

# Developer's Guide

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# 1 General

## 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.recdatetime`

`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 name** `pspm_get_xxx` (where `xxx` is the channel type)

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

`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 name** `pspm_bf_xxx`

**Function 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 ( $\leq$ v3.9.0)	acq	.acq	Biopac	✓	✓		
Biopac AcqKnowledge (exported)	acqmat	.mat	Biopac	✓	✓		
Labchart (any Version, Windows only)	labchart	.adicht	ADInstruments	✓	✓	✓	
Labchart exported ( $\leq$ v7.1)	labchartmat_ext	.mat	ADInstruments	✓	✓	✓	✓
Labchart exported ( $\geq$ 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 <sub>14</sub>	.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.*

### 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 → File → 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 → 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 → {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 application `cfg_configui` in the folder `MATLABbatch/cfg_configui`.
- Put Generate code into the Module list by selecting ConfGUI → 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 application.
  - Output directory: All files which are created by the ConfGUI will be stored into this directory (choose a directory which is added to the MATLAB path)
  - Root node of config: Name of the root node of the application'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\_mlbatches\_appcfg.m) should be created and added into the folder {Output directory}.
- Each time MATLABbatch is started, it will search for any cfg\_mlbatches\_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 → 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 styling. 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.*

### 4.1 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 `functionname_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.

## 4.2 parameterised test classes

Parameterized 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.

## 4.3 Testcases: `pspm_align_channels_test`

### 4.3.1 Information

**TestClass** `pspm_align_channels_test`

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

### 4.3.2 Setup

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

### 4.3.3 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.

## 4.4 Testcases: pspm\_butter

### 4.4.1 Information

**Testclass** pspm\_butter\_test

**Function** [sts, b, a] = pspm\_butter(order, freqratio, pass)

### 4.4.2 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

## 4.5 Testcases: pspm\_bf\_test

### 4.5.1 Information

**Testclass** pspm\_bf\_test

**Function** [bs, x] = pspm\_bf\_<specific function name>

#### 4.5.2 Setup

This test class is parameterised.

##### Method setup parameters

These parameters define which function should be tested.

<b>Basis function</b>	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.

<b>Time res log</b>	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.
---------------------	--

#### 4.5.3 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`)

## 4.6 Testcases: `pspm_convert_unit`

### 4.6.1 Information

**Testclass** `pspm_convert_unit_test`

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

### 4.6.2 Setup

**Constants** `inch_to_cm = 2.54`

### 4.6.3 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.

## 4.7 Testcases: pspm\_ecg2hb

### 4.7.1 Information

**Testclass** pspm\_ecg2hb\_test

**Function** [sts,pt\_debug] = pspm\_ecg2hb(fn, chan, options)

### 4.7.2 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);

### 4.7.3 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
	<code>pspm_ecg2hb()</code> [no arguments]	ID:invalid_input
	<code>pspm_ecg2hb(1)</code> [invalid file name]	ID:invalid_input
	<code>pspm_ecg2hb(this.fn, 'bla')</code> [invalid channel (text)]	ID:invalid_input
	<code>pspm_ecg2hb(this.fn, 1)</code> [invalid channel type]	ID:not_allowed_channeltype
	<code>o.twthresh = 'bla'; pspm_ecg2hb(this.fn, this.chan.nr, o)</code> [invalid twthresh (text)]	ID:invalid_input
	<code>o.minHR = 202; pspm_ecg2hb(this.fn, this.chan.nr, o)</code> [invalid minHR (> default_maxHR)]	ID:invalid_input
	<code>o.minHR = 202; o.maxHR = 19; pspm_ecg2hb(this.fn, this.chan.nr, o)</code> [invalid minHR > maxHR]	ID:invalid_input
	<code>o.maxHR = 19; pspm_ecg2hb(this.fn, this.chan.nr, o)</code> [invalid maxHR (< default_minHR)]	ID:invalid_input
	<code>o.debugmode = 5; pspm_ecg2hb(this.fn, this.chan.nr, o)</code> [invalid debugmode (not in [0,1])]	ID:invalid_input
	<code>o.semi = 5; pspm_ecg2hb(this.fn, this.chan.nr, o)</code> [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
	<code>pspm_ecg2hb(this.fn, this.chan.nr, this.options)</code>	-
	<code>pspm_ecg2hb(this.fn, this.chan.name, this.options)</code>	-
	<code>this.test_added_data()</code>	-

