Package ‘spectrolab’

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Description Input/Output, processing and visualization of spectra taken with different spectrometers, including SVC (Spectra Vista), ASD and PSR (Spectral Evolution). Implements an S3 class 'spectra' that other packages can build on. Provides methods to access, plot, manipulate, splice sensor overlap, vector normalize and smooth spectra.

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aggregate.spectra

A function to apply a function (and meta if specified) over spectra. It aggregates by a factor 'by'. It can be specified to apply a function to the metadata as well.

Description

Applies FUN (and FUN_meta) over spectra aggregating by factor 'by'.

Usage

## S3 method for class 'spectra'
aggregate(x, by, FUN, FUN_meta = NULL, ...)

Arguments

- **x**: spectra object
- **by**: vector of factors to guide the aggregation
- **FUN**: function to be applied to value (and meta if FUN_meta is NULL)
- **FUN_meta**: function to be applied to metadata. If NULL (default), same FUN applied to value is used.
- **...**: extra args to FUN

Details

Argument FUN_meta is useful if you want to apply a different function to metadata and value. If you want to aggregate spectra and metadata using 'mean', 'sd', 'median' etc. but try to keep the text values, wrap your function in try_keep_txt(f).

Value

- **spectra object**
**apply_by_band**

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec_mean = aggregate(spec, by = names(spec), mean, try_keep_txt(mean))
```

---

**apply_by_band**

*Apply numeric function by band*

**Description**

`apply_by_band` is conceptually similar to `apply(as.matrix(x), 2, fun)`, but returns a spectra object while dealing with metadata and attributes. Applying a function that does not act on numeric values may crash the function or render all values NA.

**Usage**

```r
apply_by_band(x, fun, na.rm = TRUE, keep_txt_meta = TRUE, name = NULL, ...)
```

```r
## S3 method for class 'spectra'
apply_by_band(x, fun, na.rm = TRUE, keep_txt_meta = TRUE, name = NULL, ...)
```

**Arguments**

- **x**: spectra
- **fun**: numeric function to be applied to each band.
- **na.rm**: boolean. remove NAs?
- **keep_txt_meta**: boolean. try to keep text in the metadata?
- **name**: name for each sample in the output spectra. The default (NULL) will give samples sequential numeric names. Recycled if necessary.
- **...**: extra arguments passed to fun

**Value**

spectra

**Methods (by class)**

- spectra: Apply a numeric function by band

**Author(s)**

Jose Eduardo Meireles

Jose Eduardo Meireles
Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec_mean = apply_by_band(spec, mean)
```

**as.data.frame.spectra**  
*Convert spectra to data.frame*

**Description**

Returns a data.frame that includes sample names, metadata (if present) and value data. One advantage over as.matrix, is that the metadata are returned.

**Usage**

```r
## S3 method for class 'spectra'
as.data.frame(
  x,
  row.names = NULL,
  optional = FALSE,
  fix_names = "none",
  metadata = TRUE,
  ...
)
```

**Arguments**

- `x` spectra object
- `row.names` does nothing. Here for compatibility with S3 generics
- `optional` does nothing. Here for compatibility with S3 generics
- `fix_names` Use make.names to normalize names? Pick one: "none" "row" "col" "both".
- `metadata` boolean. Include spectral metadata? Defaults to TRUE
- `...` extra parameters passed to the generic as_spectra

**Value**

data.frame with: sample_name, metadata (if any) and value.

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
df  = as.data.frame(spec, fix_names = "none")
```
as.matrix.spectra

Convert spectra to matrix

Description

Convert spectra to matrix

Usage

## S3 method for class 'spectra'

as.matrix(x, fix_names = "none", ...)

Arguments

x  spectra object
fix_names Use make.names to normalize names? Pick one: "none" "row" "col" "both".
...  does nothing. Here for compatibility with S3 generics

Value

matrix of spectral value. columns are bands and rows are samples

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
mat = as.matrix(spec)

as_spectra

Convert matrix or data frame to spectra

Description

Convert matrix or data frame to spectra

Usage

as_spectra(x, name_idx = NULL, meta_idx = NULL)
### as_spectra.data.frame

#### Arguments

- **x**: matrix or dataframe. Samples are in rows and bands in columns. Any data that are not the spectra themselves (labels or metadata) must have their column index included in 'name_idx' or 'meta_idxs'.
- **name_idx**: column index with sample names. Defaults to NULL. If NULL or 0, row-names(x) or a sequence of integers will be assigned as names.
- **meta_idxs**: column indices with metadata (not name and not value). Defaults to NULL.

#### Value

spectra object

#### Author(s)

Jose Eduardo Meireles

#### Examples

