

# Package ‘spant’

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**Type** Package

**Title** MR Spectroscopy Analysis Tools

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**Description** Tools for reading, visualising and processing Magnetic Resonance Spectroscopy data. The package includes methods for spectral fitting: Wilson (2021) <DOI:10.1002/mrm.28385> and spectral alignment: Wilson (2018) <DOI:10.1002/mrm.27605>.

**BugReports** <https://github.com/martin3141/spant/issues/>

**License** GPL-3

**RoxygenNote** 7.1.1

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**Language** en-GB

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---------------	--

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### Description

spant provides a set of tools for reading, visualising and processing Magnetic Resonance Spectroscopy (MRS) data.

### Details

To get started with spant, take a look at the introduction vignette:

```
vignette("spant-intro", package="spant")
```

Full list of vignettes:

```
browseVignettes(package = "spant")
```

Full list of functions:

```
help(package = spant, help_type = "html")
```

An online version of the documentation is available from:

<https://martin3141.github.io/spant/>

### Author(s)

**Maintainer:** Martin Wilson <martin@pipegrep.co.uk> ([ORCID](#))

Other contributors:

- Yong Wang [contributor]
- John Muschelli [contributor]

### See Also

Useful links:

- <https://martin3141.github.io/spant/>
- <https://github.com/martin3141/spant/>
- Report bugs at <https://github.com/martin3141/spant/issues/>

---

`abfit_opts`*Return a list of options for an ABfit analysis.*

---

**Description**

Return a list of options for an ABfit analysis.

**Usage**

```
abfit_opts(  
  init_damping = 5,  
  maxiters = 1024,  
  max_shift = 10,  
  max_damping = 15,  
  max_phase = 360,  
  lambda = NULL,  
  ppm_left = 4,  
  ppm_right = 0.2,  
  zp = TRUE,  
  bl_ed_pppm = 2,  
  auto_bl_flex = TRUE,  
  bl_comps_pppm = 15,  
  export_sp_fit = FALSE,  
  max_asym = 0.25,  
  max_basis_shift = 1,  
  max_basis_damping = 2,  
  maxiters_pre = 1000,  
  algo_pre = "NLOPT_LN_NELDERMEAD",  
  min_bl_ed_pppm = NULL,  
  max_bl_ed_pppm = 7,  
  auto_bl_flex_n = 20,  
  pre_fit_bl_ed_pppm = 1,  
  remove_lip_mm_prefit = FALSE,  
  pre_align = TRUE,  
  max_pre_align_shift = 0.1,  
  pre_align_ref_freqs = c(2.01, 3.03, 3.22),  
  noise_region = c(-0.5, -2.5),  
  optimal_smooth_criterion = "maic",  
  aic_smoothing_factor = 5,  
  anal_jac = TRUE,  
  pre_fit_ppm_left = 4,  
  pre_fit_ppm_right = 1.8,  
  phi1_optim = FALSE,  
  phi1_init = 0,  
  max_dphi1 = 0.2,  
  max_basis_shift_broad = 1,  
  max_basis_damping_broad = 2,  
)
```



```

    ahat_calc_method = "lh_pnnls",
    prefit_phase_search = TRUE
)

```

### Arguments

<code>init_damping</code>	initial value of the Gaussian global damping parameter (Hz). Very poorly shimmed or high field data may benefit from a larger value.
<code>maxiters</code>	The maximum number of iterations to run for the detailed fit.
<code>max_shift</code>	The maximum allowable shift to be applied in the optimisation phase of fitting (Hz).
<code>max_damping</code>	maximum permitted value of the global damping parameter (Hz).
<code>max_phase</code>	the maximum absolute permitted value of the global zero-order phase term (degrees). Note, the <code>prefit_phase_search</code> option is not constrained by this term.
<code>lambda</code>	manually set the the baseline smoothness parameter.
<code>ppm_left</code>	downfield frequency limit for the fitting range (ppm).
<code>ppm_right</code>	upfield frequency limit for the fitting range (ppm).
<code>zp</code>	zero pad the data to twice the original length before fitting.
<code>bl_ed_pppm</code>	manually set the the baseline smoothness parameter (ED per ppm).
<code>auto_bl_flex</code>	automatically determine the level of baseline smoothness.
<code>bl_comps_pppm</code>	spline basis density (signals per ppm).
<code>export_sp_fit</code>	add the fitted spline functions to the fit result.
<code>max_asym</code>	maximum allowable value of the asymmetry parameter.
<code>max_basis_shift</code>	maximum allowable frequency shift for individual basis signals (Hz).
<code>max_basis_damping</code>	maximum allowable Lorentzian damping factor for individual basis signals (Hz).
<code>maxiters_pre</code>	maximum iterations for the coarse (pre-)fit.
<code>algo_pre</code>	optimisation method for the coarse (pre-)fit.
<code>min_bl_ed_pppm</code>	minimum value for the candidate baseline flexibility analyses (ED per ppm).
<code>max_bl_ed_pppm</code>	minimum value for the candidate baseline flexibility analyses (ED per ppm).
<code>auto_bl_flex_n</code>	number of candidate baseline analyses to perform.
<code>pre_fit_bl_ed_pppm</code>	level of baseline flexibility to use in the coarse fitting stage of the algorithm (ED per ppm).
<code>remove_lip_mm_prefit</code>	remove broad signals in the coarse fitting stage of the algorithm.
<code>pre_align</code>	perform a pre-alignment step before coarse fitting.
<code>max_pre_align_shift</code>	maximum allowable shift in the pre-alignment step (ppm).
<code>pre_align_ref_freqs</code>	a vector of prominent spectral frequencies used in the pre-alignment step (ppm).

noise_region	spectral region to estimate the noise level (ppm).
optimal_smooth_criterion	method to determine the optimal smoothness.
aic_smoothing_factor	modification factor for the AIC calculation.
anal_jac	use a analytical approximation to the jacobian in the detailed fitting stage.
pre_fit_ppm_left	downfield frequency limit for the fitting range in the coarse fitting stage of the algorithm (ppm).
pre_fit_ppm_right	upfield frequency limit for the fitting range in the coarse fitting stage of the algorithm (ppm).
phi1_optim	apply and optimise a frequency dependant phase term.
phi1_init	initial value for the frequency dependant phase term (ms).
max_dphi1	maximum allowable change from the initial frequency dependant phase term (ms).
max_basis_shift_broad	maximum allowable shift for broad signals in the basis (Hz). Determined based on their name beginning with Lip or MM.
max_basis_damping_broad	maximum allowable Lorentzian damping for broad signals in the basis (Hz). Determined based on their name beginning with Lip or MM.
ahat_calc_method	method to calculate the metabolite amplitudes. May be one of: "lh_pnnls" or "ls".
prefit_phase_search	perform a 1D search for the optimal phase in the prefit stage of the algorithm.

**Value**

full list of options.

**Examples**

```
opts <- abfit_opts(ppm_left = 4.2, noise_region = c(-1, -3))
```

---

abfit_opts_v1_9_0	<i>Return a list of options for an ABfit analysis to maintain comparability with analyses performed with version 1.9.0 (and earlier) of spant.</i>
-------------------	--

---

**Description**

Return a list of options for an ABfit analysis to maintain comparability with analyses performed with version 1.9.0 (and earlier) of spant.

**Usage**

```
abfit_opts_v1_9_0(...)
```

**Arguments**

... arguments passed to [abfit\\_opts](#).

**Value**

full list of options.

---

acquire	<i>Simulate pulse sequence acquisition.</i>
---------	---

---

**Description**

Simulate pulse sequence acquisition.

**Usage**

```
acquire(sys, rec_phase = 180, tol = 1e-04, detect = NULL)
```

**Arguments**

sys	spin system object.
rec_phase	receiver phase in degrees.
tol	ignore resonance amplitudes below this threshold.
detect	detection nuclei.

**Value**

a list of resonance amplitudes and frequencies.

---

align	<i>Align spectra to a reference frequency using a convolution based method.</i>
-------	---

---

**Description**

Align spectra to a reference frequency using a convolution based method.

**Usage**

```
align(
  mrs_data,
  ref_freq = 4.65,
  zf_factor = 2,
  lb = 2,
  max_shift = 20,
  ret_df = FALSE
)
```

**Arguments**

mrs_data	data to be aligned.
ref_freq	reference frequency in ppm units. More than one frequency may be specified.
zf_factor	zero filling factor to increase alignment resolution.
lb	line broadening to apply to the reference signal.
max_shift	maximum allowable shift in Hz.
ret_df	return frequency shifts in addition to aligned data (logical).

**Value**

aligned data object.

---

apodise_xy	<i>Apodise MRSI data in the x-y direction with a k-space filter.</i>
------------	--

---

**Description**

Apodise MRSI data in the x-y direction with a k-space filter.

**Usage**

```
apodise_xy(mrs_data, func = "hamming", w = 2.5)
```

**Arguments**

mrs_data	MRSI data.
func	must be "hamming" or "gaussian".
w	the reciprocal of the standard deviation for the gaussian function.

**Value**

apodised data.

---

append_basis	<i>Combine a pair of basis set objects.</i>
--------------	---

---

**Description**

Combine a pair of basis set objects.

**Usage**

```
append_basis(basis_a, basis_b)
```

**Arguments**

basis_a	first basis.
basis_b	second basis.

**Value**

combined basis set object.

---

append_coils	<i>Append MRS data across the coil dimension, assumes they matched across the other dimensions.</i>
--------------	---

---

**Description**

Append MRS data across the coil dimension, assumes they matched across the other dimensions.

**Usage**

```
append_coils(...)
```

**Arguments**

...	MRS data objects as arguments, or a list of MRS data objects.
-----	---

**Value**

a single MRS data object with the input objects concatenated together.

---

append_dyns	<i>Append MRS data across the dynamic dimension, assumes they matched across the other dimensions.</i>
-------------	--

---

**Description**

Append MRS data across the dynamic dimension, assumes they matched across the other dimensions.

**Usage**

```
append_dyns(...)
```

**Arguments**

... MRS data objects as arguments, or a list of MRS data objects.

**Value**

a single MRS data object with the input objects concatenated together.

---

apply_axes	<i>Apply a function over specified array axes.</i>
------------	--

---

**Description**

Apply a function over specified array axes.

**Usage**

```
apply_axes(x, axes, fun, ...)
```

**Arguments**

x	an array.
axes	a vector of axes to apply fun over.
fun	function to be applied.
...	optional arguments to fun.

**Value**

array.

**Examples**

```
z <- array(1:1000, dim = c(10, 10, 10))
a <- apply_axes(z, 3, fft)
a[1,1,] == fft(z[1,1,])
a <- apply_axes(z, 3, sum)
a[1,1,] == sum(z[1,1,])
```

---

 apply\_mrs

*Apply a function across given dimensions of a MRS data object.*


---

**Description**

Apply a function across given dimensions of a MRS data object.

**Usage**

```
apply_mrs(mrs_data, dims, fun, ..., data_only = FALSE)
```

**Arguments**

mrs_data	MRS data.
dims	dimensions to apply the function.
fun	name of the function.
...	arguments to the function.
data_only	return an array rather than an MRS data object.

---

apply\_pvc

*Convert default LCM/TARQUIN concentration scaling to molal units with partial volume correction.*


---

**Description**

Convert default LCM/TARQUIN concentration scaling to molal units with partial volume correction.

**Usage**

```
apply_pvc(fit_result, p_vols, te, tr)
```

**Arguments**

fit_result	a fit_result object to apply partial volume correction.
p_vols	a numeric vector of partial volumes.
te	the MRS TE.
tr	the MRS TR.

**Value**

a `fit_result` object with a rescaled results table.

---

<code>Arg.mrs_data</code>	<i>Apply Arg operator to an MRS dataset.</i>
---------------------------	--

---

**Description**

Apply Arg operator to an MRS dataset.

**Usage**

```
## S3 method for class 'mrs_data'
Arg(z)
```

**Arguments**

`z` MRS data.

**Value**

MRS data following Arg operator.

---

<code>array2mrs_data</code>	<i>Convert a 7 dimensional array in into a mrs_data object. The array dimensions should be ordered as : dummy, X, Y, Z, dynamic, coil, FID.</i>
-----------------------------	---

---

**Description**

Convert a 7 dimensional array in into a `mrs_data` object. The array dimensions should be ordered as : dummy, X, Y, Z, dynamic, coil, FID.

**Usage**

```
array2mrs_data(
  data_array,
  fs = def_fs(),
  ft = def_ft(),
  ref = def_ref(),
  nuc = def_nuc(),
  fd = FALSE
)
```



**Arguments**

data_array	7d data array.
fs	sampling frequency in Hz.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
nuc	nucleus that is resonant at the transmitter frequency.
fd	flag to indicate if the matrix is in the frequency domain (logical).

**Value**

mrs\_data object.

---

auto_phase	<i>Perform zeroth-order phase correction based on the minimisation of the squared difference between the real and magnitude components of the spectrum.</i>
------------	---

---

**Description**

Perform zeroth-order phase correction based on the minimisation of the squared difference between the real and magnitude components of the spectrum.

**Usage**

```
auto_phase(mrs_data, xlim = NULL, ret_phase = FALSE)
```

**Arguments**

mrs_data	an object of class mrs_data.
xlim	frequency range (default units of PPM) to including in the phase.
ret_phase	return phase values (logical).

**Value**

MRS data object and phase values (optional).

---

back_extrap_ar	<i>Back extrapolate time-domain data points using an autoregressive model.</i>
----------------	--

---

### Description

Back extrapolate time-domain data points using an autoregressive model.

### Usage

```
back_extrap_ar(
  mrs_data,
  extrap_pts,
  pred_pts = NULL,
  method = "burg",
  rem_add = TRUE,
  ...
)
```

### Arguments

mrs_data	mrs_data object.
extrap_pts	number of points to extrapolate.
pred_pts	number of points to base the extrapolation on.
method	character string specifying the method to fit the model. Must be one of the strings in the default argument (the first few characters are sufficient). Defaults to "burg".
rem_add	remove additional points from the end of the FID to maintain the original length of the dataset. Default to TRUE.
...	additional arguments to specific methods, see ?ar.

### Value

back extrapolated data.

---

basis2mrs_data	<i>Convert a basis object to an mrs_data object - where basis signals are spread across the dynamic dimension.</i>
----------------	--

---

### Description

Convert a basis object to an mrs\_data object - where basis signals are spread across the dynamic dimension.

**Usage**

```
basis2mrs_data(basis, sum_elements = FALSE, amp = NULL, shift = NULL)
```

**Arguments**

basis	basis set object.
sum_elements	return the sum of basis elements (logical)
amp	a vector of scaling factors to apply to each basis element.
shift	a vector of frequency shifts (in PPM) to apply to each basis element.

**Value**

an mrs\_data object with basis signals spread across the dynamic dimension or summed.

---

bbase	<i>Generate a spline basis, slightly adapted from : "Splines, knots, and penalties", Eilers 2010.</i>
-------	---

---

**Description**

Generate a spline basis, slightly adapted from : "Splines, knots, and penalties", Eilers 2010.

**Usage**

```
bbase(N, number, deg = 3)
```

**Arguments**

N	number of data points.
number	number of spline functions.
deg	spline degree : deg = 1 linear, deg = 2 quadratic, deg = 3 cubic.

**Value**

spline basis as a matrix.

---

bc_als	<i>Baseline correction using the ALS method.</i>
--------	--

---

**Description**

Baseline correction using the ALS method.

**Usage**

```
bc_als(mrs_data, lambda = 10000, p = 0.001)
```

**Arguments**

mrs_data	mrs_data object.
lambda	lambda parameter.
p	p parameter.

**Value**

baseline corrected data.

---

bc_constant	<i>Remove a constant baseline offset based on a reference spectral region.</i>
-------------	--

---

**Description**

Remove a constant baseline offset based on a reference spectral region.

**Usage**

```
bc_constant(mrs_data, xlim)
```

**Arguments**

mrs_data	MRS data.
xlim	spectral range containing a flat baseline region to measure the offset.

**Value**

baseline corrected data.

---

beta2lw	<i>Covert a beta value in the time-domain to an equivalent linewidth in Hz: <math>x * \exp(-i * t * t * \text{beta})</math>.</i>
---------	--

---

**Description**

Covert a beta value in the time-domain to an equivalent linewidth in Hz:  $x * \exp(-i * t * t * \text{beta})$ .

**Usage**

```
beta2lw(beta)
```

**Arguments**

beta            beta damping value.

**Value**

linewidth value in Hz.

---

calc_coil_noise_cor	<i>Calculate the noise correlation between coil elements.</i>
---------------------	---

---

**Description**

Calculate the noise correlation between coil elements.

**Usage**

```
calc_coil_noise_cor(noise_data)
```

**Arguments**

noise\_data      mrs\_data object with one FID for each coil element.

