Developer's Guide

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by the PsPM team[1]:

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[1] If you have comments on or error corrections to this documentation, please send them to the PsPM team or post them on: bachlab.org/pspm

Contents

1 General

Contributed by Dominik R Bach

Updated by Dadi Zhao in Feburary 2022

1.1 Data files: General structure

In PsPM the data is saved in mat-files. Each file contains two variables:

`infos` A struct variable with general infos

`data` A cell array with a cell for each channel.

The cells contain a struct with channel specific `infos` and `data`. The structs have the following mandatory fields:

`infos.duration` Duration in seconds.

`data{n}.header` `data{n}.header.chantype` (as defined in the settings)

`data{n}.header.sr` (sample rate in 1/second, or timestamp units in seconds)

`data{n}.header.units` (data units, or 'events')

`data{n}.data` (actual data)

Additionally, a typical file contains the optional infos:

- `infos.sourcefile`
- `infos.importfile`
- `infos.importdate`
- `infos.sourcetype`
- `infos.recdate`
- `infos.rectime`

Some data manipulation functions (in particular, `pspm_trim`) update infos to record some file history.

1.2 How to add a new import data type

1.2.1 Add function

Function name `pspm_get_xxx` (where `xxx` is the data type name).

Format `[sts, import, sourceinfo] = pspm_get_xxx(datafile, import).` The function needs to take an import job and add, for each job.

Fields

- Mandatory

  `.data` - the actual data for this channel (column vector)

  `.sr` - the sample rate for this channel (only if `.autosr` enabled in `pspm_init`)

- Optional

  `.marker` For marker channels (`timestamps` or `continuous`, see `pspm_get_marker`)

  `.markerinfo` See `pspm_get_marker`

  `.minfreq` Minimum frequency for pulse channels

  `.units` If data units are defined by the recording software

  `sts` Set as -1 if import is unsuccessful

  `sourceinfo` Contains information on the source file, with field

  `.chan` A cell of string descriptions of the imported source channels, e. g. names, or numbers any optional fields that will be added to `infos.source` (e. g. recording date & time, and others)

Notes for multiple blocks File formats that support multiple block storage within one file can return cell arrays `import{1:blkno}` and `sourceinfo{1:blkno}`. PsPM will save individual files for each block, with a filename `pspm_fn_blk0x.mat`.

1.2.2 Add information to settings

The file pspm_init contains a block that defines possible import data types. Add a new field here

```
% Description of data type
% ------------------------------------------
defaults.import.datatypes(1) = ...
struct('short', 'xxx', ... % short name for internal purposes
'long', 'Datatype description', ... % long name for GUI
'ext', '*', ... % data file extension
'funct', @pspm_get_xxx, ... % import function
'chantypes', {{defaults.chantypes.type}}, ... % allowed channel types
'chandescription', 'channel', ... % description of channels for GUI
'multioption', 1, ... % import of multiple channels for GUI
'searchoption', 1, ... % allow channel name search for GUI
'automarker', 0, ... % marker not stored in separate channel
'autosr', 1); % sample rate automatically assigned
```

Good to know

- The “long” definition is used in the GUI – make sure it’s readable.
- If no event channels can be imported, change `.chantypes`.
- If channels have searchable names in the import file, set `.searchoption = 1`.
- If no channel number needs to be assigned for the marker channel, set `.automarker = 1`.
- If sample rate is contained in import file and determined during import, set `.autosr = 1`.
- If you need external functions – put them into a folder in the ‘import’ subdirectory and add/remove this path within the `pspm_get_xxx` function.

1.3 How to add a new channel type

1.3.1 Add function

Function `pspm_get_xxx` (where `xxx` is the channel type)

Format `[sts, data] = pspm_get_channeltype(import)`

Arguments

`data` Data cell of structure readable by `pspm_load_data`.

Good to know For event channels, use the function `pspm_get_events` to convert various event formats into time stamps (see `pspm_get_marker` or `pspm_get_hb` as an example)

1.3.2 Add information to settings

Add information on the new channel type and import function to

```
defaults.chantypes(k).type = 'xxx';% channel type name
defaults.chantypes(k).import = @pspm_get_xxx; % conversion function
defaults.chantypes(k).data = 'xxx'; % 'wave' or 'events'
```

1.4 How to add a new GLM type

1.4.1 Add information to settings (Example SCR)

```
defaults.glm(1) = ...
struct('modality', 'scr', ... % modality name
'cbf', struct('fhandle', @pspm_bf_scrf, 'args', 1), ...
% default basis function/set
'filter', struct('lpfreq', 5, 'lporder', 1, ...
'hpfreq', 0.05, 'hporder', 1, 'down', 10, 'direction', 'uni'));
% default filter settings
```

1.4.2 Add default basis function

Function `pspm_bf_xxx`

Arguments vector of arguments, first element is time resolution, further arguments as defined in `defaults.glm(n).cbf.args`.

1.5 Warning IDs in PsPM

1.5.1 General

- `invalid_input`
- `invalid_channeltype`
- `nonexistent_file`
- `channel_not_contained_in_file`
- `obsolete_function`
- `not_allowed_channeltype`
- `invalid_data_structure`
- `no_matching_channels`
- `unknown_action`
- `missing_data`
- `out_of_range`

1.5.2 Function specific

- `pspm_load1`
  - `not_saving_data`
- `pspm_interpolate`
  - `option_disabled`
- `pspm_trim`
  - `marker_out_of_range`
- `pspm_find_channel`
  - `multiple_matching_channels`
- `pspm_find_sounds`
  - `no_marker_chan`

    - no_sound_chan
- pspm_get_scr
    - no_conversion_constant
- pspm_pp
    - invalid_freq
- pspm_prepdata
    - no_low_pass_filtering
    - downsampling_failed
    - nonint_sr
- pspm_get_timing
    - invalid_vector_size
    - event_names_dont_match
    - no_numeric_vector
    - no_integers
- pspm_down
    - rate_below_minimum

2 List of data formats

2.1 Supported Channel types

Data format	SCR	ECG	Heart Rate	Heart Beat	Heart Period	Respiration	Pupil Size	Marker	Custom	Sound channel	Pulse oxymeter	Gaze x/y, l/r
CED Spike	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MATLAB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Text	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Biopach AcqKnowledge ($\leq$ v3.9.0)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Biopac AcqKnowledge (exported)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Labchart (any Version, Windows only)	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Labchart exported ($\leq$ v7.1)	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Labchart exported ($\geq$ v7.2)	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
VarioPort	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Biograph Infiniti (exported)	✓			✓		✓						
Mindmedia Biotrace (exported)	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Brain Vision	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Windaq (wdq)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Observer XT compatible	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NeuroScan	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
BioSemi	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Eyelink							✓	✓	✓			✓
European Data Format	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Philips Scanphyslog		✓				✓		✓	✓		✓	
SMI							✓	✓	✓			✓
ViewPoint							✓	✓	✓			✓

2.2 Further settings

Data format	Datatype	File extension	Manufacturer	Import multiple channels	Search channel names	Automarker	Ask for sampling rate
CED Spike	spike	`.smr`	CED	✓	✓		
MATLAB	mat	`.mat`		✓			✓
Text	txt	`.txt`		✓	✓		
Biopach AcqKnowledge (≤ v3.9.0)	acq	`.acq`	Biopac	✓	✓		
Biopac AcqKnowledge (exported)	acqmat	`.mat`	Biopac	✓	✓		
Labchart (any Version, Windows only)	labchart	`.adicht`	ADInstruments	✓	✓	✓	
Labchart exported (≤ v7.1)	labchartmat_ext	`.mat`	ADInstruments	✓	✓	✓	✓
Labchart exported (≥ v7.2)	labchartmat_in	`.mat`	ADInstruments	✓		✓	
VarioPort	vario	`.vpd`	Becker MediTec	✓	✓	✓	
Biograph Infiniti (exported)	biograph	`.txt`	Thought Technology				
Mindmedia Biotrace (exported)	biotrace	`.txt`	MindMedia			✓	
Brain Vision	brainvision	`.eeg`	BrainProducts	✓	✓	✓	
Windaq (wdq)	windaq	`.wdq`	Dataq	✓			
Observer XT compatible	observer	`.any`	Noldus	✓	✓		
NeuroScan	cnt	`.cnt`		✓	✓	✓	
BioSemi	biosemi	`.bdf`		✓	✓	✓	
Eyelink	txt	`.asc`		✓		✓	
European Data Format	edf	`.edf`	European Data Format	✓	✓	✓	
Philips Scanphyslog	txt	`.log`	Philips	✓			
SMI	txt	`.txt`	SensoMotoric Instruments	✓	✓	✓	
ViewPoint	txt	`.txt`	Arrington Research	✓	✓	✓	

Note: Automarkers means no channel number has to be specified because markers are always at the same place.

3 GUI

Contributed by Gabriel Gräni and Dadi Zhao.

Revised by Dadi Zhao in Feburary 2022.

3.1 MATLABbatch: Getting started

1. Add the trunk folder to the MATLAB path.
2. Type `pspm_init` into the command window (after the execution of the command the folders `pspm_cfg` and MATLABbatch should be added to the MATLAB path)
3. Start MATLABbatch by the typing `cfg_ui` into the command window
4. If the item PsPM exists in the menu bar of MATLABbatch you can skip steps 5 to 7 and continue at step 8
5. Select $\rightarrow$ File $\rightarrow$ Add Application
6. Navigate to the folder `pspm_cfg` on the left hand side of the window and select the file `pspm_cfg.m` on the right hand side $\rightarrow$ Press the button Done
7. A new item, called PsPM, will appear in the upper menu bar.
8. By selecting PsPM the desired action can be selected (at the moment, there is only Data Preparation $\rightarrow$ {Import, Trim} available)

3.1.1 Example Function: Trim

This example demonstrates how MATLABbatch can be used to execute a function. For all other functions MATLABbatch behaves in the same manner.

- Select a file by pressing the Select Files Button (under Datafile)
- Select Reference and choose an item in the lower part of the window
- Fill in the desired values in the fields which are marked with "<-X"
- After you have chosen a file and filled in all values correctly, you will see a green arrow on the upper left part of the window
- By pressing on the green arrow the selected file will be trimmed according to the filled in values

3.2 MATLABbatch: How to

3.2.1 Preliminaries

- Add folder of MATLABbatch to the MATLAB path
- Add first application and then load the batch in order to execute a function

3.2.2 Some notes for creating a new application

- Leafs (items) are specified first
- Assigning child items to `.val` or `.values` fields of their parent items
- Root node of a tree is specified last
- Some examples of items:
  - cfg_item

```
item1= cfg_item; % Defines generic configuration item
item1.name= 'Def 1'; % The display name
item1.tag = 'def1'; % The name appearing in the harvested job
% structure. This name must be unique
% among all items in the val field of the
% superior node
item1.val = {true}; % Value of item (optional)
item1.help = {'Help...'}; % Help text
```

  - cfg_entry

```
entry1 = cfg_entry; % Defines entry configuration item
entry1.name = 'Input';
entry1.tag = 'input';
entry1.strtye = 'r'; % Type of values which can be entered
entry1.num = [1 1]; % Expected dimension of the input
entry1.help = {'Help...'};
```

  - cfg_choice

```
choice = cfg_item; % Defines choice configuration item
choice.name = 'Choice';
choice.tag = 'choice';
choice.values = {item1, entry1}; % Defines which items will be
% selectable in the choice menu.
choice.help = {'Help...'};
```

  - cfg_exbranch

```
fct = cfg_exbranch; % Defines the branch that has information
% about how to run this module fct.name = 'Trim';
fct.tag = 'trim';
fct.val = {choice}; % The items that belong to this branch.
% All items must be filled before this
% branch can run or produce virtual
% outputs
```

```
fct.prog = @cfg_run_fct; % A function handle that will be called
% with the harvested job to run the
% computation
trim.vout = @cfg_vout_fct; % A function handle that will be
% called with the harvested job to
% determine virtual outputs
trim.help = {Help...'};
```

- There exists a number of other item classes. Here is a list of the most important classes: `cfg_item`, `cfg_entry`, `cfg_choice`, `cfg_menu`, `cfg_exbranch`, `cfg_files`, `cfg_branch`, `cfg_repeat`. For more information call the help function in MATLAB (e.g. `help cfg_item`)

Note The inputs to each module have to be described in a tree-like structure.

During data entry, there is no way to change the tree structure based on input data. Add application to the configuration tree by default

3.2.3 Add application to the configuration tree by default

In the following it is shown how an application can be added to the menu bar of MATLABbatch by default (without adding it every time MATLABbatch is started)

- Start MATLABbatch and add the appliaction `cfg_confgui` in the folder `MATLABbatch/cfg_confgui` .
- Put Generate code into the Module list by selecting ConfGUI $\rightarrow$ Generate code in the menu bar
- Fill out all the input fields on the right side:
  - Output filename: This file will contain the whole menu structure, validity constraints and links to run time code of the appliaction.
  - Output directory: All files which are created by the ConfGUI will be stored into this directory (chose a directory which is added to the MATLAB path)
  - Root node of config: Name of the root node of the appliaction's configuration tree
  - Options:
    1. Create Defaults File: `Yes`
    2. Create `mlbatch_appcfg` File: `Yes`
    3. Create Code for `addpath()`: `No`
- Finally press the green arrow on the upper left side of the batch editor

- As no error occurred 3 new files ({Output filename}.m, {Output filename}_def.m, cfg_mlbatch_appcfg.m) should be created and added into the folder {Output directory}.
- Each time MATLABbatch is started, it will search for any cfg_mlbatch_appcfg.m file (this file contains the names of the configuration files) and will add the corresponding application to the batch editor.

3.2.4 Add modules to module list

Example Module Import and Trim will be added to the module list

```
arg1 = 'scr.prep.import_data';
arg2 = 'scr.prep.trim';
mod_cfg_id1 = cfg_util('tag2mod_cfg_id',arg1);
mod_cfg_id2 = cfg_util('tag2mod_cfg_id',arg2);
cjob = cfg_util('initjob');
mod_job_id1 = cfg_util('addtojob', cjob, mod_cfg_id1);
mod_job_id2 = cfg_util('addtojob', cjob, mod_cfg_id2);
cfg_util('harvest', cjob, mod_job_id1);
cfg_util('harvest', cjob, mod_job_id2);
cfg_ui('local_showjob', cfg_ui, cjob);
```

3.2.5 Changes

- In the function private/cfg_onscreen at line 36 figure(fg); is commented out in order to prevent the appearance of the GUI for a short time if the function cfg_ui('Visible', 'off') is called.