```r
library(spectrolab)
as_spectra(spec_matrix_example, name_idx = 1)
```

---

### as_spectra.data.frame  
*Convert data.frame to spectra*

#### Description

Convert data.frame to spectra

#### Usage

```r
## S3 method for class 'data.frame'
as_spectra(x, name_idx = NULL, meta_idxs = NULL)
```

#### Arguments

- **x**: data.frame
- **name_idx**: column index with sample names. Defaults to NULL.
- **meta_idxs**: column indices with metadata (not name and not value). Defaults to NULL.

#### Value

spectra object

#### Author(s)

Jose Eduardo Meireles
as_spectra.matrix  Convert matrix to spectra

Description
Convert matrix to spectra

Usage
```r
## S3 method for class 'matrix'
as_spectra(x, name_idx = NULL, meta_idxs = NULL)
```

Arguments
- `x` matrix
- `name_idx` column index with sample names. Defaults to NULL
- `meta_idxs` column indices with metadata (not name and not value). Defaults to NULL

Value
spectra object

Author(s)
Jose Eduardo Meireles

bands  Get spectra band labels

Description
bands returns a vector of band labels from spectra

Usage
```r
bands(x, min = NULL, max = NULL, return_num = TRUE)
```

## S3 method for class 'spectra'
bands(x, min = NULL, max = NULL, return_num = TRUE)

Arguments
- `x` spectra object
- `min` = NULL
- `max` = NULL
- `return_num` boolean. return vector of numeric values (default). otherwise, a vector of strings is returned
Value

vector of bands. numeric if ‘return_num’ = TRUE (default).

Methods (by class)

• spectra: Get spectra band labels

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
head(bands(spec))

bands<-

Set band labels

Description

bands sets band labels of lhs to the rhs values

Usage

bands(x) <- value

Arguments

x                  spectra object (lhs)
value              rhs

Value

nothing. called for its side effect.

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
bands(spec) = bands(spec) / 1000
combine

**Combine spectral datasets**

**Description**

combine binds two spectral datasets. Both spectra must have the very same band labels, but different metadata are acceptable.

**Usage**

```r
combine(s1, s2)
```

## S3 method for class 'spectra'

```r
combine(s1, s2)
```

**Arguments**

- `s1`: spectra object 1
- `s2`: spectra object 2

**Value**

combined spectra object

**Methods (by class)**

- `spectra`: Combines two spectral datasets

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)

# Create dummy spectra datasets. Pretend that these are all different...
s1 = as_spectra(spec_matrix_example, name_idx = 1)
s2 = as_spectra(spec_matrix_example, name_idx = 1)
s3 = as_spectra(spec_matrix_example, name_idx = 1)

# combine 2 spectra objects
s_land2 = combine(s1, s2)

# combine n spectra objects using the `Reduce` function
s_n = Reduce(combine, list(s1, s2, s3))
```
### default spec regions

**Description**

Return default spectral regions matrix

**Usage**

```r
default_spec_regions()
```

**Value**

matrix with default_spec_regions

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
# matrix that defines regions on the spectra
# Useful for plotting w/ plot_regions()
```

### dim.spectra

**Description**

dim returns a vector with number of samples and bands (bands)

**Usage**

```r
## S3 method for class 'spectra'

dim(x)
```

**Arguments**

- `x` spectra object

**Value**

tuple of integers: c("n_samples", "n_bands")
guess_splice_at

Author(s)
Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
dim(spec)

guess_splice_at(x)

## S3 method for class 'spectra'
guess_splice_at(x)

Arguments

x spectra object

Value
vector of band values

Methods (by class)

• spectra: Guess splice bands (bounds between sensors)

Author(s)
Jose Eduardo Meireles
**is_spectra**

*Is it a spectra object?*

**Description**

`is_spectra` tests if the argument is a spectra class object

**Usage**

`is_spectra(x)`

**Arguments**

- `x` any object

**Value**

boolean

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec1 = unclass(spec)
is_spectra(spec)
is_spectra(spec1)
```

---

**match_sensors**

*Match spectra at sensor transitions*

**Description**

`match_sensors` scales values of sensors 1 (VIS) and 3 (SWIR 2)