**Value**

correlation matrix.

---

calc\_coil\_noise\_sd     *Calculate the noise standard deviation for each coil element.*

---

**Description**

Calculate the noise standard deviation for each coil element.

**Usage**

```
calc_coil_noise_sd(noise_data)
```

**Arguments**

noise\_data     mrs\_data object with one FID for each coil element.

**Value**

array of standard deviations.

---

calc\_ed\_from\_lambda     *Calculate the effective dimensions of a spline smoother from lambda.*

---

**Description**

Calculate the effective dimensions of a spline smoother from lambda.

**Usage**

```
calc_ed_from_lambda(spline_basis, deriv_mat, lambda)
```

**Arguments**

spline\_basis     spline basis.  
deriv\_mat        derivative matrix.  
lambda            smoothing parameter.

**Value**

the effective dimension value.

---

calc_peak_info_vec	<i>Calculate the FWHM of a peak from a vector of intensity values.</i>
--------------------	--

---

**Description**

Calculate the FWHM of a peak from a vector of intensity values.

**Usage**

```
calc_peak_info_vec(data_pts, interp_f)
```

**Arguments**

data_pts	input vector.
interp_f	interpolation factor to improve the FWHM estimate.

**Value**

a vector of: x position of the highest data point, maximum peak value in the y axis, FWHM in the units of data points.

---

calc_sd_poly	<i>Perform a polynomial fit, subtract and return the standard deviation of the residuals.</i>
--------------	---

---

**Description**

Perform a polynomial fit, subtract and return the standard deviation of the residuals.

**Usage**

```
calc_sd_poly(y, degree = 1)
```

**Arguments**

y	array.
degree	polynomial degree.

**Value**

standard deviation of the fit residuals.

---

calc_spec_diff	<i>Calculate the sum of squares differences between two mrs_data objects.</i>
----------------	---

---

**Description**

Calculate the sum of squares differences between two mrs\_data objects.

**Usage**

```
calc_spec_diff(mrs_data, ref = NULL, xlim = c(4, 0.5))
```

**Arguments**

mrs_data	mrs_data object.
ref	reference mrs_data object to calculate differences.
xlim	spectral limits to perform calculation.

**Value**

an array of the sum of squared difference values.

---

calc_spec_snr	<i>Calculate the spectral SNR.</i>
---------------	------------------------------------

---

**Description**

SNR is defined as the maximum signal value divided by the standard deviation of the noise.

**Usage**

```
calc_spec_snr(  
  mrs_data,  
  sig_region = c(4, 0.5),  
  noise_region = c(-0.5, -2.5),  
  p_order = 2,  
  interp_f = 4,  
  full_output = FALSE  
)
```



**Arguments**

mrs_data	an object of class mrs_data.
sig_region	a ppm region to define where the maximum signal value should be estimated.
noise_region	a ppm region to defined where the noise level should be estimated.
p_order	polynomial order to fit to the noise region before estimating the standard deviation.
interp_f	interpolation factor to improve detection of the highest signal value.
full_output	output signal, noise and SNR values separately.

**Details**

The mean noise value is subtracted from the maximum signal value to reduce DC offset bias. A polynomial detrending fit (second order by default) is applied to the noise region before the noise standard deviation is estimated.

**Value**

an array of SNR values.

---

check_lcm	<i>Check LCMModel can be run</i>
-----------	----------------------------------

---

**Description**

Check LCMModel can be run

**Usage**

```
check_lcm()
```

---

check_tqn	<i>Check the TARQUIN binary can be run</i>
-----------	--

---

**Description**

Check the TARQUIN binary can be run

**Usage**

```
check_tqn()
```

---

circ_mask	<i>Create a logical circular mask spanning the full extent of an n x n matrix.</i>
-----------	--

---

**Description**

Create a logical circular mask spanning the full extent of an n x n matrix.

**Usage**

```
circ_mask(d, n, offset = 1)
```

**Arguments**

d	diameter of the mask.
n	number of matrix rows and columns.
offset	offset the mask centre in matrix dimension units.

**Value**

logical n x n mask matrix.

---

collapse_to_dyns	<i>Collapse MRS data by concatenating spectra along the dynamic dimension.</i>
------------------	--

---

**Description**

Collapse MRS data by concatenating spectra along the dynamic dimension.

**Usage**

```
collapse_to_dyns(x, rm_masked = FALSE)
```

```
## S3 method for class 'mrs_data'
collapse_to_dyns(x, rm_masked = FALSE)
```

```
## S3 method for class 'fit_result'
collapse_to_dyns(x, rm_masked = FALSE)
```

**Arguments**

x	data object to be collapsed (mrs_data or fit_result object).
rm_masked	remove masked dynamics from the output.

**Value**

collapsed data with spectra or fits concatenated along the dynamic dimension.

---

comb_coils	<i>Combine coil data based on the first data point of a reference signal.</i>
------------	---

---

**Description**

By default, elements are phased and scaled prior to summation. Where a reference signal is not given, the mean dynamic signal will be used instead.

**Usage**

```
comb_coils(
  metab,
  ref = NULL,
  noise = NULL,
  scale = TRUE,
  scale_method = "sig_noise_sq",
  sum_coils = TRUE,
  noise_region = c(-0.5, -2.5),
  average_ref_dyns = TRUE
)
```

**Arguments**

metab	MRS data containing metabolite data.
ref	MRS data containing reference data (optional).
noise	MRS data from a noise scan (optional).
scale	option to rescale coil elements based on the first data point (logical).
scale_method	one of "sig_noise_sq", "sig_noise" or "sig".
sum_coils	sum the coil elements as a final step (logical).
noise_region	the spectral region (in ppm) to estimate the noise.
average_ref_dyns	take the mean of the reference scans in the dynamic dimension before use.

**Value**

MRS data.

---

comb_csv_results	<i>Combine the results from multiple csv format files into a table.</i>
------------------	---

---

**Description**

Combine the results from multiple csv format files into a table.

**Usage**

```
comb_csv_results(pattern, supp_mess = TRUE, ...)
```

**Arguments**

pattern	glob string to match csv files.
supp_mess	suppress messages from the read_csv function.
...	extra parameters to pass to read_csv.

**Value**

results table.

---

comb_fits	<i>Combine a list of fit_result objects into a single fit object containing a dynamic series.</i>
-----------	---

---

**Description**

Combine a list of fit\_result objects into a single fit object containing a dynamic series.

**Usage**

```
comb_fits(fit_list)
```

**Arguments**

fit_list	list of fit_result objects.
----------	-----------------------------

**Value**

fit\_result object.

---

comb_metab_ref	<i>Combine a reference and metabolite mrs_data object.</i>
----------------	--

---

**Description**

Combine a reference and metabolite mrs\_data object.

**Usage**

```
comb_metab_ref(metab, ref)
```

**Arguments**

metab	metabolite mrs_data object.
ref	reference mrs_data object.

**Value**

combined metabolite and reference mrs\_data object.

---

Conj.mrs_data	<i>Apply Conj operator to an MRS dataset.</i>
---------------	---

---

**Description**

Apply Conj operator to an MRS dataset.

**Usage**

```
## S3 method for class 'mrs_data'  
Conj(z)
```

**Arguments**

z	MRS data.
---	-----------

**Value**

MRS data following Conj operator.

---

conv_mrs	<i>Convolve two MRS data objects.</i>
----------	---------------------------------------

---

**Description**

Convolve two MRS data objects.

**Usage**

```
conv_mrs(mrs_data, conv)
```

**Arguments**

mrs_data	MRS data to be convolved.
conv	convolution data stored as an mrs_data object.

**Value**

convolved data.

---

crop_spec	<i>Crop mrs_data object based on a frequency range.</i>
-----------	---

---

**Description**

Crop mrs\_data object based on a frequency range.

**Usage**

```
crop_spec(mrs_data, xlim = c(4, 0.2), scale = "ppm")
```

**Arguments**

mrs_data	MRS data.
xlim	range of values to crop in the spectral dimension eg xlim = c(4, 0.2).
scale	the units to use for the frequency scale, can be one of: "ppm", "hz" or "points".

**Value**

cropped mrs\_data object.

---

crop_td_pts	<i>Crop mrs_data object data points in the time-domain.</i>
-------------	---

---

**Description**

Crop mrs\_data object data points in the time-domain.

**Usage**

```
crop_td_pts(mrs_data, start = NULL, end = NULL)
```

**Arguments**

mrs_data	MRS data.
start	starting data point (defaults to 1).
end	ending data point (defaults to the last saved point).

**Value**

cropped mrs\_data object.

---

crop_xy	<i>Crop an MRSI dataset in the x-y direction</i>
---------	--

---

**Description**

Crop an MRSI dataset in the x-y direction

**Usage**

```
crop_xy(mrs_data, x_dim, y_dim)
```

**Arguments**

mrs_data	MRS data object.
x_dim	x dimension output length.
y_dim	y dimension output length.

**Value**

selected subset of MRS data.

---

crossprod_3d	<i>Compute the vector cross product between vectors x and y. Adapted from <a href="http://stackoverflow.com/questions/15162741/what-is-rs-crossproduct-function">http://stackoverflow.com/questions/15162741/what-is-rs-crossproduct-function</a></i>
--------------	---

---

**Description**

Compute the vector cross product between vectors x and y. Adapted from <http://stackoverflow.com/questions/15162741/what-is-rs-crossproduct-function>

**Usage**

```
crossprod_3d(x, y)
```

**Arguments**

x	vector of length 3.
y	vector of length 3.

**Value**

vector cross product of x and y.

---

decimate_mrs_fd	<i>Decimate an MRS signal to half the original sampling frequency by filtering in the frequency domain before down sampling.</i>
-----------------	--

---

**Description**

Decimate an MRS signal to half the original sampling frequency by filtering in the frequency domain before down sampling.

**Usage**

```
decimate_mrs_fd(mrs_data)
```

**Arguments**

mrs_data	MRS data object.
----------	------------------

**Value**

decimated data at half the original sampling frequency.



---

decimate_mrs_td	<i>Decimate an MRS signal by filtering in the time domain before downsampling.</i>
-----------------	--

---

**Description**

Decimate an MRS signal by filtering in the time domain before downsampling.

**Usage**

```
decimate_mrs_td(mrs_data, q = 2, n = 4, ftype = "iir")
```

**Arguments**

mrs_data	MRS data object.
q	integer factor to downsample by (default = 2).
n	filter order used in the downsampling.
ftype	filter type, "iir" or "fir".

**Value**

decimated data.

---

def_acq_paras	<i>Return (and optionally modify using the input arguments) a list of the default acquisition parameters.</i>
---------------	---

---

**Description**

Return (and optionally modify using the input arguments) a list of the default acquisition parameters.

**Usage**

```
def_acq_paras(
  ft = getOption("spant.def_ft"),
  fs = getOption("spant.def_fs"),
  N = getOption("spant.def_N"),
  ref = getOption("spant.def_ref"),
  nuc = getOption("spant.def_nuc")
)
```

**Arguments**

ft	specify the transmitter frequency in Hz.
fs	specify the sampling frequency in Hz.
N	specify the number of data points in the spectral dimension.
ref	specify the reference value for ppm scale.
nuc	specify the resonant nucleus.

**Value**

A list containing the following elements:

- ft transmitter frequency in Hz.
- fs sampling frequency in Hz.
- N number of data points in the spectral dimension.
- ref reference value for ppm scale.
- nuc resonant nucleus.

---

def_fs	<i>Return the default sampling frequency in Hz.</i>
--------	---

---

**Description**

Return the default sampling frequency in Hz.

**Usage**

```
def_fs()
```

**Value**

sampling frequency in Hz.

---

def_ft	<i>Return the default transmitter frequency in Hz.</i>
--------	--

---

**Description**

Return the default transmitter frequency in Hz.

**Usage**

```
def_ft()
```

**Value**

transmitter frequency in Hz.

---

def_N	<i>Return the default number of data points in the spectral dimension.</i>
-------	--

---

**Description**

Return the default number of data points in the spectral dimension.

**Usage**

def\_N()

**Value**

number of data points in the spectral dimension.

---

def_nuc	<i>Return the default nucleus.</i>
---------	------------------------------------

---

**Description**

Return the default nucleus.

**Usage**

def\_nuc()

**Value**

number of data points in the spectral dimension.

---

def_ref	<i>Return the default reference value for ppm scale.</i>
---------	--

---

**Description**

Return the default reference value for ppm scale.

**Usage**

def\_ref()

**Value**

reference value for ppm scale.

---

dicom_reader	<i>A very simple DICOM reader.</i>
--------------	------------------------------------

---

### Description

Note this reader is very basic and does not use a DICOM dictionary or try to convert the data to the correct datatype. For a more robust and sophisticated reader use the oro.dicom package.

### Usage

```
dicom_reader(
  input,
  tags = list(sop_class_uid = "0008,0016"),
  endian = "little",
  debug = FALSE
)
```

### Arguments

input	either a file path or raw binary object.
tags	a named list of tags to be extracted from the file. eg tags <- list(spec_data = "7FE1,1010", pat_name = "0010,0010")
endian	can be "little" or "big".
debug	print out some debugging information, can be "little" or "big".

### Value

a list with the same structure as the input, but with tag codes replaced with the corresponding data in a raw format.

---

diff_mrs	<i>Apply the diff operator to an MRS dataset in the FID/spectral dimension.</i>
----------	---

---

### Description

Apply the diff operator to an MRS dataset in the FID/spectral dimension.

### Usage

```
diff_mrs(mrs_data, ...)
```

### Arguments

mrs_data	MRS data.
...	additional arguments to the diff function.

**Value**

MRS data following diff operator.

---

downsample_mrs_fd	<i>Downsample an MRS signal by a factor of 2 using an FFT "brick-wall" filter.</i>
-------------------	--

---

**Description**

Downsample an MRS signal by a factor of 2 using an FFT "brick-wall" filter.

**Usage**

```
downsample_mrs_fd(mrs_data)
```

**Arguments**

mrs\_data          MRS data object.

**Value**

downsampled data.

---

downsample_mrs_td	<i>Downsample an MRS signal by a factor of 2 by removing every other data point in the time-domain. Note, signals outside the new sampling frequency will be aliased.</i>
-------------------	---

---

**Description**

Downsample an MRS signal by a factor of 2 by removing every other data point in the time-domain. Note, signals outside the new sampling frequency will be aliased.

**Usage**

```
downsample_mrs_td(mrs_data)
```

**Arguments**

mrs\_data          MRS data object.

**Value**

downsampled data.

---

ecc *Eddy current correction.*

---

### Description

Apply eddy current correction using the Klose method.

### Usage

```
ecc(metab, ref, rev = FALSE)
```

### Arguments

metab	MRS data to be corrected.
ref	reference dataset.
rev	reverse the correction.

### Details

In vivo proton spectroscopy in presence of eddy currents. Klose U. Magn Reson Med. 1990 Apr;14(1):26-30.

### Value

corrected data in the time domain.

---

est\_noise\_sd *Estimate the standard deviation of the noise from a segment of an mrs\_data object.*

---

### Description

Estimate the standard deviation of the noise from a segment of an mrs\_data object.

### Usage

```
est_noise_sd(mrs_data, n = 100, offset = 100, p_order = 2)
```

### Arguments

mrs_data	MRS data object.
n	number of data points (taken from the end of array) to use in the estimation.
offset	number of final points to exclude from the calculation.
p_order	polynomial order to fit to the data before estimating the standard deviation.

**Value**

standard deviation array.

---

fd2td	<i>Transform frequency-domain data to the time-domain.</i>
-------	--

---

**Description**

Transform frequency-domain data to the time-domain.

**Usage**

```
fd2td(mrs_data)
```

**Arguments**

mrs\_data      MRS data in frequency-domain representation.

**Value**

MRS data in time-domain representation.

---

fd_conv_filt	<i>Frequency-domain convolution based filter.</i>
--------------	---

---

**Description**

Frequency-domain convolution based filter.

**Usage**

```
fd_conv_filt(mrs_data, K = 25, ext = 1)
```

**Arguments**

mrs\_data      MRS data to be filtered.  
 K              window width in data points.  
 ext            point separation for linear extrapolation.

---

fit_amps	<i>Extract the fit amplitudes from an object of class fit_result.</i>
----------	---

---

**Description**

Extract the fit amplitudes from an object of class fit\_result.

**Usage**

```
fit_amps(  
  x,  
  inc_index = FALSE,  
  sort_names = FALSE,  
  append_common_1h_comb = TRUE  
)
```

**Arguments**

x	fit_result object.
inc_index	include columns for the voxel index.
sort_names	sort the basis set names alphabetically.
append_common_1h_comb	append commonly used 1H metabolite combinations eg tNAA = NAA + NAAG.

**Value**

a dataframe of amplitudes.