#### 4.7.4 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

## 4.8 Testcases: pspm\_filtfilt

### 4.8.1 Information

**Testclass** pspm\_filtfilt\_test

**Function** y = pspm\_filtfilt(b,a,x)

### 4.8.2 Testcases

#### Invalid input

**Function name** invalid\_input(this)

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

#### Tests

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

## 4.9 Testcases: pspm\_find\_channel

### 4.9.1 Information

**Testclass** pspm\_find\_channel\_test

**Function** chan = pspm\_find\_channel(headercell, chantype)

## 4.9.2 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
<code>pspm_find_channel('str','scr') [no headercell]</code>	ID:invalid_input
<code>pspm_find_channel(headercell, 'str')</code>	ID:not_allowed_channeltype
<code>pspm_find_channel(headercell, 4) [no string chantype]</code>	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
<code>pspm_find_channel(headercell, 'pupil')</code>	3	
<code>pspm_find_channel(headercell, 'resp')</code>	0	ID:no_matching_channels
<code>pspm_find_channel(headercell, 'scr')</code>	-1	ID:multiple_matching_channels
<code>pspm_find_channel(headercell, {'mark', 'str', 'bla'})</code>	4	
<code>pspm_find_channel(headercell, {'call', 'str', 'me'})</code>	0	no matching channel, but no warning
<code>pspm_find_channel(headercell, {'scr', 'gsr', 'eda'})</code>	-1	multiple matching channels, but no warning

## 4.10 Testcases: pspm\_extract\_segments

### 4.10.1 Information

**Testclass** pspm\_extract\_segments\_test

**Function** [sts, out] = pspm\_extract\_segments(varargin)

### 4.10.2 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

### 4.10.3 Testcases

#### Invalid input

**Function name** invalid\_input(this)

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

### Tests

Input	Expected warning
pspm_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{int a;int b;int c;int d;int e;int f;int g;int h;int i;int j;int k;int l;int m;int n;int o;int p;int q;int r;int s;int t;int u;int v;int w;int x;int y;int z;int aa;int ab;int ac;int ad;int ae;int af;int ag;int ah;int ai;int aj;int ak;int al;int am;int an;int ao;int ap;int aq;int ar;int as;int at;int au;int av;int aw;int ax;int ay;int az;int ba;int bb;int bc;int bd;int be;int bf;int bg;int bh;int bi;int bj;int bk;int bl;int bm;int bn;int bo;int bp;int bq;int br;int bs;int bt;int bu;int bv;int bw;int bx;int by;int bz;int ca;int cb;int cc;int cd;int ce;int cf;int cg;int ch;int ci;int cj;int ck;int cl;int cm;int cn;int co;int cp;int cq;int cr;int cs;int ct;int cu;int cv;int cw;int cx;int cy;int cz;int da;int db;int dc;int dd;int de;int df;int dg;int dh;int di;int dj;int dk;int dl;int dm;int dn;int do;int dp;int dq;int dr;int ds;int dt;int du;int dv;int dw;int dx;int dy;int dz;int ea;int eb;int ec;int ed;int ee;int ef;int eg;int eh;int ei;int ej;int ek;int el;int em;int en;int eo;int ep;int eq;int er;int es;int et;int eu;int ev;int ew;int ex;int ey;int ez;int fa;int fb;int fc;int fd;int fe;int ff;int fg;int fh;int fi;int fj;int fk;int fl;int fm;int fn;int fo;int fp;int fq;int fr;int fs;int ft;int fu;int fv;int fw;int fx;int fy;int fz;int ga;int gb;int gc;int gd;int ge;int gf;int gg;int gh;int gi;int gj;int gk;int gl;int gm;int gn;int go;int gp;int gq;int gr;int gs;int gt;int gu;int gv;int gw;int gx;int gy;int gz;int ha;int hb;int hc;int hd;int he;int hf;int hg;int hh;int hi;int hj;int hk;int hl;int hm;int hn;int ho;int hp;int hq;int hr;int hs;int ht;int hu;int hv;int hw;int hx;int hy;int hz;int ia;int ib;int ic;int id;int ie;int if;int ig;int ih;int ii;int ij;int ik;int il;int im;int in;int io;int ip;int iq;int ir;int is;int it;int iu;int iv;int iw;int ix;int iy;int iz;int ja;int jb;int jc;int jd;int je;int jf;int jg;int jh;int ji;int jj;int jk;int jl;int jm;int jn;int jo;int jp;int jq;int jr;int js;int jt;int ju;int jv;int jw;int jx;int jy;int jz;int ka;int kb;int kc;int kd;int ke;int kf;int kg;int kh;int ki;int kj;int kk;int kl;int km;int kn;int ko;int kp;int kq;int kr;int ks;int kt;int ku;int kv;int kw;int kx;int ky;int kz;int la;int lb;int lc;int ld;int le;int lf;int lg;int lh;int li;int lj;int lk;int ll;int lm;int ln;int lo;int lp;int lq;int lr;int ls;int lt;int lu;int lv;int lw;int lx;int ly;int lz;int ma;int mb;int mc;int md;int me;int mf;int mg;int mh;int mi;int mj;int mk;int ml;int mm;int mn;int mo;int mp;int mq;int mr;int ms;int mt;int mu;int mv;int mw;int mx;int my;int mz;int na;int nb;int nc;int nd;int ne;int nf;int ng;int nh;int ni;int nj;int nk;int nl;int nm;int nn;int no;int np;int nq;int nr;int ns;int nt;int nu;int nv;int nw;int nx;int ny;int nz;int oa;int ob;int oc;int od;int oe;int of;int og;int oh;int oi;int oj;int ok;int ol;int om;int on;int oo;int op;int oq;int or;int os;int ot;int ou;int ov;int ow;int ox;int oy;int oz;int pa;int pb;int pc;int pd;int pe;int pf;int pg;int ph;int pi;int pj;int pk;int pl;int pm;int pn;int po;int pp;int pq;int pr;int ps;int pt;int pu;int pv;int pw;int px;int py;int pz;int qa;int qb;int qc;int qd;int qe;int qf;int qg;int qh;int qi;int qj;int qk;int ql;int qm;int qn;int qo;int qp;int qq;int qr;int qs;int qt;int qu;int qv;int qw;int qx;int qy;int qz;int ra;int rb;int rc;int rd;int re;int rf;int rg;int rh;int ri;int rj;int rk;int rl;int rm;int rn;int ro;int rp;int rq;int rr;int rs;int rt;int ru;int rv;int rw;int rx;int ry;int rz;int sa;int sb;int sc;int sd;int se;int sf;int sg;int sh;int si;int sj;int sk;int sl;int sm;int sn;int so;int sp;int sq;int sr;int ss;int st;int su;int sv;int sw;int sx;int sy;int sz;int ta;int tb;int tc;int td;int te;int tf;int tg;int th;int ti;int tj;int tk;int tl;int tm;int tn;int to;int tp;int tq;int tr;int ts;int tt;int tu;int tv;int tw;int tx;int ty;int tz;int ua;int ub;int uc;int ud;int ue;int uf;int ug;int uh;int ui;int uj;int uk;int ul;int um;int un;int uo;int up;int uq;int ur;int us;int ut;int uu;int uv;int uw;int ux;int uy;int uz;int va;int vb;int vc;int vd;int ve;int vf;int vg;int vh;int vi;int vj;int vk;int vl;int vm;int vn;int vo;int vp;int vq;int vr;int vs;int vt;int vu;int vv;int vw;int vx;int vy;int vz;int wa;int wb;int wc;int wd;int we;int wf;int wg;int wh;int wi;int wj;int wk;int wl;int wm;int wn;int wo;int wp;int wq;int wr;int ws;int wt;int wu;int wv;int ww;int wx;int wy;int wz;int xa;int xb;int xc;int xd;int xe;int xf;int xg;int xh;int xi;int xj;int xk;int xl;int xm;int xn;int xo;int xp;int xq;int xr;int xs;int xt;int xu;int xv;int xw;int xx;int xy;int xz;int ya;int yb;int yc;int yd;int ye;int yf;int yg;int yh;int yi;int yj;int yk;int yl;int ym;int yn;int yo;int yp;int yq;int yr;int ys;int yt;int yu;int yv;int yw;int yx;int yy;int yz;int za;int zb;int zc;int zd;int ze;int zf;int zg;int zh;int zi;int zj;int zk;int zl;int zm;int zn;int zo;int zp;int zq;int zr;int zs;int zt;int zu;int zv;int zw;int zx;int zy;int zz;	ID:invalid_input