3.3 MATLABbatch: changing help texts and fieldnames

3.3.1 File structure of MATLABbatch GUI

There exist two files per function: 1 configuration file and 1 run file. The configuration file defines the structure of the corresponding function in the MATLABbatch GUI whereas the run file firstly gathers all entered values and secondly calls the corresponding SCR function. Both types of files are located in the subfolder pspm_cfg. The name of a configuration or a run file consists of two parts. The prefix of a configuration filename is called pspm_cfg_ whereas the filename of a run file begins with pspm_cfg_run. The second part of the filename is named after the function name (eg. for the function pspm_import.m $\rightarrow$ pspm_cfg_import.m, pspm_cfg_run_import.m).

3.3.2 Edit help texts and fieldname

In order to change any help text or fieldname in a MATLABbatch GUI function the corresponding configuration file has to be opened. For each item

in a MATLABbatch GUI function a struct variable which contains several struct fields is defined in the configuration file.

- Help text The field `.help` defines the help text of the item which can be edited in order to change the help text. As soon as MATLABbatch has been closed and opened again, the changes in the help text will be visible in MATLABbatch GUI.
- Fieldname The fieldname of an MATLABbatch GUI item is defined by the struct field `.tag`. In case a fieldname of an item should be changed be careful to verify if no other item, which has the same root node, hold the same fieldname. Otherwise MATLABbatch will not work properly. After the fieldname of an item has been changed the run file (`pspm_cfg_run_functionname.m`) of the corresponding function has to be adapted as well in order to ensure that the function call in the run file is done properly.

3.4 Recommendations for GUI development

3.4.1 Mlapp

`Mlapp` is the new format for developing GUI in MATLAB. The old GUIDE based GUI will lose support from Mathworks in a future release. Therefore, it is recommended to move from the old GUIDE to the new Mlapp.

The `.mlapp` file can be created natively through the new MATLAB GUI guide. Alternatively, it can be generated by converting the classic GUIDE based .fig file through the feature *migration*.

3.4.2 Style

The new GUI is currently using the colour `#7f2534` for stylishing. The main typeface for UI design is Segoe UI, Helvetica Neue and DejaVu Sans for Windows, macOS and Linux, respectively.

4 Test Environment

Contributed by Linus Rüttimann, Tobias Moser and Dadi Zhao.
Revised and updated by Dadi Zhao in Feburary 2022.

4.0.1 Unittest: General implementation

In PsPM the MATLAB Unit Testing Framework is used for testing of functions. For each tested function there is a MATLAB class with the name `functionname_test`, which contains the unittests for that specific function. Additionally there is a documentation page for each of the test classes, where information about the unittests can be found.

To run the unittests of a test class, an object of the class has to be created

```
testCase = functionname_test.
```

where `testCase` is an arbitrary object name and `funtionname_test` is the name of a test class. Then all the unittest that are contained in the test class can be run with

```
testCase.run.
```

A specific unittest can be run with

```
testCase.run(unittest_name').
```

Remember that a new test class object must be generated each time the test class has been changed.

4.0.2 parameterised test classes

Parmeterised test classes is a feature provided by the MATLAB test case class. A test class is parameterised when it has

- Test parameters defined (within the property section)
- Test methods implementing the defined test parameters

Each function implementing test parameters will be called multiple times with each possible parameter combination (which is determined by MATLAB). Thus parameterised classes allow to write single tests for different parameter combinations. If one of the following test cases is a parameterised test class, it will be mentioned accordingly.

4.1 Align Channels

4.1.1 Overview

Testclass `pspm_align_channels_test`

Format `[sts, data, duration] = pspm_align_channels(data, induration)`

4.1.2 Setup

This test uses data stored in `ImportTestData/ecg2hb/tpspm_s102_s1.mat`

4.1.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings given invalid inputs.

Lower optional duration

Function name `lower_optional_duration(this)`

Description Passes an optional duration that is less than the maximum duration of all channels in the input to `pspm_align_channels`.

Tests

1. Assert that lower optional duration has no effect on the output.
2. Check if all of the returned channels have the same duration.

Same optional duration

Function name `same_optional_duration(this)`

Description Passes an optional duration that is equal to the maximum duration of all channels in the input to `pspm_align_channels` and does the exact same checks as in lower duration case.

Higher optional duration

Function name `higher_optional_duration(this)`

Description Passes an optional duration that is higher than the maximum duration of all channels.

Tests

1. Assert that durations of all returned channels is the same as the passed optional duration.

Max duration is passed in marker channel

Function name `max_duration_is_given_in_events(this)`

Description Passes the maximum duration in marker channel to pspm_align_channels.

Tests

1. Assert that all returned channels are aligned to the maximum duration passed in marker channel.

Various case checks

Function names

`only_one_channel_longer_others_same(this)`

`only_one_channel_shorter_others_same(this)`

`increasing_channel_lengths(this)`

`two_same_others_shorter(this)`

Description In each of these cases check if the returned channels have the same duration that is equal to the maximum duration of all input channels.

4.2 Butter

4.2.1 Overview

Testclass `pspm_butter_test`

Function `[sts, b, a] = pspm_butter(order, freqratio, pass)`

4.2.2 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid and if the signal processing toolbox is installed.

Tests

Input	Expected warning
`pspm_butter() [no input]`	`ID:invalid_input`
`pspm_butter(1,1,'abc') [pass not equal to 'high' or 'low']`	`ID:invalid_input`
`pspm_butter(2,1) ['Signal processing toolbox is missing' #1]`	`ID:toolbox_missing`
`pspm_butter(1,1) ['Signal processing toolbox is missing' #2]`	`ID:toolbox_missing`

4.3 pspm_bf_test

4.3.1 Overview

Testclass `pspm_bf_test`

Format `[bs, x] = pspm_bf_<specific function name>`

4.3.2 Setup

This test class is parameterised.

Method setup parameters These parameters define which function should be tested**.**

Basis function Specifies the basis functions to test (without the `pspm_bf_prefix`). The current basis function to test is then called via `this.bf()`;

Test parameters These are parameters which define what kind of data or option should be passed to each basis function.

Time res log	Specifies for the basic test different time resolutions (argument `'td'`) which a basis function should be able to handle (as long as `td <= duration`). The values are logarithmic and have to be translated before passed to the basis function.

4.3.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid. Tests

Input	Expected warning
`this.bf() [no parameters]`	`ID:invalid_input`
`this.bf(dur+1) [pass 'td' > duration of function]`	`ID:invalid_input`
`this.bf(0) [invalid time resolution]`	`ID:invalid_input`

Basic

Function name `test_basic(this, time_res_log)`

Description Test for different requirements to verify whether the current basis function is valid or not.

Tests

1. Test with `td = 0.1`, verify that no warning is issued and determine the duration
2. Test with `td = 0.01` and check if the new duration is equal to the duration calculated before.
3. Test if function runs through without warning and that the time vector begins at `<= 0`.
4. Test if the function runs through without warning with `td = 10^time_res_log` (as long as `td < duration`)

4.4 pspm_convert_unit

4.4.1 Overview

Testclass `pspm_convert_unit_test`

Function `[sts, converted] = pspm_convert_unit(data, from, to)`

4.4.2 Setup

Constants `inch_to_cm = 2.54`

4.4.3 Testcases

Invalid input

Function name `invalid_input(testCase)`

Description Pass invalid from or to metrics and check if warnings are issued.

Valid input

Function name `valid_input(this)`

Description Pass various valid inputs and compare results to manually calculated ones.

Tests

1. If empty input data is passed, result is also empty.
2. Convert single cm value to m.
3. Various unit conversion checks:
   (a) Conversion between same units (`cm` to `cm`)
   (b) `mm` to `km` and `km` to `mm` conversions
   (c) `inch` to `cm` conversions
4. Negative value conversions
5. Convert single dimensional array with multiple elements.
6. Convert each element in 3D array.

4.5 pspm_ecg2hb

4.5.1 Overview

Testclass `pspm_ecg2hb_test`

Format `[sts,pt_debug] = pspm_ecg2hb(fn, chan, options)`

4.5.2 Setup

Constants

- testdata{0}.chan_struct = struct('nr', 1, 'name', 'ecg');
- testdata{0}.filename = 'ImportTestData\ecg2hb\test_ecg77.mat';
- testdata{0}.num_channels = 1
- testdata{1}.chan_struct = struct('nr', 3, 'name', 'ecg');
- testdata{1}.filename = 'ImportTestData\ecg2hb\tpspm_s102_s1.mat';
- testdata{1}.num_channels = 5
- backup_suffix = '_backup';
- options = struct('semi', 0);

4.5.3 Testcases

Invalid input arguments

Function name `invalid_input(this)`

Description Pass invalid input arguments and check if the warnings are as expected.

Tests

Input	Expected warning
pspm_ecg2hb() [no arguments]	ID:invalid_input
pspm_ecg2hb(1) [invalid file name]	ID:invalid_input
pspm_ecg2hb(this.fn, 'bla') [invalid channel (text)]	ID:invalid_input
pspm_ecg2hb(this.fn, 1) [invalid channel type]	ID:not_allowed_channelt
o.twthresh = 'bla'; pspm_ecg2hb(this.fn, this.chan.nr, o) [invalid twthresh (text)]	ID:invalid_input
o.minHR = 202; pspm_ecg2hb(this.fn, this.chan.nr, o) [invalid minHR (> default_maxHR)]	ID:invalid_input
o.minHR = 202; o.maxHR = 19; pspm_ecg2hb(this.fn, this.chan.nr, o) [invalid minHR > maxHR]	ID:invalid_input
o.maxHR = 19; pspm_ecg2hb(this.fn, this.chan.nr, o) [invalid maxHR (< default_minHR)]	ID:invalid_input
o.debugmode = 5; pspm_ecg2hb(this.fn, this.chan.nr, o) [invalid debugmode (not in [0,1])]	ID:invalid_input
o.semi = 5; pspm_ecg2hb(this.fn, this.chan.nr, o) [invalid semi (not in [0,1])]	ID:invalid_input

Valid input arguments

Function name `valid_input(this)`

Description Pass valid input arguments and check if there are no warnings.

Tests

Input	Expected warning
`pspm_ecg2hb(this.fn, this.chan.nr, this.options)`	-
`pspm_ecg2hb(this.fn, this.chan.name, this.options)`	-
`this.test_added_data()`	-

4.5.4 Other Methods

Test for added data

Function name `test_added_data()`

Description Check if added hb channels show an expected behaviour.

Tests (for each channel)

Tested Value	Expected Value
Sampling rate	`1`
Unit	`'events'`
Channel type	`'hb'`
Amount of data points in data	`> 1`
Heartbeat indices are monotonically increasing	`True`
Maximum number of heartbeats per second	`< 5`
Data is distributed equally (standard deviation)	`< 2s`
Time between end of recording and last data point	`< 60s`

4.6 pspm_filtfilt

4.6.1 Overview

Testclass `pspm_filtfilt_test`

Format `y = pspm_filtfilt(b,a,x)`

4.6.2 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expect
`pspm_filtfilt() [no input]`	`ID:inv`
`pspm_filtfilt([1:10],[1:20],[1:10]) [data length less than 3 times filter order]`	`ID:inv`

4.7 pspm_find_channel

4.7.1 Overview

Testclass `pspm_find_channel_test`

Format `chan = pspm_find_channel(headercell, chantype)`

4.7.2 Testcases

Invalid input arguments

Function name `invalid_inputargs(this)`

Description Checks for warnings, if the input arguments are invalid.

Setup `headercell = {'heart', 'scr', 'pupil'};`

Tests

Input	Expected warning
`pspm_find_channel('str','scr') [no headercell]`	`ID:invalid_input`
`pspm_find_channel(headercell, 'str')`	`ID:not_allowed_channeltype`
`pspm_find_channel(headercell, 4) [no string chantype]`	`ID:invalid_input`

Valid Input Arguments

Function name `valid_inputargs(this)`

Description Checks for correct return value if the input arguments are valid

Setup `headercell = {'heart', 'scr', 'pupil', 'mark', 'gsr', 'eda'};`

Tests

Input	Exp. Output	Expected warning
`pspm_find_channel(headercell, 'pupil')`	3	
`pspm_find_channel(headercell, 'resp')`	0	`ID:no_matching_channels`
`pspm_find_channel(headercell, 'scr')`	-1	`ID:multiple_matching_channels`
`pspm_find_channel(headercell, {'mark', 'str', 'bla'})`	4	
`pspm_find_channel(headercell, {'call', 'str', 'me'})`	0	`no matching channel, but no warning`
`pspm_find_channel(headercell, {'scr', 'gsr', 'eda'})`	-1	`multiple matching channels, but no warning`

4.8 pspm_extract_segments

4.8.1 Overview

Testclass `pspm_extract_segments_test`

Format `[sts, out] = pspm_extract_segments(varargin)`

4.8.2 Setup

This test class is parameterised. For manual mode tests, the test data is generated by the function itself and when needed, files will be written to `testdatafile<variable_nr>.mat`. For auto mode tests, the test data must be in `ImportTestData/fitted_models` folder with names as specified in the tests.

Test parameters These are parameters which define what kind of data should be passed to `pspm_extract_segments` in auto mode tests and which options should be set.

`nan_output` This option defines whether the user wants to output the `NaN` ratios of the trials for each condition. If so, we values can be printed on the screen (on MATLAB command window) or written to a created file.

`nan_ratio` Defines ratio of `NaN` values in the generated test data

`nr_trail` Number of trails in the generated test data

4.8.3 Testcases

Invalid input

Format `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
`pspm_extract_segments()`	`ID:invalid_input`
`pspm_extract_segments('a','b')`	`ID:invalid_input`
`pspm_extract_segments('manual',fn,0)`	`ID:invalid_input`
`pspm_extract_segments('manual',struct('a',10),0)`	`ID:invalid_input`
`pspm_extract_segments('manual',[1,3],0)`	`ID:invalid_input`
`pspm_extract_segments('manual',fn,'a')`	`ID:invalid_input`
`pspm_extract_segments('manual',fn,{1})`	`ID:invalid_input`
`pspm_extract_segments('auto',{1})`	`ID:invalid_input`
`pspm_extract_segments('auto','some')`	`ID:invalid_input`

Test manual mode with indicated length

Function name `test_manual_length(this,nr_trial,nan_ratio)`

Desctiption Checks for equality of produced segments by `pspm_extract_segments` with manually computed segments.

Tests

1. Generate segments form test data.
2. Test if function call wirked WarningFree
3. Test if variable `segments` existis in output
4. Test if correct number of segments were produced
5. Test each segment holds correct data

Test manual mode with durations

Function name `test_manual_duration(this,nr_trial,nan_ratio)`

Desctiption Checks for equality of produced segments by `pspm_extract_segments` with manually computed segments.