---

fit_diags	<i>Calculate diagnostic information for object of class fit_result.</i>
-----------	---

---

**Description**

Calculate diagnostic information for object of class fit\_result.

**Usage**

```
fit_diags(x, amps = NULL)
```

**Arguments**

x	fit_result object.
amps	known metabolite amplitudes.

**Value**

a dataframe of diagnostic information.



---

fit_mrs	<i>Perform a fit based analysis of MRS data.</i>
---------	--

---

### Description

Note that TARQUIN and LCModel require these packages to be installed, and the functions `set_tqn_cmd` and `set_lcm_cmd` (respectively) need to be used to specify the location of these software packages.

### Usage

```
fit_mrs(  
  metab,  
  basis = NULL,  
  method = "ABFIT",  
  w_ref = NULL,  
  opts = NULL,  
  parallel = FALSE,  
  time = TRUE,  
  progress = "text"  
)
```

### Arguments

<code>metab</code>	metabolite data.
<code>basis</code>	basis class object or character vector to basis file in LCModel .basis format.
<code>method</code>	'ABFIT' (default), 'VARPRO', 'VARPRO_3P', 'TARQUIN' or 'LCMODEL'.
<code>w_ref</code>	water reference data for concentration scaling (optional).
<code>opts</code>	options to pass to the analysis method.
<code>parallel</code>	perform analyses in parallel (TRUE or FALSE).
<code>time</code>	measure the time taken for the analysis to complete (TRUE or FALSE).
<code>progress</code>	option is passed to <code>plyr::alply</code> function to display a progress bar during fitting. Default value is "text", set to "none" to disable.

### Details

Fitting approaches described in the following references: ABfit Wilson, M. Adaptive baseline fitting for 1H MR spectroscopy analysis. *Magn Reson Med* 2012;85:13-29.

VARPRO van der Veen JW, de Beer R, Luyten PR, van Ormondt D. Accurate quantification of in vivo 31P NMR signals using the variable projection method and prior knowledge. *Magn Reson Med* 1988;6:92-98.

TARQUIN Wilson, M., Reynolds, G., Kauppinen, R. A., Arvanitis, T. N. & Peet, A. C. A constrained least-squares approach to the automated quantitation of in vivo 1H magnetic resonance spectroscopy data. *Magn Reson Med* 2011;65:1-12.

LCModel Provencher SW. Estimation of metabolite concentrations from localized in vivo proton NMR spectra. *Magn Reson Med* 1993;30:672-679.

**Value**

MRS analysis object.

**Examples**

```
fname <- system.file("extdata","philips_spar_sdat_WS.SDAT",package="spant")
svs <- read_mrs(fname, format="spar_sdat")
## Not run:
basis <- sim_basis_1h_brain_press(svs)
fit_result <- fit_mrs(svs, basis)

## End(Not run)
```

---

fit_res2csv	<i>Write fit results table to a csv file.</i>
-------------	---

---

**Description**

Write fit results table to a csv file.

**Usage**

```
fit_res2csv(fit_res, fname, unscaled = FALSE)
```

**Arguments**

fit_res	fit result object.
fname	filename of csv file.
unscaled	output the unscaled result table (default = FALSE).

---

fp_phase	<i>Return the phase of the first data point in the time-domain.</i>
----------	---

---

**Description**

Return the phase of the first data point in the time-domain.

**Usage**

```
fp_phase(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

**Value**

phase values in degrees.

---

fp_phase_correct	<i>Perform a zeroth order phase correction based on the phase of the first data point in the time-domain.</i>
------------------	---

---

**Description**

Perform a zeroth order phase correction based on the phase of the first data point in the time-domain.

**Usage**

```
fp_phase_correct(mrs_data, ret_phase = FALSE)
```

**Arguments**

mrs_data	MRS data to be corrected.
ret_phase	return phase values (logical).

**Value**

corrected data or a list with corrected data and optional phase values.

---

fp_scale	<i>Scale the first time-domain data point in an mrs_data object.</i>
----------	--

---

**Description**

Scale the first time-domain data point in an mrs\_data object.

**Usage**

```
fp_scale(mrs_data, scale = 0.5)
```

**Arguments**

mrs_data	MRS data.
scale	scaling value, defaults to 0.5.

**Value**

scaled mrs\_data object.

---

fs	<i>Return the sampling frequency in Hz of an MRS dataset.</i>
----	---

---

**Description**

Return the sampling frequency in Hz of an MRS dataset.

**Usage**

```
fs(mrs_data)
```

**Arguments**

mrs\_data      MRS data.

**Value**

sampling frequency in Hz.

---

ft_shift	<i>Perform a fft and fshift on a vector.</i>
----------	--

---

**Description**

Perform a fft and fshift on a vector.

**Usage**

```
ft_shift(vec_in)
```

**Arguments**

vec\_in      vector input.

**Value**

output vector.

---

ft_shift_mat	<i>Perform a fft and fftshift on a matrix with each column replaced by its shifted fft.</i>
--------------	---

---

**Description**

Perform a fft and fftshift on a matrix with each column replaced by its shifted fft.

**Usage**

```
ft_shift_mat(mat_in)
```

**Arguments**

mat\_in            matrix input.

**Value**

output matrix.

---

gen_F	<i>Generate the F product operator.</i>
-------	---

---

**Description**

Generate the F product operator.

**Usage**

```
gen_F(sys, op, detect = NULL)
```

**Arguments**

sys                spin system object.  
op                 operator, one of "x", "y", "z", "p", "m".  
detect             detection nuclei.

**Value**

F product operator matrix.

---

gen_F_xy	<i>Generate the Fxy product operator with a specified phase.</i>
----------	--

---

**Description**

Generate the Fxy product operator with a specified phase.

**Usage**

```
gen_F_xy(sys, phase, detect = NULL)
```

**Arguments**

sys	spin system object.
phase	phase angle in degrees.
detect	detection nuclei.

**Value**

product operator matrix.

---

get_1h_brain_basis_paras	<i>Return a list of mol_parameter objects suitable for 1H brain MRS analyses.</i>
--------------------------	---

---

**Description**

Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.

**Usage**

```
get_1h_brain_basis_paras(ft, metab_lw = NULL, lcm_compat = FALSE)
```

**Arguments**

ft	transmitter frequency in Hz.
metab_lw	linewidth of metabolite signals (Hz).
lcm_compat	when TRUE, lipid, MM and -CrCH molecules will be excluded from the output.

**Value**

list of mol\_parameter objects.

---

get\_1h\_brain\_basis\_paras\_v1

*Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.*

---

**Description**

Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.

**Usage**

```
get_1h_brain_basis_paras_v1(ft, metab_lw = NULL, lcm_compat = FALSE)
```

**Arguments**

ft	transmitter frequency in Hz.
metab_lw	linewidth of metabolite signals (Hz).
lcm_compat	when TRUE, lipid, MM and -CrCH molecules will be excluded from the output.

**Value**

list of mol\_parameter objects.

---

get\_1h\_brain\_basis\_paras\_v2

*Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.*

---

**Description**

Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.

**Usage**

```
get_1h_brain_basis_paras_v2(ft, metab_lw = NULL, lcm_compat = FALSE)
```

**Arguments**

ft	transmitter frequency in Hz.
metab_lw	linewidth of metabolite signals (Hz).
lcm_compat	when TRUE, lipid, MM and -CrCH molecules will be excluded from the output.

**Value**

list of mol\_parameter objects.

---

get\_1h\_brain\_basis\_paras\_v3

*Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.*

---

### Description

Return a list of mol\_parameter objects suitable for 1H brain MRS analyses.

### Usage

```
get_1h_brain_basis_paras_v3(ft, metab_lw = NULL, lcm_compat = FALSE)
```

### Arguments

ft	transmitter frequency in Hz.
metab_lw	linewidth of metabolite signals (Hz).
lcm_compat	when TRUE, lipid, MM and -CrCH molecules will be excluded from the output.

### Value

list of mol\_parameter objects.

---

get\_2d\_psf

*Get the point spread function (PSF) for a 2D phase encoded MRSI scan.*

---

### Description

Get the point spread function (PSF) for a 2D phase encoded MRSI scan.

### Usage

```
get_2d_psf(FOV = 160, mat_size = 16, sampling = "circ", hamming = FALSE)
```

### Arguments

FOV	field of view in mm.
mat_size	acquisition matrix size (not interpolated).
sampling	can be either "circ" for circular or "rect" for rectangular.
hamming	should Hamming k-space weighting be applied (default FALSE).

### Value

A matrix of the PSF with 1mm resolution.



---

get_acq_paras	<i>Return acquisition parameters from a MRS data object.</i>
---------------	--

---

**Description**

Return acquisition parameters from a MRS data object.

**Usage**

```
get_acq_paras(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

**Value**

list of acquisition parameters.

---

get_dyns	<i>Extract a subset of dynamic scans.</i>
----------	---

---

**Description**

Extract a subset of dynamic scans.

**Usage**

```
get_dyns(mrs_data, subset)
```

**Arguments**

mrs_data	dynamic MRS data.
subset	vector containing indices to the dynamic scans to be returned.

**Value**

MRS data containing the subset of requested dynamics.

---

get\_even\_dyns                      *Return even numbered dynamic scans starting from 1 (2,4,6...).*

---

**Description**

Return even numbered dynamic scans starting from 1 (2,4,6...).

**Usage**

```
get_even_dyns(mrs_data)
```

**Arguments**

mrs\_data                      dynamic MRS data.

**Value**

dynamic MRS data containing even numbered scans.

---

get\_fh\_dyns                      *Return the first half of a dynamic series.*

---

**Description**

Return the first half of a dynamic series.

**Usage**

```
get_fh_dyns(mrs_data)
```

**Arguments**

mrs\_data                      dynamic MRS data.

**Value**

first half of the dynamic series.

---

get_fit_map	<i>Get a data array from a fit result.</i>
-------------	--

---

**Description**

Get a data array from a fit result.

**Usage**

```
get_fit_map(fit_res, name)
```

**Arguments**

fit_res	fit_result object.
name	name of the quantity to plot, eg "tNAA".

---

get_fit_table	<i>Combine all fitting data points into a single dataframe.</i>
---------------	---

---

**Description**

Combine all fitting data points into a single dataframe.

**Usage**

```
get_fit_table(fit_res)
```

**Arguments**

fit_res	a single fit_result object.
---------	-----------------------------

**Value**

a dataframe containing the fit data points.

---

get_fp	<i>Return the first time-domain data point.</i>
--------	---

---

**Description**

Return the first time-domain data point.

**Usage**

```
get_fp(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

**Value**

first time-domain data point.

---

get_guassian_pulse	<i>Generate a gaussian pulse shape.</i>
--------------------	---

---

**Description**

Generate a gaussian pulse shape.

**Usage**

```
get_guassian_pulse(angle, n, trunc = 1)
```

**Arguments**

angle	pulse angle in degrees.
n	number of points to generate.
trunc	percentage truncation factor.

---

get_metab	<i>Extract the metabolite component from an mrs_data object.</i>
-----------	--

---

**Description**

Extract the metabolite component from an mrs\_data object.

**Usage**

```
get_metab(mrs_data)
```

**Arguments**

mrs\_data      MRS data.

**Value**

metabolite component.

---

get_mol_names	<i>Return a character array of names that may be used with the get_mol_paras function.</i>
---------------	--

---

**Description**

Return a character array of names that may be used with the get\_mol\_paras function.

**Usage**

```
get_mol_names()
```

**Value**

a character array of names.

---

get_mol_paras	<i>Get a mol_parameters object for a named molecule.</i>
---------------	--

---

**Description**

Get a mol\_parameters object for a named molecule.

**Usage**

```
get_mol_paras(name, ...)
```

**Arguments**

name	the name of the molecule.
...	arguments to pass to molecule definition function.

---

get_mrsi2d_seg	<i>Calculate the partial volume estimates for each voxel in a 2D MRSI dataset.</i>
----------------	--

---

**Description**

Localisation is assumed to be perfect in the z direction and determined by the ker input in the x-y direction.

**Usage**

```
get_mrsi2d_seg(mrs_data, mri_seg, ker)
```

**Arguments**

mrs_data	2D MRSI data with multiple voxels in the x-y dimension.
mri_seg	MRI data with values corresponding to the segmentation class. Must be 1mm isotropic resolution.
ker	MRSI PSF kernel in the x-y direction compatible with the mmand package, eg: mmand::shapeKernel(c(10, 10), type = "box").

**Value**

a data frame of partial volume estimates.

---

get\_mrsi\_voi                    *Generate a MRSI VOI from an mrs\_data object.*

---

**Description**

Generate a MRSI VOI from an mrs\_data object.

**Usage**

```
get_mrsi_voi(mrs_data, target_mri = NULL, map = NULL, ker = mmand::boxKernel())
```

**Arguments**

mrs_data	MRS data.
target_mri	optional image data to match the intended volume space.
map	optional voi intensity map.
ker	kernel to rescale the map data to the target_mri.

**Value**

volume data as a nifti object.

---

get\_mrsi\_voxel                *Generate a MRSI voxel from an mrs\_data object.*

---

**Description**

Generate a MRSI voxel from an mrs\_data object.

**Usage**

```
get_mrsi_voxel(mrs_data, target_mri, x_pos, y_pos, z_pos)
```

**Arguments**

mrs_data	MRS data.
target_mri	optional image data to match the intended volume space.
x_pos	x voxel coordinate.
y_pos	y voxel coordinate.
z_pos	z voxel coordinate.

**Value**

volume data as a nifti object.

---

get\_mrsi\_voxel\_xy\_psf *Generate a MRSI voxel PSF from an mrs\_data object.*

---

### Description

Generate a MRSI voxel PSF from an mrs\_data object.

### Usage

```
get_mrsi_voxel_xy_psf(mrs_data, target_mri, x_pos, y_pos, z_pos)
```

### Arguments

mrs_data	MRS data.
target_mri	optional image data to match the intended volume space.
x_pos	x voxel coordinate.
y_pos	y voxel coordinate.
z_pos	z voxel coordinate.

### Value

volume data as a nifti object.

---

get\_mrs\_affine *Generate an affine for nifti generation.*

---

### Description

Generate an affine for nifti generation.

### Usage

```
get_mrs_affine(mrs_data, x_pos = 1, y_pos = 1, z_pos = 1)
```

### Arguments

mrs_data	input data.
x_pos	x_position coordinate.
y_pos	y_position coordinate.
z_pos	z_position coordinate.

### Value

affine matrix.



---

get_odd_dyns	<i>Return odd numbered dynamic scans starting from 1 (1,3,5...).</i>
--------------	--

---

**Description**

Return odd numbered dynamic scans starting from 1 (1,3,5...).

**Usage**

```
get_odd_dyns(mrs_data)
```

**Arguments**

mrs\_data          dynamic MRS data.

**Value**

dynamic MRS data containing odd numbered scans.

---

get_ref	<i>Extract the reference component from an mrs_data object.</i>
---------	---

---

**Description**

Extract the reference component from an mrs\_data object.

**Usage**

```
get_ref(mrs_data)
```

**Arguments**

mrs\_data          MRS data.

**Value**

reference component.

---

get_seg_ind	<i>Get the indices of data points lying between two values (end &gt; x &gt; start).</i>
-------------	---

---

**Description**

Get the indices of data points lying between two values (end > x > start).

**Usage**

```
get_seg_ind(scale, start, end)
```

**Arguments**

scale	full list of values.
start	smallest value in the subset.
end	largest value in the subset.

**Value**

set of indices.

---

get_sh_dyns	<i>Return the second half of a dynamic series.</i>
-------------	--

---

**Description**

Return the second half of a dynamic series.

**Usage**

```
get_sh_dyns(mrs_data)
```

**Arguments**

mrs_data	dynamic MRS data.
----------	-------------------

**Value**

second half of the dynamic series.

---

get_slice	<i>Return a single slice from a larger MRSI dataset.</i>
-----------	--

---

**Description**

Return a single slice from a larger MRSI dataset.

**Usage**

```
get_slice(mrs_data, z_pos)
```

**Arguments**

mrs_data	MRSI data.
z_pos	the z index to extract.

**Value**

MRS data.

---

get_subset	<i>Extract a subset of MRS data.</i>
------------	--------------------------------------

---

**Description**

Extract a subset of MRS data.

**Usage**

```
get_subset(  
  mrs_data,  
  x_set = NULL,  
  y_set = NULL,  
  z_set = NULL,  
  dyn_set = NULL,  
  coil_set = NULL,  
  fd_set = NULL,  
  td_set = NULL  
)
```

**Arguments**

mrs_data	MRS data object.
x_set	x indices to include in the output (default all).
y_set	y indices to include in the output (default all).
z_set	z indices to include in the output (default all).
dyn_set	dynamic indices to include in the output (default all).
coil_set	coil indices to include in the output (default all).
fd_set	frequency domain data indices to include in the output (default all).
td_set	time-domain indices to include in the output (default all).

**Value**

selected subset of MRS data.

---

get\_svs\_voi

*Generate a SVS acquisition volume from an mrs\_data object.*

---

**Description**

Generate a SVS acquisition volume from an mrs\_data object.

**Usage**