### Test manual mode with indicated length

**Function name** test\_manual\_length(this,nr\_trial,nan\_ratio)

**Description** 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)

**Description** 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.

## 4.11 Testcases: `pspm_find_sounds`

### 4.11.1 Information

**Testclass** `pspm_find_sounds_test`

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

### 4.11.2 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.

<b>Channel output</b>	Specifies whether 'all' found markers or only 'corrected' markers should be returned.
<b>Max delay</b>	Varies the max delay option and defines how far away a marker at most can be.
<b>Min delay</b>	Varies the min delay option and defines how far away a marker at least should be.
<b>Threshold</b>	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.
<b>Resample</b>	Defines whether the function should resample (and interpolate) the data to a higher sample rate in order to get more exact marker findings.
<b>Channel action</b>	Defines whether a newly created marker channel should replace the existing marker channel or should be added as a new marker channel.

### 4.11.3 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 returns 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 return 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

## 4.12 Testcases: `pspm_find_valid_fixations`

### 4.12.1 Information

**Testclass** `pspm_find_valid_fixations_test`

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

### 4.12.2 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.

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

#### 4.12.3 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 37 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
  - (a) `overwrite = 1`
  - (b) `eyes = work_eye`
  - (c) `channel_action = 'add'`
3. Test if function runs through without warning
4. Test if `sts` equals 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 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
  - (a) `overwrite = 1`
  - (b) `interpolate = interpolate`
  - (c) `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 and eyes 'lr'
2. Set options with
  - (a) `overwrite = 1`
  - (b) `interpolate = interpolate`
  - (c) `channel_action = 'add'`



3. Test if function runs through without warning
4. Test if sts equals 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 and eyes 'lr'.
2. Set options with
  - (a) overwrite = 1
  - (b) channel\_action = channel\_action
3. Test if function runs through without warning
4. Test if sts equals 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 and 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 equals 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. overwrite = 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 validation**

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

- i. 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

## **4.13 Testcases: pspm\_get\_ecg**

### **4.13.1 Information**

Testclass: pspm\_get\_ecg\_test

Function: [sts, data] = pspm\_get\_ecg(import)

### **4.13.2 Testcases**

#### **Test**

Function name: test(this)

Description: Test if all fields are returned correctly

Tests:

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

## **4.14 Testcases: pspm\_get\_events**

### **4.14.1 Information**

Testclass: pspm\_get\_events\_test

Function: [sts, import] = pspm\_get\_events(import)

### **4.14.2 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' is equal 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' is equal 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.