Tests

1. Generate segments form test data.
2. Test if function call wirked WarningFree
3. Test if variable 'segments' existis in output
4. Test if correct number of segments were produced
5. Test each segment holds correct data

Test auto mode with GLM using marker onsets

Function name `test_auto_mode_glm_with_markers(this)`

Description Runs `pspm_extract_segments` with a particular GLM model stored in `ImportTestData/fitted_models` and compares the results to manually calculated results.

Tests

1. Test if length of the returned cell array (from now on called `segments`) is the same as the number of conditions
2. Test if shape of data arrays in each element of `segments` agrees with the passed durations and number of onsets.
3. Test if `segments.trial_idx` agrees with input data.
4. Test if statistics calculated manually from `segments.data` is the same as `segments.mean` and `segments.std`.
5. Compute each statistic field in each element of `segments` manually using the input data and compare the results to `segments`.

Test auto mode with GLM using second onsets

Function name `test_auto_mode_glm_with_seconds(this)`

Description Do the exact same tests as in `test_auto_mode_glm_with_markers` but this time using seconds to specify onsets.

Test auto mode with DCM

Function name `test_auto_mode_dcm(this)`

Description Runs `pspm_extract_segments` with a particular DCM model stored in `ImportTestData/fitted_models` and compares the results to manually calculated results. In order to get meaningful condition statistic information this test function assigns the same trial name to certain groups of trials.

Note Since in DCM case onsets are calculated using trial start and end seconds of DCM trials, there is no second/marker distinction in DCM test.

Tests Do the exact same tests as in `test_auto_mode_glm_with_markers` by adapting the computation steps to DCM case.

4.9 pspm_find_sounds

4.9.1 Overview

Testclass `pspm_find_sounds_test`

Format `[sts, infos] = pspm_find_sounds(file, options)`

4.9.2 Setup

This test class is parameterised. The test data is generated by the function itself and when needed, files will be written to `testdatafile<variable_nr>.mat`.

Test parameters These are parameters which define what kind of data should be passed to pspm_find_sounds and which options should be set.

Channel output	Specifies whether ‘`all`’ found markers or only ‘`corrected`’ markers should be returned.
Max delay	Varies the max delay option and defines how far away a marker at most can be.
Min delay	Varies the min delay option and defines how far away a marker at least should be.
Threshold	Defines the minimum size of a marker to be recognized as a marker event. Passed in percent of the maximum amplitude of the recorded data.
Resample	Defines whether the function should resample (and interpolate) the data to a higher sample rate in order to get more exact marker findings.
Channel action	Defines whether a newly created marker channel should replace the existing marker channel or should be added as a new marker channel.

4.9.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
`pspm_find_sounds('')`	`ID:file_not_found`
`pspm_find_sounds(fn) [invalid pspm file]`	`ID:invalid_input`
`pspm_find_sounds(fn) [pspm file without a 'snd' channel]`	`ID:no_sound_chan`
`pspm_find_sounds(fn, o) [invalid values for positive integer fields]`	`ID:invalid_input`
`pspm_find_sounds(fn, o) [invalid values for positive numeric fields]`	`ID:invalid_input`
`pspm_find_sounds(fn, o) [invalid values for logic fields]`	`ID:invalid_input`
`pspm_find_sounds(fn, o) [invalid channel ids for channel fields]`	`ID:out_of_range`
`pspm_find_sounds(fn, o) [enabled diagnostics without a marker channel]`	`ID:no_marker_chan`
`pspm_find_sounds(fn, o) [invalid values for channelaction]`	`ID:invalid_input`
`pspm_find_sounds(fn, o) [invalid values for roi]`	`ID:invalid_input`
`pspm_find_sounds(fn, o) [maxdelay < mindelay]`	`ID:invalid_input`

Test add channel

Function name `test_add_channel(this, channeloutput, max_delay, resample, channelaction)`

Description Test add channel with different options. Diagnostics is always enabled, Channel output, Max delay, Resample and Channel action are varied. Once `pspm_find_sounds` is complete, the function tests if the returned data has the expected format.

Tests

1. Generate data with channel `snd` and `marker`; and count amount of reference markers
2. Set
   (a) `options` according to test parameters

   (b) `diagnostics` to `1`
3. Test if function runs through without warning
4. Test if returned data has the correct format
5. Test if channels has been added or replaced
6. Test if added channel has correct amount of data

Test region count

Function name `test_region_count(this)`

Description Test region of interest in combination with expected sound count.

Tests

1. Generate data with channel ‘snd’ and ‘marker’
2. Test if function finds the function finds all markers in the whole file
3. Test if function finds all the markers in the whole file with initial threshold 1
4. Test if function finds half of the markers in half of the file

Test threshold

Function name `test_threshold(this, threshold)`

Description Vary the threshold option and test whether the functions returnes the expected data.

Tests

1. Generate data with channel ‘`snd`’ and ‘`marker`’
2. Set
   (a) `threshold` according to test parameter
   (b) `diagnostics` to `1`
3. Test if function runs through without warning
4. Test if returned data has the correct format

Test plot

Function name `test_plot(this, threshold)`

Description Test if the plot functions returne the expected data and runs through without warning.

Tests

1. Generate data with channel `snd` and `marker`
2. Set
   (a) `plot` to `1`
   (b) `diagnostics` to `1`
3. Test if function runs through without warning
4. Test if returned data has the correct format

4.10 pspm_find_valid_fixations

4.10.1 Overview

Testclass `pspm_find_valid_fixations_test`

Format `[sts, out_file] = pspm_find_valid_fixations(fn, options)`

4.10.2 Setup

This test class is parameterised. The test data is generated by the function itself and when needed, files will be written to `testdatafile<variable_nr>.mat`.

Test parameters These are parameters which define what kind of data should be passed to `pspm_find_valid_fixations` and which options should be set.

Distance	Used for gaze validation; defines the distance between eyes and screen.
Aspect used	Used for gaze validation; defines the aspect ratio set in the software.
Aspect actual	Used for gaze validation; defines the aspect ratio of the hardware.
Screen size	Used for gaze validation; defines the size of the screen in inches.
Eyes	Is used for data generation and tells the function for which eyes data should be generated.
Channel action	Defines whether to `'add'` or `'replace'` existing channels.
Newfile	Defines whether to create a new file or extend the existing file.
Overwrite	Defines whether to overwrite the existing file or not.
Interpolate	Defines whether to interpolate `NaN` values in validated channels or not.
Missing	Defines whether to create a channel which holds information about which positions have been set to `NaN` (and may have been interpolated afterwards).
Work eye	Defines which eyes should be used for fixation validation.
Work chans	Defines which channels should be set to NaN during invalid fixations.

4.10.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_find_valid_fixations()	ID:invalid_input
pspm_find_valid_fixations('a')	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.validate_fixations]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.box_degree]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.screen_settings]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [missing fields for options.screen_settings]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.aspect_actual]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.aspect_used]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.bitmap]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.display_size]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.display_size]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.fixation_point]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.channel_action]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.newfile]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.overwrite]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.interpolate]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.missing]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid eyes]	ID:invalid_input
pspm_find_valid_fixations(fn, options) [invalid options.channels]	ID:invalid_input

Test work chans

Function name `test_work_chans(this, work_chans)`

Description Tests whether the option ‘`channels`’ actually works on the specified channels or not.

Tests

1. Generate data with

   ```
   distance 500
   aspect_used 16:9
   aspect_actual 4:3
   screen_size 20
   eyes ‘lr’
   ```

2. Set options with

   ```
   overwrite 1
   channels work_chans
   channel_action ‘add’
   ```

3. Test if function runs through without warning
4. Test if `sts==1`
5. Test if specified `work_chans` are added as new processed channels

Test work eye

Function name `test_work_eye(this, work_eye)`

Description Test whether the option ‘`eyes`’ actually works on the specified eyes or not.

Tests

1. Generate data with

   ```
   distance 500
   aspect_used 16:9
   aspect_actual 4:3
   screen_size 20
   eyes 'lr'
   ```

2. Set options with

   overwrite 1
   eyes work_eye
   channel_action 'add'

3. Test if function runs through without warning
4. Test if `sts==1`
5. Test if specified eyes have been processed accordingly and test if not specified eyes have ignored.

Test missing

Function name `test_missing(this, missing)`

Description Test whether for each a a new missing channel is created if missing is specified as true.

Tests

1. Generate data with

   ```
   distance 500
   aspect_used 16:9
   aspect_actual 4:3
   screen_size 20
   eyes 'lr'
   ```

2. Set options with

   ```
   overwrite 1
   missing missing
   ```

`channel_action 'add'`

3. Test if function runs through without warning
4. Test if `sts==1`
5. Depending on the status of `'missing'`, test if there are any missing channels or if there is no missing channel

Test interpolate

Function name `test_interpolate(this, interpolate)`

Description Test whether data is interpolated during periods which are set to `NaN` by the function.

Tests

1. Generate data with

   `distance 500`
   `aspect_used 16:9`
   `aspect_actual 4:3`
   `screen_size 20`
   `eyes 'lr'`

2. Set options with

   overwrite 1
   interpolate interpolate
   channel_action 'add'

3. Test if function runs through without warning
4. Test if `sts==1`
5. Depending on the status of `'interpolate'` test whether there are some `NaN` values or if `NaN` periods have been interpolated accordingly.

Test overwrite

Function name `test_overwrite(this, overwrite)`

Description Test if files are overwritten, if specified with `'overwrite'` option.

Tests

1. Generate data with

   ```
   distance 500
   aspect_used 16:9
   aspect_actual 4:3
   screen_size 20
   eyes 'lr'
   ```

2. Set options with

   ```
   overwrite 1
   interpolate interpolate
   channel_action 'add'
   ```

3. Test if function runs through without warning
4. Test if `sts==1`
5. Test if file has been overwritten or not (tests, if there are any new channels).

Test channel action

Function name `test_channel_action(this, channel_action)`

Description Test if channels are added or replaced (according to `channel_action`).

Tests

1. Generate data with

   ```
   distance 500
   aspect_used 16:9
   aspect_actual 4:3
   screen_size 20
   eyes 'lr'
   ```

2. Set options with

`overwrite 1`

`channel_action channel_action`

3. Test if function runs through without warning
4. Test if `sts==1`
5. Test if channels have been added or replaced (tests, if there are any new channels).

Test newfile

Function name `test_newfile(this, newfile)`

Description Test whether the output is written to a newfile or to the input file.

Tests

1. Generate data with

   `distance 500`

   `aspect_used 16:9`

   `aspect_actual 4:3`

   `screen_size 20`

   `eyes 'lr'`

2. Set options with

   (a) `overwrite = 1`

   (b) if `newfile` enabled

      i. search for new file name

      ii. set options.newfile to new file name

   (c) if `newfile` is disabled, set `options.newfile` to `''`

3. Test if function runs through without warning
4. Test if `sts==1`
5. Test if returned outputfile equals the specified newfile or not (depending on the value of `'newfile'`)

Test gaze validation

Function name `test_gaze_validation(this, distance, screen_size, aspect_actual, aspect_used, eyes)`

Description Test whether gaze validation is done correctly.

Tests

1. Generate data with the according function parameters
2. Iterate to returned degree values generated by the generation function
   (a) set function options
      i. overewrite = 1
      ii. validate_fixation =1
      iii. screen_settings and distance to function call settings
      iv. missing = 1
   (b) depending on the specified degree, test whether function runs through without warnings or not
   (c) load outputfile and test if (according to degree expectation) gaze validation has been done or not

Test bitmap validtion

Function name `test_bitmap_validation(this, distance, resolution, eyes)`

Description Test whether bitmap validation is done correctly.

Tests

1. Generate data with the according function parameters
2. Iterate to returned bitmaps generated by the generation function
   (a) Set function options
   `missing 1`
   (b) Depending on the specified number of valid fixations in the bitmap, test whether function runs through without warnings or not.
   (c) Load outputfile and test if (according to bitmap expectation) bitmap validation has been done or not.

4.11 pspm_get_ecg

4.11.1 Overview

Testclass `pspm_get_ecg_test`

Function `[sts, data] = pspm_get_ecg(import)`

4.11.2 Testcases

Test

Function name `test(this).`

Description Test if all fields are returned correctly.

Tests

1. Test if `sts==1`.
2. Test if `data.data` is equal to `import.data`.
3. Test if `data.header.chantype` is `'ecg'`.
4. Test if `data.header.units` is equal to `import.units`.
5. Test if `data.header.sr` is equal to `import.sr`.

4.12 pspm_get_events

4.12.1 Overview

Testclass `pspm_get_events_test`

Function `[sts, import] = pspm_get_events(import)`

4.12.2 Testcases

Check warnings

Function name `check_warnings(this)`

Description Checks for warnings, if the field `'.markers'` is missing or contains invalid content.

Tests

Input	Expected warning
`Missing marker field`	`ID:nonexistent_field`
`import.marker = 'foo'`	`ID:invalid_field_content`

Timestamps

Function name `timestamps(this)`

Description Checks for correct output if the input is timestamp data.

Tests

1. Test if `sts==1`.
2. Test if the length of the output data is equal to the length of the input data.

Continuous

Function name `continuous(this)`

Description Checks for correct output if the input is continuous data.

Tests

1. Perform three tests with different settings

   Tests:

   (a) Test if `sts==1`.

   (b) Test if the length of the field `'markerinfo'` is equal to the length of the output data.

   (c) Test if the length of the output data is equal to the expected number of pulses in the input data.

   Settings

   (a) `flank='both'` (default)

   (b) `flank='both'` & `data offset=50`

   (c) `flank='ascending'`

   (d) `flank='descending'`

   (e) inverted input signal

(f) signal with angular flanks

(g) check with

2. Additional test for setting (b): Test if `data offset` has been removed in the output data.
3. Additional test for setting (c) and (d): Test if positions returned by output data correspond to flank changes in the input data.
4. Test if markerinfo is not set if it has been set before.

4.13 pspm_get_eyelink

4.13.1 Overview

Testclass `pspm_get_eyelink_test`

Function `[sts, data] = pspm_get_eyelink(import)`

4.13.2 Methods

Set import values

Function `[import_struct, channel typles] = set_import_values(this)`

Description Helperfunction, which creates an import data set and the expected channel data set

Verify basic data structure

Function name `verify_basic_data_structure(this, data, sourceinfo, channel_types)`

Description Tests if the returned data structure is valid and match a given expected pattern.