**Usage**

```r
match_sensors(x, splice_at, fixed_sensor = 2, interpolate_wvl = c(5, 1))
```

```r
# S3 method for class 'spectra'
match_sensors(x, splice_at, fixed_sensor = 2, interpolate_wvl = c(5, 2))
```
Arguments

x spectra object
splice_at bands that serve as splice points, i.e the beginnings of the rightmost sensor. Must be length 1 or 2 (max 3 sensors)
fixed_sensor sensor to keep fixed. Can be 1 or 2 if matching 2 sensors. If matching 3 sensors, 'fixed_sensor' must be 2 (default).
interpolate_wvl extent around splice_at values over which the splicing factors will be calculated. Defaults to 5

Details

Splice_at has no default because sensor transition points vary between vendors and individual instruments. The function guess_splice_at can help you guess what those values could be. However, splice_at is an important parameter though, so you should visually inspect your spectra before assigning it. Typical values in our own individual instruments were: SVC ~ c(990, 1900), ASD ~ c(1001, 1801).

If the factors used to match spectra are unreasonable, match_sensors will throw. Unreasonable factors (f) are defined as 0.5 > f > 3 or NaN, which happens when the value for the right sensor is 0.

Value

spectra object

Methods (by class)

• spectra: Match sensor overlap regions

Author(s)

Jose Eduardo Meireles and Anna Schweiger

max.spectra

Description

max Returns the maximum value in a spectra object

Usage

```r
## S3 method for class 'spectra'
max(..., na.rm = FALSE)
```
mean.spectra

Arguments

... spectra object
na.rm boolean. remove NAs? Defaults to FALSE

Value

single numeric value

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
max(spec)

Description

mean computes the arithmetic mean spectrum.

Usage

## S3 method for class 'spectra'
mean(x, na.rm = TRUE, keep_txt_meta = TRUE, ...)

Arguments

x spectra
na.rm boolean. remove NAs? Defaults to TRUE
keep_txt_meta try to keep text in the metadata
... nothing

Value

single spectrum

Author(s)

Jose Eduardo Meireles
**median.spectra**

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
mean(spec)
```

---

**Description**

`median` computes the median spectrum.

**Usage**

```r
## S3 method for class 'spectra'
median(x, na.rm = TRUE, keep_txt_meta = TRUE, ...)
```

**Arguments**

- `x`: spectra
- `na.rm`: boolean. remove NAs? Defaults to TRUE
- `keep_txt_meta`: try to keep text in the metadata
- `...`: nothing

**Value**

single spectrum

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
median(spec)
```
Description

`meta` returns metadata of spectra

Usage

```r
meta(x, label, sample, simplify = FALSE, quiet = TRUE)
```

```r
# S3 method for class 'spectra'
meta(x, label = NULL, sample = NULL, simplify = FALSE, quiet = TRUE)
```

Arguments

- `x`      spectra object
- `label`  metadata column index or label
- `sample` sample index or name
- `simplify` boolean. defaults to FALSE
- `quiet` boolean. warn about non-existent metadata? defaults to TRUE

Value

data frame or vector

Methods (by class)

- spectra: get metadata

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec = normalize(spec)
meta(spec, "normalization_magnitude")
```
### meta<-  Set metadata

**Description**

meta sets metadata

**Usage**

```r
meta(x, label, sample) <- value
```

**Arguments**

- `x`: spectra object (lhs)
- `label`: metadata column label
- `sample`: sample name
- `value`: rhs. TODO

**Value**

nothing. called for its side effect

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
meta(spec, "random") = rnorm(nrow(spec), mean(10), sd = 2)
```

---

### min.spectra  Minimum value

**Description**

min Returns the minimum value in a spectra object

**Usage**

```r
## S3 method for class 'spectra'
min(..., na.rm = FALSE)
```
Names of Spectra

Arguments

... spectra object

na.rm boolean. remove NAs? Defaults to FALSE

Value

single numeric value

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
min(spec)

names.spectra Get spectra sample names

Description

names returns a vector of sample names

Usage

## S3 method for class 'spectra'
names(x)

Arguments

x spectra object

Value

vector of sample names

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
names(spec)
names<-.spectra

Set spectra sample names

Description

names assigns sample names to lhs

Usage

## S3 replacement method for class 'spectra'
names(x) <- value

Arguments

x       spectra object (lhs)
value   values to be assigned (rhs)

Details

Sample names must not be coercible to numeric. That is, names such as "1" and "153.44" are invalid even if they are encoded as character. names will add the prefix "spec_" to any element of value that is coercible to numeric.