## **4.15 Testcases: pspm\_get\_eyelink**

### **4.15.1 Information**

Testclass: pspm\_get\_eyelink\_test

Function: [sts, data] = pspm\_get\_eyelink(import)

### **4.15.2 Methods**

#### **set\_import\_values**

Function : [import\_struct, channel types] = 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'

### 4.15.3 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. passes 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. Creates an import data set and the expected channel data set and 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. Calls 'set\_import\_values(this)' to get import data set and expected channel data set

2. overwrites some import data and channel data
3. pass returned sets to 'verify\_basic\_data\_structure()'

## **4.16 Testcases: pspm\_get\_hb**

### **4.16.1 Information**

Testclass: pspm\_get\_hb\_test

Function: [sts, data] = pspm\_get\_hb(import)

### **4.16.2 Testcases**

#### **Test**

Function name: test(this)

Description: Test if all fields are returned correctly

Tests:

1. Test if 'sts' is equal 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 is 1

## **4.17 Testcases: pspm\_get\_hr**

### **4.17.1 Information**

Testclass: pspm\_get\_hr\_test

Function: [sts, data] = pspm\_get\_hr(import)

### **4.17.2 Testcases**

#### **Test**

Function name: test(this)

Description: Test if all fields are returned correctly

Tests:

1. Test if 'sts' is equal 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

## **4.18 Testcases: pspm\_get\_marker**

### **4.18.1 Information**

Testclass: pspm\_get\_marker\_test

Function: [sts, data] = pspm\_get\_marker(import)

### **4.18.2 Testcases**

#### **Test**

Function name: test(this)

Description: Test if all fields are returned correctly

Tests:

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

## **4.19 Testcases: pspm\_get\_pupil**

### **4.19.1 Information**

Testclass: pspm\_get\_pupil\_test

Function: [sts, data] = pspm\_get\_pupil(import)

### **4.19.2 Testcases**

#### **Test**

Function name: test(this)

Description: Test if all fields are returned correctly

Tests:

1. Test if 'sts' is equal 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 import.units
5. Test if data.header.sr is equal import.sr

## **4.20 Testcases: pspm\_get\_resp**

### **4.20.1 Information**

Testclass: pspm\_get\_resp\_test

Function: [sts, data] = pspm\_get\_resp(import)

### **4.20.2 Testcases**

#### **Test**

Function name: test(this)

Description: Test if all fields are returned correctly

Tests:

1. Test if 'sts' is equal 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

## **4.21 Testcases: pspm\_get\_scr**

### **4.21.1 Information**

Testclass: pspm\_get\_scr\_test

Function: [sts, data] = pspm\_get\_scr(import)

### **4.21.2 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' is equal 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 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: struct\_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.

## **4.22 Testcases: pspm\_get\_timing**

### **4.22.1 Information**

Testclass: pspm\_get\_timing\_test

Function:

```
[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)
```

### **4.22.2 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: mat file with the 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:

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.

## **4.23 Testcases: pspm\_get\_<datatype>**

### **4.23.1 Information**

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)

#### **4.23.2 Notes**

#### **4.23.3 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

#### **4.23.4 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' is equal 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').

## **4.24 Testcases: pspm\_get\_acq**

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

### **4.24.1 Information**

Testclass: `pspm_get_acq_test`

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

### **4.24.2 Testcases**

#### **get\_acq should return the exact same data as Acqknowledge exported mat file**

Function name: `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.

Tests:

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



## 4.25 Testcases: pspm\_glm

### 4.25.1 Information

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 implementing these parameters (Test 1 to Test 5) are called several times with all the different values and combinations of the mentioned parameters.

### 4.25.2 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**

Function name: 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**

Function name: 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**

Function name: 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**

Function name: 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

Function name: 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

Function name: 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  $\text{pmod}(1).\text{poly}\{1\} = 2$  and  $\text{pmod}(1).\text{poly}\{2\} = 3$ )
- second condition: no pmods

### Test7:

Function name: 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 condition which should be excluded

## 4.26 Testcases: pspm\_hb2hp

### 4.26.1 Information

Testclass: pspm\_hb2hp\_test

Function: [sts, infos] = pspm\_hb2hp(fn, sr, chan, options)

### 4.26.2 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 channel]	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

## 4.27 Testcases: pspm\_import

### 4.27.1 Information

Testclass: pspm\_import\_test

Function: outfile = pspm\_import(datafile, datatype, import, options)