```
get_svs_voi(mrs_data, target_mri)
```

**Arguments**

mrs_data	MRS data.
target_mri	optional image data to match the intended volume space.

**Value**

volume data as a nifti object.

---

get_td_amp	<i>Return an array of amplitudes derived from fitting the initial points in the time domain and extrapolating back to t=0.</i>
------------	--

---

**Description**

Return an array of amplitudes derived from fitting the initial points in the time domain and extrapolating back to t=0.

**Usage**

```
get_td_amp(mrs_data, nstart = 10, nend = 50)
```

**Arguments**

mrs_data	MRS data.
nstart	first data point to fit.
nend	last data point to fit.

**Value**

array of amplitudes.

---

get_uncoupled_mol	<i>Generate a mol_parameters object for a simple spin system with one resonance.</i>
-------------------	--

---

**Description**

Generate a mol\_parameters object for a simple spin system with one resonance.

**Usage**

```
get_uncoupled_mol(name, chem_shift, nucleus, scale_factor, lw, lg)
```

**Arguments**

name	name of the molecule.
chem_shift	chemical shift of the resonance (PPM).
nucleus	nucleus (1H, 31P...).
scale_factor	multiplicative scaling factor.
lw	linewidth in Hz.
lg	Lorentz-Gauss lineshape parameter (between 0 and 1).

**Value**

mol\_parameters object.

---

get_voi_cog	<i>Calculate the centre of gravity for an image containing 0 and 1's.</i>
-------------	---

---

**Description**

Calculate the centre of gravity for an image containing 0 and 1's.

**Usage**

```
get_voi_cog(voi)
```

**Arguments**

voi            nifti object.

**Value**

triplet of x,y,z coordinates.

---

get_voi_seg	<i>Return the white matter, gray matter and CSF composition of a volume.</i>
-------------	--

---

**Description**

Return the white matter, gray matter and CSF composition of a volume.

**Usage**

```
get_voi_seg(voi, mri_seg)
```

**Arguments**

voi            volume data as a nifti object.  
mri\_seg        segmented brain volume as a nifti object.

**Value**

a vector of partial volumes expressed as percentages.

---

get_voi_seg_psf	<i>Return the white matter, gray matter and CSF composition of a volume.</i>
-----------------	--

---

**Description**

Return the white matter, gray matter and CSF composition of a volume.

**Usage**

```
get_voi_seg_psf(psf, mri_seg)
```

**Arguments**

psf	volume data as a nifti object.
mri_seg	segmented brain volume as a nifti object.

**Value**

a vector of partial volumes expressed as percentages.

---

get_voxel	<i>Return a single voxel from a larger mrs dataset.</i>
-----------	---

---

**Description**

Return a single voxel from a larger mrs dataset.

**Usage**

```
get_voxel(mrs_data, x_pos = 1, y_pos = 1, z_pos = 1, dyn = 1, coil = 1)
```

**Arguments**

mrs_data	MRS data.
x_pos	the x index to plot.
y_pos	the y index to plot.
z_pos	the z index to plot.
dyn	the dynamic index to plot.
coil	the coil element number to plot.

**Value**

MRS data.

---

gridplot	<i>Arrange spectral plots in a grid.</i>
----------	--

---

**Description**

Arrange spectral plots in a grid.

**Usage**

```
gridplot(x, ...)
```

**Arguments**

x	object for plotting.
...	arguments to be passed to methods.

---

gridplot.mrs_data	<i>Arrange spectral plots in a grid.</i>
-------------------	--

---

**Description**

Arrange spectral plots in a grid.

**Usage**

```
## S3 method for class 'mrs_data'
gridplot(
  x,
  rows = NA,
  cols = NA,
  mar = c(0, 0, 0, 0),
  oma = c(3.5, 1, 1, 1),
  bty = "o",
  restore_def_par = TRUE,
  ...
)
```

**Arguments**

x	object of class <code>mrs_data</code> .
rows	number of grid rows.
cols	number of grid columns.
mar	option to adjust the plot margins. See <code>?par</code> .
oma	outer margin area.



bty                   option to draw a box around the plot. See ?par.  
 restore\_def\_par       restore default plotting par values after the plot has been made.  
 ...                    other arguments to pass to the plot method.

---

grid\_shift\_xy           *Grid shift MRSI data in the x/y dimension.*

---

### Description

Grid shift MRSI data in the x/y dimension.

### Usage

```
grid_shift_xy(mrs_data, x_shift, y_shift)
```

### Arguments

mrs\_data            MRSI data in the spatial domain.  
 x\_shift             shift to apply in the x-direction in units of voxels.  
 y\_shift             shift to apply in the y-direction in units of voxels.

### Value

shifted data.

---

hsvd                   *HSVD of an mrs\_data object.*

---

### Description

HSVD method as described in: Barkhuijsen H, de Beer R, van Ormondt D. Improved algorithm for noniterative and timedomain model fitting to exponentially damped magnetic resonance signals. J Magn Reson 1987;73:553-557.

### Usage

```
hsvd(mrs_data, comps = 40, irlba = TRUE, max_damp = 10)
```

### Arguments

mrs\_data            mrs\_data object to be decomposed.  
 comps               number of Lorentzian components to use for modelling.  
 irlba               option to use irlba SVD (logical).  
 max\_damp            maximum allowable damping factor.

**Value**

basis matrix and signal table.

---

hsvd_filt	<i>HSVD based signal filter.</i>
-----------	----------------------------------

---

**Description**

HSVD based signal filter described in: Barkhuijsen H, de Beer R, van Ormondt D. Improved algorithm for noniterative and timedomain model fitting to exponentially damped magnetic resonance signals. J Magn Reson 1987;73:553-557.

**Usage**

```
hsvd_filt(mrs_data, xlim = c(-30, 30), comps = 40, irlba = TRUE, max_damp = 10)
```

**Arguments**

mrs_data	MRS data to be filtered.
xlim	frequency range in Hz to filter.
comps	number of Lorentzian components to use for modelling.
irlba	option to use irlba SVD (logical).
max_damp	maximum allowable damping factor.

**Value**

filtered data.

---

hsvd_vec	<i>HSVD of a complex vector.</i>
----------	----------------------------------

---

**Description**

HSVD method as described in: Barkhuijsen H, de Beer R, van Ormondt D. Improved algorithm for noniterative and timedomain model fitting to exponentially damped magnetic resonance signals. J Magn Reson 1987;73:553-557.

**Usage**

```
hsvd_vec(y, fs, comps = 40, irlba = TRUE, max_damp = 0)
```

**Arguments**

y	time domain signal to be filtered as a vector.
fs	sampling frequency of y.
comps	number of Lorentzian components to use for modelling.
irlba	option to use irlba SVD (logical).
max_damp	maximum allowable damping factor. Default value of 0 ensures resultant model is damped.

**Value**

basis matrix and signal table.

---

hz	<i>Return the frequency scale of an MRS dataset in Hz.</i>
----	--

---

**Description**

Return the frequency scale of an MRS dataset in Hz.

**Usage**

```
hz(mrs_data, fs = NULL, N = NULL)
```

**Arguments**

mrs_data	MRS data.
fs	sampling frequency in Hz.
N	number of data points in the spectral dimension.

**Value**

frequency scale.

---

ift_shift	<i>Perform an iffshift and ifft on a vector.</i>
-----------	--

---

**Description**

Perform an iffshift and ifft on a vector.

**Usage**

```
ift_shift(vec_in)
```

**Arguments**

vec\_in            vector input.

**Value**

output vector.

---

ift_shift_mat	<i>Perform an ifft and ifftshift on a matrix with each column replaced by its shifted ifft.</i>
---------------	---

---

**Description**

Perform an ifft and ifftshift on a matrix with each column replaced by its shifted ifft.

**Usage**

```
ift_shift_mat(mat_in)
```

**Arguments**

mat\_in            matrix input.

**Value**

output matrix.

---

Im.mrs_data	<i>Apply Im operator to an MRS dataset.</i>
-------------	---

---

**Description**

Apply Im operator to an MRS dataset.

**Usage**

```
## S3 method for class 'mrs_data'
Im(z)
```

**Arguments**

z                    MRS data.

**Value**

MRS data following Im operator.

---

image.mrs_data	<i>Image plot method for objects of class mrs_data.</i>
----------------	---

---

**Description**

Image plot method for objects of class mrs\_data.

**Usage**

```
## S3 method for class 'mrs_data'
image(
  x,
  xlim = NULL,
  mode = "re",
  col = NULL,
  plot_dim = NULL,
  x_pos = NULL,
  y_pos = NULL,
  z_pos = NULL,
  dyn = 1,
  coil = 1,
  restore_def_par = TRUE,
  y_ticks = NULL,
  vline = NULL,
  hline = NULL,
  ...
)
```

**Arguments**

x	object of class <code>mrs_data</code> .
xlim	the range of values to display on the x-axis, eg <code>xlim = c(4,1)</code> .
mode	representation of the complex numbers to be plotted, can be one of: "re", "im", "mod" or "arg".
col	Colour map to use, defaults to <code>viridis</code> .
plot_dim	the dimension to display on the y-axis, can be one of: "dyn", "x", "y", "z", "coil" or NULL. If NULL (the default) all spectra will be collapsed into the dynamic dimension and displayed.
x_pos	the x index to plot.
y_pos	the y index to plot.
z_pos	the z index to plot.
dyn	the dynamic index to plot.
coil	the coil element number to plot.
restore_def_par	restore default plotting par values after the plot has been made.
y_ticks	a vector of indices specifying where to place tick marks.
vline	draw a vertical line at the value of <code>vline</code> .
hline	draw a horizontal line at the value of <code>hline</code> .
...	other arguments to pass to the plot method.

---



---

*Transform 2D MRSI data to k-space in the x-y direction.*


---

**Description**

Transform 2D MRSI data to k-space in the x-y direction.

**Usage**

```
img2kspace_xy(mrs_data)
```

**Arguments**

mrs_data	2D MRSI data.
----------	---------------

**Value**

k-space data.

---

interleave_dyns	<i>Interleave the first and second half of a dynamic series.</i>
-----------------	--

---

**Description**

Interleave the first and second half of a dynamic series.

**Usage**

```
interleave_dyns(mrs_data)
```

**Arguments**

mrs_data	dynamic MRS data.
----------	-------------------

**Value**

interleaved data.

---

int_spec	<i>Integrate a spectral region.</i>
----------	-------------------------------------

---

**Description**

Integrate a spectral region.

**Usage**

```
int_spec(mrs_data, xlim = NULL, scale = "ppm", mode = "re", summation = "sum")
```

**Arguments**

mrs_data	MRS data.
xlim	spectral range to be integrated (defaults to full range).
scale	units of xlim, can be : "ppm", "Hz" or "points".
mode	spectral mode, can be : "re", "im", "mod" or "cplx".
summation	can be "sum" (default), "mean" or "I2".

**Value**

an array of integral values.

---

inv_even_dyns	<i>Invert even numbered dynamic scans starting from 1 (2,4,6...).</i>
---------------	---

---

**Description**

Invert even numbered dynamic scans starting from 1 (2,4,6...).

**Usage**

```
inv_even_dyns(mrs_data)
```

**Arguments**

mrs\_data      dynamic MRS data.

**Value**

dynamic MRS data with inverted even numbered scans.

---

inv_odd_dyns	<i>Invert odd numbered dynamic scans starting from 1 (1,3,5...).</i>
--------------	--

---

**Description**

Invert odd numbered dynamic scans starting from 1 (1,3,5...).

**Usage**

```
inv_odd_dyns(mrs_data)
```

**Arguments**

mrs\_data      dynamic MRS data.

**Value**

dynamic MRS data with inverted odd numbered scans.



---

is_fd	<i>Check if the chemical shift dimension of an MRS data object is in the frequency domain.</i>
-------	--

---

**Description**

Check if the chemical shift dimension of an MRS data object is in the frequency domain.

**Usage**

```
is_fd(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

**Value**

logical value.

---

kspace2img_xy	<i>Transform 2D MRSI data from k-space to image space in the x-y direction.</i>
---------------	---

---

**Description**

Transform 2D MRSI data from k-space to image space in the x-y direction.

**Usage**

```
kspace2img_xy(mrs_data)
```

**Arguments**

mrs_data	2D MRSI data.
----------	---------------

**Value**

MRSI data in image space.

---

l2_reg	<i>Perform l2 regularisation artefact suppression.</i>
--------	--

---

**Description**

Perform l2 regularisation artefact suppression using the method proposed by Bilgic et al. JMRI 40(1):181-91 2014.

**Usage**

```
l2_reg(mrs_data, thresh = 0.05, b = 1e-11, A = NA, xlim = NA)
```

**Arguments**

mrs_data	input data for artefact suppression.
thresh	threshold parameter to extract lipid signals from mrs_data based on the integration of the full spectral width in magnitude mode.
b	regularisation parameter.
A	set of spectra containing the artefact basis signals. The thresh parameter is ignored when A is specified.
xlim	spectral limits in ppm to restrict the reconstruction range. Defaults to the full spectral width.

**Value**

l2 reconstructed mrs\_data object.

---

lb	<i>Apply line-broadening (apodisation) to MRS data or basis object.</i>
----	---

---

**Description**

Apply line-broadening (apodisation) to MRS data or basis object.

**Usage**

```
lb(x, lb, lg = 1)

## S3 method for class 'mrs_data'
lb(x, lb, lg = 1)

## S3 method for class 'basis_set'
lb(x, lb, lg = 1)
```

**Arguments**

x	input mrs_data or basis_set object.
lb	amount of line-broadening in Hz.
lg	Lorentz-Gauss lineshape parameter (between 0 and 1).

**Value**

line-broadened data.

---

lw2alpha	<i>Covert a linewidth in Hz to an equivalent alpha value in the time-domain ie: <math>x * \exp(-t * \alpha)</math>.</i>
----------	---

---

**Description**

Covert a linewidth in Hz to an equivalent alpha value in the time-domain ie:  $x * \exp(-t * \alpha)$ .

**Usage**

lw2alpha(lw)

**Arguments**

lw	linewidth in Hz.
----	------------------

**Value**

beta damping value.

---

lw2beta	<i>Covert a linewidth in Hz to an equivalent beta value in the time-domain ie: <math>x * \exp(-t * t * \beta)</math>.</i>
---------	---

---

**Description**

Covert a linewidth in Hz to an equivalent beta value in the time-domain ie:  $x * \exp(-t * t * \beta)$ .

**Usage**

lw2beta(lw)

**Arguments**

lw	linewidth in Hz.
----	------------------

**Value**

beta damping value.

---

mask_dyns	<i>Mask an MRS dataset in the dynamic dimension.</i>
-----------	--

---

**Description**

Mask an MRS dataset in the dynamic dimension.

**Usage**

```
mask_dyns(mrs_data, mask)
```

**Arguments**

mrs_data	MRS data object.
mask	vector of boolean values specifying the dynamics to mask, where a value of TRUE indicates the spectrum should be removed.

**Value**

masked dataset.

---

mask_xy	<i>Mask an MRSI dataset in the x-y direction</i>
---------	--

---

**Description**

Mask an MRSI dataset in the x-y direction

**Usage**

```
mask_xy(mrs_data, x_dim, y_dim)
```

**Arguments**

mrs_data	MRS data object.
x_dim	x dimension output length.
y_dim	y dimension output length.

**Value**

masked MRS data.

---

mask_xy_mat	<i>Mask a 2D MRSI dataset in the x-y dimension.</i>
-------------	---

---

**Description**

Mask a 2D MRSI dataset in the x-y dimension.

**Usage**

```
mask_xy_mat(mrs_data, mask, value = NA)
```

**Arguments**

mrs_data	MRS data object.
mask	matrix of boolean values specifying the voxels to mask, where a value of TRUE indicates the voxel should be removed.
value	the value to set masked data to (usually NA or 0).

**Value**

masked dataset.

---

mat2mrs_data	<i>Convert a matrix (with spectral points in the column dimension and dynamics in the row dimensions) into a mrs_data object.</i>
--------------	---

---

**Description**

Convert a matrix (with spectral points in the column dimension and dynamics in the row dimensions) into a mrs\_data object.

**Usage**

```
mat2mrs_data(
  mat,
  fs = def_fs(),
  ft = def_ft(),
  ref = def_ref(),
  nuc = def_nuc(),
  fd = FALSE
)
```

**Arguments**

mat	data matrix.
fs	sampling frequency in Hz.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
nuc	resonant nucleus.
fd	flag to indicate if the matrix is in the frequency domain (logical).