Value

nothing. called for its side effect.

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
names(spec) = toupper(names(spec))
**normalize**

Vector normalize spectra

**Description**

`normalize` returns a spectra obj with vector normalized values. Normalization value for each spectrum computed as `sqrt(sum(x^2))`

**Usage**

```r
normalize(x, quiet = FALSE, ...)
## S3 method for class 'spectra'
normalize(x, quiet = FALSE, ...)
```

**Arguments**

- `x` spectra object. bands must be strictly increasing
- `quiet` boolean. Warn about change in y value units? Defaults to FALSE
- `...` nothing

**Value**

spectra object with normalized spectra

**Methods (by class)**

- spectra: Vector normalize spectra

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec = normalize(spec)
```
**Ops.spectra**  
*Arithmetic operators for spectra*

**Description**  
Overloads arithmetic operators for spectra using 'Ops.'

**Usage**  
```r  
## S3 method for class 'spectra'  
Ops(e1, e2)  
```

**Arguments**

- `e1`  
  lhs

- `e2`  
  rhs

**Value**  
Depends on the operator. math operators will return spectra and logical or comparison operators will return boolean matrices

**Author(s)**  
Jose Eduardo Meireles

**Examples**

```r  
library(spectrolab)  
spec = as_spectra(spec_matrix_example, name_idx = 1)  
spec1 = spec * 2  
spec2 = spec + spec  
all(spec1 == spec2)  
```

---

**plot.spectra**  
*Plot spectra*

**Description**  
plot plots spectra.

**Usage**

```r  
## S3 method for class 'spectra'  
plot(x, ylab = "value", xlab = "band", col = "black", lty = 1, type = "l", ...)  
```
plot_interactive

Arguments

x  spectra object
ylab  label for y axis. Defaults to "value".
xlab  label for x axis. Defaults to "band".
col  line color. Defaults to "black".
lty  line type. Defaults to 1.
type  type of plot. Meant to take either line "l" or no plotting "n".
...  other arguments passed to matplot.

Value

nothing. Called for side effect.

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
plot(spec, lwd = 1.2)

plot_interactive  Plot spectra interactively

Description

Interactively plots spectra with a shiny app. Useful to inspect large datasets.

Usage

plot_interactive(
spec,
colpalette = function(n) RColorBrewer::brewer.pal(n, "Dark2"),
...
)

Arguments

spec  spectra object
colpalette  a color palette function, e.g. rainbow, terrain.colors, or a function returned by colorRampPalette() or colorRamps package
...  Other arguments passed to plot
Details

plot_interact limits the number of spectra displayed at once to 600 for performance reasons. As of now, the function does not return anything and does not have side effects. This means that spectra can be selected and highlighted but not yet deleted or subset from the shiny app.

Value

interactive plot

Author(s)

Jose Eduardo Meireles and Anna K. Schweiger

Examples

## Not run:
# Create a spectra object
spec = as_spectra(spec_matrix_example, name_idx = 1)

# Start interactive plot
plot_interactive(spec)

## End(Not run)

---

plot_quantile  Plot spectra quantiles

Description

plot_quantile plots polygons for the quantiles of spectra per band.

Usage

plot_quantile(
  spec,
  total_prob = 0.95,
  col = rgb(0, 0, 0, 0.1),
  border = TRUE,
  add = FALSE,
  na.rm = TRUE,
  ...
)
plot_regions

Arguments

spec: spectra object

total_prob: total probability mass to encompass. Single number between 0.0 and 1.0. Defaults to 0.95.

col: polygon color

border: boolean. Draw border?

add: if add = FALSE (default), a new plot is created. Otherwise (add = TRUE), the quantile is added to the current plot.

na.rm: boolean. remove NAs to compute quantiles? Defaults to TRUE

... other parameters passed to polygon() or to plot.

Value

nothing. Called for its side effect.

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
plot_quantile(spec, total_prob = 0.5)

plot_regions

Plot polygons for spectral regions

Description

plot_regions plots polygons for default (VIS, NIR, SWIR 1, SWIR 2) or customized regions of the spectrum.

Usage

plot_regions(
  spec,
  regions = default_spec_regions(),
  col = grDevices::rgb(0.7, 0.7, 0.7, 0.3),
  border = FALSE,
  add = TRUE,
  add_label = TRUE,
  cex_label = 1,
  ...
)

plot_regions

Arguments

spec  spectra object
regions  matrix with spectral regions in columns and only two rows named "begin" and "end". Values are the bands where a spectral regions begins and ends. See details for how the default regions are defined.
col  color for regions. Single value or vector of length ncol (regions).
border  color for region borders. Defaults to FALSE (no border).
add  boolean. If TRUE (default) adds polygons to current plot (if a plot exists) or throws an error if a plot does not exist. If FALSE, a new plot is created **without** any spectra.
add_label  boolean. Add region column names on top of the polygons?
cex_label  label scale
...
additional parameters passed to polygon().

Details

Default regions: spec_regions = cbind("VIS" = c(begin = 400, end = 700), "NIR" = c(begin = 800, end = 1300), "SWIR1" = c(begin = 1550, end = 1800), "SWIR2" = c(begin = 2000, end = 2400)).

Value

nothing. Called for its side effect.

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
plot_regions(spec, default_spec_regions())
plot(spec, add = TRUE)

# Alternatively, if you want to get fancy...
## Not run:
col_fun = colorRampPalette(c(rgb(1, 1, 0.7),rgb(1, 0, 0.7)), alpha = TRUE)
colors = col_fun(4)
plot_regions(spec,default_spec_regions(), col = colors)
plot(spec, add = TRUE)

## End(Not run)
print.spectra

Print spectra

Description

print prints basic information about the spectra obj to the console

Usage

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

Arguments

- `x`: spectra object
- `...`: other arguments passed to print. not implemented for spectra

Value

nothing. called for side effect

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
print(spec)
# or simply
spec
```