### 4.27.2 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.

## 4.28 Testcases: pspm\_interpolate

### 4.28.1 Information

Testclass: pspm\_interpolate\_test

Function: [sts, outdata] = pspm\_interpolate(indata, options)

#### 4.28.2 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.

<b>Amount</b>	Specifies how many elements in data (for pspm_interpolate) should have.
<b>Datatype</b>	Specifies what type of data should be generated. <ul style="list-style-type: none"><li>• struct - a valid data struct will be generated</li><li>• inline - a numeric vector will be generated</li><li>• file - a valid scr file will be generated</li><li>• all - all types will sequentially be generated until amount is reached</li></ul>
<b>Chans</b>	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).
<b>Nan method</b>	Specifies how NaN values will be put into the data. <ul style="list-style-type: none"><li>• start - range is 1+offset:&lt;random number before the center&gt;</li><li>• center - range is &lt;random number before the center&gt;:&lt;random number after the center&gt;</li><li>• end - range is &lt;random number after the center&gt;:end-offset</li></ul> 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).
<b>Extrap</b>	Is either true or false and activates or deactivates the extrapolation.
<b>Interp method</b>	Specifies the interpolation method.
<b>Newfile</b>	True or false and tells the function to either create a file or add the data as new channel.
<b>Overwrite</b>	True or false and tells the function to either overwrite an existing file or not.
<b>Replace channel</b>	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.

### **4.28.3 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.dont_ask_overwrite is invalid]	ID:invalid_input
13	pspm_interpolate(valid_data, options) [options.replace_channels is invalid]	ID:invalid_input
14	pspm_interpolate(invalid_data, options) [try to interpolate an events channel]	ID:invalid_channeltype
15	pspm_interpolate(invalid_data) [try to interpolate with nan from beginning and without extrapolation]	ID:option_disabled
16	pspm_interpolate(invalid_data, options) [try to interpolate with nan from beginning and with extrapolation]	ID:out_of_range
17	pspm_interpolate(invalid_data) [try to interpolate with nan from end and without extrapolation]	ID:option_disabled
18	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.

Tests:

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

### Test interpolation variations

Function name: `test_interpolation_variations(this, interp_method, extrapol, 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` is 1
4. Test if size of outdata equals the size of the data
5. Test if data has no more NaNs

**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 value 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 is 1
4. Test if size of outdata equals the size of data
5. Test if outdata equals data
6. Test if data has no NaNs

### **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 is 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 is 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 whether 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 is 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.

## **4.28.4 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.

## **4.29 Testcases: pspm\_load1**

### **4.29.1 Information**

Testclass: pspm\_load1\_test

Function: [sts, data, mdltype] = pspm\_load1(fn, action, savedata, options)