**Value**

mrs\_data object.

---

max_mrs	<i>Apply the max operator to an MRS dataset.</i>
---------	--

---

**Description**

Apply the max operator to an MRS dataset.

**Usage**

```
max_mrs(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

**Value**

MRS data following max operator.

---

max_mrs_interp	<i>Apply the max operator to an interpolated MRS dataset.</i>
----------------	---

---

**Description**

Apply the max operator to an interpolated MRS dataset.

**Usage**

```
max_mrs_interp(mrs_data, interp_f = 4)
```

**Arguments**

mrs\_data            MRS data.  
 interp\_f            interpolation factor.

**Value**

Array of maximum values (real only).

---

mean.mrs_data	<i>Calculate the mean spectrum from an mrs_data object.</i>
---------------	---

---

**Description**

Calculate the mean spectrum from an mrs\_data object.

**Usage**

```
## S3 method for class 'mrs_data'
mean(x, ...)
```

**Arguments**

x                    object of class mrs\_data.  
 ...                  other arguments to pass to the colMeans function.

**Value**

mean mrs\_data object.

---

mean_dyns	<i>Calculate the mean dynamic data.</i>
-----------	---

---

**Description**

Calculate the mean dynamic data.

**Usage**

```
mean_dyns(mrs_data)
```

**Arguments**

mrs\_data            dynamic MRS data.

**Value**

mean dynamic data.

---

mean_dyn_blocks	<i>Calculate the mean of adjacent dynamic scans.</i>
-----------------	--

---

**Description**

Calculate the mean of adjacent dynamic scans.

**Usage**

```
mean_dyn_blocks(mrs_data, block_size)
```

**Arguments**

mrs_data	dynamic MRS data.
block_size	number of adjacent dynamics scans to average over.

**Value**

dynamic data averaged in blocks.

---

mean_dyn_pairs	<i>Calculate the pairwise means across a dynamic data set.</i>
----------------	--

---

**Description**

Calculate the pairwise means across a dynamic data set.

**Usage**

```
mean_dyn_pairs(mrs_data)
```

**Arguments**

mrs_data	dynamic MRS data.
----------	-------------------

**Value**

mean dynamic data of adjacent dynamic pairs.



---

median_dyns	<i>Calculate the median dynamic data.</i>
-------------	---

---

**Description**

Calculate the median dynamic data.

**Usage**

```
median_dyns(mrs_data)
```

**Arguments**

mrs\_data          dynamic MRS data.

**Value**

median dynamic data.

---

Mod.mrs_data	<i>Apply Mod operator to an MRS dataset.</i>
--------------	--

---

**Description**

Apply Mod operator to an MRS dataset.

**Usage**

```
## S3 method for class 'mrs_data'  
Mod(z)
```

**Arguments**

z                  MRS data.

**Value**

MRS data following Mod operator.

---

mrs_data2basis	<i>Convert an mrs_data object to basis object - where basis signals are spread across the dynamic dimension in the MRS data.</i>
----------------	--

---

**Description**

Convert an mrs\_data object to basis object - where basis signals are spread across the dynamic dimension in the MRS data.

**Usage**

```
mrs_data2basis(mrs_data, names)
```

**Arguments**

mrs_data	mrs_data object with basis signals spread across the dynamic dimension.
names	list of names corresponding to basis signals.

**Value**

basis set object.

---

mrs_data2mat	<i>Convert mrs_data object to a matrix, with spectral points in the column dimension and dynamics in the row dimension.</i>
--------------	---

---

**Description**

Convert mrs\_data object to a matrix, with spectral points in the column dimension and dynamics in the row dimension.

**Usage**

```
mrs_data2mat(mrs_data, collapse = TRUE)
```

**Arguments**

mrs_data	MRS data object or list of MRS data objects.
collapse	collapse all other dimensions along the dynamic dimension, eg a 16x16 MRSI grid would be first collapsed across 256 dynamic scans.

**Value**

MRS data matrix.

---

mrs_data2vec	<i>Convert mrs_data object to a vector.</i>
--------------	---

---

**Description**

Convert mrs\_data object to a vector.

**Usage**

```
mrs_data2vec(mrs_data, dyn = 1, x_pos = 1, y_pos = 1, z_pos = 1, coil = 1)
```

**Arguments**

mrs_data	MRS data object.
dyn	dynamic index.
x_pos	x index.
y_pos	y index.
z_pos	z index.
coil	coil element index.

**Value**

MRS data vector.

---

mvfftshift	<i>Perform a fftshift on a matrix, with each column replaced by its shifted result.</i>
------------	---

---

**Description**

Perform a fftshift on a matrix, with each column replaced by its shifted result.

**Usage**

```
mvfftshift(x)
```

**Arguments**

x	matrix input.
---	---------------

**Value**

output matrix.

---

<code>mvfftshift</code>	<i>Perform an ifftshift on a matrix, with each column replaced by its shifted result.</i>
-------------------------	---

---

**Description**

Perform an ifftshift on a matrix, with each column replaced by its shifted result.

**Usage**

```
mvfftshift(x)
```

**Arguments**

`x`                    matrix input.

**Value**

output matrix.

---

<code>n2coord</code>	<i>Print fit coordinates from a single index.</i>
----------------------	---

---

**Description**

Print fit coordinates from a single index.

**Usage**

```
n2coord(n, fit_res)
```

**Arguments**

`n`                    fit index.  
`fit_res`            fit\_result object.

---

Ncoils	<i>Return the total number of coil elements in an MRS dataset.</i>
--------	--

---

**Description**

Return the total number of coil elements in an MRS dataset.

**Usage**

```
Ncoils(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

---

Ndysns	<i>Return the total number of dynamic scans in an MRS dataset.</i>
--------	--

---

**Description**

Return the total number of dynamic scans in an MRS dataset.

**Usage**

```
Ndysns(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

---

nifti_flip_lr	<i>Flip the x data dimension order of a nifti image. This corresponds to flipping MRI data in the left-right direction, assuming the data is saved in neurological format (can check with fslorient program).</i>
---------------	---

---

**Description**

Flip the x data dimension order of a nifti image. This corresponds to flipping MRI data in the left-right direction, assuming the data is saved in neurological format (can check with fslorient program).

**Usage**

```
nifti_flip_lr(x)
```

**Arguments**

x                    nifti object to be processed.

**Value**

nifti object with reversed x data direction.

---

norm_mrs	<i>Normalise mrs_data to a spectral region.</i>
----------	---

---

**Description**

Normalise mrs\_data to a spectral region.

**Usage**

```
norm_mrs(mrs_data, xlim = NULL, scale = "ppm", mode = "re", summation = "l2")
```

**Arguments**

mrs_data	MRS data.
xlim	spectral range to be integrated (defaults to full range).
scale	units of xlim, can be : "ppm", "Hz" or "points".
mode	spectral mode, can be : "re", "im", "mod" or "cplx".
summation	can be "sum", "mean" or "l2" (default).

**Value**

normalised data.

---

Npts	<i>Return the number of data points in an MRS dataset.</i>
------	--

---

**Description**

Return the number of data points in an MRS dataset.

**Usage**

```
Npts(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

**Value**

number of data points.

---

Nspec	<i>Return the total number of spectra in an MRS dataset.</i>
-------	--

---

**Description**

Return the total number of spectra in an MRS dataset.

**Usage**

Nspec(mrs\_data)

**Arguments**

mrs\_data      MRS data.

---

Nx	<i>Return the total number of x locations in an MRS dataset.</i>
----	--

---

**Description**

Return the total number of x locations in an MRS dataset.

**Usage**

Nx(mrs\_data)

**Arguments**

mrs\_data      MRS data.

---

Ny	<i>Return the total number of y locations in an MRS dataset.</i>
----	--

---

**Description**

Return the total number of y locations in an MRS dataset.

**Usage**

Ny(mrs\_data)

**Arguments**

mrs\_data      MRS data.

---

Nz	<i>Return the total number of z locations in an MRS dataset.</i>
----	--

---

**Description**

Return the total number of z locations in an MRS dataset.

**Usage**

```
Nz(mrs_data)
```

**Arguments**

mrs_data	MRS data.
----------	-----------

---

ortho3	<i>Display an orthographic projection plot of a nifti object.</i>
--------	---

---

**Description**

Display an orthographic projection plot of a nifti object.

**Usage**

```
ortho3(  
  underlay,  
  overlay = NULL,  
  xyz = NULL,  
  zlim = NULL,  
  zlim_ol = NULL,  
  alpha = 0.7,  
  col_ol = viridisLite::viridis(64),  
  orient_lab = TRUE,  
  rescale = 1,  
  crosshairs = TRUE,  
  ch_lwd = 1,  
  colourbar = TRUE,  
  bg = "black",  
  mar = c(0, 0, 0, 0),  
  smallplot = c(0.63, 0.65, 0.07, 0.42)  
)
```



**Arguments**

underlay	underlay image to be shown in grayscale.
overlay	optional overlay image.
xyz	x, y, z slice coordinates to display.
zlim	underlay intensity limits.
zlim_ol	overlay intensity limits.
alpha	transparency of overlay.
col_ol	colour palette of overlay.
orient_lab	display orientation labels (default TRUE).
rescale	rescale factor for the underlay and overlay images.
crosshairs	display the crosshairs (default TRUE).
ch_lwd	crosshair linewidth.
colourbar	display a colourbar for the overlay (default TRUE).
bg	plot background colour.
mar	plot margins.
smallplot	smallplot option for positioning the colourbar.

---

 ortho3\_inter

---

*Display an interactive orthographic projection plot of a nifti object.*


---

**Description**

Display an interactive orthographic projection plot of a nifti object.

**Usage**

```
ortho3_inter(
  underlay,
  overlay = NULL,
  xyz = NULL,
  zlim = NULL,
  zlim_ol = NULL,
  alpha = 0.7,
  ...
)
```

**Arguments**

underlay	underlay image to be shown in grayscale.
overlay	optional overlay image.
xyz	x, y, z slice coordinates to display.
zlim	underlay intensity limits.
zlim_ol	overlay intensity limits.
alpha	transparency of overlay.
...	other options to be passed to the ortho3 function.

---

peak_info	<i>Search for the highest peak in a spectral region and return the frequency, height and FWHM.</i>
-----------	--

---

**Description**

Search for the highest peak in a spectral region and return the frequency, height and FWHM.

**Usage**

```
peak_info(
  mrs_data,
  xlim = c(4, 0.5),
  interp_f = 4,
  scale = "ppm",
  mode = "real"
)
```

**Arguments**

mrs_data	an object of class mrs_data.
xlim	frequency range (default units of PPM) to search for the highest peak.
interp_f	interpolation factor, defaults to 4x.
scale	the units to use for the frequency scale, can be one of: "ppm", "hz" or "points".
mode	spectral mode, can be : "real", "imag" or "mod".

**Value**

list of arrays containing the highest peak frequency, height and FWHM in units of PPM and Hz.

---

pg\_extrap\_xy

*Papoulis-Gerchberg (PG) algorithm method for k-space extrapolation.*

---

## Description

PG method as described in: Haupt CI, Schuff N, Weiner MW, Maudsley AA. Removal of lipid artifacts in 1H spectroscopic imaging by data extrapolation. Magn Reson Med. 1996 May;35(5):678-87. Extrapolation is performed to expand k-space coverage by a factor of 2, with the aim to reduce Gibbs ringing.

## Usage

```
pg_extrap_xy(  
  mrs_data,  
  img_mask = NULL,  
  kspace_mask = NULL,  
  intensity_thresh = 0.15,  
  iters = 50  
)
```

## Arguments

mrs_data	MRS data object.
img_mask	a boolean matrix of voxels with strong signals to be extrapolated. Must be twice the dimensions of the input data.
kspace_mask	a boolean matrix of kspace points that have been sampled. Typically a circle for MRSI, but defaults to the full rectangular area of k-space covered by the input data. Must match the x-y dimensions of the input data.
intensity_thresh	used to define img_mask based on the strength of the signal in each voxel. Defaults to intensities greater than 15% of the maximum. Ignored if img_mask is specified as argument.
iters	number of iterations to perform.

## Value

extrapolated mrs\_data object.

---

phase	<i>Apply phasing parameters to MRS data.</i>
-------	--

---

**Description**

Apply phasing parameters to MRS data.

**Usage**

```
phase(mrs_data, zero_order, first_order = 0)
```

**Arguments**

mrs_data	MRS data.
zero_order	zero'th order phase term in degrees.
first_order	first order (frequency dependent) phase term in ms.

**Value**

MRS data with applied phase parameters.

---

plot.fit_result	<i>Plot the fitting results of an object of class fit_result.</i>
-----------------	---

---

**Description**

Plot the fitting results of an object of class fit\_result.

**Usage**

```
## S3 method for class 'fit_result'
plot(
  x,
  dyn = 1,
  x_pos = 1,
  y_pos = 1,
  z_pos = 1,
  coil = 1,
  xlim = NULL,
  data_only = FALSE,
  label = NULL,
  plot_sigs = NULL,
  n = NULL,
  sub_b1 = FALSE,
  mar = NULL,
```

```

    restore_def_par = TRUE,
    ylim = NULL,
    y_scale = FALSE,
    show_grid = TRUE,
    grid_nx = NULL,
    grid_ny = NA,
    ...
)

```

### Arguments

x	fit_result object.
dyn	the dynamic index to plot.
x_pos	the x index to plot.
y_pos	the y index to plot.
z_pos	the z index to plot.
coil	the coil element number to plot.
xlim	the range of values to display on the x-axis, eg xlim = c(4,1).
data_only	display only the processed data (logical).
label	character string to add to the top left of the plot window.
plot_sigs	a character vector of signal names to add to the plot.
n	single index element to plot (overrides other indices when given).
sub_bl	subtract the baseline from the data and fit (logical).
mar	option to adjust the plot margins. See ?par.
restore_def_par	restore default plotting par values after the plot has been made.
ylim	range of values to display on the y-axis, eg ylim = c(0,10).
y_scale	option to display the y-axis values (logical).
show_grid	plot gridlines behind the data (logical). Defaults to TRUE.
grid_nx	number of cells of the grid in x and y direction. When NULL the grid aligns with the tick marks on the corresponding default axis (i.e., tickmarks as computed by axTicks). When NA, no grid lines are drawn in the corresponding direction.
grid_ny	as above.
...	further arguments to plot method.

---

`plot.mrs_data`*Plotting method for objects of class mrs\_data.*

---

**Description**

Plotting method for objects of class `mrs_data`.

**Usage**

```
## S3 method for class 'mrs_data'
plot(
  x,
  dyn = 1,
  x_pos = 1,
  y_pos = 1,
  z_pos = 1,
  coil = 1,
  fd = TRUE,
  x_units = NULL,
  xlim = NULL,
  y_scale = FALSE,
  x_ax = TRUE,
  mode = "re",
  lwd = NULL,
  bty = NULL,
  label = "",
  restore_def_par = TRUE,
  mar = NULL,
  xaxis_lab = NULL,
  xat = NULL,
  xlabs = TRUE,
  yat = NULL,
  ylabs = TRUE,
  show_grid = TRUE,
  grid_nx = NULL,
  grid_ny = NA,
  col = NULL,
  alpha = NULL,
  ...
)
```

**Arguments**

<code>x</code>	object of class <code>mrs_data</code> .
<code>dyn</code>	the dynamic index to plot.
<code>x_pos</code>	the x index to plot.

y_pos	the y index to plot.
z_pos	the z index to plot.
coil	the coil element number to plot.
fd	display data in the frequency-domain (default), or time-domain (logical).
x_units	the units to use for the x-axis, can be one of: "ppm", "hz", "points" or "seconds".
xlim	the range of values to display on the x-axis, eg xlim = c(4,1).
y_scale	option to display the y-axis values (logical).
x_ax	option to display the x-axis values (logical).
mode	representation of the complex numbers to be plotted, can be one of: "re", "im", "mod" or "arg".
lwd	plot linewidth.
bty	option to draw a box around the plot. See ?par.
label	character string to add to the top left of the plot window.
restore_def_par	restore default plotting par values after the plot has been made.
mar	option to adjust the plot margins. See ?par.
xaxis_lab	x-axis label.
xat	x-axis tick label values.
xlabs	x-axis tick labels.
yat	y-axis tick label values.
ylabs	y-axis tick labels.
show_grid	plot gridlines behind the data (logical). Defaults to TRUE.
grid_nx	number of cells of the grid in x and y direction. When NULL the grid aligns with the tick marks on the corresponding default axis (i.e., tickmarks as computed by axTicks). When NA, no grid lines are drawn in the corresponding direction.
grid_ny	as above.
col	set the line colour, eg col = rgb(0.5, 0.5, 0.5).
alpha	set the line transparency, eg alpha = 0.5 is 50% transparency. Overrides any transparency levels set by col.
...	other arguments to pass to the plot method.