quantile.spectra

Compute spectra quantiles

Description

quantile computes quantiles by band and returns them as ‘spectra’.
Usage

```r
## S3 method for class 'spectra'
quantile(
  x,
  probs = c(0.025, 0.25, 0.5, 0.75, 0.975),
  na.rm = TRUE,
  names = NULL,
  ...
)
```

Arguments

- `x`: spectra object.Must have at least the same number of sample that length(probs) has.
- `probs`: Probabilities to compute quantiles. Must be a vector of numerics between 0.0 and 1.0. Defaults to c(0.025, 0.25, 0.5, 0.75, 0.975). Duplicated probs will be removed.
- `na.rm`: remove NAs before computing quantiles? Defaults to TRUE
- `names`: names for each quantile spectrum. If NULL (default), names are set to ‘probs’. A char vector should otherwise be given. Recycled.
- `...`: other arguments passed to quantile.

Value

spectra object with one spectrum for each prob

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
quantile(spec, probs = c(0.25, 0.75))
```

---

range.spectra

Range of spectral values

Description

`range` Returns the range of (min, max) values in spectra

Usage

```r
## S3 method for class 'spectra'
range(..., na.rm = FALSE)
```
read_spectra

Arguments

...  spectra object
na.rm  boolean. remove NAs? Defaults to FALSE

Value

tuple of numeric values (min, max)

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
range(spec)

read_spectra  Read files from various formats into ‘spectra’

Description

Read files from various formats into ‘spectra’

Usage

read_spectra(
  path,
  format = NULL,
  type = "target_reflectance",
  extract_metadata = FALSE,
  exclude_if_matches = NULL,
  ignore_extension = FALSE
)

Arguments

path  Path to directory or input files.
format  File format. Defaults to NULL so spectrolab tries to guess it from the file name. Alternatively, use "asd" for ASD; "sig" for SVC (Spectra Vista); or "sed" for PSR (Spectral Evolution)
type  Data type to read. "target_reflectance", "target_radiance", or "reference_radiance". Defaults to "target_reflectance".
resample

Description
resample returns spectra resampled to new bands using spline smoothing. Possible to increase or decrease the spectral resolution.

Usage
resample(x, new_bands, ...)

## S3 method for class 'spectra'
resample(x, new_bands, ...)

Arguments

x spectra object. bands must be strictly increasing
new_bands numeric vector of bands to sample from spectra
... additional parameters passed to the smooth.spline function.

Details
resample doesn’t predict values for bands outside of the original range.
Value

spectra object with resampled spectra

Methods (by class)

- spectra: Resample spectra

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec = resample(spec, new_bands = seq(400, 2400, 0.5), parallel = FALSE)

sd

Standard deviation

Description

sd computes the standard deviation spectrum. Note that values will not reflect value anymore, but the sd of the value instead.

Usage

sd(x, na.rm = FALSE)

Arguments

- x: a numeric vector or an R object which is coercible to one by as.double(x)
- na.rm: logical. Should missing values be removed?

Value

standard deviation
sd.default

Default variance

Description

This function computes the standard deviation of the values in x. If na.rm is TRUE then missing values are removed before computation proceeds.

Usage

## Default S3 method:
sd(x, na.rm = FALSE)

Arguments

x

a numeric vector or an R object but not a factor coercible to numeric by as.double(x).

na.rm

logical. Should missing values be removed?

Details

Like var this uses denominator n − 1.

The standard deviation of a length-one or zero-length vector is NA.

See Also

var for its square, and mad, the most robust alternative.

Examples

sd(1:2) ^ 2

sd.spectra

Standard deviation spectrum

Description

Forces keep_txt_meta = TRUE

Usage

## S3 method for class 'spectra'
sd(x, na.rm = TRUE)
**smooth**

**Arguments**

- `x` spectra
- `na.rm` boolean. remove NAs?

**Value**

single spectrum

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
sd(spec)
```