### **4.29.2 Setup**

The datafile fn is referring to a datafile which was generated with pspm\_load1\_test.generate\_testdata(th 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];
```

### 4.29.3 Testcases

#### Invalid model structure (general)

Function: `invalid_model_tructure_general(this)`

Description: Tries to pass invalid data structures, and tests for certain warnings. Applies 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. dont\_ask\_overwrite = 1 & overwrite = 0 returns warning ID: not\_saving\_data and field 'test' in model struct does not match generated number
2. dont\_ask\_overwrite = 1 & overwrite = 1 field 'test' in returned model struct does match generated number

Tests for DCM (with dont\_ask\_overwrite = 1 & 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 calling with zscored = 1 & action = 'cond' (should not zscore, when not specified)

#### **4.29.4 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) equals 1

#### **4.30 Testcases: pspm\_load\_data**

##### **4.30.1 Information**

Testclass: pspm\_load\_data\_test

Function: [sts, infos, data, filestruct] = pspm\_load\_data(fn, chan)

### 4.30.2 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.

### 4.30.3 Testcases

#### Invalid input arguments

Function name: `invalid_inputargs(testCase)`

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

Tests:

Input	Expected warning
<code>pspm_load_data [no filename]</code>	ID:invalid_input
<code>pspm_load_data(1) [no char filename]</code>	ID:invalid_input
<code>pspm_load_data(fn, -1) [neg. channel no]</code>	ID:invalid_input
<code>pspm_load_data(fn, 'foobar') [no allowed ch type]</code>	ID:invalid_input
<code>pspm_load_data(fn, foo) [missing field in foo struct]</code>	ID:invalid_input
<code>pspm_load_data(fn, {1}) [invalid channel option]</code>	ID:invalid_input
<code>pspm_load_data(struct) [struct has no infos field]</code>	ID:invalid_input
<code>pspm_load_data(fn, 250) [nonexisting channel]</code>	ID:invalid_input

#### Invalid datafile

Function name: `invalid_datafile(testCase)`

Description: Checks for warnings, if the datafile is invalid.

Tests:

Test No.	Input	Expected warning
1	non-existent datafile	ID:nonexistent_file
2	missing 'infos' variable	ID:invalid_data_structure
3	missing 'data' variable	ID:invalid_data_structure
4	missing 'data' field in 'data{2}'	ID:invalid_data_structure
5	missing 'header' field 'data{3}'	ID:invalid_data_structure
6	missing 'sr' field in 'data{7}.header'	ID:invalid_data_structure
7	data{4} is a nx2 vector (instead of a nx1 vector)	ID:invalid_data_structure
8	the length of data{1}.data is incompatible with the duration	ID:invalid_data_structure
9	An entry of data{2}.data is larger than 'duration'	ID:invalid_data_structure
10	data{5} has an non-existent chantype ('scanner')	ID:invalid_data_structure
11	duplicates (9) with struct chan input	ID:invalid_data_structure

#### **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 one channel**

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).

## 4.31 Testcases: pspm\_pp

### 4.31.1 Information

Testclass: pspm\_pp\_test

Function: newfile = pspm\_pp('median', datafile, n, channelnumber) or newfile = pspm\_pp('butter', datafile, freq, channelnumber)

### 4.31.2 Testcases

#### Invalid input

Function name: invalid\_input(this)

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

Tests:

Input	Expected warning
pspm_pp('butter', 'file') [no freq]	ID:invalid_input
pspm_pp('foo', 'file', 100) [no valid first argument]	ID:invalid_input
pspm_pp('butter', 'file', 19) [freq below 20]	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

## **4.32 Testcases: pspm\_prepdata**

### **4.32.1 Information**

Testclass: pspm\_prepdata\_test

Function: [sts, outdata, newsr] = pspm\_prepdata(data, filt)

### 4.32.2 Testcases

#### Invalid input

Function name: `invalid_input(this)`

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

Tests:

Input	Expected warning
<code>pspm_prepdata([1 NaN 3], filt)</code> [NaN values in data]	ID:invalid_input
<code>pspm_prepdata([1 2 3])</code> [no filt variable]	ID:invalid_input
<code>pspm_prepdata(data, filt)</code> [filt has no hporder field]	ID:invalid_input
<code>pspm_prepdata('foo', filt)</code> [no numeric data]	ID:invalid_input
<code>pspm_prepdata(data, filt)</code> [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';
```

```
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)

## 4.33 Testcases: pspm\_process\_illuminance

### 4.33.1 Information

Testclass: pspm\_process\_illuminance\_test

Function: [sts, out] = pspm\_process\_illuminance(ldata, sr, options)

### 4.33.2 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.

<b>bf_dur</b>	Defines the duration of the basis function.
<b>bf_offset</b>	Defines the offset of the basis function.
<b>dur</b>	Defines the duration of the generated dataset.
<b>sr</b>	Defines the samplerate of the generated dataset.
<b>n_times</b>	Defines how many datasets should be generated.