Tests

1. Test if all channels are numeric
2. Test if recorded time and date have a valid format
3. Test if `blink channels` have correct unit

4. Test if `pupil channels` have either ‘`diameter`’ or ‘`area`’ as unit
5. Test if channels labeled with ‘`position`’ have unit ‘`pixel`’
6. Test if channels labeled with ‘`blink`’ have unit ‘`blink`’

4.13.3 Testcases

test_multi_session

Function name `test_multi_session(this)`

Description Test if the returned data structure fits into the pattern of a multi session data set.

Tests

1. Calls ‘`set_import_values(this)`’ to get import data set and expected channel data set.
2. passses returned sets to ‘`verify_basic_data_structure()`’.

test_two_eyes

Function name `test_two_eyes(this)`

Description Test if the returned data structure fits into the pattern of a two eyes data set.

Tests

1. Calls ‘`set_import_values(this)`’ to get import data set and expected channel data set.
2. Passes returned sets to ‘`verify_basic_data_structure()`’.

test_one_eye

Function name `test_one_eye(this)`

Description Test if the returned data structure fits into the pattern of a one eye data set.

Tests

1. Create an import data set and the expected channel data set an pass it to ‘`verify_basic_data_structure()`’.

test_track_dist

Function name test_track_dist(this)

Description Test if the returned data structure fits into the pattern of a two eyes data with `eyelink_trackdist` set.

Tests

1. Call ‘`set_import_values(this)`’ to get import data set and expected channel data set.
2. Overwrite some import data and channel data.
3. Pass returned sets to ‘`verify_basic_data_structure()`’.

4.14 pspm_get_hb

4.14.1 Overview

Testclass `pspm_get_hb_test`

Format `[sts, data] = pspm_get_hb(import)`

4.14.2 Testcases

Test

Function name `test(this)`

Description Test if all fields are returned correctly.

Tests

1. Test if `sts==1`.
2. Test if `data.data` is equal `import.data`
3. Test if `data.header.chantype` is `'hb'`
4. Test if `data.header.units` is `'events'`
5. Test if `data.header.sr==1`

4.15 pspm_get_hr

4.15.1 Overview

Testclass `pspm_get_hr_test`

Function `[sts, data] = pspm_get_hr(import)`

4.15.2 Testcases

Test

Function name `test(this)`

Description Test if all fields are returned correctly.

Tests

1. Test if `sts==1`.
2. Test if `data.data` is equal `import.data`
3. Test if `data.header.chantype` is `'hr'`
4. Test if `data.header.units` is equal `import.units`
5. Test if `data.header.sr` is equal `import.sr`

4.16 pspm_get_marker

4.16.1 Overview

Testclass `pspm_get_marker_test`

Function `[sts, data] = pspm_get_marker(import)`

4.16.2 Testcases

Test

Function name `test(this)`

Description Test if all fields are returned correctly.

Tests

1. Test if `sts==1`.
2. Test if `data.data` is equal to `import.data`.
3. Test if `data.header.chantype` is `'marker'`.
4. Test if `data.header.units` is `'events'`.
5. Test if `data.header.sr==1`.

4.17 pspm_get_pupil

4.17.1 Overview

Testclass `pspm_get_pupil_test`

Function `[sts, data] = pspm_get_pupil(import)`

4.17.2 Testcases

Test

Function name `test(this)`

Description Test if all fields are returned correctly

Tests

1. Test if `sts==1`.
2. Test if `data.data` is equal `import.data`
3. Test if `data.header.chantype` is `'pupil'`
4. Test if `data.header.units` is equal to `import.units`
5. Test if `data.header.sr` is equal `import.sr`

4.18 pspm_get_resp

4.18.1 Overview

Testclass `pspm_get_resp_test`

Function `[sts, data] = pspm_get_resp(import)`

4.18.2 Testcases

Test

Function name `test(this)`

Description `Test if all fields are returned correctly`

Tests

1. Test if `sts==1`
2. Test if `data.data` is equal `import.data`
3. Test if `data.header.chantype` is `'resp'`
4. Test if `data.header.units` is equal `import.units`
5. Test if `data.header.sr` is equal `import.sr`

4.19 pspm_get_scr

4.19.1 Overview

Testclass `pspm_get_scr_test`

Function `[sts, data] = pspm_get_scr(import)`

4.19.2 Testcases

There are three test functions. One for the case that no transfer parameters are defined, one for the case that the transfer parameters are defined in a struct and one for the case that they are defined in a .mat file. They are all performing the following tests, plus eventually some individual tests.

Tests

1. Test if `sts==1`
2. Test if the field `data.data` exists
3. Test if the field `data.data` is not empty
4. Test if the field `data.header.units` exists
5. Test if the field `data.header.sr` exists
6. Test if the field `data.header.chantype` exists
7. Test if `data.header.sr` is equal to `import.sr`
8. Test if `data.header.chantype` is `'scr'`

No transfer parameters

Function name `no_transferparams(testCase)`

Description Test if all fields are returned correctly, if no transfer parameters are defined.

Additional Tests No additional tests

Struct transfer parameters

Function name `stuct_transferparams(testCase)`

Description Test if all fields are returned correctly, if the transfer parameters are defined in a struct.

Additional Tests

1. Check for warning if the conversion constant `(import.transfer.c)` is not defined
2. Checks that there are no warnings if `import.transfer.Rs` or `import.transfer.offset` is not defined.

File transfer parameters

Function name `file_transferparams(testCase)`

Description Test if all fields are returned correctly, if the transfer parameters are defined in a `.mat` file.

Additional Tests

1. Check for warning if the transfer parameter file doesn't exist.

4.20 pspm_get_timing

4.20.1 Overview

Testclass `pspm_get_timing_test`

Functions

- `[sts, multi] = pspm_get_timing('onsets', intiming, timeunits)`
- `[sts, events] = pspm_get_timing('markervalues', markerinfo, names)`
- `[sts, epochs] = pspm_get_timing('epochs', epochs)`
- `[sts, events] = pspm_get_timing('events', events)`

4.20.2 Testcases

Invalid input arguments

Function name `invalid_inputargs(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_get_timing('epochs') [missing input var]	ID:invalid_input
pspm_get_timing('onsets', 'str') [no timeunits var]	ID:invalid_input
pspm_get_timing('foo') [unknown format]	ID:invalid_input
pspm_get_timing('onsets', intiming, 'samples') [two sessions with nonmatching number of conditions]	ID:number_of_elements_dont_match
pspm_get_timing('onsets', intiming, 'samples') [two sessions with nonmatching condition names]	ID:event_names_dont_match
pspm_get_timing('onsets', intiming, 'samples') [intiming.onsets{1} is no numeric vector]	ID:no_numeric_vector
pspm_get_timing('epochs', fn_mat, 'samples') [epochs is not an integer array]	ID:no_integers
pspm_get_timing('markervalues', markerinfo) [no markervalue and no name]	ID:invalid_input
pspm_get_timing('markervalues', markerinfo, markervalue, names) [markervalue is not of numeric type nor a cell array]	ID:invalid_input
pspm_get_timing('markervalues', markerinfo, markervalue, names) [markervalue and names are not of the same length]	ID:invalid_input

Case Epochs

Function name `case_epochs(this)`

Description Checks the function in 'epochs' mode.

Function `[sts, epochs] = pspm_get_timing('epochs', epochs)`

Test 1 (matfile input)

Input `mat` file with variable: `epochs = [1 4; 2 5; 3 6]`
Check if `sts==1` and if the return value is equal the input array.

Test 2 (spm input)

Input `mat` file with variable: `onsets{1} = [1 2 3]'; onsets{2} = [4 5 6]';`
Check if `sts==1` and if the return value is equal `[onsets{1}, onsets{2}]`.

Test 3 (textfile input)

Input textfile with variable: `epochs = [1 4; 2 5; 3 6]`
Check if `sts==1` and if the return value is equal the input array.

Test 4 (matrix input)

Input matrix: `epochs = [1 4; 2 5; 3 6]`
Check if `sts==1` and if the return value is equal the input array.

Case onsets

Function name `case_onsets(this)`

Description Checks the function in '`onsets`' mode.

Function `[sts, multi] = pspm_get_timing('onsets', intiming, timeunits)`

Test 1

Input A `.mat` file with the following variables

- `names = {'name1', 'name2'};`
- `onsets = {[1 2], [3 4]};`
- `pmod.name = {'name3', 'name4'};`
- `pmod.param = {[2 3], [4 5]};`
- `pmod.poly = {2, 2};`
- `save(fn_mat, 'names', 'onsets', 'pmod');`

Function call `[sts, outtiming] = pspm_get_timing('onsets', fn_mat, 'samples');`

Tests Check if `sts==1`, if onsets and names are unchanged and if `outtiming.pmod.param == {[2 3], [4 9], [4 5], [16 25]}`

Test 2

Input A `.mat` file with the variables

- `names = {'name1', 'name2'};`
- `onsets = {[1 2 3], [3 4 5]}; durations = {[3 4 5]', [5 6 7]'};`
- `pmod.name = {'name3', 'name4'};`
- `pmod.param = {[2 3 4], [4 5 6]};`
- `pmod.poly = {2, 1};`

Function call `[sts, outtiming] = pspm_get_timing('onsets', fn_mat, 'samples');`

Tests Check if `sts==1`, if onsets, names and durations are unchanged and if `outtiming.pmod.param == {[2 3 4], [4 9 16], [4 5 6]}`.

Case events

Function name `case_events(this)`

Description Checks the function in `'events'` mode.

Function `[sts, epochs] = pspm_get_timing('events', events)`
Check the function if input is a one element cell array and a multiple element cell array.
Check for warnings (`ID:invalid_vector_size`) if elements have more than two columns and if not all elements have the same number of rows.

4.21 pspm_get_<datatype>

4.21.1 Overview

The datatype import functions are all tested in a similar way. The individual testclasses must inherit the class `'pspm_get_superclass'`, from which they inherit the main test function `'valid_datafile'`. They also have to

implement the property ‘fhandle’, which is a function handle to the specific import function.

The tests are performed with the sampledata files that are listed in the SampleDataMasterList.docx file (as at 18.11.2013).

Superclass pspm_get_superclass

Testclasses

- pspm_get_acq_test
- pspm_get_acqmat_test
- pspm_get_biograph_test
- pspm_get_biosemi_test
- pspm_get_biotrace_test
- pspm_get_brainvis_test
- pspm_get_edf
- pspm_get_labchartmat_ext_test
- pspm_get_labchartmat_in_test
- pspm_get_mat_test
- pspm_get_obs_test
- pspm_get_spike_test
- pspm_get_superclass
- pspm_get_txt_test
- pspm_get_vario_test
- pspm_get_eyelink_test

Function [sts, import, sourceinfo] = pspm_get_<datatype>(datafile, import)

4.21.2 Notes

4.21.3 Setup

Define testcases In this method the testcases are defined and the testdata is generated (if needed). Each testcase is a cell in the cellarray ‘testcases’. Each testcase has the following fields:

- .pth: the path to the samplefile
- .import: the input variable

For datatypes which support blocks there has to be an additional field:

- .numofblocks

4.21.4 Testcases

Valid datafile

Function name `valid_datafile(this)`

Description The main test function, for tests with valid inputdata. It tests all testcases equally.

Tests

1. Test if `sts==1`.
2. If the datatype supports blocks, test if the number of blocks is correct.
3. Test if number of elements of the returned `'import'` variable is correct.
4. Test if each importjob has a field `'data'`, that is a numeric vector.
5. Test if each importjob has a field `'sr'`, that is a number.
6. Test if each importjob has a field `'type'`.
7. Test if all event importjobs have a field `'marker'`.
8. Test if all importjobs have duration below `1h`.
9. Test if all importjobs have a samplerate between `1` and `10000` for continuous channels or between `10^-6` and `1` for timestamp channels.

Invalid datafile

Function name `invalid_datafile(this)`

Description The main test function, for tests with invalid inputdata.

Tests If the datatype supports multiple channels: Check for warning when trying to import a channel, that is not contained in the file (`'ID:channel_not_contained_in_file'`).

4.22 pspm_get_acq

In this section we describe the testcases specific to `pspm_get_acq` apart from generic `pspm_get` tests.

4.22.1 Overview

Testclass `pspm_get_acq_test`

Function `[tss, import, sourceinfo] = pspm_get_acq(datafile, import)`

4.22.2 Testcases

get_acq should return the exact same data as Acqknowledge exported mat file

Function `get_acq_returns_same_data_as_acqknowledge_exported_mat(this)`

Description The data obtained by using `pspm_get_acq` should be identical with the data obtained by using export `.mat` file functionality in Acqknowledge software.

Steps

1. Load data stored in `ImportTestData/acq/impedance_acq.acq` and `ImportTestData/acq/impedance_m` separately.
2. Compare the first channel of `impedance_mat` with the first channel of data obtained by calling `pspm_get_acq` on `impedance_acq`.

4.23 pspm_glm

4.23.1 Overview

Testclass `pspm_glm_test`

Function `glm = pspm_glm(model, options)`
There are seven testcase functions. One invalid input arguments test and test 1 to 6. Tests 1 to 5 are of the same kind. There are one or multiple testcases per test function, have a look at the testcase description for more information. In these tests only Kronecker delta functions are used as basis functions, furthermore all conditions, pmods and nuisance regressors are pairwise orthogonal. The data is also not down sampled and not filtered. With these limitations it's easy to calculate the data vectors and the expected stats. For each testcase it is then tested:

- If `numel(glm.names)` has the expected value.
- If `numel(glm.stats)` has the expected value.
- If `glm.stats` has the expected value (with a tolerance of `1%`).

In test 6 the default basis functions are used, and not all conditions and pmods are orthogonal. The data is down sampled and low and high pass filtered. In exchange the stats are not tested for correct values, just for the correct number of elements. The properties '`shiftbf`' and '`norm`'

are TestParameters, which means that this testclass is parameterised. All functions implmementing these parameters (Test 1 to Test 5) are called several times with all the different values and combinations of the mentioned parameters.

