Package 'spectra2rgb'

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Type Package

Title Convert Spectral Signatures to sRGB and CIELAB Colour Coordinates

Version 0.1.2

Description Converts hyperspectral reflectance signatures to sRGB hex codes and CIE L*a*b* coordinates using the CIE 1931 2-degree standard observer and the D65 standard illuminant. CIELAB coordinates are calculated directly from CIE XYZ values; sRGB output is generated independently. Includes bundled reference data so the package is self-contained. Handles missing and non-finite reflectance values via a configurable policy.

License GPL (>= 3)

Encoding UTF-8

Depends R (>= 4.0)

Imports stats, grDevices, utils

Suggests testthat (>= 3.0.0), knitr, rmarkdown

VignetteBuilder knitr

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`hs_to_xyz` *Convert hyperspectral reflectance to CIE XYZ*

Description

Integrates a reflectance spectrum (or a matrix of spectra) against the CIE 1931 2-degree standard observer and the D65 standard illuminant to obtain tristimulus values XYZ.

Usage

```
hs_to_xyz(wavelengths, reflectance)
```

Arguments

`wavelengths`	Numeric vector of wavelengths in nanometres.
`reflectance`	Numeric vector (single spectrum) or matrix (rows = samples, columns = wavelengths). Column order must match `wavelengths`.

Details

The CIE 1931 colour-matching functions (`ciexyz31`) and the D65 illuminant (`illuminantD65`) are bundled with the package. Values are linearly interpolated onto `wavelengths`. Wavelengths outside the CMF range are extrapolated flat (`rule = 2` in `approx`); the user is responsible for ensuring the input range is appropriate (400-700 nm is standard for visible colour).

Non-finite reflectance values are replaced by 0 and values are clamped to $[0, 1]$ before integration.

Value

A data.frame with columns `X`, `Y`, `Z`.

Examples

```
wl  <- seq(400, 700, by = 10)
ref <- rep(0.5, length(wl))
hs_to_xyz(wl, ref)
```

rgb_to_lab *Convert sRGB to CIELAB*

Description

Convert sRGB to CIELAB

Usage

```
rgb_to_lab(R, G, B, white = c(X = 95.047, Y = 100, Z = 108.883))
```

Arguments

R, G, B	Integer vectors (0-255).
white	Reference white point.

Value

A data.frame with numeric columns L, a, b.

spectra_to_lab *Convert a data frame of spectra to CIELAB*

Description

Convert a data frame of spectra to CIELAB

Usage

```
spectra_to_lab(
  df,
  id_col = NULL,
  na_action = c("zero", "drop", "keep"),
  white = c(X = 95.047, Y = 100, Z = 108.883)
)
```

Arguments

df	A data.frame or matrix where each row is a sample and each column is a wavelength band. Column names must be parseable as numeric wavelengths in nanometres.
id_col	Optional character vector of sample IDs, or a column name or index in df. If NULL, the row names are used, or seq_len(nrow(df)) if row names are absent.
na_action	One of "zero" (default; replace non-finite with 0), "drop" (remove all-NA rows with a warning), or "keep" (preserve NA in the output).
white	Reference white point for XYZ -> sRGB.

Value

A data.frame with columns `Sample_ID`, `L`, `a`, `b`.

`spectra_to_rgb` *Convert a data frame of spectra to sRGB*

Description

Convert a data frame of spectra to sRGB

Usage

```
spectra_to_rgb(
  df,
  id_col = NULL,
  na_action = c("zero", "drop", "keep"),
  white = c(X = 95.047, Y = 100, Z = 108.883)
)
```

Arguments

`df`	A data.frame or matrix where each row is a sample and each column is a wavelength band. Column names must be parseable as numeric wavelengths in nanometres.
`id_col`	Optional character vector of sample IDs, or a column name or index in `df`. If `NULL`, the row names are used, or `seq_len(nrow(df))` if row names are absent.
`na_action`	One of `"zero"` (default; replace non-finite with 0), `"drop"` (remove all-NA rows with a warning), or `"keep"` (preserve NA in the output).
`white`	Reference white point for XYZ -> sRGB.

Value

A data.frame with columns `Sample_ID`, `R`, `G`, `B`, `hex`.

`spectra_to_rgb_lab` *Convert a data frame of spectra to sRGB and CIELAB*

Description

Convert a data frame of spectra to sRGB and CIELAB

Usage

```
spectra_to_rgb_lab(
  df,
  id_col = NULL,
  na_action = c("zero", "drop", "keep"),
  white = c(X = 95.047, Y = 100, Z = 108.883)
)
```

Arguments

df	A data.frame or matrix where each row is a sample and each column is a wavelength band. Column names must be parseable as numeric wavelengths in nanometres.
id_col	Optional character vector of sample IDs, or a column name or index in df. If NULL, the row names are used, or seq_len(nrow(df)) if row names are absent.
na_action	One of "zero" (default; replace non-finite with 0), "drop" (remove all-NA rows with a warning), or "keep" (preserve NA in the output).
white	Reference white point used for both the XYZ-to-sRGB and direct XYZ-to-CIELAB conversions. XYZ values and the white point use the same tristimulus scale.

Details

RGB and CIELAB coordinates are calculated independently from the same unquantized CIE XYZ tristimulus values. The CIELAB calculation does not pass through 8-bit sRGB values.

Value

A data.frame with columns Sample_ID, R, G, B, hex, L, a, b.

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xyz_to_lab *Convert CIE XYZ directly to CIELAB*

Description

Converts CIE XYZ tristimulus values directly to CIELAB coordinates using the specified reference white. This calculation does not pass through sRGB and therefore avoids sRGB gamut clipping, gamma encoding, and 8-bit quantization.

Usage

```
xyz_to_lab(XYZ, white = c(X = 95.047, Y = 100, Z = 108.883))
```

Arguments

XYZ	A data frame with columns X, Y, and Z, or a numeric matrix with three columns. XYZ values and white must use the same scale.
white	Reference white point, expressed on the same scale as XYZ. Must contain three positive, finite values named X, Y, and Z. Defaults to D65 (c(X = 95.047, Y = 100, Z = 108.883)).

Details

The standard CIELAB piecewise function is applied to the normalized tristimulus values X/X_n, Y/Y_n, and Z/Z_n, where X_n, Y_n, and Z_n are the tristimulus values of the reference white.

Missing XYZ values propagate to the output coordinates that depend on them. Specifically, missing X affects a^*, missing Y affects all three coordinates, and missing Z affects b^*.

Value

A data frame with numeric columns L, a, and b.

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xyz_to_rgb *Convert CIE XYZ to sRGB*

Description

Convert CIE XYZ tristimulus values to 8-bit sRGB colour values and hexadecimal colour codes using the standard D65 sRGB matrix.

Usage

```
xyz_to_rgb(XYZ, white = c(X = 95.047, Y = 100, Z = 108.883))
```

Arguments

XYZ	A data.frame with columns X, Y, Z (as returned by hs_to_xyz), or a numeric matrix with exactly 3 columns.
white	Reference white point. Defaults to D65 (c(X = 95.047, Y = 100, Z = 108.883)). This function uses the standard D65 sRGB conversion matrix. Chromatic adaptation from other reference whites is not performed.

Value

A data.frame with integer columns R, G, B (0-255) and a character column hex (e.g. "#654909").

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