<b>mode</b>	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'
<b>overwrite</b>	Defines whether existing files should be overwritten or not.

### 4.33.3 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  $sr \cdot dur < 1$
  - (b) expect invalid\_input if  $sr \cdot bf\_dur < 1$
  - (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`.

Tests:

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 is 1
4. For  $n\_times == 1$ , test if out has 10\*100 data points
5. for  $n\_times \sim 1$ , 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 equals 1
4. Test if existing file was overwritten or not

#### 4.33.4 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'.

### 4.34 Testcases: pspm\_pulse\_convert

#### 4.34.1 Information

Testclass: pspm\_pulse\_convert\_test

Function: wavedata = pspm\_pulse\_convert(pulsedata, resamplingrate, samplingrate)

#### 4.34.2 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 <sup>-3</sup> * (1:10000)')	ID:invalid_input
pspm_pulse_convert(10 <sup>-3</sup> * (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.

Tests:

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

## 4.35 Testcases: pspm\_ren

### 4.35.1 Information

Testclass: pspm\_ren\_test

Function: out\_newfilename = pspm\_ren(filename, newfilename)

### 4.35.2 Testcases

#### Invalid input

Function name: invalid\_input (this)

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

Tests:

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

#### 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.

Tests:

1. Check if out\_newfilename = 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.

## **4.36 Testcases: pspm\_resp\_pp**

### **4.36.1 Information**

Testclass: `pspm_resp_pp_test`

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

### **4.36.2 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

## **4.37 Testcases: pspm\_split\_sessions**

### **4.37.1 Information**

Testclass: `pspm_split_sessions_test`

Properties: `expected_number_of_files = 3;`

Function: `newdatafile = pspm_split_sessions(datafile, markerchannel, options)`

### 4.37.2 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 & 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.

### 4.37.3 Testcases

#### Invalid input

Function name: invalid\_input (this)

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

Tests:

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

#### 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.

Tests:

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 if 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.

## 4.38 Testcases: `pspm_trim`

### 4.38.1 Information

Testclass: `pspm_trim_test`

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

### 4.38.2 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.

### 4.38.3 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

#### 4.38.4 Reference = 'marker' tests

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) 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')`

#### **4.38.5 Reference = 'file' tests**

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 =  $-1 * \text{marker}(3)$  to =  $\text{duration} - \text{marker}(8)$  `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 file-names or a cell array of two structs. 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.

#### **Options 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: Test 1: Checks for a warning if the selected channel

is no marker channel. Test 2: Checks if the selected channel is actually used.

## **4.39 Testcases: pspm\_write\_channel**

### **4.39.1 Information**

Testclass: pspm\_write\_channel\_test

Function: [sts] = pspm\_write\_channel(fn, newdata, action, options)

### **4.39.2 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 100 Hz and the duration is 500s.

### **4.39.3 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 = -1 pspm_write_channel('some_file', [], 'add', options) [negative channel]	ID:invalid_input
options.channel = 0 pspm_write_channel('some_file', [], 'delete', options) [no channel and no data given]	ID:invalid_input
options.channel = 0 pspm_write_channel('some_file', [], 'add', options) [empty newdata]	ID:invalid_input
options.channel = 0 pspm_write_channel('some_file', 1:3, 'add', options) [newdata is not cell and not struct]	ID:invalid_input
options.channel = 1:5 pspm_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 relies 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

#### 4.39.4 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

Changes made for use in PsPM:

- *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*, 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

Changes made for use in PsPM:



- *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*, 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 List of functions

Name	Main author	Test exists	Test Doc
f_SCR	Dominik Bach & Jean Daunizeau	-	-
f_SF	Dominik Bach	-	-
g_SCR	Dominik Bach	-	-
pspm	Dominik Bach	x	x