---

plot_bc	<i>Convenience function to plot a baseline estimate with the original data.</i>
---------	---

---

**Description**

Convenience function to plot a baseline estimate with the original data.

**Usage**

```
plot_bc(orig_data, bc_data, ...)
```

**Arguments**

orig_data	the original data.
bc_data	the baseline corrected data.
...	other arguments to pass to the stackplot function.

---

plot_slice_fit	<i>Plot a 2D slice from an MRSI fit result object.</i>
----------------	--

---

**Description**

Plot a 2D slice from an MRSI fit result object.

**Usage**

```
plot_slice_fit(
  fit_res,
  map,
  map_denom = NULL,
  slice = 1,
  zlim = NULL,
  interp = 1
)
```

**Arguments**

fit_res	fit_result object.
map	fit result values to display as a colour map. Can be specified as a character string or array of numeric values. Defaults to "tNAA".
map_denom	fit result values to divide the map argument by. Can be specified as a character string (eg "tCr") or array of numeric values.
slice	slice to plot in the z direction.
zlim	range of values to plot.
interp	interpolation factor.



---

plot\_slice\_fit\_inter *Plot a 2D slice from an MRSI fit result object.*

---

### Description

Plot a 2D slice from an MRSI fit result object.

### Usage

```
plot_slice_fit_inter(  
  fit_res,  
  map = NULL,  
  map_denom = NULL,  
  slice = 1,  
  zlim = NULL,  
  interp = 1,  
  xlim = NULL  
)
```

### Arguments

fit_res	fit_result object.
map	fit result values to display as a colour map. Can be specified as a character string or array of numeric values. Defaults to "tNAA".
map_denom	fit result values to divide the map argument by. Can be specified as a character string (eg "tCr") or array of numeric values.
slice	slice to plot in the z direction.
zlim	range of values to plot.
interp	interpolation factor.
xlim	spectral plot limits for the x axis.

---

plot\_slice\_map *Plot a slice from a 7 dimensional array.*

---

### Description

Plot a slice from a 7 dimensional array.

**Usage**

```

plot_slice_map(
    data,
    zlim = NULL,
    mask_map = NULL,
    mask_cutoff = 20,
    interp = 1,
    slice = 1,
    dyn = 1,
    coil = 1,
    ref = 1,
    denom = NULL,
    horizontal = FALSE
)

```

**Arguments**

data	7d array of values to be plotted.
zlim	smallest and largest values to be plotted.
mask_map	matching map with logical values to indicate if the corresponding values should be plotted.
mask_cutoff	minimum values to plot (as a percentage of the maximum).
interp	map interpolation factor.
slice	the slice index to plot.
dyn	the dynamic index to plot.
coil	the coil element number to plot.
ref	reference index to plot.
denom	map to use as a denominator.
horizontal	display the colourbar horizontally (logical).

---

plot\_slice\_map\_inter *Plot an interactive slice map from a data array where voxels can be selected to display a corresponding spectrum.*

---

**Description**

Plot an interactive slice map from a data array where voxels can be selected to display a corresponding spectrum.

**Usage**

```
plot_slice_map_inter(  
  mrs_data,  
  map = NULL,  
  xlim = NULL,  
  slice = 1,  
  zlim = NULL,  
  mask_map = NULL,  
  denom = NULL,  
  mask_cutoff = 20,  
  interp = 1,  
  mode = "re",  
  y_scale = FALSE,  
  ylim = NULL,  
  coil = 1,  
  fd = TRUE  
)
```

**Arguments**

<code>mrs_data</code>	spectral data.
<code>map</code>	array of values to be plotted, defaults to the integration of the modulus of the full spectral width.
<code>xlim</code>	spectral region to plot.
<code>slice</code>	the slice index to plot.
<code>zlim</code>	smallest and largest values to be plotted.
<code>mask_map</code>	matching map with logical values to indicate if the corresponding values should be plotted.
<code>denom</code>	map to use as a denominator.
<code>mask_cutoff</code>	minimum values to plot (as a percentage of the maximum).
<code>interp</code>	map interpolation factor.
<code>mode</code>	representation of the complex spectrum to be plotted, can be one of: "re", "im", "mod" or "arg".
<code>y_scale</code>	option to display the y-axis values (logical).
<code>ylim</code>	intensity range to plot.
<code>coil</code>	coil element to plot.
<code>fd</code>	display data in the frequency-domain (default), or time-domain (logical).

---

plot\_voi\_overlay      *Plot a volume as an image overlay.*

---

### Description

Plot a volume as an image overlay.

### Usage

```
plot_voi_overlay(mri, voi, export_path = NULL, zlim = NULL, ...)
```

### Arguments

mri	image data as a nifti object or path to data file.
voi	volume data as a nifti object or path to data file.
export_path	optional path to save the image in png format.
zlim	underlay intensity limits.
...	additional arguments to the ortho3 function.

---

plot\_voi\_overlay\_seg      *Plot a volume as an overlay on a segmented brain volume.*

---

### Description

Plot a volume as an overlay on a segmented brain volume.

### Usage

```
plot_voi_overlay_seg(mri_seg, voi, export_path = NULL, ...)
```

### Arguments

mri_seg	segmented brain volume as a nifti object.
voi	volume data as a nifti object.
export_path	optional path to save the image in png format.
...	additional arguments to the ortho3 function.

---

ppm *Return the ppm scale of an MRS dataset or fit result.*

---

### Description

Return the ppm scale of an MRS dataset or fit result.

### Usage

```
ppm(x, ft = NULL, ref = NULL, fs = NULL, N = NULL)

## S3 method for class 'mrs_data'
ppm(x, ft = NULL, ref = NULL, fs = NULL, N = NULL)

## S3 method for class 'fit_result'
ppm(x, ft = NULL, ref = NULL, fs = NULL, N = NULL)
```

### Arguments

x	MRS dataset or fit result.
ft	transmitter frequency in Hz, does not apply when the object is a fit result.
ref	reference value for ppm scale, does not apply when the object is a fit result.
fs	sampling frequency in Hz, does not apply when the object is a fit result.
N	number of data points in the spectral dimension, does not apply when the object is a fit result.

### Value

ppm scale.

---

precomp *Save function results to file and load on subsequent calls to avoid repeat computation.*

---

### Description

Save function results to file and load on subsequent calls to avoid repeat computation.

### Usage

```
precomp(file, fun, ...)
```

**Arguments**

file	file name to write the results.
fun	function to run.
...	arguments to be passed to fun.

---

print.fit_result	<i>Print a summary of an object of class fit_result.</i>
------------------	--

---

**Description**

Print a summary of an object of class fit\_result.

**Usage**

```
## S3 method for class 'fit_result'  
print(x, ...)
```

**Arguments**

x	fit_result object.
...	further arguments.

---

print.mrs_data	<i>Print a summary of mrs_data parameters.</i>
----------------	--

---

**Description**

Print a summary of mrs\_data parameters.

**Usage**

```
## S3 method for class 'mrs_data'  
print(x, full = FALSE, ...)
```

**Arguments**

x	mrs_data object.
full	print all parameters (default FALSE).
...	further arguments.

---

qn_states	<i>Get the quantum coherence matrix for a spin system.</i>
-----------	--

---

**Description**

Get the quantum coherence matrix for a spin system.

**Usage**

```
qn_states(sys)
```

**Arguments**

sys            spin system object.

**Value**

quantum coherence number matrix.

---

rats	<i>Robust Alignment to a Target Spectrum (RATS).</i>
------	--

---

**Description**

Robust Alignment to a Target Spectrum (RATS).

**Usage**

```
rats(  
  mrs_data,  
  ref = NULL,  
  xlim = c(4, 0.5),  
  max_shift = 20,  
  p_deg = 2,  
  sp_N = 2,  
  sp_deg = 3,  
  max_t = 0.2,  
  basis_type = "poly"  
)
```

**Arguments**

mrs_data	MRS data to be corrected.
ref	optional MRS data to use as a reference, the mean of all dynamics is used if this argument is not supplied.
xlim	optional frequency range to perform optimisation, set to NULL to use the full range.
max_shift	maximum allowable frequency shift in Hz.
p_deg	polynomial degree used for baseline modelling. Negative values disable baseline modelling.
sp_N	number of spline functions, note the true number will be sp_N + sp_deg.
sp_deg	degree of spline functions.
max_t	truncate the FID when longer than max_t to reduce time taken
basis_type	may be one of "poly" or "spline".

**Value**

a list containing the corrected data; phase and shift values in units of degrees and Hz respectively.

---

Re.mrs_data	<i>Apply Re operator to an MRS dataset.</i>
-------------	---

---

**Description**

Apply Re operator to an MRS dataset.

**Usage**

```
## S3 method for class 'mrs_data'
Re(z)
```

**Arguments**

z	MRS data.
---	-----------

**Value**

MRS data following Re operator.



---

read_basis	<i>Read a basis file in LCModel .basis format.</i>
------------	--

---

**Description**

Read a basis file in LCModel .basis format.

**Usage**

```
read_basis(basis_file, ref = def_ref())
```

**Arguments**

basis_file	path to basis file.
ref	assumed ppm reference value.

**Value**

basis object.

---

read_ima_coil_dir	<i>Read a directory containing Siemens MRS IMA files and combine along the coil dimension. Note that the coil ID is inferred from the sorted file name and should be checked when consistency is required between two directories.</i>
-------------------	--

---

**Description**

Read a directory containing Siemens MRS IMA files and combine along the coil dimension. Note that the coil ID is inferred from the sorted file name and should be checked when consistency is required between two directories.

**Usage**

```
read_ima_coil_dir(dir)
```

**Arguments**

dir	data directory path.
-----	----------------------

**Value**

mrs\_data object.

---

read_ima_dyn_dir	<i>Read a directory containing Siemens MRS IMA files and combine along the dynamic dimension. Note that the coil ID is inferred from the sorted file name and should be checked when consistency is required.</i>
------------------	---

---

**Description**

Read a directory containing Siemens MRS IMA files and combine along the dynamic dimension. Note that the coil ID is inferred from the sorted file name and should be checked when consistency is required.

**Usage**

```
read_ima_dyn_dir(dir)
```

**Arguments**

dir                    data directory path.

**Value**

mrs\_data object.

---

read_lcm_coord	<i>Read an LCModel formatted coord file containing fit information.</i>
----------------	---

---

**Description**

Read an LCModel formatted coord file containing fit information.

**Usage**

```
read_lcm_coord(coord_f)
```

**Arguments**

coord\_f                path to the coord file.

**Value**

list containing a table of fit point and results structure containing signal amplitudes, errors and fitting diagnostics.

---

read_mrs	<i>Read MRS data from a file.</i>
----------	-----------------------------------

---

**Description**

Read MRS data from a file.

**Usage**

```
read_mrs(
  fname,
  format = NULL,
  ft = NULL,
  fs = NULL,
  ref = NULL,
  n_ref_scans = NULL,
  full_data = FALSE,
  verbose = FALSE
)
```

**Arguments**

fname	filename of the dpt format MRS data.
format	string describing the data format. Must be one of the following : "spar_sdat", "rda", "dicom", "twix", "pfile", "list_data", "paravis", "dpt", "lcm_raw", "rds", "nifti", "varian". If not specified, the format will be guessed from the filename extension.
ft	transmitter frequency in Hz (required for list_data format).
fs	sampling frequency in Hz (required for list_data format).
ref	reference value for ppm scale (required for list_data format).
n_ref_scans	override the number of water reference scans detected in the file header (GE p-file only).
full_data	export all data points, including those before the start of the FID (default = FALSE).
verbose	print data file information (default = FALSE).

**Value**

MRS data object.

**Examples**

```
fname <- system.file("extdata", "philips_spar_sdat_WS.SDAT", package = "spant")
mrs_data <- read_mrs(fname)
print(mrs_data)
```

---

read_mrs_dpt	<i>Read MRS data stored in dangerplot (dpt) v3 format.</i>
--------------	--

---

**Description**

Read MRS data stored in dangerplot (dpt) v3 format.

**Usage**

```
read_mrs_dpt(fname)
```

**Arguments**

fname            filename of the dpt format MRS data.

**Value**

MRS data object.

**Examples**

```
## Not run:
mrs_data <- read_mrs_dpt(system.file("extdata", "svs.dpt", package="spant"))

## End(Not run)
```

---

read_mrs_tqn	<i>Read MRS data using the TARQUIN software package.</i>
--------------	--

---

**Description**

Read MRS data using the TARQUIN software package.

**Usage**

```
read_mrs_tqn(fname, fname_ref = NA, format, id = NA, group = NA)
```

**Arguments**

fname            the filename containing the MRS data.  
 fname\_ref        a second filename containing reference MRS data.  
 format           format of the MRS data. Can be one of the following: siemens, philips, ge, dcm, dpt, rda, lcm, varian, bruker, jmrui\_txt.  
 id                optional ID string.  
 group            optional group string.

**Value**

MRS data object.

**Examples**

```
fname <- system.file("extdata","philips_spar_sdat_WS.SDAT",package="spant")
## Not run:
mrs_data <- read_mrs_tqn(fname, format="philips")

## End(Not run)
```

---

read\_siemens\_txt\_hdr *Read the text format header found in Siemens IMA and TWIX data files.*

---

**Description**

Read the text format header found in Siemens IMA and TWIX data files.

**Usage**

```
read_siemens_txt_hdr(input, version = "vd")
```

**Arguments**

input            file name to read or raw data.  
version         software version, can be "vb" or "vd".

**Value**

a list of parameter values

---

read\_tqn\_fit            *Reader for csv fit results generated by TARQUIN.*

---

**Description**

Reader for csv fit results generated by TARQUIN.

**Usage**

```
read_tqn_fit(fit_f)
```

**Arguments**

fit\_f            TARQUIN fit file.

**Value**

A data frame of the fit data points.

**Examples**

```
## Not run:  
fit <- read_tqn_fit(system.file("extdata", "fit.csv", package="spant"))  
  
## End(Not run)
```

---

read_tqn_result	<i>Reader for csv results generated by TARQUIN.</i>
-----------------	---

---

**Description**

Reader for csv results generated by TARQUIN.

**Usage**

```
read_tqn_result(result_f, remove_rcs = TRUE)
```

**Arguments**

result_f	TARQUIN result file.
remove_rcs	omit row, column and slice ids from output.

**Value**

list of amplitudes, crlbs and diagnostics.

**Examples**

```
## Not run:  
result <- read_tqn_result(system.file("extdata", "result.csv", package="spant"))  
  
## End(Not run)
```

---

rep_array_dim	<i>Repeat an array over a given dimension.</i>
---------------	--

---

**Description**

Repeat an array over a given dimension.

**Usage**

```
rep_array_dim(x, rep_dim, n)
```

**Arguments**

x	array.
rep_dim	dimension to extend.
n	number of times to repeat.

**Value**

extended array.

---

rep_dyn	<i>Replicate a scan in the dynamic dimension.</i>
---------	---

---

**Description**

Replicate a scan in the dynamic dimension.

**Usage**

```
rep_dyn(mrs_data, times)
```

**Arguments**

mrs_data	MRS data to be replicated.
times	number of times to replicate.

**Value**

replicated data object.

---

rep_mrs	<i>Replicate a scan over a given dimension.</i>
---------	---

---

**Description**

Replicate a scan over a given dimension.

**Usage**

```
rep_mrs(mrs_data, x_rep = 1, y_rep = 1, z_rep = 1, dyn_rep = 1, coil_rep = 1)
```

**Arguments**

mrs_data	MRS data to be replicated.
x_rep	number of x replications.
y_rep	number of y replications.
z_rep	number of z replications.
dyn_rep	number of dynamic replications.
coil_rep	number of coil replications.

**Value**

replicated data object.

---

resample_img	<i>Resample an image to match a target image space.</i>
--------------	---

---

**Description**

Resample an image to match a target image space.

**Usage**

```
resample_img(source, target, interp = 3L)
```

**Arguments**

source	image data as a nifti object.
target	image data as a nifti object.
interp	interpolation parameter, see niftyreg.linear definition.

**Value**

resampled image data as a nifti object.



---

resample_voi	<i>Resample a VOI to match a target image space using nearest-neighbour interpolation.</i>
--------------	--

---

**Description**

Resample a VOI to match a target image space using nearest-neighbour interpolation.

**Usage**

```
resample_voi(voi, mri)
```

**Arguments**

voi	volume data as a nifti object.
mri	image data as a nifti object.

**Value**

volume data as a nifti object.

---

reslice_to_mrs	<i>Reslice a nifti object to match the orientation of mrs data.</i>
----------------	---

---

**Description**

Reslice a nifti object to match the orientation of mrs data.