4.23.2 Testcases

Invalid input arguments

Function name `invalid_input (this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_glm(model) [no timeunits field]	ID:invalid_input
pspm_glm(model) [no timeunits var]	ID:invalid_input
pspm_glm(model) with model.timeunits = 'foo' [no valid timeunits field]	ID:invalid_input
pspm_glm(model) with model.timing = zeros(10,2) [no valid timing field]	ID:invalid_input
pspm_glm(model) with model.modality = 'foo' [no valid modality field]	ID:invalid_input
pspm_glm(model) with model.channel = 'scr' [no valid channel field]	ID:invalid_input
pspm_glm(model) with model.norm = 'no' [no valid norm field]	ID:invalid_input
pspm_glm(model) with model.filt.down = 'none' [filt.down is not numeric]	ID:invalid_input
pspm_glm(model) with model.bf.fhandle = 'foohandle' [non existing bf]	ID:invalid_fhandle
pspm_glm(model) with numel(model.datafile) != numel(model.timing)	ID:number_of_elements_dont_match
pspm_glm(model) with model.missing is struct [non valid missing field]	ID:invalid_input
pspm_glm(model) with numel(model.datafile) != numel(model.missing)	ID:number_of_elements_dont_match
pspm_glm(model) with model.nuisance is struct [non valid nuisance field]	ID:invalid_input
pspm_glm(model) with numel(model.datafile) != numel(model.nuisance)	ID:number_of_elements_dont_match
pspm_glm(model) with no R variable in the nuisance file	ID:invalid_input
pspm_glm(model) with R variable in the nuisance file that has not the same length as the datafile	ID:number_of_elements_dont_match

Test 1

Format `test1(this, shiftbf)`

Description Basic test with one basis function, one session, no nuisance regressors, no missings and one condition. Timeunits are seconds.

Testcases

1. no pmods
2. one pmod
3. two pmods

Test 2

Format `test2(this, shiftbf)`

Description Test with one basis function, one session, no nuisance regressors, no missings and two conditions. Timeunits are seconds.

Testcases

1. no pmods
2. first condition: no pmods; second condition: one pmod
3. first condition: one pmod; second condition: two pmods

Test 3

Format test3(this, shiftbf)

Description Test with one basis function, one session, two nuisance regressors (1Hz cosinus, 1Hz sinus), no missings, one condition and no pmods. Timeunits are seconds.

Testcases Only one testcase.

Test 4

Format `test4(this, shiftbf)`

Description Test with one basis function, two sessions, no nuisance regressors, no missings and one condition.

Testcases

1. timeunits are seconds
2. timeunits are samples
3. timeunits are markers

Test 5

Format `test5(this, shiftbf)`

Description Test with two basis functions, one session, no nuisance regressors and one condition. Timeunits are seconds.

Testcases

1. no missings
2. with missings

Test 6

Format `test6(this)`

Description Test with default basis function and non-orthogonal conditions and pmods.

Testcase Default basis functions, no nuisance regressors, no missings, two sessions and two conditions. Timeunits are seconds.

- first condition: two pmods (with pmod(1).poly{1} = 2 and pmod(1).poly{2} = 3)
- second condition: no pmods

Test 7

Format test_extract_missing(this, cutoff, nan_percent)

Description Test with one basis function, one session, no nuisance regressors, no missings and three conditions. Timeunits are seconds.

Testcases for all combinations of the test parameters `cutoff` and `nan_percent`.

- `glm` vector `stats_missing` has the appropriate length according to the number of conditions.
- percentages in `glm` vector `stats_missing` contains the expected value.
- `glm` vector `stats_exclude` has the appropriate length according to the number of conditions.
- `glm` vector `stats_exclude` contains the expected condistion which should be excluded.

4.24 pspm_hb2hp

4.24.1 Overview

Testclass `pspm_hb2hp_test`

Function `[sts, infos] = pspm_hb2hp(fn, sr, chan, options)`

4.24.2 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_hb2hp() [no input]	ID:invalid_input
pspm_hb2hp(2) [not a string filename]	ID:invalid_input
pspm_hb2hp('abc') [no sample rate]	ID:invalid_input
pspm_hb2hp('abc','abc') [not a string sample rate]	ID:invalid_input
pspm_hb2hp('abc',2,'abc') [not a numeric chanel]	ID:invalid_input
pspm_hb2hp(files{1},100) [call of pspm_load_data fails]	ID:invalid_input
pspm_hb2hp(files{2}, 100) [not enough points for interp1]	ID:too_strict_limits
pspm_hb2hp(files{3},100,[],options) [pspm_write_channel fails]	ID:invalid_input

4.25 pspm_import

4.25.1 Overview

Testclass `pspm_import_test`

Function `outfile = pspm_import(datafile, datatype, import, options)`

4.25.2 Testcases

Invalid input arguments

Function name `invalid_inputargs(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Test No.	Input	Expected warning
1	`pspm_import(datafile, datatype) [no import variable]`	`ID:invalid_input`
2	`pspm_import(datafile, datatype, 'foo') [no cell/struct import var.]`	`ID:invalid_input`
3	`pspm_import(datafile, 'foo', import) [invalid channeltype]`	`ID:invalid_channeltype`
4	`pspm_import(5, datatype, import) [no char filename]`	`ID:invalid_input`

Invalid import variable structure

Function name `invalid_import_struct(this)`

Description Checks for warnings, if the structure of the import variable is invalid.

Tests

Test No.	Input	Expected warning
1	Multiple channel, though not supported	ID:invalid_import_struct
2	Not allowed channeltype	ID:invalid_import_struct
3	No sr given, though autosr is not supported	ID:invalid_import_struct
4	Nonexistent file	ID:nonexistent_file

One datafile

Function name `one_datafile(this)`

Description Checks the function, if datafile is a string (import of one datafile) and all inputs are correct. The outfile is checked with the `pspm_load_data` function. The tests are performed with a spike samplefile and a labchart-mat_in samplefile (to check the handling of blocks).

Multiple datafiles

Function name `multiple_datafiles(this)`

Description Checks the function, if datafile is a cell array of strings (import of multiple datafiles) and all inputs are correct. The outfiles are tested with the `pspm_load_data` function.

4.26 pspm_interpolate

4.26.1 Overview

Testclass `pspm_interpolate_test`

Function `[sts, outdata] = pspm_interpolate(indata, options)`

4.26.2 Setup

This test class is parameterised. The test data is generated by the function itself and when needed, files will be written to `datafile<variable_nr>.mat`.

Test parameters These are parameters which define what kind of data should be passed to `pspm_interpolate` and which options should be set.

Amount	Specifies how many elements indata (for `pspm_interpolate`) should have.
Datatype	Specifies what type of data should be generated. `struct` a valid data struct will be generated `inline` a numeric vector will be generated `file` a valid scr file will be generated `all` all types will sequentially be generated until amount is reached
Chans	If datatype is not inline this specifies how many and which type of data channels the generated data should have. In a second field it also defines which of these channels should be interpolated (this will be passed later in options.channels).

Nan method	Specifies how `NaN` values will be put into the data.
	`start` range is `1+offset:<random number before the center>`
	`center` range is `<radnom number before the center>:<random number after the center>`
	`end` range is `<random number after the center>:end-offset`
	The offset is `1` if `'extrap'` is not defined. This is needed because if there is no data at the end or beginning of the data, the function is unable to interpolate (unless extrapolation is activated).

Extrap	Is either true or false and activates or deactivates the extrapolation.
Interp method	Specifies the interpolation method.
Newfile	True or false and tells the function to either create a file or add the data as new channel.
Overwrite	True or false and tells the function to either overwrite an existing file or not.
Replace channel	True or false and tells the function to either replace the given channels with the interpolated data or to add the interpolated data as new channel.

4.26.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Test No.	Input	Expected warning
1	pspm_interpolate() [no arguments]	ID:missing_data
2	pspm_interpolate({{}}) [data is not char, struct, numeric]	ID:invalid_input
3	pspm_interpolate({}) [data empty]	ID:missing_data
4	pspm_interpolate(struct()) [invalid struct]	ID:invalid_data_structure
5	pspm_interpolate(invalid_data) [file which does not exist]	ID:nonexistent_file
6	pspm_interpolate(valid_data, options) [options.channels is larger than valid_data]	ID:invalid_input
7	pspm_interpolate(valid_data, options) [options.channels is not numeric]	ID:invalid_input
8	pspm_interpolate(valid_data, options) [options.method is invalid]	ID:invalid_input
9	pspm_interpolate(valid_data, options) [options.newfile is invalid]	ID:invalid_input
10	pspm_interpolate(valid_data, options) [options.extrapolate is invalid]	ID:invalid_input
11	pspm_interpolate(valid_data, options) [options.overwrite is invalid]	ID:invalid_input
12	pspm_interpolate(valid_data, options) [options.replace_channels is invalid]	ID:invalid_input
13	pspm_interpolate(invalid_data, options) [try to interpolate an events channel]	ID:invalid_channeltype
14	pspm_interpolate(invalid_data) [try to interpolate with nan from beginning and without extrapolation]	ID:option_disabled
15	pspm_interpolate(invalid_data, options) [try to interpolate with nan from beginning and with extrapolation]	ID:out_of_range
16	pspm_interpolate(invalid_data) [try to interpolate with nan from end and without extrapolation]	ID:option_disabled
17	pspm_interpolate(invalid_data, options) [try to interpolate with nan from end and with extrapolation]	ID:out_of_range

Test datatypes

Function name `test_datatypes(this, datatype, amount, chans)`

Description Tries to interpolate with different datatypes, amount of data, channels.

Steps

1. Generate data with datatype, amount, 'center', chans, false
2. Test if function issues no warnings
3. Test if `sts==1`
4. Test if size of outdata equals the size of the data
5. Test if channels to be interpolated have no more `NaN`s
6. Test if channels not to be interpolated still contain `NaN`s

Test interpolation variations

Function name `test_interpolation_variations(this, interp_method, extrap, nan_method)`

Description Tries to interpolate with different interpolation methods while varying `options.extrapolate` and the `nan_method`.

Tests

1. Generate data with `'inline', 1, nan_method, {{'scr'}, []}, extrap`
2. Test if function issues no warnings
3. Test if `sts==1`
4. Test if size of outdata equals the size of the data
5. Test if data has no more `NaN`s

Special case When extrapolation is on and `nan_method` is `'start'` and `interp_method` is `'previous'` or nan_method is `'end'` and `interp_method` is `'next'`. This should issue a warning because this is not possible (e.g. interpolate with previous value when first `NaN` is at the beginning of the data set).

1. Generate data as above
2. Test if function issues a warning.

Test no nan

Function name `test_no_nan(this)`

Description Test whether function works even if there is nothing to interpolate.

Tests

1. Generate data struct() with `pspm_test_data_gen()`
2. Test if function issues no warnings
3. Test if `sts==1`
4. Test if size of outdata equals the size of data
5. Test if outdata equals data
6. Test if data has no `NaN`s

Test write

Function name `test_write(this, newfile)`

Description Vary the option newfile and test whether new file is created correctly or data is correctly added to a new channel.

Tests

1. Generate data with `'file'`, `2`, `'center'`, `{{'scr', 'scr', 'scr'}, [1,3]}`, `false`
2. Test if function issues no warnings
3. Test if `sts==1`
4. Test if size of `outdata` equals the size of `data`
5. Test if `outdata` does not equal `data`

New files only

1. Test if new file exists
2. Load old and new file and test if size of data is equal
3. Verify that interpolated channels in the new file are `NaN` free

Added to existing file only

1. Test if all returned values are numeric (new channel ids)
2. Verify that the added channels are `NaN` free
3. Test if added channels match the size of the original data channels

Test overwrite

Function name `test_overwrite(this, overwrite)`

Description Vary overwrite and test whether files are overwritten or not.

Tests

1. Generate data with `'file'`, `2`, `'center'`, `{{'scr', 'scr', 'scr'}, [1,2,3]}`, `false`
2. Create files with expected filenames
3. Test if function issues no warning
4. Test if `sts==1`
5. According to overwrite test if file has been overwritten or not

Test replace channel

Function name `test_replace_channel(this, replace_channels)`

Description Vary `replace_channel` and test wether channels are overwritten or not.

Tests

1. Generate data with `'file'`, `2`, `'center'`, `{{'scr', 'scr', 'scr'}, [1,2,3]}`, false
2. Test if function issues no warnings
3. Test if `sts==1`
4. Test if size of `outdata` equals the size of `data`
5. Test if `outdata` does not equal `data`
6. According to `replace_channel` test whether returned channel ids correspond to replaced channels or correspond to added channels.

4.26.4 Other methods

Generate data

Has all of the Test parameters as parameter implemented and accordingly generates the data. It calls put nan to insert NaN values into the data. The generated data is returned as data to the calling function. Also all return values are stored in the property testdata (for cleanup data).

Cleanup data

Sits in MethodTeardown and is called once the test class has finished all tests. It then removes all the datafiles which can be found in the property 'testdata'.

Verify NaN free

Helper function to verify whether the data is NaN free or not. It copes with two states. Either a channel should have been interpolated, then it shouldn't contain any NaN values or a channel should not have been interpolated, then the channel should still contain NaN values.

4.27 pspm_load1

4.27.1 Overview

Testclass `pspm_load1_test`

Function `[sts, data, mdltype] = pspm_load1(fn, action, savedata, options)`

4.27.2 Setup

The datafile `fn` is referring to a datafile which was generated with `pspm_load1_test.generate_testdata(1`
The function is part of the test object and generates models for all of the available model types (defined in `settings.first`). The models are created with data generated with `pspm_testdata_gen`. Two files belong to each model: `model_<modeltype><variable nr.>.mat (fn)` and `dummy_<modeltype><variable_nr>.mat (dfn)`. The model file on the one hand is the actual model file while on the other hand, the dummy file is a copy of the model file, used by the test to manipulate the test data.

Generated aquisition data (pspm_testdata_gen) `data{1}.chantype = 'scr';`
`data{2}.chantype = 'hb';`
The duration of the channels is `100s`.

Generated GLM model `model.timing{1}.names = {'a';'b';'c'};`
`model.timing{1}.onsets = {[10, 20, 30], [15, 25, 35], [18, 28, 38]};`

Generated DCM & SF model `model.timing{1} = [10,20; 23,38; 40,70;];`
`model.condition{1}.name = {'a';'b'};`
`model.condition{1}.index = [1;2];`

4.27.3 Testcases

Invalid model structure (general)

Function `invalid_model_tructure_general(this)`

Description Tries to pass invalid data structures, and tests for certain warnings. Applys to all available modeltypes.

Tests

Input	Expected warning
empty model file	`ID:invalid_data_structure`
missing field ‘`modelfile`’	`ID:invalid_data_structure`
missing field ‘`modeltype`’	`ID:invalid_data_structure`
missing field ‘`modality`’	`ID:invalid_data_structure`
missing field ‘`stats`’	`ID:invalid_data_structure`
missing field ‘`names`’	`ID:invalid_data_structure`

Invalid model structure (specific)

Function `invalid_model_structure_general(this)`

Description Tries to pass invalid data structures, and tests for certain warnings. Model specific.