scr	Dominik Bach	x	x
pspm_align_channels	Dominik Bach	x	x
pspm_axpos	Dominik Bach	-	-
pspm_bf_brf	Saurabh Khemka & Dominik Bach	-	-
pspm_bf_FIR	Dominik Bach	-	-
pspm_bf_Fourier	Dominik Bach	-	-
pspm_bf_hprf	Dominik Bach	-	-
pspm_bf_hprf_e	Tobias Moser	-	-
pspm_bf_hprf_fc	Tobias Moser	-	-
pspm_bf_hprf_fc_f	Tobias Moser	-	-
pspm_bf_lcrf_gm	Tobias Moser	-	-
pspm_bf_ldrf_gm	Tobias Moser	-	-
pspm_bf_ldrf_gu	Tobias Moser	-	-
pspm_bf_psr_f	Tobias Moser	-	-
pspm_rarf_e	Tobias Moser	-	-
pspm_rarf_fc	Tobias Moser	-	-
pspm_rfrrf_e	Tobias Moser	-	-
pspm_rprf_e	Tobias Moser	-	-
pspm_bf_scrf_f	Dominik Bach	-	-
pspm_bf_scrf	Dominik Bach	-	-
pspm_bf_spsrf_box	Laure Ciernik	-	-
pspm_bf_spsrf_gamma	Laure Ciernik	-	-
pspm_butter	Dominik Bach	X	X
pspm_compute_visual_angle	Laure Ciernik	-	-
pspm_con1	Dominik Bach	-	-

pspm_con2	Dominik Bach	-	-
pspm_contrast	Dominik Bach	-	-
pspm_convert_area2diameter	Tobias Moser	-	-
pspm_convert_au2mm	Tobias Moser	-	-
pspm_convert_illum2lum	Tobias Moser	-	-
pspm_convert_lux2cdm2	Tobias Moser	-	-
pspm_convert_mm2visdeg	Tobias Moser	-	-
pspm_convert_pixel2unit	Laure Ciernik	-	-
pspm_convert_unit	Tobias Moser	x	x
pspm_convert_visangle2sps	Laure Ciernik	-	-
pspm_data_editor	Tobias Moser	-	-
pspm_dcm_inv	Dominik Bach	-	-
pspm_dcm	Dominik Bach	-	-
pspm_denoise_spike	Dominik Bach	-	-
pspm_display	Philipp C Paulus	-	-
pspm_down	Dominik Bach	x	-
pspm_downsample	Dominik Bach	-	-
pspm_ecg2hb	Philipp C Paulus	x	x
pspm_ecg2hb_amri	Eshref Yozdemir	x	-
pspm_ecg_editor	Tobias Moser	-	-
pspm_exp	Dominik Bach	x	-
pspm_extract_segments	Tobias Moser	x	x
pspm_filtfilt	Dominik Bach	x	x
pspm_find_channel	Dominik Bach	x	x
pspm_find_data_epochs	Tobias Moser	-	-
pspm_find_sounds	Samuel Gerster	x	x
pspm_find_valid_fixations	Tobias Moser	x	x
pspm_get_acq_bioread	Tobias Moser	x	x
pspm_get_acq	Dominik Bach	x	x
pspm_get_acqmat	Dominik Bach	x	x
pspm_get_biograph	Dominik Bach	x	x
pspm_get_biosemi	Dominik Bach	x	x
pspm_get_biotrace	Dominik Bach	x	x
pspm_get_blink_l	Tobias Moser	-	-
pspm_get_blink_r	Tobias Moser	-	-
pspm_get_brainvis	Dominik Bach	x	x
pspm_get_cell	Dominik Bach	-	-
pspm_get_cnt	Dominik Bach	-	-
pspm_get_custom	Tobias Moser	-	-
pspm_get_ecg	Dominik Bach	x	x
pspm_get_edf	Tobias Moser	x	x
pspm_get_events	Dominik Bach	x	x

pspm_get_eyelink	Christoph Korn, Tobias Moser	x	x
pspm_get_gaze_x_l	Tobias Moser	-	-
pspm_get_gaze_y_l	Tobias Moser	-	-
pspm_get_gaze_x_r	Tobias Moser	-	-
pspm_get_gaze_y_r	Tobias Moser	-	-
pspm_get_hb	Dominik Bach	x	x
pspm_get_hp	Dominik Bach	-	-
pspm_get_hr	Dominik Bach	x	x
pspm_get_labchartmat_ext	Dominik Bach	x	x
pspm_get_labchartmat_in	Dominik Bach	x	x
pspm_get_marker	Dominik Bach	x	x
pspm_get_markerinfo	Dominik Bach	-	-
pspm_get_mat	Dominik Bach	x	x
pspm_get_obs	Linus Rüttimann	x	x
pspm_get_physlog	Tobias Moser	-	-
pspm_get_pupil	Dominik Bach	x	x
pspm_get_pupil_l	Tobias Moser	-	-
pspm_get_pupil_r	Tobias Moser	-	-
pspm_get_resp	Dominik Bach	x	x
pspm_get_rf	Dominik Bach	-	-
pspm_get_saccade_l	Laure Ciernik	-	-
pspm_get_saccade_r	Laure Ciernik	-	-
pspm_get_scr	Dominik Bach	x	x
pspm_get_smi	Eshref Yozdemir	-	-
pspm_get_sps	Laure Ciernik	-	-
pspm_get_spike	Dominik Bach	x	x
pspm_get_sound	Tobias Moser	-	-
pspm_get_timing	Dominik Bach	x	x
pspm_get_txt	Dominik Bach	x	x
pspm_get_vario	Dominik Bach	x	x
pspm_get_viewpoint	Eshref Yozdemir	-	-
pspm_get_wdq	Dominik Bach	-	-
pspm_get_wdq_n	Tobias Moser	x	x
pspm_glm_recon	Dominik Bach	-	-
pspm_glm	Dominik Bach	x	x
pspm_hb2hp	Dominik Bach	x	x
pspm_hb2hr	Dominik Bach	-	-
pspm_import	Dominik Bach	x	x
pspm_init	Dominik Bach	-	-
pspm_interpolate	Tobias Moser	x	x
pspm_jobman	Gabriel Gräni	-	-
pspm_job_create	Dominik Bach	-	-

pspm_load_data	Dominik Bach	x	x
pspm_load1	Dominik Bach	x	x
pspm_load_single_chan	Eshref Yozdemir	-	-
pspm_merge	Dominik Bach	-	-
pspm_path	Eshref Yozdemir	x	-
pspm_peakscore	Dominik Bach	-	-
pspm_pp	Dominik Bach	x	x
pspm_ppu2hb	Samuel Gerster	-	-
pspm_predval	Dominik Bach	-	-
pspm_prepdata	Dominik Bach	x	x
pspm_process_illuminance	Tobias Moser	x	-
pspm_pulse_convert	Dominik Bach	x	-
pspm_pupil_correct_eyelink	Eshref Yozdemir	x	-
pspm_pupil_correct	Eshref Yozdemir	x	-
pspm_pupil_pp	Eshref Yozdemir	x	-
pspm_pupil_pp_options	Eshref Yozdemir	-	-
pspm_quit	Dominik Bach	-	-
pspm_ren	Dominik Bach	x	x
pspm_resp_pp	Dominik Bach	-	-
pspm_rev_con	Dominik Bach	-	-
pspm_rev_dcm	Dominik Bach	-	-
pspm_rev_glm	Dominik Bach	-	-
pspm_rev2	Dominik Bach	-	-
pspm_review	Gabriel Graeni	-	-
pspm_segment_mean	Tobias Moser	-	-
pspm_scr_pp	Dadi Zhao	x	x
pspm_sf_auc	Dominik Bach	-	-
pspm_sf_dcm	Dominik Bach	-	-
pspm_sf_mp	Dominik Bach	-	-
pspm_sf_scl	Dominik Bach	-	-
pspm_sf_theta	Dominik Bach	-	-
pspm_sf	Dominik Bach	-	-
pspm_sf_get_theta	Dominik Bach	-	-
pspm_show_arms	Dominik Bach	-	-
pspm_spike_convert	Dominik Bach	-	-
pspm_split_sessions	Linus Rüttimann	x	x
pspm_transfer_function	Dominik Bach	-	-
pspm_time2index	Dadi Zhao	x	x
pspm_trim	Dominik Bach	x	x
pspm_version	Tobias Moser	-	-
pspm_write_channel	Tobias Moser	x	x
set_blinks_saccades_to_nan	Eshref Yozdemir	x	-