**Usage**

```
reslice_to_mrs(mri, mrs)
```

**Arguments**

mri	nifti object to be resliced.
mrs	mrs_data object for the target orientation.

**Value**

resliced imaging data.

---

reson\_table2mrs\_data    *Generate mrs\_data from a table of single Lorentzian resonances.*

---

### Description

Generate mrs\_data from a table of single Lorentzian resonances.

### Usage

```
reson_table2mrs_data(
  reson_table,
  acq_paras = def_acq_paras(),
  back_extrap_pts = 0
)
```

### Arguments

reson\_table    as produced by the hsvd function.  
 acq\_paras    list of acquisition parameters. See  
 back\_extrap\_pts    number of data points to back extrapolate [def\\_acq\\_paras](#)

### Value

mrs\_data object.

---

re\_weighting    *Apply a weighting to the FID to enhance spectral resolution.*

---

### Description

Apply a weighting to the FID to enhance spectral resolution.

### Usage

```
re_weighting(mrs_data, re, alpha)
```

### Arguments

mrs\_data    data to be enhanced.  
 re    resolution enhancement factor (rising exponential factor).  
 alpha    alpha factor (Guassian decay)

### Value

resolution enhanced mrs\_data.

---

rm_dyns	<i>Remove a subset of dynamic scans.</i>
---------	--

---

**Description**

Remove a subset of dynamic scans.

**Usage**

```
rm_dyns(mrs_data, subset)
```

**Arguments**

mrs_data	dynamic MRS data.
subset	vector containing indices to the dynamic scans to be removed.

**Value**

MRS data without the specified dynamic scans.

---

scale_amp_molal_pvc	<i>Apply partial volume correction to a fitting result object.</i>
---------------------	--

---

**Description**

Apply partial volume correction to a fitting result object.

**Usage**

```
scale_amp_molal_pvc(fit_result, ref_data, p_vols, te, tr)
```

**Arguments**

fit_result	result object generated from fitting.
ref_data	water reference MRS data object.
p_vols	a numeric vector of partial volumes.
te	the MRS TE in seconds.
tr	the MRS TR in seconds.

**Value**

A fit\_result object with a rescaled results table.

---

scale_amp_molar	<i>Apply water reference scaling to a fitting results object to yield metabolite quantities in millimolar (mM) units (mol/litre).</i>
-----------------	---

---

**Description**

Apply water reference scaling to a fitting results object to yield metabolite quantities in millimolar (mM) units (mol/litre).

**Usage**

```
scale_amp_molar(fit_result, ref_data, w_att = 0.7, w_conc = 35880)
```

**Arguments**

fit_result	a result object generated from fitting.
ref_data	water reference MRS data object.
w_att	water attenuation factor (default = 0.7).
w_conc	assumed water concentration (default = 35880).

**Value**

a fit\_result object with a rescaled results table.

---

scale_amp_ratio	<i>Scale fitted amplitudes to a ratio of signal amplitude.</i>
-----------------	--

---

**Description**

Scale fitted amplitudes to a ratio of signal amplitude.

**Usage**

```
scale_amp_ratio(fit_result, name)
```

**Arguments**

fit_result	a result object generated from fitting.
name	the signal name to use as a denominator (usually, "tCr" or "tNAA").

**Value**

a fit\_result object with a rescaled results table.

---

scale\_amp\_water\_ratio *Scale metabolite amplitudes as a ratio to the unsuppressed water amplitude.*

---

**Description**

Scale metabolite amplitudes as a ratio to the unsuppressed water amplitude.

**Usage**

```
scale_amp_water_ratio(fit_result, ref_data)
```

**Arguments**

fit\_result      a result object generated from fitting.  
ref\_data        a water reference MRS data object.

**Value**

a fit\_result object with a rescaled results table.

---

sd *Calculate the standard deviation spectrum from an mrs\_data object.*

---

**Description**

Calculate the standard deviation spectrum from an mrs\_data object.

**Usage**

```
sd(x, na.rm)
```

**Arguments**

x                object of class mrs\_data.  
na.rm            remove NA values.

**Value**

sd mrs\_data object.

---

<code>sd.mrs_data</code>	<i>Calculate the standard deviation spectrum from an <code>mrs_data</code> object.</i>
--------------------------	--

---

**Description**

Calculate the standard deviation spectrum from an `mrs_data` object.

**Usage**

```
## S3 method for class 'mrs_data'  
sd(x, na.rm = FALSE)
```

**Arguments**

<code>x</code>	object of class <code>mrs_data</code> .
<code>na.rm</code>	remove NA values.

**Value**

`sd` `mrs_data` object.

---

<code>seconds</code>	<i>Return a time scale vector to match the FID of an MRS data object.</i>
----------------------	---

---

**Description**

Return a time scale vector to match the FID of an MRS data object.

**Usage**

```
seconds(mrs_data)
```

**Arguments**

<code>mrs_data</code>	MRS data.
-----------------------	-----------

**Value**

time scale vector in units of seconds.

---

seq_cpmg_ideal	<i>CPMG style sequence with ideal pulses.</i>
----------------	---

---

**Description**

CPMG style sequence with ideal pulses.

**Usage**

```
seq_cpmg_ideal(spin_params, ft, ref, TE = 0.03, echoes = 4)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
TE	echo time in seconds.
echoes	number of echoes.

**Value**

list of resonance amplitudes and frequencies.

---

seq_mega_press_ideal	<i>MEGA-PRESS sequence with ideal localisation pulses and Gaussian shaped editing pulse.</i>
----------------------	--

---

**Description**

MEGA-PRESS sequence with ideal localisation pulses and Gaussian shaped editing pulse.

**Usage**

```
seq_mega_press_ideal(  
  spin_params,  
  ft,  
  ref,  
  ed_freq = 1.89,  
  TE1 = 0.015,  
  TE2 = 0.053,  
  BW = 110,  
  steps = 50  
)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
ed_freq	editing pulse frequency in ppm.
TE1	TE1 sequence parameter in seconds (TE=TE1+TE2).
TE2	TE2 sequence parameter in seconds.
BW	editing pulse bandwidth in Hz.
steps	number of hard pulses used to approximate the editing pulse.

**Value**

list of resonance amplitudes and frequencies.

---

seq_press_ideal	<i>PRESS sequence with ideal pulses.</i>
-----------------	--

---

**Description**

PRESS sequence with ideal pulses.

**Usage**

```
seq_press_ideal(spin_params, ft, ref, TE1 = 0.01, TE2 = 0.02)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
TE1	TE1 sequence parameter in seconds (TE=TE1+TE2).
TE2	TE2 sequence parameter in seconds.

**Value**

list of resonance amplitudes and frequencies.



---

seq\_pulse\_acquire      *Simple pulse and acquire sequence with ideal pulses.*

---

**Description**

Simple pulse and acquire sequence with ideal pulses.

**Usage**

```
seq_pulse_acquire(spin_params, ft, ref)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.

**Value**

list of resonance amplitudes and frequencies.

---

seq\_pulse\_acquire\_31p      *Simple pulse and acquire sequence with ideal pulses.*

---

**Description**

Simple pulse and acquire sequence with ideal pulses.

**Usage**

```
seq_pulse_acquire_31p(spin_params, ft, ref)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.

**Value**

list of resonance amplitudes and frequencies.

---

seq\_slaser\_ideal      *sLASER sequence with ideal pulses.*

---

**Description**

sLASER sequence with ideal pulses.

**Usage**

```
seq_slaser_ideal(spin_params, ft, ref, TE1 = 0.008, TE2 = 0.011, TE3 = 0.009)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
TE1	first echo time (between exc. and 1st echo) in seconds.
TE2	second echo time (between 2nd echo and 4th echo) in seconds.
TE3	third echo time (between 4th echo and 5th echo) in seconds.

**Value**

list of resonance amplitudes and frequencies.

---

seq\_spin\_echo\_ideal      *Spin echo sequence with ideal pulses.*

---

**Description**

Spin echo sequence with ideal pulses.

**Usage**

```
seq_spin_echo_ideal(spin_params, ft, ref, TE = 0.03)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
TE	echo time in seconds.

**Value**

list of resonance amplitudes and frequencies.

---

seq\_spin\_echo\_ideal\_31p

*Spin echo sequence with ideal pulses.*

---

**Description**

Spin echo sequence with ideal pulses.

**Usage**

```
seq_spin_echo_ideal_31p(spin_params, ft, ref, TE = 0.03)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
TE	echo time in seconds.

**Value**

list of resonance amplitudes and frequencies.

---

seq\_steam\_ideal

*STEAM sequence with ideal pulses.*

---

**Description**

STEAM sequence with ideal pulses.

**Usage**

```
seq_steam_ideal(spin_params, ft, ref, TE = 0.03, TM = 0.02)
```

**Arguments**

spin_params	spin system definition.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
TE	sequence parameter in seconds.
TM	sequence parameter in seconds.

**Value**

list of resonance amplitudes and frequencies.

---

set\_def\_acq\_paras      *Set the default acquisition parameters.*

---

**Description**

Set the default acquisition parameters.

**Usage**

```
set_def_acq_paras(  
    ft = getOption("spant.def_ft"),  
    fs = getOption("spant.def_fs"),  
    N = getOption("spant.def_N"),  
    ref = getOption("spant.def_ref"),  
    nuc = getOption("spant.nuc")  
)
```

**Arguments**

ft	transmitter frequency in Hz.
fs	sampling frequency in Hz.
N	number of data points in the spectral dimension.
ref	reference value for ppm scale.
nuc	resonant nucleus.

---

set\_lcm\_cmd      *Set the command to run the LCModel command-line program.*

---

**Description**

Set the command to run the LCModel command-line program.

**Usage**

```
set_lcm_cmd(cmd)
```

**Arguments**

cmd	path to binary.
-----	-----------------

---

set_lw	<i>Apply line-broadening to an mrs_data object to achieve a specified linewidth.</i>
--------	--

---

**Description**

Apply line-broadening to an mrs\_data object to achieve a specified linewidth.

**Usage**

```
set_lw(mrs_data, lw, xlim = c(4, 0.5))
```

**Arguments**

mrs_data	data in.
lw	target linewidth in units of ppm.
xlim	region to search for peaks to obtain a linewidth estimate.

**Value**

line-broadened data.

---

set_precomp_mode	<i>Set the precompute mode.</i>
------------------	---------------------------------

---

**Description**

Set the precompute mode.

**Usage**

```
set_precomp_mode(mode = NA)
```

**Arguments**

mode	can be one of: "default", "overwrite", "clean" or "disabled".
------	---

---

set\_precomp\_verbose     *Set the verbosity of the precompute function.*

---

### **Description**

Set the verbosity of the precompute function.

### **Usage**

```
set_precomp_verbose(verbose = NA)
```

### **Arguments**

verbose                 can be TRUE or FALSE.

---

set\_ref                     *Set the ppm reference value (eg ppm value at 0Hz).*

---

### **Description**

Set the ppm reference value (eg ppm value at 0Hz).

### **Usage**

```
set_ref(mrs_data, ref)
```

### **Arguments**

mrs\_data                 MRS data.  
ref                         reference value for ppm scale.

---

set\_td\_pts                     *Set the number of time-domain data points, truncating or zero-filling as appropriate.*

---

### **Description**

Set the number of time-domain data points, truncating or zero-filling as appropriate.

### **Usage**

```
set_td_pts(mrs_data, pts)
```

**Arguments**

mrs_data	MRS data.
pts	number of data points.

**Value**

MRS data with pts data points.

---

set_tqn_cmd	<i>Set the command to run the TARQUIN command-line program.</i>
-------------	---

---

**Description**

Set the command to run the TARQUIN command-line program.

**Usage**

```
set_tqn_cmd(cmd)
```

**Arguments**

cmd	path to binary.
-----	-----------------

---

shift	<i>Apply a frequency shift to MRS data.</i>
-------	---

---

**Description**

Apply a frequency shift to MRS data.

**Usage**

```
shift(mrs_data, shift, units = "ppm")
```

**Arguments**

mrs_data	MRS data.
shift	frequency shift (in ppm by default).
units	of the shift ("ppm" or "hz").

**Value**

frequency shifted MRS data.

---

sim_basis	<i>Simulate a basis set object.</i>
-----------	-------------------------------------

---

**Description**

Simulate a basis set object.

**Usage**

```
sim_basis(
    mol_list,
    pul_seq = seq_pulse_acquire,
    acq_paras = def_acq_paras(),
    xlim = NULL,
    ...
)
```

**Arguments**

mol_list	list of mol_parameter objects.
pul_seq	pulse sequence function to use.
acq_paras	list of acquisition parameters or an mrs_data object. See <a href="#">def_acq_paras</a>
xlim	ppm range limiting signals to be simulated.
...	extra parameters to pass to the pulse sequence function.

**Value**

basis object.

---

sim_basis_1h_brain	<i>Simulate a basis-set suitable for 1H brain MRS analysis acquired with a PRESS sequence. Note, ideal pulses are assumed.</i>
--------------------	--

---

**Description**

Simulate a basis-set suitable for 1H brain MRS analysis acquired with a PRESS sequence. Note, ideal pulses are assumed.

**Usage**

```
sim_basis_1h_brain(
    pul_seq = seq_press_ideal,
    acq_paras = def_acq_paras(),
    xlim = c(0.5, 4.2),
    lcm_compat = FALSE,
    ...
)
```



**Arguments**

pul_seq	pulse sequence function to use.
acq_paras	list of acquisition parameters or an mrs_data object. See <a href="#">def_acq_paras</a> .
xlim	range of frequencies to simulate in ppm.
lcm_compat	exclude lipid and MM signals for use with default LCModel options.
...	extra parameters to pass to the pulse sequence function.

**Value**

basis object.

---

sim\_basis\_1h\_brain\_press

*Simulate a basis-set suitable for 1H brain MRS analysis acquired with a PRESS sequence. Note, ideal pulses are assumed.*

---

**Description**

Simulate a basis-set suitable for 1H brain MRS analysis acquired with a PRESS sequence. Note, ideal pulses are assumed.

**Usage**

```
sim_basis_1h_brain_press(
  acq_paras = def_acq_paras(),
  xlim = c(0.5, 4.2),
  lcm_compat = FALSE,
  TE1 = 0.01,
  TE2 = 0.02
)
```

**Arguments**

acq_paras	list of acquisition parameters or an mrs_data object. See <a href="#">def_acq_paras</a>
xlim	range of frequencies to simulate in ppm.
lcm_compat	exclude lipid and MM signals for use with default LCModel options.
TE1	TE1 of PRESS sequence (TE = TE1 + TE2).
TE2	TE2 of PRESS sequence.

**Value**

basis object.

---

sim_basis_tqn	<i>Simulate a basis file using TARQUIN.</i>
---------------	---

---

**Description**

Simulate a basis file using TARQUIN.

**Usage**

```
sim_basis_tqn(  
  fs = def_fs(),  
  ft = def_ft(),  
  N = def_N(),  
  ref = def_ref(),  
  opts = NULL  
)
```

**Arguments**

fs	sampling frequency
ft	transmitter frequency
N	number of data points
ref	chemical shift reference
opts	list of options to pass to TARQUIN.

**Examples**

```
## Not run:  
write_basis_tqn('test.basis',mrs_data,c("--echo","0.04"))  
  
## End(Not run)
```

---

sim_brain_1h	<i>Simulate MRS data with a similar appearance to normal brain (by default).</i>
--------------	--

---

**Description**

Simulate MRS data with a similar appearance to normal brain (by default).

**Usage**

```
sim_brain_1h(
  acq paras = def_acq_paras(),
  type = "normal_v1",
  pul_seq = seq_press_ideal,
  xlim = c(0.5, 4.2),
  full_output = FALSE,
  amps = NULL,
  ...
)
```

**Arguments**

acq_paras	list of acquisition parameters or an mrs_data object. See <a href="#">def_acq_paras</a> .
type	type of spectrum, only "normal" is implemented currently.
pul_seq	pulse sequence function to use.
xlim	range of frequencies to simulate in ppm.
full_output	when FALSE (default) only output the simulated MRS data. When TRUE output a list containing the MRS data, basis set object and corresponding amplitudes.
amps	a vector of basis amplitudes may be specified to modify the output spectrum.
...	extra parameters to pass to the pulse sequence function.

**Value**

see full\_output option.

---

sim_mol	<i>Simulate a mol_parameter object.</i>
---------	---

---

**Description**

Simulate a mol\_parameter object.

**Usage**

```
sim_mol(
  mol,
  pul_seq = seq_pulse_acquire,
  ft = def_ft(),
  ref = def_ref(),
  fs = def_fs(),
  N = def_N(),
  xlim = NULL,
  ...
)
```

**Arguments**

mol	mol_parameter object.
pul_seq	pulse sequence function to use.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
fs	sampling frequency in Hz.
N	number of data points in the spectral dimension.
xlim	ppm range limiting signals to be simulated.
...	extra parameters to pass to the pulse sequence function.