Tests for GLM

Input	Expected warning
field ‘`stats`’ is not an `n x 1` vector	`ID:invalid_data_structure`
unequal amount of numbers and parameters in field ‘`stats`’	`ID:invalid_data_structure`
`options.zscored = 1 & action = ‘cond’`	`ID:invalid_input`

Tests for DCM & SF

Input	Expected warning
unequal size for fields in ‘`trlnames`’ and rows in ‘`stats`’	`ID:invalid_data_structure`
missing field ‘`trlnames`’	`ID:invalid_data_structure`
unequal size for fields in ‘`names`’ and columns in ‘`stats`’	`ID:invalid_data_structure`
`action = ‘recon’`	`ID:invalid_input`

Tests for DCM

Input	Expected warning
`options.zscored = 1 & pspm_load1(dfn, ‘none’, {}, options)`	`ID:invalid_input`
`options.zscored = 1 & pspm_load1(dfn, ‘cond’, {}, options)`	-
`options.zscored = 1 & pspm_load1(dfn, ‘stats’, {}, options)`	-

Tests for GLM & SF

Input	Expected warning
`options.zscored = 1 & pspm_load1(dfn, ‘cond’, {}, options)`	`ID:invalid_input`

Action ‘none’

Function `test_action_none(this)`

Description Test for all modeltypes if action ‘`none`’ matches the expected behaviour.

Tests

1. Basic function test
2. Test if returned data is empty.

Action ‘stats’

Function `test_action_stats(this)`

Description Test for all modeltypes if action ‘`stats`’ matches the expected behaviour.

Tests for all

1. Basic function test
2. Returned data contains field ‘`stats`’
3. Returned data contains field ‘`names`’

Tests for DCM & SF

1. Returned data contains field ‘`trlnames`’
2. Returned data contains field ‘`condnames`’

Action ‘cond’

Function `test_action_cond(this)`

Description Test for all modeltypes if action ‘`cond`’ matches the expected behaviour.

Tests for all

1. Basic function test
2. Returned data contains field ‘stats’
3. Returned data contains field ‘names’

Tests for DCM & SF

1. Returned data contains field ‘trlnames’
2. Returned data contains field ‘condnames’

Action ‘recon’

Function `test_action_recon(this)`

Description Test for all modeltypes if action ‘recon’ matches the expected behaviour.

Tests for GLM

1. Basic function test
2. Returned data contains field ‘stats’
3. Returned data contains field ‘names’

Tests for `DCM & SF` already done in specific structure test.

Action ‘savecon’

Function `test_action_savecon(this)`

Description Test for all modeltypes if action ‘savecon’ matches the expected behaviour. Generates a number, passes it within the ‘savecon’ struct and tests if the number is returned correctly.

Tests

1. Basic function test
2. Returned data contains field ‘con’
3. Field ‘con’ contains field ‘test’
4. Field ‘con.test’ is equal to the randomly generated number

Action ‘con’

Function `test_action_con(this)`

Description Test for all modeltypes if action ‘con’ matches the expected behaviour. Tests if the in ‘savecon’ generated field test is still returned.

Tests

1. Basic function test
2. Returned data contains field `‘con’`
3. Field `‘con’` contains field `‘test’`.

Action ‘all’

Function `test_action_all(this)`

Description Test for all modeltypes if action `‘all’` matches the expected behaviour.

Tests

1. Basic function test
2. Returned data is not empty.

Action ‘save’

Function `test_action_save(this)`

Description Test for all modeltypes if action `‘save’` matches the expected behaviour. Test with `options.overwrite = 1`. Generates random number and writes it into field `‘test’` in model structure.

Tests

1. Basic function test
2. Model structure contains field `‘test’`
3. Field `‘test’` in model structure equals to the randomly generated number.

Options

Function `test_options(this)`

Description Test for all modeltypes if options passed with options structure cause the expected behaviour. Does also work with a randomly generated number in `<model struct>.test` to test whether the data is written or not.

Tests for all

1. `overwrite = 0` returns warning `ID:not_saving_data` and field `'test'` in model struct does not match generated number
2. `overwrite = 1` field `'test'` in returned model struct does match generated number

Tests for DCM with `overwrite = 1`

1. `zscored = 0 & action = 'stats'`
   (a) Basic function test
   (b) Returned `data.stats` is not zscored
2. `zscored = 1 & action = 'stats'`
   (a) Basic function test
   (b) Returned `data.stats` is zscored
3. `zscored = 0 & action = 'cond'`
   (a) Basic function test
   (b) Returned data is different when callng with `zscroed = 1 & action = 'cond'` (should not zscore, when not specified)

4.27.4 Other methods

Remove testdata Removes all the test data generated by the test class. It is called once the class is finished with testing.

Basic function test Is called in each test after the tested function has been called. It does two checks:

- Returned modeltype matches the modeltype stored in the returned model structure
- Returned status `sts==1`

4.28 pspm_load_data

Reviewed and updated by Teddy on 19 April 2022

4.28.1 Overview

Testclass `pspm_load_data_test`

Function `[sts, infos, data, filestruct] = pspm_load_data(fn, chan)`

4.28.2 Setup

If not otherwise declared, the input variable fn is referring to a datafile which was generated with `pspm_testdata_gen` and consists out of the following channels:

```
data{1}.chantype 'scr';
data{2}.chantype 'marker';
data{3}.chantype 'hr';
data{4}.chantype 'hb';
data{5}.chantype 'marker';
data{6}.chantype 'resp';
data{7}.chantype 'scr';
```

The duration of the channels is `10s`.

4.28.3 Testcases

Invalid input arguments

Function name `invalid_inputargs(testCase)`

Description Checks for warnings, if the input arguments are invalid.

Tests

#	Issue	Input	Expected warning
1	No filename	/	`ID:invalid_input`
2	No char filename	`1`	`ID:invalid_input`
3	Negative channel number	`fn, -1`	`ID:invalid_input`
4	No allowed ch type	`fn, 'foobar'`	`ID:invalid_input`
5	Missing field in foo struct	`fn, foo`	`ID:invalid_input`
6	Invalid channel option	`fn, {1}`	`ID:invalid_input`
7	Struct has no infos field	`struct`	`ID:invalid_input`
8	Nonexisting channel	`fn, 250`	`ID:invalid_input`

Invalid datafile

Format `invalid_datafile(testCase)`

Description Checks for warnings, if the datafile is invalid.

Tests

#	Issue	Input	Expected w
1	non-existent datafile		`ID:nonexist`
2	missing 'infos' variable		`ID:invalid_dat`
3	missing 'data' variable		`ID:invalid_dat`
4	missing 'data' field in 'data{2}'		`ID:invalid_dat`
5	missing 'header' field 'data{3}'		`ID:invalid_dat`
6	missing 'sr' field in 'data{7}.header'		`ID:invalid_dat`
7	data{4} is a nx2 vector (instead of a nx1 vector)		`ID:invalid_dat`
8	the length of data{1}.data is incompatible with the duration		`ID:invalid_dat`
9	An entry of data{2}.data is larger than 'duration'		`ID:invalid_dat`
10	data{5} has an non-existent chantype ('scanner')		`ID:invalid_dat`
11	duplicates (9) with struct chan input		`ID:invalid_dat`

Return all channels

Function name `valid_datafile_0(testCase)`

Description Checks the function, if all channels shall be returned (`chan = 0`).

Return all channels (struct input)

Function name `valid_datafile_1(testCase)`

Description Checks the function, if all channels shall be returned (`chan = 0`) and the input is a struct.

Return one channel

Function name `valid_datafile_2(testCase)`

Description Checks the function, if only one channel shall be returned (`chan = 2`).

Return multiple channels

Function name `valid_datafile_3(testCase)`

Description Checks the function, if multiple channels shall be returned (`chan = [3 5]`).

Return scr channels

Function name `valid_datafile_4(testCase)`

Description Checks the function, if only the scr channels shall be returned.

Return event channels

Function name `valid_datafile_5(testCase)`

Description Checks the function, if only the event channels shall be returned.

Save data

Function name `valid_datafile_6(testCase)`

Description Checks the function, if data is to be saved (`chan struct`).

4.29 pspm_pp

4.29.1 Overview

Testclass `pspm_pp_test`

Format `newfile = pspm_pp('median', datafile, n, channelnumber)`
or `newfile = pspm_pp('butter', datafile, freq, channelnumber)`

4.29.2 Testcases

Invalid input

Format `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

#	Issue	Parameters of the function	Expected warning
1	No frequency	`'butter', 'file'`	`ID:invalid_input`
2	No valid first argument	`'foo', 'file', 100`	`ID:invalid_input`
3	Freq below `20`	`'butter', 'file', 19`	`ID:invalid_input`

Median test

Function name `median_test(this)`

Description Checks medianfilter functionality

Setup Testfile with `3` channels (`scr`, `hb`, `scr`).

Tests

1. Filter one channel `[Input: newfile = pspm_pp('median', testfile, 50, 3)]`
   i. Check if `sts == 1`, when data is loaded with `pspm_load_data`.
   ii. Check if newfile has the same number of channels as testfile

2. Filter multiple channel [Input: newfile = pspm_pp('median', testfile, 50)]
   i. Check if sts == 1, when data is loaded with pspm_load_data.
   ii. Check if newfile has the same number of channels as testfile

Butterworth filter test

Function name butter_test(this)

Description Checks Butterworth filter functionality

Setup Testfile with 3 channels (scr, hb, scr).

Tests

1. Filter one channel [Input: newfile = pspm_pp('butter', testfile, 40, 3)]
   i. Check if sts == 1, when data is loaded with pspm_load_data.
   ii. Check if newfile has the same number of channels as testfile
2. Filter multiple channel [Input: newfile = pspm_pp('butter', testfile, 40)]
   i. Check if sts == 1, when data is loaded with pspm_load_data.
   ii. Check if newfile has the same number of channels as testfile

4.30 pspm_prepdata

4.30.1 Overview

Testclass pspm_prepdata_test

Function [sts, outdata, newsr] = pspm_prepdata(data, filt)

4.30.2 Testcases

Invalid input

Function name invalid_input(this)

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_prepdata([1 NaN 3], filt) [NaN values in data]	ID:invalid_input
pspm_prepdata([1 2 3]) [no filt variable]	ID:invalid_input
pspm_prepdata(data, filt) [filt has no hporder field]	ID:invalid_input
pspm_prepdata('foo', filt) [no numeric data]	ID:invalid_input
pspm_prepdata(data, filt) [with lpfreq = 'foo' (not valid)]	ID:invalid_input

Hipassfilter test

Function name `hipassfilter_test(this)`

Description Checks hipassfilter functionality (without downsampling)

Setup

`data rand(1000,1)`

`filt.sr 100`

`filt.lpfreq 'none'`

`filt.lporder 1`

`filt.hpfreq 20`

`filt.hporder 1`

`filt.down 'none'`

Tests

1. Unidirectional tests `[filt.direction = 'uni']`
   i. Check if `sts == 1`
   ii. Check if `newsr == filt.sr`
   iii. Check if `outdata` is empty
   iv. Check if `length(outdata) == length(data)`
2. Unidirectional tests `[filt.direction = 'bi']`
   i. Check if `sts == 1`
   ii. Check if `newsr == filt.sr`
   iii. Check if `outdata` is empty
   iv. Check if `length(outdata) == length(data)`

Lowpassfilter test

Function name `lowpassfilter_test(this)`

Description Checks hipassfilter functionality (without downsampling)

Setup

```
data rand(1000,1)

filt.sr 100

filt.lpfreq 40

filt.lporder 1

filt.hpfreq 'none'

filt.hporder 1

filt.down 'none'
```

Tests Same tests as in `hipassfilter_test`. Additionally there is a check for a warning if `filt.lpfreq` is higher (or equal) than the nyquist frequency

Input	Expected warning
`pspm_prepdata(data, filt) [filt.sr = 100; filt.lpfreq = 60]`	`ID:no_low_pass_filtering`

Bandpassfilter test

Function name `bandpassfilter_test(this)`

Description Checks bandpassfilter functionality (without downsampling).

Setup

```
data rand(1000,1)

filt.sr 200

filt.lpfreq 99

filt.lporder 1

filt.hpfreq 20
```

`filt.hporder 1`

`filt.down 'none'`

Tests Same tests as in hipassfilter_test.

Integer samplerate ratio downsampling test

Function name int_sr_ratio_downsample_test(this)

Description Checks downsampling functionality, if the ratio between filt.sr and filt.down is an integer.

Setup

`ratio 2 % ratio between filt.sr and filt.down`

`filt.down 100`

`filt.sr ratio*filt.down`

`filt.lpfreq 40`

`filt.lporder 1`

`filt.hpfreq 'none'`

`filt.hporder 1`

`filt.direction 'uni'`

and `data = rand(filt.sr * 10,1)`.

Tests

1. Check if `sts == 1`
2. Check if `newsr == filt.down`
3. Check if `outdata` is empty
4. Check if `ratio*length(outdata) == length(data)`

4.31 pspm_process_illuminance

4.31.1 Overview

Testclass `pspm_process_illuminance_test`

Function `[sts, out] = pspm_process_illuminance(ldata, sr, options)`

4.31.2 Setup

This test class is parameterised. The test data is generated by the function itself and when needed, files will be written to `datafile<variable_nr>.mat`.

Test parameters These are parameters which define what kind of data should be passed to `pspm_process_illuminance` and which options should be set.

`bf_dur` Defines the duration of the basis function.

`bf_offset` Defines the offset of the basis function.

`dur` Defines the duration of the generated dataset.

`sr` Defines the samplerate of the generated dataset.

`n_times` Defines how many datasets should be generated.

`mode` Defines the whether the dataset should be written to a file, kept as inline variable or should be a mix of both. Can be either `'file'`, `'inline'` or `'mixed'`.

`overwrite` Defines whether existing files should be overwritten or not.