---

**smooth**  
*Generic Smoothing function*

**Description**

Generic Smoothing function

**Usage**

```r
smooth(x, ...)
```

**Arguments**

- `x` data to smooth over
- `...` additional arguments

**Value**

smoothed data
smooth.default  

**Default smoothing function**

**Description**

Default smoothing function

**Usage**

```r
## Default S3 method:
smooth(x, ...)
```

**Arguments**

- `x` : data to smooth over
- `...` : additional arguments

**Value**

smoothed data

---

smooth.spectra  

**Smooth spectra**

**Description**

smooth runs each spectrum by a smoothing and returns the spectra

**Usage**

```r
## S3 method for class 'spectra'
smooth(x, method = "spline", ...)
```

**Arguments**

- `x` : spectra object. bands must be strictly increasing
- `method` : Choose smoothing method: "spline" (default) or "moving_average"
- `...` : additional parameters passed to smooth.spline or parameters 'n' and 'save_bands_to_meta' for the moving average smoothing.

**Value**

a spectra object of with smoothed spectra
smooth_moving_avg

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)

spec = as_spectra(spec_matrix_example, name_idx = 1)
spec = smooth(spec, parallel = FALSE)
```

Description

Smooth moving average for spectra

Usage

```r
smooth_moving_avg(x, n = NULL, save_bands_to_meta = TRUE)
```

Arguments

- `x` spectra object
- `n` = NULL
- `save_bands_to_meta` boolean. keep lost ends of original wvls in metadata

Value

spectra object

Author(s)

Jose Eduardo Meireles
smooth_spline  

Smooth spline functions for spectra

Description

Gets spline functions for each spectrum in a spectra object.

Usage

smooth_spline(x, parallel = TRUE, return_fn = FALSE, ...)

Arguments

x  
spectra object. bands must be strictly increasing

parallel  
boolean. Do computation in parallel? Defaults to TRUE. Unfortunately, the parallelization does not work on Windows.

return_fn  
Boolean. If TRUE, smooth_spline returns the spline functions instead of the smoothed spectra. Defaults to FALSE

...  
additional parameters passed to smooth.spline except nknots, which is computed internally

Value

Smoothed spectra or, if return_fn = TRUE, a list of spline functions.

Author(s)

Jose Eduardo Meireles

spectra  

Spectra object constructor

Description

spectra “manually” creates a spectra object

Usage

spectra(value, bands, names, meta = NULL, ...)

Arguments

value N by M numeric matrix. N samples in rows and M bands in columns
bands band names in vector of length M
names sample names in vector of length N
meta spectra metadata. defaults to NULL. Must be either of length or nrow equals to
the number of samples (nrow(value) or length(names))
... additional arguments to metadata creation. not implemented yet

Value

spectra object

Note

This function resorts to an ugly hack to deal with metadata assignment. Need to think a little harder
to find a solution.

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
# 1. Create a value matrix.
#   In this case, by removing the first column that holds the species name
rf = spec_matrix_example[, -1]

# (2) Create a vector with band labels that match
#      the value matrix columns.
wl = colnames(rf)

# (3) Create a vector with sample labels that match
#      the value matrix rows.
#      In this case, use the first column of spec_matrix_example
sn = spec_matrix_example[, 1]

# Finally, construct the spectra object using the `spectra` constructor
spec = spectra(value = rf, bands = wl, names = sn)

spectrolab Spectrolab

Description

Class and methods for hyperspectral data.
spec_matrix_example  
Example spectral dataset

**Description**

Simulated spectral dataset as a matrix. First column hold species names and the remaining ones store the spectra values. band labels are given as column names.

**Usage**

`spec_matrix_example`

**Format**

An object of class `matrix` (inherits from `array`) with 50 rows and 2102 columns.

**Author(s)**

Jose Eduardo Meireles

---

split.spectra  
Split spectra

**Description**

split a spectra object into a list of spectra according to grouping f.

**Usage**

