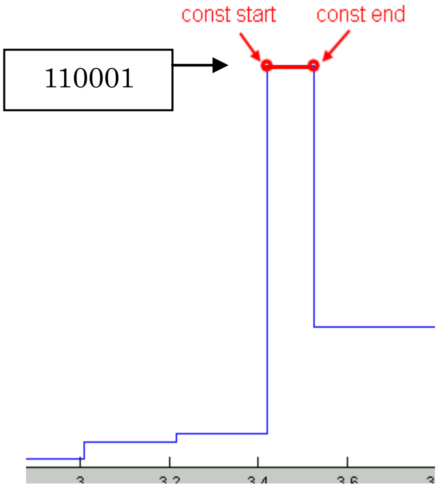


Type: integer

Slope: const_start

Bit pattern(H>L): 0

Other parameters: optional / advanced



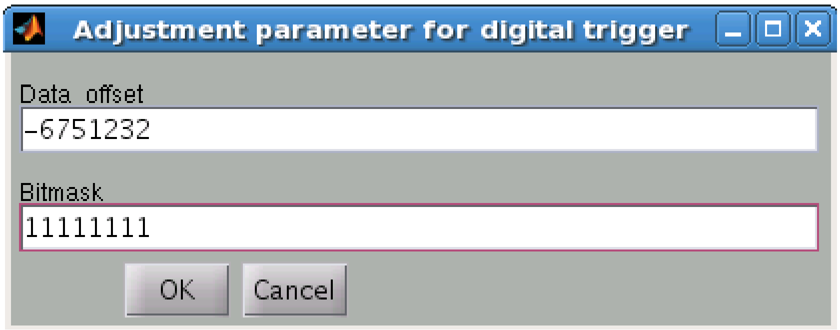
Bit Pattern(H->L)：e.g. 110001

Slope：

const_start：Find points that the given bit pattern appears.

const_end　：Find points that the given bit pattern disappears.

＊Optional parameter



Adjustment parameter for digital trigger

Data offset: -6751232

Bitmask: 11111111

Data offset: If the baseline of trigger channel is not 0, specify this value.

Data – (Data offset) correction would be done.

When you press the property button next to the trigger channel, you will see the maximum/minumum value of the data contained in the channel, this value is specified with reference to it.

Bitmask　：Mask processing is applied to leave the required bit data. Specify 0 or 1.

For example, if you specify 11111111, then retrieve the data from the lower 8bit.

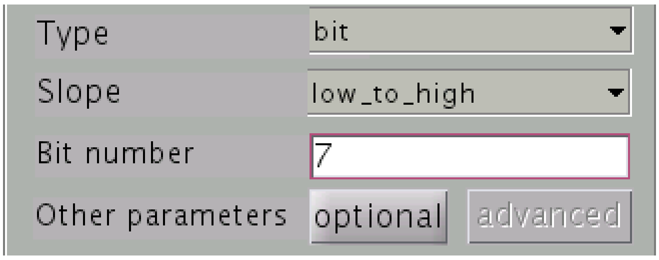
bit

Find onset points using bit number.

Check the ON / OFF of the number of bits specified to detect the onset position.

It never think of specified bit number.

＊Basic parameter

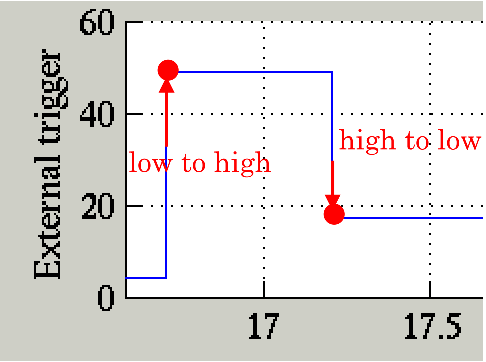


Type: bit

Slope: low_to_high

Bit number: 7

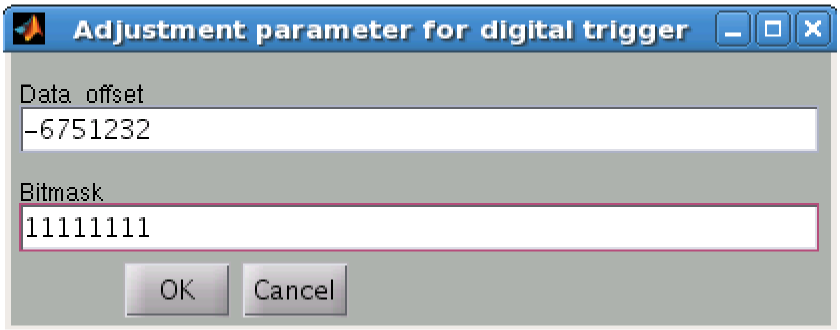
Other parameters:



Bit number : bit number from 0 [integer]

Slope : low_to_high : Find points that specified bit turn on.
high_to_low : Find points that specified bit turn off.