4.31.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Test No.	Input	Expected warning
1	pspm_process_illuminance() [no arguments]	ID:invalid_input
2	pspm_process_illuminance([]) [empty data]	ID:missing_data
3	pspm_process_illuminance(1:10) [missing samplerate]	ID:invalid_input
4	pspm_process_illuminance(1:10, 'a') [invalid ssamplerate]	ID:invalid_input
5	pspm_process_illuminance({1:10}, 1) [cell, no cell]	ID:invalid_input
6	pspm_process_illuminance(1:10, {1}) [no cell, cell]	ID:invalid_input
7	pspm_process_illuminance({1:10, 10:10}, {1}) [different sized cells]	ID:invalid_input
8	pspm_process_illuminance({1:10, 'a'},{1,2}) [invalid file]	ID:non_existent_file
9	pspm_process_illuminance({1:10, 1:10}, {1, 'a'}) [invalid samplerate]	ID:invalid_input
10	pspm_process_illuminance({1:10}, {1}, 'o') [wrong options]	ID:invalid_input
11	pspm_process_illuminance({1:10}, {1}, opt)[wrong transfer settings]	ID:invalid_input
12	pspm_process_illuminance({1:10}, {1}, opt)[wrong duration]	ID:invalid_input
13	pspm_process_illuminance({1:10}, {1}, opt)[wrong offset]	ID:invalid_input
14	pspm_process_illuminance({1:10}, {1}, opt)[wrong outputfile]	ID:invalid_input
15	pspm_process_illuminance({1:10}, {1}, opt)[format of ldata and opt.fn differs]	ID:invalid_input
16	pspm_process_illuminance({1:10}, {1}, opt)[opt.overwrite is not boolean]	ID:invalid_input

Test options

Function name `test_options(this, sr, dur, bf_dur, bf_offset)`

Description Tries out different combination options to process the generated illuminance data.

Tests

1. Generate data with `sr` and `dur`
2. Set options according to `bf_dur` and `bf_offset`
3. Set expected warning according to `sr*dur` and `sr*bf_dur`
   (a) expect empty data if `sr*dur < 1`
   (b) expect invalid_input if `sr*bf_dur < 1`
   (c) otherwise expect no warning
4. Test if issued warning equals expected warning
5. Test if `sts` equals expected value
6. Test if amount of data elements of input and output data is equal

Test multi

Function name `test_multi(this, n_times, mode)`

Description Generates n sets of illuminance data and passes it to `pspm_process_illuminance`.

Steps

1. Generate data with `10` (`sr`), 100 (`dur`), `n_times` (`amount`), mode
2. Test if `pspm_process_illuminance` issues no warning
3. Test if `sts==1`
4. For `n_times == 1`, test if out has `10×100` data points
5. For `n_times ~= 1`, test if output has same size as input

Test overwrite

Function name `test_overwrite(this, overwrite)`

Description Generate illuminance file and test overwrite behaviour.

Tests

1. Generate data with `10` (`sr`), `100` (`dur`), `1` (`amount`), `'file'`
2. Test if `pspm_process_illuminance` issues no warning
3. Test if `sts==1`
4. Test if existing file was overwriten or not

4.31.4 Other methods

Generate lx Has some of the Test parameters as parameter implemented and accordingly generates the `lx` data. According to the calling arguments the output is a cell of files and data vectors. All generated files will be stored in the property `'datafiles'`. They will be removed once all tests have finished.

Cleanup Located in MethodTeardown and is called once the test class has finished all tests. It then removes all the datafiles which can be found in the property `'datafiles'`.

4.32 pspm_pulse_convert

4.32.1 Overview

Testclass `pspm_pulse_convert_test`

Function `wavedata = pspm_pulse_convert(pulsedata, resamplingrate, samplingrate)`

4.32.2 Testcases

Invalid input

Function name `invalid_input(testCase)`

Description Pass invalid input arguments and test if the error message is correct.

Tests

Input	Expected warning
`pspm_pulse_convert()`	`ID:invalid_input`
`pspm_pulse_convert(10^-3 * (1:10000)')`	`ID:invalid_input`
`pspm_pulse_convert(10^-3 * (1:10000)', 10000)`	`ID:invalid_input`

Valid input

Function name `valid_input(testCase)`

Description Pass generated, valid data and test if function issues no warning.

Steps

1. Test function without downsampling the data
2. Test function with downsampling the data

4.33 pspm_ren

4.33.1 Overview

Testclass `pspm_ren_test`

Function `out_newfilename = pspm_ren(filename, newfilename)`

4.33.2 Testcases

Invalid input

Function name `invalid_input (this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected
`pspm_ren('fn') [no newfilename]`	`ID:inval`
`pspm_ren({'fn1', 'fn2'}, {'rfn1', 'rfn2', 'rfn3'}) [non same size cell arrays]`	`ID:inval`

Char Valid Input

Function name `char_valid_input (this)`

Description Checks the function if the input variables are of type char. It uses `pspm_load_data` to check the files.

Steps

1. Check if `out_newefilename = newfilename`
2. Check if `sts==1` (of `pspm_load_data output`)
3. Check if the field '`infos.rendata`' exists
4. Check if the field '`infos.newname`' exists
5. Check if the original file has been deleted

Cell Valid Input

Function name `cell_valid_input (this)`

Description Checks the function if the input variables are of type cell. It uses `pspm_load_data` to check the files.

Tests The inputs are two-element cell arrays. For both elements the same tests as in the `char_valid_input` function are performed individually.

4.34 pspm_resp_pp

4.34.1 Overview

Testclass `pspm_resp_pp_test`

Function `sts = pspm_resp_pp(fn, sr, chan, options)`

4.34.2 Testcases

Regression Test against Revision r660

Function name `compare_results_to_results_obtained_from_r660_version(this)`

Description In r660, there was a bug found in `pspm_resp_pp` that caused it to crash with index out of bounds error on inputs containing some edge-case. This test specifically checks whether the fixed version returns the same results as the version before the bugfix on data that didn't cause a crash.

Tests

1. Check if the returned channel types have the same name and ordering
2. Check if the returned data is the same

4.35 pspm_scr_pp

4.35.1 Overview

Testclass `pspm_scr_pp_test`

Properties ...

Format ...

4.36 pspm_split_sessions

4.36.1 Overview

Testclass `pspm_split_sessions_test`

Properties `expected_number_of_files = 3`

Format `newdatafile = pspm_split_sessions(datafile, markerchannel, options)`

4.36.2 Setup

For the tests a testdatafile with three channels is used (duration is `100s`). The markerchannel data is
`data = [1 4 9 12 30 31 34 41 43 59 65 72 74 80 89 96]'.`
Hence if `MAXSN==10` and `BRK2NORM==3` (default values), the datafiles should be split into 3 files. If different values are being used, update the property `'expected_number_of_files'` of the testclass object accordingly.

4.36.3 Testcases

Invalid input

Function name `invalid_input (this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warn
`pspm_split_sessions() [no filename]`	`ID:invalid_in`
`pspm_split_sessions (2) [no string filename]`	`ID:invalid_in`
`pspm_split_sessions ('fn', 'foo') [no numeric marker channel no.]`	`ID:invalid_in`

One datafile

Function name `one_datafile(this)`

Description Checks the function if the variable `'datafile'` is of type char (one datafile). The markerchannel number is not assigned explicitly.

Steps

1. Check if the file has been split into `'expected_number_of_files'` files For each output file the following tests are performed:
2. Check if `sts == 1`, when data is loaded with `pspm_load_data`.
3. Check if number of channels is correct.
4. Check it the field `infos.slitdate` exists
5. Check if the field `infos.splitsn` exists
6. Check if the field `infos.splitfile` exists.

Multiple datafiles

Function name `multiple_datafiles(this)`

Description Checks the function if the variable `'datafile'` is of type cell (two datafiles). The markerchannel number is assigned explicitly.

Tests For both datafiles the same tests as in the `one_datafile` function are performed individually. Additionally it is tested if the number of input files does match the number of output files.

4.37 pspm_trim

Reviewed and updated by Teddy on 19 April 2022

4.37.1 Overview

Testclass `pspm_trim_test`

Function `newdatafile = pspm_trim(datafile, from, to, reference, options)`

4.37.2 Setup

If not otherwise declared, the input variable fn is referring to a datafile which was generated with `pspm_testdata_gen` and consists of the following channels

`data{1}.chantype 'scr'`

`data{2}.chantype 'marker'`

`data{3}.chantype 'hr'`

`data{4}.chantype 'hb'`

`data{5}.chantype 'marker'`

`data{6}.chantype 'resp'`

`data{7}.chantype 'scr'`

The duration of the data recording is `10s`.

4.37.3 Testcases

Invalid input arguments

Function name `invalid_inputargs(testCase)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_trim(testCase.fn, [1 2], 5, 'marker') [invalid from parameter]	ID:invalid_input
pspm_trim(testCase.fn, 0, 'bla', 'marker') [invalid to parameter]	ID:invalid_input
pspm_trim(testCase.fn, 0, '[]', 'marker') [invalid to parameter]	ID:invalid_input
pspm_trim(fn, 0, 5) [no reference]	ID:invalid_input
pspm_trim(fn, 0, 5, 6) [no char or 2-element numeric reference]	ID:invalid_input
pspm_trim(fn, 0, 5, 'bla') [invalid char reference]	ID:invalid_input
pspm_trim(fn, 0, 5, [-1 5]) [invalid numeric start reference]	ID:invalid_input
pspm_trim(fn, 0, 5, [5 4]) [invalid numeric start/end reference]	ID:invalid_input

Testing 'marker' as reference

- **Function name**
  - `marker_tests(testCase)`
- **Description**
  - A wrapper function for tests with `reference = 'marker'`. It executes the methods `markertest_k`, where the testcases are defined.

markertest_1

- **Description**
  - from and to are set so that the trimming points are out of the range `[0,duration]`. Hence the data should not be trimmed.
- **Expected warning**
  - `ID: marker_out_of_range`
- **Input**
  - `pspm_trim(fn, -20, 20, 'marker')`

markertest_2

- **Description**
  - from and to are set so that the trimming points are exactly `(0, duration)`. Hence the data should not be trimmed.
- **Input**
  - `from -1 * marker(1)`
  - `to duration - marker(end)`
  - then `pspm_trim(fn, from, to, 'marker')`

markertest_3

- **Description**
  - from and to are set so that the trimming points in the range [0,duration].
- **Input**
  - `pspm_trim(fn, 1, -2, 'marker')`

Testing 'file' as reference

- **Function name**
  - `file_tests(testCase)`
- **Description**
  - A wrapper function for tests with `reference = 'file'`. It executes the methods `filetest_k`, where the testcases are defined.

filetest_1

- **Description**
  - `from` and `to` are set so that the trimming points are out of the range `[0,duration]`. Hence the data should not be trimmed.
- **Expected warning**
  - `ID: marker_out_of_range`
- **Input**
  - `pspm_trim(fn, -12.5, 50, 'marker')`

filetest_2

- **Description**
  - `from` and `to` are set so that the trimming points are exactly `(0, duration)`. Hence the data should not be trimmed.
- **Input**
  - `pspm_trim(fn, 0 , duration, 'marker')`

filetest_3

- **Description**
  - `from` and `to` are set so that the trimming points in the range `[0, duration]`.
- **Input**
  - `pspm_trim(fn,2.1, duration - 2.5, 'marker')`

Numeric reference tests

- **Function name**
  - `num_tests(testCase)`
- **Description**
  - A wrapper function for tests with `reference = [a b]` (`a, b` are two integers with `a<b`). It executes the methods `markertest_k`, where the testcases are defined.

numtest_1

- **Description**
  - `from` and `to` are set so that the trimming points are out of the range `[0,duration]`. Hence the data should not be trimmed.
- **Expected warning**
  - `ID: marker_out_of_range`
- **Input**
  - `pspm_trim(fn, -20, 20, [2 14])`

numtest_2

- **Description**
  - `from` and `to` are set so that the trimming points are exactly `(0, duration)`. Hence the data should not be trimmed.
- **Input**
  - `from = -1 * marker(3)`
  - `to = duration - marker(8)`
  - then `pspm_trim(fn, from, to, [3 8])`

numtest_3

- **Description**
  - `from` and `to` are set so that the trimming points in the range `[0, duration]`.
- **Input**
  - `pspm_trim(fn, -1.5, 2, [2 7])`

numtest_4

- **Description**
  - Second reference point is out of the marker range; from is set to `'none'`. Hence the data should not be trimmed.
- **Expected warning**
  - `ID: marker_out_of_range`
- **Input**
  - `pspm_trim(fn, 'none', 0, [1 (numel(marker) + 1)])`

Multiple file reference tests

- **Function name**
  - `multiple_files(testCase)`
- **Description**
  - The input variable `datafile` is either a cell array of two filenames or a cell array of two stucts. In both cases it is tested whether the return value is also a cell array of two filenames and whether both files are trimmed correctly.

Option tests (marker channel number option)

- **Function name**
  - `marker_chan_num_option_test(testCase)`
- **Description**
  - Tests if the option `marker_chan_num` is working correctly. There are two tests:
    1. Checks for a warning if the selected channel is no marker channel.
    2. Checks if the selected channel is actually used.

4.38 pspm_write_channel

4.38.1 Overview

Testclass `pspm_write_channel_test`

Format `[sts] = pspm_write_channel(fn, newdata, action, options)`

4.38.2 Setup

Testdatafile The testdatafile is a class property. It is generated by the function `generate_testdatafile()` once the test class is setup. Changes made by a test to the testdatafile won't be reverted. Thus some test functions rely on the changes made by another test function. Therefore the functions may not work properly if called individually.

Structure Created with `generate_testdatafile()`.

```
data{1}.chantype 'scr';

data{2}.chantype 'marker';

data{3}.chantype 'scr';
```

The sampling rate is `100Hz` and the duration is `500s`.

4.38.3 Testcases

Invalid input

Function name `invalid_input(this)`

Description Checks for warnings, if the input arguments are invalid.

Tests

Input	Expected warning
pspm_write_channel() [no parameter]	ID:invalid_input
pspm_write_channel(1) [fn is a number]	ID:invalid_input
pspm_write_channel('some_file', []) [no action passed]	ID:unknown_action
pspm_write_channel('some_file', [], '') [empty action passed]	ID:unknown_action
options.channel = 'some invalid channel'pspm_write_channel('some_file', [], 'add', options) [invalid channel]	ID:invalid_input
options.channel = -1pspm_write_channel('some_file', [], 'add', options) [negative channel]	ID:invalid_input
options.channel = 0pspm_write_channel('some_file', [], 'delete', options) [no channel and no data given]	ID:invalid_input
options.channel = 0pspm_write_channel('some_file', [], 'add', options) [empty newdata]	ID:invalid_input
options.channel = 0pspm_write_channel('some_file', 1:3, 'add', options) [newdata is not cell and not struct]	ID:invalid_input
options.channel = 1:5pspm_write_channel(this.testdatafile, [], 'delete', options) [more given channels than in file exist]	ID:invalid_input
options.channel = 'ecg'; pspm_write_channel(this.testdatafile, [], 'delete', options)	ID:no_matching_channels
pspm_write_channel(this.testdatafile, gen_data.data{1}, 'add') [generated data has the wrong format (two rows in one channel)]	ID:invalid_data_structure

Action 'add'

Function name `test_add(this)`

Description Checks if action `'add'` behaves as expected. A new channel with `chantype = 'hb'`, `sr = 200` and `duration = 500` is generated.