```r
## S3 method for class 'spectra'
split(x, f, drop = FALSE, ...)
```

**Arguments**

- `x`  
spectra object
- `f`  
factor vector defining the grouping. Must have length nrow(x)
- `drop`  
NOT used
- `...`  
NOT used

**Value**

list of spectra

**Author(s)**

Jose Eduardo Meireles
Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec_list = split(spec, names(spec))
```

str.spectra  
Structure of the spectra object

Description

Structure of the spectra object

Usage

```r
## S3 method for class 'spectra'
str(object, ...)
```

Arguments

- `object` spectra object
- `...` additional args. not implemented

Value

prints to console

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
str(spec)
```
subset_by() subsets spectra by a factor ‘by’ ensuring that it appears at most ‘n_max’ times **and** at least ‘n_min’ times in the dataset.

**Usage**

```r
subset_by(x, by, n_min, n_max, random = TRUE)
```

## S3 method for class 'spectra'
subset_by(x, by, n_min, n_max, random = TRUE)

**Arguments**

- `x`: spectra object
- `by`: vector coercible to factor and of same length as nrow(x)
- `n_min`: int. only keep spectra with at least (inclusive) ‘n_min’ number of samples per unique ‘by’.
- `n_max`: int. keep at most (incl) this number of spectra per unique ‘by’
- `random`: boolean. Sample randomly or keep first n_max? Defaults to TRUE

**Details**

Note that subset_by forces you to provide both a minimum and a maximum number of spectra to be kept for each unique value of ‘by’. In case you’re interested in subsetting only based on ‘n_min’, set ‘n_max’ to ‘Inf’.

**Value**

spectra

**Methods (by class)**

- spectra: Subset spectra by factor

**Author(s)**

Jose Eduardo Meireles
Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)

# remove spec of species with less than 4 samples
spec = subset_by(spec, by = names(spec), n_min = 4, n_max = Inf)

summary.spectra

Summary spectra

Description

Summarize spectra

Usage

## S3 method for class 'spectra'
summary(object, ...)

Arguments

  object         spectra object
  ...            additional params to summary, not used yet

Value

nothing yet (just prints to console)

Author(s)

Jose Eduardo Meireles

Examples

library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
summary(spec)
## t.spectra

### Spectra Transpose

#### Description
spectra are not transposable. Transpose the value instead

#### Usage
```r
## S3 method for class 'spectra'

\[ t(x) \]
```

#### Arguments
- **x** spectra

#### Value
nothing. operation not allowed

#### Author(s)
Jose Eduardo Meireles

#### Examples
```r
library(spectrolab)
s = as_spectra(spec_matrix_example, name_idx = 1)

# This will throw an error
## Not run:
t(s)

## End(Not run)
# But these options should work
   t(value(s))
   t(as.matrix(s))
```

## try_keep_txt

### Wrap function to try to keep text

#### Description
Function operator returning a function f that tries to keep text.

#### Usage
```r
try_keep_txt(f)
```
Arguments

\( f \) function to be applied

Details

\texttt{try\_keep\_txt} takes a function \( f \) as argument, typically a mathematical operation such as mean, median, etc. and returns a modified version of it that will try return a string of unique values in case function \( f \) emits a warning. Useful when aggregating over spectral metadata that has both numeric values (which you want to aggregate) and text values, which you want to keep.

Value

modified function \( f \) (\( f' \)).

Author(s)

Jose Eduardo Meireles

Examples

\begin{verbatim}
library(spectrolab)
g = try_keep_txt(mean)
g(c(1, 2))
g(c("a", "b"))
\end{verbatim}

\begin{tabular}{ll}
\hline
value & \emph{Get spectra value} \\
\hline
\end{tabular}

Description

\emph{value} returns the value matrix from spectra

Usage

\begin{verbatim}
value(x)

## S3 method for class 'spectra'
value(x)
\end{verbatim}

Arguments

\( x \) spectra object

Value

matrix with samples in rows and bands in columns
Methods (by class)

• spectra: Get spectra value

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
is.matrix(value(spec))
```

