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

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
Author(s)
Jose Eduardo Meireles

Examples

```
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

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

## 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)

- apply_by_band(spectra): Apply a numeric function by band

Author(s)
Jose Eduardo Meireles
Examples

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

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

## 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

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

```r
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_idxs = 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

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

## 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_idx = NULL)
```

**Arguments**

- `x`: matrix
- `name_idx`: column index with sample names. Defaults to NULL
- `meta_idx`: 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)
```

**Arguments**

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

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

**Methods (by class)**  
- bands(spectra): Get spectra band labels

**Author(s)**  
Jose Eduardo Meireles

**Examples**  
```r  
library(spectrolab)  
spec = as_spectra(spec_matrix_example, name_idx = 1)  
head(bands(spec))  
```

---

**Description**  
bands sets band labels of lhs to the rhs values

**Usage**  
```r  
bands(x) <- value  
```

**Arguments**  
- `x`: spectra object (lhs)  
- `value`: rhs

**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)  
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)
```

```r
# S3 method for class 'spectra'
combine(s1, s2)
```

**Arguments**

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

**Value**

combined spectra object

**Methods (by class)**

- `combine(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_1and2 = 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
default_spec_regions()

Value
matrix with default_spec_regions

Author(s)
Jose Eduardo Meireles

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

dim.spectra
Get dimension of spectra

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

Usage
## 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

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

Description

Guess splice bands (bounds between sensors)

Usage

```r
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)

- `guess_splice_at(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

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

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

## 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)

- `match_sensors(spectra)`: Match sensor overlap regions

Author(s)

Jose Eduardo Meireles and Anna Schweiger

---

**max.spectra**

**Maximum value**

**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)

mean.spectra Mean spectrum

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

library(spectrolab)

spec = as_spectra(spec_matrix_example, name_idx = 1)

mean(spec)

median.spectra

Median spectrum

Description

median computes the median spectrum

Usage

## 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

library(spectrolab)

spec = as_spectra(spec_matrix_example, name_idx = 1)

median(spec)
Description

meta returns metadata of spectra

Usage

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

## 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)

* meta(spectra): get metadata

Author(s)

Jose Eduardo Meireles

Examples

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**

`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)
```

```r
```
## names.spectra

**Arguments**

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

**Value**

single numeric value

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
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**

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

**Arguments**

- x spectra object

**Value**

vector of sample names

**Author(s)**

Jose Eduardo Meireles

**Examples**

```r
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 returns a spectra obj with vector normalized values. Normalization value for each spectrum computed as $\sqrt{\text{sum}(x^2)}$

Usage

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)

- normalize(spectra): Vector normalize spectra

Author(s)

Jose Eduardo Meireles

Examples

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
plot_quantile

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

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 polygons for spectral regions

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 region 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, 0.7),rgb(1, 0, 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
## 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
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))
```

---

Description

`range.spectra` Range of spectral values

Usage

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

**Description**

Read files from various formats into 'spectra'

**Usage**

```r
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".

**Value**

tuple of numeric values (min, max)

**Author(s)**

Jose Eduardo Meireles

**Examples**

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

```
extract_metadata
    Boolean. Defaults to FALSE. Only implemented for the Spectra Vista (.sig) and
    Spectral Evolution (.sed) file types.
exclude_if_matches
    excludes files that match this regular expression. Example: "BAD"
ignore_extension
    Boolean. If TRUE, the parser will try to read every file in path regardless of the
    expected extension.

Value
    a single 'spectra' or a list of 'spectra' (in case files have incompatible band number or bands values)

Author(s)
    Jose Eduardo Meireles

Examples
    library(spectrolab)
    dir_path = system.file("extdata", "Acer_example", package = "spectrolab")
    spec = read_spectra(path = dir_path, format = "sig")
```

```
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)

• resample(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
Description
This function computes the standard deviation of the values in \( x \). If \( na.rm \) is \( \text{TRUE} \) then missing values are removed before computation proceeds.

Usage

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

Arguments

- \( x \): a numeric vector or an \( R \) object but not a \texttt{factor} coercible to numeric by \texttt{as.double(x)}.
- \( na.rm \): logical. Should missing values be removed?

Details

Like \texttt{var} this uses denominator \( n - 1 \).

The standard deviation of a length-one or zero-length vector is \text{NA}.

See Also

\texttt{var} for its square, and \texttt{mad}, the most robust alternative.

Examples

```r
sd(1:2)^2
```

Description

Forces \texttt{keep_txt_meta} = \text{TRUE}

Usage

```r
## 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

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

smooth  Generic Smoothing function

Description

  Generic Smoothing function

Usage

  smooth(x, ...)

Arguments

  x          data to smooth over
          ...  additional arguments

Value

  smoothed data
smooth.default  Default smoothing function

Description
Default smoothing function

Usage
## 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
## 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
library(spectrolab)

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

smooth_moving_avg  Smooth moving average for spectra

Description
Smooth moving average for spectra

Usage
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

```r
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.
w = 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 = w, names = sn)
```

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**

```r
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))
```

---

**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

Subset spectra by factor

Description

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

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)

- subset_by(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

## 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)
```
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

```r
library(spectrolab)
g = try_keep_txt(mean)
g(c(1, 2))
g(c("a", "b"))
```

Description

`value` returns the value matrix from spectra

Usage

`value(x)`

```r
## S3 method for class 'spectra'
value(x)
```

Arguments

- `x` spectra object

Value

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

- `value(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
```
var

Description

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

Usage

```r
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

---

var.default

Description

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

Usage

```r
## Default S3 method:
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

---

**var.spectra**

Variance spectrum

---

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)
```
Subset spectra

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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