**Value**

mrs\_data object.

---

sim_noise	<i>Simulate a time-domain mrs_data object containing simulated Gaussian noise.</i>
-----------	--

---

**Description**

Simulate a time-domain mrs\_data object containing simulated Gaussian noise.

**Usage**

```
sim_noise(
  sd = 0.1,
  fs = def_fs(),
  ft = def_ft(),
  N = def_N(),
  ref = def_ref(),
  dyns = 1,
  fd = TRUE
)
```

**Arguments**

sd	standard deviation of the noise.
fs	sampling frequency in Hz.
ft	transmitter frequency in Hz.
N	number of data points in the spectral dimension.
ref	reference value for ppm scale.
dyns	number of dynamic scans to generate.
fd	return data in the frequency-domain (TRUE) or time-domain (FALSE)

**Value**

mrs\_data object.

---

sim_resonances	<i>Simulate a MRS data object containing a set of simulated resonances.</i>
----------------	---

---

**Description**

Simulate a MRS data object containing a set of simulated resonances.

**Usage**

```
sim_resonances(  
  freq = 0,  
  amp = 1,  
  lw = 0,  
  lg = 0,  
  phase = 0,  
  freq_ppm = TRUE,  
  acq_paras = def_acq_paras(),  
  fp_scale = TRUE,  
  back_extrap_pts = 0  
)
```

**Arguments**

freq	resonance frequency.
amp	resonance amplitude.
lw	line width in Hz.
lg	Lorentz-Gauss lineshape parameter (between 0 and 1).
phase	phase in degrees.
freq_ppm	frequencies are given in ppm units if set to TRUE, otherwise Hz are assumed.
acq_paras	list of acquisition parameters. See <a href="#">def_acq_paras</a>
fp_scale	multiply the first data point by 0.5.
back_extrap_pts	number of data points to back extrapolate.

**Value**

MRS data object.

**Examples**

```
sim_data <- sim_resonances(freq = 2, lw = 5)
```

---

spant\_mpress\_drift      *Example MEGA-PRESS data with significant B0 drift.*

---

**Description**

Example MEGA-PRESS data with significant B0 drift.

**Usage**

spant\_mpress\_drift

**Format**

An object of class `mrs_data` of length 13.

---

spin\_sys      *Create a spin system object for pulse sequence simulation.*

---

**Description**

Create a spin system object for pulse sequence simulation.

**Usage**

spin\_sys(spin\_params, ft, ref)

**Arguments**

spin\_params      an object describing the spin system properties.  
ft                transmitter frequency in Hz.  
ref                reference value for ppm scale.

**Value**

spin system object.

---

spm_pve2categorical	<i>Convert SPM style segmentation files to a single categorical image where the numerical values map as: 0) Other, 1) CSF, 2) GM and 3) WM.</i>
---------------------	---

---

**Description**

Convert SPM style segmentation files to a single categorical image where the numerical values map as: 0) Other, 1) CSF, 2) GM and 3) WM.

**Usage**

```
spm_pve2categorical(fname)
```

**Arguments**

fname	any of the segmentation files (eg c1_MY_T1.nii).
-------	--

**Value**

nifti object.

---

ssp	<i>Signal space projection method for lipid suppression.</i>
-----	--

---

**Description**

Signal space projection method as described in: Tsai SY, Lin YR, Lin HY, Lin FH. Reduction of lipid contamination in MR spectroscopy imaging using signal space projection. Magn Reson Med 2019 Mar;81(3):1486-1498.

**Usage**

```
ssp(mrs_data, comps = 5, xlim = c(1.5, 0.8))
```

**Arguments**

mrs_data	MRS data object.
comps	the number of spatial components to use.
xlim	spectral range (in ppm) covering the lipid signals.

**Value**

lipid suppressed mrs\_data object.

---

stackplot	<i>Produce a plot with multiple traces.</i>
-----------	---

---

**Description**

Produce a plot with multiple traces.

**Usage**

```
stackplot(x, ...)
```

**Arguments**

x	object for plotting.
...	arguments to be passed to methods.

---

stackplot.fit_result	<i>Plot the fitting results of an object of class fit_result with individual basis set components shown.</i>
----------------------	--

---

**Description**

Plot the fitting results of an object of class fit\_result with individual basis set components shown.

**Usage**

```
## S3 method for class 'fit_result'
stackplot(
  x,
  xlim = NULL,
  y_offset = 0,
  dyn = 1,
  x_pos = 1,
  y_pos = 1,
  z_pos = 1,
  coil = 1,
  n = NULL,
  sub_bl = FALSE,
  labels = FALSE,
  label_names = NULL,
  sig_col = "black",
  restore_def_par = TRUE,
  omit_signals = NULL,
  combine_lipmm = FALSE,
  combine_metab = FALSE,
```



```

    mar = NULL,
    show_grid = TRUE,
    grid_nx = NULL,
    grid_ny = NA,
    ...
)

```

### Arguments

x	fit_result object.
xlim	the range of values to display on the x-axis, eg xlim = c(4,1).
y_offset	separate basis signals in the y-axis direction by this value.
dyn	the dynamic index to plot.
x_pos	the x index to plot.
y_pos	the y index to plot.
z_pos	the z index to plot.
coil	the coil element number to plot.
n	single index element to plot (overrides other indices when given).
sub_bl	subtract the baseline from the data and fit (logical).
labels	print signal labels at the right side of the plot.
label_names	provide a character vector of signal names to replace the defaults determined from the basis set.
sig_col	colour of individual signal components.
restore_def_par	restore default plotting par values after the plot has been made.
omit_signals	a character vector of basis signal names to be removed from the plot.
combine_lipmm	combine all basis signals with names starting with "Lip" or "MM".
combine_metab	combine all basis signals with names not starting with "Lip" or "MM".
mar	option to adjust the plot margins. See ?par.
show_grid	plot gridlines behind the data (logical). Defaults to TRUE.
grid_nx	number of cells of the grid in x and y direction. When NULL the grid aligns with the tick marks on the corresponding default axis (i.e., tickmarks as computed by axTicks). When NA, no grid lines are drawn in the corresponding direction.
grid_ny	as above.
...	further arguments to plot method.

---

stackplot.mrs\_data      *Stackplot plotting method for objects of class mrs\_data.*

---

### Description

Stackplot plotting method for objects of class `mrs_data`.

### Usage

```
## S3 method for class 'mrs_data'
stackplot(
  x,
  xlim = NULL,
  mode = "re",
  x_units = NULL,
  fd = TRUE,
  col = NULL,
  alpha = NULL,
  x_offset = 0,
  y_offset = 0,
  plot_dim = NULL,
  x_pos = NULL,
  y_pos = NULL,
  z_pos = NULL,
  dyn = 1,
  coil = 1,
  bty = NULL,
  labels = NULL,
  lab_cex = 1,
  right_marg = NULL,
  bl_lty = NULL,
  restore_def_par = TRUE,
  show_grid = NULL,
  grid_nx = NULL,
  grid_ny = NA,
  lwd = NULL,
  ...
)
```

### Arguments

<code>x</code>	object of class <code>mrs_data</code> .
<code>xlim</code>	the range of values to display on the x-axis, eg <code>xlim = c(4,1)</code> .
<code>mode</code>	representation of the complex numbers to be plotted, can be one of: "re", "im", "mod" or "arg".
<code>x_units</code>	the units to use for the x-axis, can be one of: "ppm", "hz", "points" or "seconds".

fd	display data in the frequency-domain (default), or time-domain (logical).
col	set the colour of the line, eg col = rgb(1, 0, 0, 0.5).
alpha	set the line transparency, eg alpha = 0.5 is 50% transparency. Overrides any transparency levels set by col.
x_offset	separate plots in the x-axis direction by this value. Default value is 0.
y_offset	separate plots in the y-axis direction by this value.
plot_dim	the dimension to display on the y-axis, can be one of: "dyn", "x", "y", "z", "coil" or NULL. If NULL (the default) all spectra will be collapsed into the dynamic dimension and displayed.
x_pos	the x index to plot.
y_pos	the y index to plot.
z_pos	the z index to plot.
dyn	the dynamic index to plot.
coil	the coil element number to plot.
bty	option to draw a box around the plot. See ?par.
labels	add labels to each data item.
lab_cex	label size.
right_marg	change the size of the right plot margin.
bl_lty	linetype for the y = 0 baseline trace. A default value NULL results in no baseline being plotted.
restore_def_par	restore default plotting par values after the plot has been made.
show_grid	plot gridlines behind the data (logical). Defaults to TRUE.
grid_nx	number of cells of the grid in x and y direction. When NULL the grid aligns with the tick marks on the corresponding default axis (i.e., tickmarks as computed by axTicks). When NA, no grid lines are drawn in the corresponding direction.
grid_ny	as above.
lwd	plot linewidth.
...	other arguments to pass to the matplot method.

---

sum\_coils

*Calculate the sum across receiver coil elements.*


---

### Description

Calculate the sum across receiver coil elements.

### Usage

```
sum_coils(mrs_data)
```

**Arguments**

mrs\_data            MRS data split across receiver coil elements.

**Value**

sum across coil elements.

---

sum\_dyns            *Calculate the sum of data dynamics.*

---

**Description**

Calculate the sum of data dynamics.

**Usage**

sum\_dyns(mrs\_data)

**Arguments**

mrs\_data            dynamic MRS data.

**Value**

sum of data dynamics.

---

td2fd                *Transform time-domain data to the frequency-domain.*

---

**Description**

Transform time-domain data to the frequency-domain.

**Usage**

td2fd(mrs\_data)

**Arguments**

mrs\_data            MRS data in time-domain representation.

**Value**

MRS data in frequency-domain representation.

---

tdsr	<i>Time-domain spectral registration.</i>
------	---

---

**Description**

An implementation of the method published by Near et al MRM 73:44-50 (2015).

**Usage**

```
tdsr(mrs_data, ref = NULL, xlim = c(4, 0.5), max_t = 0.2)
```

**Arguments**

mrs_data	MRS data to be corrected.
ref	optional MRS data to use as a reference, the mean of all dynamics is used if this argument is not supplied.
xlim	optional frequency range to perform optimisation, set to NULL to use the full range.
max_t	truncate the FID when longer than max_t to reduce time taken.

**Value**

a list containing the corrected data; phase and shift values in units of degrees and Hz respectively.

---

td_conv_filt	<i>Time-domain convolution based filter.</i>
--------------	--

---

**Description**

Time-domain convolution based filter described by: Marion D, Ikura M, Bax A. Improved solvent suppression in one-dimensional and twodimensional NMR spectra by convolution of time-domain data. J Magn Reson 1989;84:425-430.

**Usage**

```
td_conv_filt(mrs_data, K = 25, ext = 1)
```

**Arguments**

mrs_data	MRS data to be filtered.
K	window width in data points.
ext	point separation for linear extrapolation.

---

varpro_3_para_opts	<p><i>Return a list of options for VARPRO based fitting with 3 free parameters:</i></p> <ul style="list-style-type: none"> <li>• <i>zero'th order phase correction</i></li> <li>• <i>global damping</i></li> <li>• <i>global frequency shift.</i></li> </ul>
--------------------	--

---

### Description

Return a list of options for VARPRO based fitting with 3 free parameters:

- zero'th order phase correction
- global damping
- global frequency shift.

### Usage

```
varpro_3_para_opts(
  nstart = 20,
  init_damping = 2,
  maxiters = 200,
  max_shift = 5,
  max_damping = 5,
  anal_jac = FALSE,
  bl_smth_pts = 80
)
```

### Arguments

nstart	position in the time-domain to start fitting, units of data points.
init_damping	starting value for the global Gaussian line-broadening term - measured in Hz.
maxiters	maximum number of levmar iterations to perform.
max_shift	maximum global shift allowed, measured in Hz.
max_damping	maximum damping allowed, FWHM measured in Hz.
anal_jac	option to use the analytic or numerical Jacobian (logical).
bl_smth_pts	number of data points to use in the baseline smoothing calculation.

### Value

list of options.

---

varpro\_opts                      *Return a list of options for VARPRO based fitting.*

---

### Description

Return a list of options for VARPRO based fitting.

### Usage

```
varpro_opts(  
  nstart = 20,  
  init_g_damping = 2,  
  maxiters = 200,  
  max_shift = 5,  
  max_g_damping = 5,  
  max_ind_damping = 5,  
  anal_jac = TRUE,  
  bl_smth_pts = 80  
)
```

### Arguments

nstart	position in the time-domain to start fitting, units of data points.
init_g_damping	starting value for the global Gaussian line-broadening term - measured in Hz.
maxiters	maximum number of levmar iterations to perform.
max_shift	maximum shift allowed to each element in the basis set, measured in Hz.
max_g_damping	maximum permitted global Gaussian line-broadening.
max_ind_damping	maximum permitted Lorentzian line-broadening for each element in the basis set, measured in Hz.
anal_jac	option to use the analytic or numerical Jacobian (logical).
bl_smth_pts	number of data points to use in the baseline smoothing calculation.

### Value

list of options.

### Examples

```
varpro_opts(nstart = 10)
```

---

vec2mrs_data	<i>Convert a vector into a mrs_data object.</i>
--------------	---

---

**Description**

Convert a vector into a mrs\_data object.

**Usage**

```
vec2mrs_data(  
  vec,  
  fs = def_fs(),  
  ft = def_ft(),  
  ref = def_ref(),  
  nuc = def_nuc(),  
  dyns = 1,  
  fd = FALSE  
)
```

**Arguments**

vec	the data vector.
fs	sampling frequency in Hz.
ft	transmitter frequency in Hz.
ref	reference value for ppm scale.
nuc	resonant nucleus.
dyns	replicate the data across the dynamic dimension.
fd	flag to indicate if the matrix is in the frequency domain (logical).

**Value**

mrs\_data object.

---

write_basis	<i>Write a basis object to an LCModel .basis formatted file.</i>
-------------	--

---

**Description**

Write a basis object to an LCModel .basis formatted file.

**Usage**

```
write_basis(basis, basis_file, fwhmba = 0.1)
```



**Arguments**

basis	basis object to be exported.
basis_file	path to basis file to be generated.
fwhmba	parameter used by LCMModel.

---

write_basis_tqn	<i>Generate a basis file using TARQUIN.</i>
-----------------	---

---

**Description**

Generate a basis file using TARQUIN.

**Usage**

```
write_basis_tqn(basis_file, metab_data, opts = NULL)
```

**Arguments**

basis_file	filename of the basis file to be generated.
metab_data	MRS data object to match the generated basis parameters.
opts	list of options to pass to TARQUIN.

**Examples**

```
## Not run:
write_basis_tqn('test.basis',mrs_data,c("--echo", "0.04"))

## End(Not run)
```

---

write_mrs	<i>Write MRS data object to file.</i>
-----------	---------------------------------------

---

**Description**

Write MRS data object to file.

**Usage**

```
write_mrs(mrs_data, fname, format = NULL)
```

**Arguments**

mrs_data	object to be written to file.
fname	the filename of the output.
format	string describing the data format. Must be one of the following : "nifti", "dpt", "lcm_raw", "rds". If not specified, the format will be guessed from the filename extension.

---

write_mrs_nifti	<i>Write MRS data object to file in NIFTI format.</i>
-----------------	---

---

**Description**

Write MRS data object to file in NIFTI format.

**Usage**

```
write_mrs_nifti(mrs_data, fname)
```

**Arguments**

mrs_data	object to be written to file.
fname	the filename of the output NIFTI MRS data.

---

zero_nzoc	<i>Zero all non-zero-order coherences.</i>
-----------	--

---

**Description**

Zero all non-zero-order coherences.

**Usage**

```
zero_nzoc(sys, rho)
```

**Arguments**

sys	spin system object.
rho	density matrix.

**Value**

density matrix.

---

zf *Zero-fill MRS data in the time domain.*

---

**Description**

Zero-fill MRS data in the time domain.

**Usage**

```
zf(x, factor = 2)

## S3 method for class 'mrs_data'
zf(x, factor = 2)

## S3 method for class 'basis_set'
zf(x, factor = 2)
```

**Arguments**

x input mrs\_data or basis\_set object.  
factor zero-filling factor, factor of 2 returns a dataset with twice the original data points.

**Value**

zero-filled data.

---

zf\_xy *Zero-fill MRSI data in the k-space x-y direction.*

---

**Description**

Zero-fill MRSI data in the k-space x-y direction.

**Usage**

```
zf_xy(mrs_data, factor = 2)
```

**Arguments**

mrs\_data MRSI data.  
factor zero-filling factor, a factor of 2 returns a dataset with twice the original points in the x-y directions. Factors smaller than one are permitted, such that a factor of 0.5 returns half the k-space points in the x-y directions.

**Value**

zero-filled data.

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