value<- Set spectra value

Description

value Assigns the rhs to the value of the lhs spectra obj

Usage

```r
value(x) <- value
```

Arguments

- `x` spectra object
- `value` value to be assigned to the lhs

Value

nothing. called for its side effect

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
# scale all reflectance values by 2
value(spec) = value(spec) * 2
```
Description

var computes the variance spectrum. Note that values will not reflect value anymore, but the variance of the value instead.

Usage

var(x, y = NULL, na.rm = FALSE, use)

Arguments

x a numeric vector, matrix or data frame
y NULL (default) or a vector, matrix or data frame with compatible dimensions to x.
na.rm logical. Should missing values be removed?
use an optional character string giving a method for computing covariances in the presence of missing values. This must be (an abbreviation of) one of the strings "everything", "all.obs", "complete.obs", "na.or.complete", or "pairwise.complete.obs"

Value

variance

Description

var computes the variance spectrum. Note that values will not reflect value anymore, but the variance of the value instead.

Usage

## Default S3 method:
var(x, y = NULL, na.rm = FALSE, use)

## Default S3 method:
var.default(x, y = NULL, na.rm = FALSE, use)
**Arguments**

- **x**: A numeric vector, matrix or data frame.
- **y**: NULL (default) or a vector, matrix or data frame with compatible dimensions to x.
- **na.rm**: Logical. Should missing values be removed?
- **use**: An optional character string giving a method for computing covariances in the presence of missing values. This must be (an abbreviation of) one of the strings "everything", "all.obs", "complete.obs", "na.or.complete", or "pairwise.complete.obs".

**Value**

- **variance**

---

**Description**

Forces keep_txt_meta = TRUE

**Usage**

```r
## S3 method for class 'spectra'
var(x, y = NULL, na.rm = TRUE, use)
```

**Arguments**

- **x**: Spectra
- **y**: Nothing
- **na.rm**: Boolean. Remove NAs?
- **use**: Nothing

**Value**

- Single spectrum

**Author(s)**

- Jose Eduardo Meireles

**Examples**

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
var(spec)
```
Description

`[` Subsets spectra by sample names (rows) or (and) bands (columns)

Usage

```r
## S3 method for class 'spectra'
x[i, j, simplify = TRUE]
```

Arguments

- `x`: spectra object
- `i`: Sample names (preferred), index, or a logical vector of length nrow(x)
- `j`: band labels, as numeric or character or a logical vector of length ncol(x). Do not use indexes!
- `simplify`: Boolean. If TRUE (default), single band selections are returned as a named vector of values

Details

Subset operations based on samples (first argument) will match sample names or indexes, in that order. The spectra constructor ensures that names are not numeric nor are coercible to numeric, such that `x[1:2, ]` will return the first and second samples in the 'spectra' object. Subsetting based on bands (second argument) matches the band labels, not indices! That is, `x[, 600]` will give you the value data for the 600nm band and not the 600th band. Boolean vectors of the appropriate length can be used to subset samples and bands.

Value

usually a spectra object, but see param 'simplify'

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
head(names(spec), n = 3)
# by name
spec1 = spec[ "species_7", ]
spec1
# by band
spec2 = spec[, 400:700]
spec2
```
Assign values to spectra

Description

`[<-` assigns the rhs values to spectra

Usage

```r
## S3 replacement method for class 'spectra'
x[i, j] <- value
```

Arguments

- `x`: spectra object (lhs)
- `i`: Sample names (preferred), index, or a logical vector of length `nrow(x)`
- `j`: band labels, as numeric or character or a logical vector of length `ncol(x)`. Do not use indexes!
- `value`: value to be assigned (rhs). Must either data coercible to numeric or another 'spectra' obj

Value

nothing. modifies spectra as side effect

Author(s)

Jose Eduardo Meireles

Examples

```r
library(spectrolab)
spec = as_spectra(spec_matrix_example, name_idx = 1)
spec[, 400:500] = spec[, 400:500] * 1.2
spec
```
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