＊Optional parameter



Adjustment parameter for digital trigger

Data offset: -6751232

Bitmask: 11111111

Data offset: If the baseline of trigger channel is not 0, specify this value.
Data – (Data offset) correction would be done.
When you press the property button next to the trigger channel, you will see the maximum/minumum value of the data contained in the channel, this value is specified with reference to it.

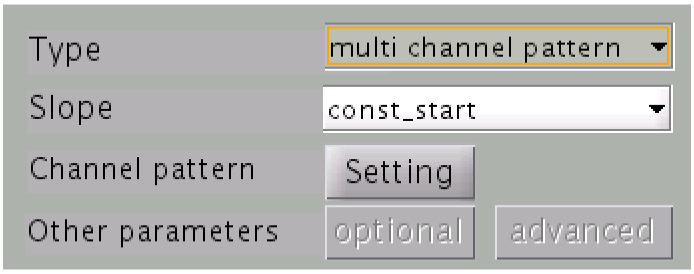
Bitmask : Mask processing is applied to leave the required bit data. Specify 0 or 1.
For example, if you specify 11111111, then retrieve the data from the lower 8bit.

multi channel pattern

Find onset points that signal changes to the given multi channel bit pattern.

Choose channel list from Extra channel list.

＊Basic parameter



Type: multi channel pattern

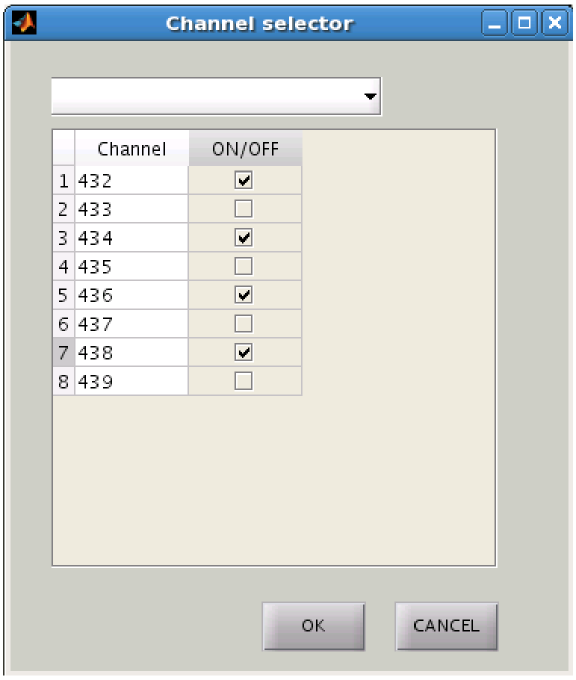
Slope: const_start

Slope：

const_start：Find points that the given channel bit pattern appears.

const_end ：Find points that the given channel bit pattern disappears.

Channel pattern： Specify channel status(ON/OFF) by checkbox.



	Channel	ON/OFF
1	432	☑
2	433	☐
3	434	☑
4	435	☐
5	436	☑
6	437	☐
7	438	☑
8	439	☐

＊Optional parameter：none

＊Advanced parameter：none

Batch Processing

Batch processing function is prepared in order to process the data that has been recorded in the same trigger method.

Function spec

vb_trial_extractor_batch_exec(trx_parm);

trx_parm : Parameter for trial extraction.

The details of the structure is written in the help of the function. The usage of the function is below.

1. Make template parameter using GUI
   (1) Extract trials by using GUI and confirm the result is correct.
   (2) Select [File]->[Save batch parameter] and save the extraction parameter to the file(.trx.mat).
2. Make batch script as below.

```
% Load template parameter
load('batch_parameter.trx.mat ', 'trx_parm ');
% Specify Continuous MEG/EEG file
trx_parm.con_file = '/home/user/subject1.meg.mat ';
% Labeling settings(if needed)
trx_parm.label_spec.base_label = { ' TRIGGER1 '};
trx_parm.label_spec.label_file    = 'label_sbj1.txt ';
% Output settings
trx_parm.output_file{1}.label_name = ‘cond1’;
trx_parm.output_file{1}.output_file = ‘/home/user/cond1.meg.mat’;
trx_parm.output_file{2}.label_name = ‘cond2’;
trx_parm.output_file{2}.output_file = ‘/home/user/cond2.meg.mat’;
trx_parm.output_sample_freq = 500; % 500Hz
% Start batch processing
vb_trial_extractor_batch_exec(trx_parm);
```

The scrip

1.Extract trials by using trx_parm -> TRIGGER1

2.Label to trials by label_sbj1.txt(cond1/cond2)

3.Output MEG files(cond1.meg.mat, cond2.meg.mat). sampling frequency: 500Hz.

NOTE: Please refer to (a)Label to trials by label file. about the label file.