Tests

1. Load condition before and after and pass it to `'Verify write'`

Action 'add transposed'

Function name `test_add_transposed(this)`

Description Checks if action `'add'` behaves as expected, when data has the wrong dimensions. A new channel with `chantype = 'rs'`, `sr = 200` and `duration = 500` is generated.

Tests

1. Transpose generated data
2. Load condition before and after and pass it to `'Verify write'`

Action 'replace'/'add'

Function name `test_replace_add(this)`

Description Checks if action `'replace'` behaves as expected. A new channel with `chantype = 'hr'`, `sr = 10` and `duration = 500` is generated.

Tests

1. Running `pspm_write_channel` with `action = 'replace'` should issue `'ID:no_matching_channels'` (channeltype should not exist before) and then instead add the channel
2. Load condition before and after and pass it to `'Verify write'`

Action 'replace'

Function name `test_replace(this)`

Description Checks if action `'replace'` behaves as expected. A new channel with `chantype = 'hr'`, `sr = 20` and `duration = 500` is generated.

Tests

1. Load condition before and after and pass it to `'Verify write'`
2. Test if `'hr'` channel has sample rate `20`

Action ‘delete’ (one channel)

Function name `test_delete_single(this)`

Description Checks if action ‘`delete`’ behaves as expected. In this test only one channel will be deleted. To test the delete algorithm there will be `7` channels added which are then also used for `test_delete_multi(this)`. The particular channels are then identified by the sample rate which corresponds to the channel `id * 10`.

Tests

1. Delete channel with `chantype = ‘hr’` in newdata.header.chantype
   (a) Verify write
   (b) Ensure only one channel has been deleted
   (c) Test if there is no more channel with `chantype = ‘hr’`
2. Delete channel with channel number in `options.channel`
   (a) Verify Write
   (b) Ensure only one channel has been deleted
3. Test the delete algorithm
   (a) Remove ‘`resp`’ channel with `options.delete = ‘last’`
      i. Verify write
      ii. Ensure only one channel has been deleted
      iii. Test if last channel was deleted
   (b) Remove ‘`resp`’ channel with `options.delete = ‘first’`
      i. Verify write
      ii. Ensure only one channel has been deleted
      iii. Test if last entry was not deleted

Action ‘delete’ (multiple channels)

Function name `test_delete_multi(this)`

Description Checks if action ‘`delete`’ behaves as expected. In this test only multiple channels will be deleted. This test relys on the changes made to the testdatafile by other test functions in this class.

Tests

1. Delete channel 1 and 2 from testdatafile
   (a) Verify write
   (b) Ensure two channels have been deleted
2. Delete all ‘resp’ channels from testdatafile
   (a) Verify write
   (b) Test if datafile contains no more ‘resp’ channels

4.38.4 Other methods

Verify write Is called after pspm_write_channel has been called (action = ‘add’ or action = ‘replace’) and tests if data was written and a new history entry was made.

Tests

1. if action == ‘add’, test if there is a new channel
2. if action == ‘replace’, test if there is still the same amount of channels
3. if action == ‘delete’, test if there have been as many channels deleted as given in outinfos.channel
4. test if history has a new entry
5. search for channels with same chantype as added channel (should be only one channel)
6. test if number of data elements in new channel and added channel is equal
7. test if new channel and added channel have same ‘sr’.

5 External functions and tools

5.1 VB (Variational Bayes) inversion algorithm by Jean Daunizeau

Updated October 2014

VBA_ReDisplay.m Fixed try-catch syntax in various places by adding a comma after "try" to avoid warning in MATLAB > 2007

VBA_inv.m In line 42, added warning off/on to suppress the warning `Matrix is singular, close to singular or badly scaled. Results may be inaccurate. RCOND = NaN.`

Updated October 2016

VBA_ReDisplay.m Fixed try-catch syntax in various places by adding a comma after "try" to avoid warning in MATLAB > 2007

VBA_inv.m In line 48: added warning off/on to suppress the warning "`Matrix is singular, close to singular or badly scaled. Results may be inaccurate. RCOND = NaN.`"

VBA_NLStateSpaceModel.m Added resetting warning to preceeding state.

6 GitHub Actions

Contributed by Dadi Zhao

Updated in March 2022

GitHub Actions is a Continuous Integration (CI) environment for testing GitHub repository, which is now used for testing and maintaining PsPM. GitHub Actions is deeply implemented in GitHub, thus there is no further website or facility needed for running GitHub Actions for PsPM.

6.1 Repositories

Until March 2022, code and test data are seperately stored in GitHub, in *PsPM* and *PsPM-data*, respectively. Both of *PsPM* and *PsPM-data* are under the *bachlab* account. *PsPM* is a public repository allowing group members and public visitors to check the code and propose issues. *PsPM-data* is a private repository allowing only group members to check the data and propose issues. This is because *PsPM-data* has some research data that may not be appropriate for public vistors. It could be a good idea to find another cloud storage service with University's approval to store research data. *PsPM-data* has all the required test data for running testsuit of *PsPM*. To run testsuit of *PsPM*, it must be gauranteed that *PsPM-data* is accessible.

6.2 Workflow

To guide the actions of GitHub Actions, a workflow script as a `.yaml` file is required, which should be storaged at `~/bachlab/PsPM/.github/workflow`. The workflow has been prepared and tested to be running well for maintaining *PsPM*. The explainations of key scripts are show below.

Step 1 Import `PsPM`

```
- name: Check out repository code
  uses: actions/checkout@v2
```

This step imports the source code of *PsPM* to the server, in our case, a Ubuntu server.

Step 2 Import `PsPM-data`

```
- name: Add test data
  uses: actions/checkout@v2
  with:
    repository: bachlab/PsPM-data
    token: ${{ secrets.PSPM_PAT }}
    path: ImportTestData
```

This step imports the test data in *PsPM-data* to the server. The details of the token is introduced in the next section.

Step 3 Setup MATLAB

```
- name: Setup MATLAB
  uses: matlab-actions/setup-matlab@v1.0.1
```

Step 4 Setup testing script

```
- name: Run script
  id: pspm_test_main
  uses: matlab-actions/run-command@v1
  with:
    command: addpath('test'), addpath('src'), pspm_test_github_actions
```

The script of testing *PsPM* has been optimised for GitHub Actions, which is saved as `pspm_test_github_actions`. Further modifications should be done here.

Step 5 Save records

```
- name: Check status
  id: check_status
  uses: andstor/file-existence-action@v1
  with:
    files: "success.txt"
```

This step return a document `success.txt` if the script does not return any error, indicating the code has passed the test suit.

Step 6 Reture success

```
- name: Return running success
  if: ${{ steps.check_status.outputs.files_exists == 'true' }}
  run: exit 0
```

Step 7 Return failure

```
- name: Return running failure
  if: ${{ steps.check_status.outputs.files_exists != 'true' }}
  run: exit 1
```

6.3 Token

Tokens are required to perform GitHub Actions for *PsPM* as the data repository is stored as private. The steps for generating and implementing tokens are described as below.

Step 1 Generate a Personal Access Token (PAT) at https://github.com/settings/tokens, name it as `PSPM_PAT` with required priviliges.

Step 2 In the YAML file, the script for running GitHub Actions, make sure the PAT file has been mentioned appropriately, like

```
token: ${{ secrets.PSPM_PAT }}
```

Step 3 In the settings of *PsPM* repository, which can be found at https://github.com/bachlab/PsPM/settings/secrets/actions, make sure *Repository Secrets*, which is under *Actions Secrets*, has contained `PSPM_PAT`. This operation requires your privilige to access the setting profiles of the correspoding repository.

Step 4 Similar to Step 3, in the settings of *PsPM-data* repository, which can be found at https://github.com/bachlab/PsPM-data/settings/secrets/actions, make sure *Repository Secrets*, which is under *Actions Secrets*, has contained `PSPM_PAT`. This operation requires your privilige to access the setting profiles of the correspoding repository.

Now the script should be running ok. Please note the PAT must be updated regularly due to security concerns.

7 List of functions

Function Name	Main Author(s)	Test Function	Test Document
f_SCR	DB & JD	-	-
f_SF	DB	-	-
g_SCR	DB	-	-
pspm	DB	x	x
scr	DB	x	x
pspm_align_channels	DB	x	x
pspm_axpos	DB	-	-
pspm_bf_brf	SK & DB	-	-
pspm_bf_FIR	DB	-	-
pspm_bf_Fourier	DB	-	-
pspm_bf_hprf	DB	-	-
pspm_bf_hprf_e	TM	-	-
pspm_bf_hprf_fc	TM	-	-
pspm_bf_hprf_fc_f	TM	-	-
pspm_bf_lcrf_gm	TM	-	-
pspm_bf_ldrf_gm	TM	-	-
pspm_bf_ldrf_gu	TM	-	-
pspm_bf_psrf_fc	TM	-	-
pspm_rarf_e	TM	-	-
pspm_rarf_fc	TM	-	-
pspm_rfrrf_e	TM	-	-
pspm_rprf_e	TM	-	-
pspm_bf_scrf_f	DB	-	-
pspm_bf_scrf	DB	-	-
pspm_bf_spsrf_box	LC	-	-
pspm_bf_spsrf_gamma	LC	-	-
pspm_butter	DB	X	X
pspm_compute_visual_angle	LC	-	-
pspm_con1	DB	-	-
pspm_con2	DB	-	-
pspm_contrast	DB	-	-
pspm_convert_area2diameter	TM	-	-
pspm_convert_au2mm	TM	-	-
pspm_convert_illum2lum	TM	-	-
pspm_convert_lux2cdm2	TM	-	-
pspm_convert_mm2visdeg	TM	-	-
pspm_convert_pixel2unit	LC	-	-
pspm_convert_unit	TM	x	x

pspm_convert_visangle2sps	LC	-	-
pspm_data_editor	TM	-	-
pspm_dcm_inv	DB	-	-
pspm_dcm	DB	-	-
pspm_denoise_spike	DB	-	-
pspm_display	PCP	-	-
pspm_down	DB	x	-
pspm_downsample	DB	-	-
pspm_ecg2hb	PCP	x	x
pspm_ecg2hb_amri	EY	x	-
pspm_ecg_editor	TM	-	-
pspm_exp	DB	x	-
pspm_extract_segments	TM	x	x
pspm_filtfilt	DB	x	x
pspm_find_channel	DB	x	x
pspm_find_data_epochs	TM	-	-
pspm_find_sounds	SG	x	x
pspm_find_valid_fixations	TM	x	x
pspm_get_acq_bioread	TM	x	x
pspm_get_acq	DB	x	x
pspm_get_acqmat	DB	x	x
pspm_get_biograph	DB	x	x
pspm_get_biosemi	DB	x	x
pspm_get_biotrace	DB	x	x
pspm_get_blink_l	TM	-	-
pspm_get_blink_r	TM	-	-
pspm_get_brainvis	DB	x	x
pspm_get_cell	DB	-	-
pspm_get_cnt	DB	-	-
pspm_get_custom	TM	-	-
pspm_get_ecg	DB	x	x
pspm_get_edf	TM	x	x
pspm_get_events	DB	x	x
pspm_get_eyelink	CK & TM	x	x
pspm_get_gaze_x_l	TM	-	-
pspm_get_gaze_y_l	TM	-	-
pspm_get_gaze_x_r	TM	-	-
pspm_get_gaze_y_r	TM	-	-
pspm_get_hb	DB	x	x
pspm_get_hp	DB	-	-
pspm_get_hr	DB	x	x
pspm_get_labchartmat_ext	DB	x	x
pspm_get_labchartmat_in	DB	x	x

pspm_get_marker	DB	x	x
pspm_get_markerinfo	DB	-	-
pspm_get_mat	DB	x	x
pspm_get_obs	LR	x	x
pspm_get_physlog	TM	-	-
pspm_get_pupil	DB	x	x
pspm_get_pupil_l	TM	-	-
pspm_get_pupil_r	TM	-	-
pspm_get_resp	DB	x	x
pspm_get_rf	DB	-	-
pspm_get_saccade_l	LC	-	-
pspm_get_saccade_r	LC	-	-
pspm_get_scr	DB	x	x
pspm_get_smi	EY	-	-
pspm_get_sps	LC	-	-
pspm_get_spike	DB	x	x
pspm_get_sound	TM	-	-
pspm_get_timing	DB	x	x
pspm_get_txt	DB	x	x
pspm_get_vario	DB	x	x
pspm_get_viewpoint	EY	-	-
pspm_get_wdq	DB	-	-
pspm_get_wdq_n	TM	x	x
pspm_glm_recon	DB	-	-
pspm_glm	DB	x	x
pspm_hb2hp	DB	x	x
pspm_hb2hr	DB	-	-
pspm_import	DB	x	x
pspm_init	DB	-	-
pspm_interpolate	TM	x	x
pspm_jobman	GG	-	-
pspm_job_create	DB	-	-
pspm_load_data	DB	x	x
pspm_load1	DB	x	x
pspm_load_single_chan	EY	-	-
pspm_merge	DB	-	-
pspm_overwrite	DZ	-	-
pspm_path	EY	x	-
pspm_peakscore	DB	-	-
pspm_pp	DB	x	x
pspm_ppu2hb	SG	-	-
pspm_predval	DB	-	-
pspm_prepdata	DB	x	x

pspm_process_illuminance	TM	x	-
pspm_pulse_convert	DB	x	-
pspm_pupil_correct_eyelink	EY	x	-
pspm_pupil_correct	EY	x	-
pspm_pupil_pp	EY	x	-
pspm_pupil_pp_options	EY	-	-
pspm_quit	DB	-	-
pspm_ren	DB	x	x
pspm_resp_pp	DB	-	-
pspm_rev_con	DB	-	-
pspm_rev_dcm	DB	-	-
pspm_rev_glm	DB	-	-
pspm_rev2	DB	-	-
pspm_review	GG	-	-
pspm_segment_mean	TM	-	-
pspm_scr_pp	DZ	x	x
pspm_sf_auc	DB	-	-
pspm_sf_dcm	DB	-	-
pspm_sf_mp	DB	-	-
pspm_sf_scl	DB	-	-
pspm_sf_theta	DB	-	-
pspm_sf	DB	-	-
pspm_sf_get_theta	DB	-	-
pspm_show_arms	DB	-	-
pspm_spike_convert	DB	-	-
pspm_split_sessions	LR	x	x
pspm_transfer_function	DB	-	-
pspm_time2index	DZ	x	x
pspm_trim	DB	x	x
pspm_version	TM	-	-
pspm_write_channel	TM	x	x
set_blinks_saccades_to_nan	EY	x	-

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