Package: rticulate (via r-universe)

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Type Package

Title Ultrasound Tongue Imaging

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Description A tool for processing Articulate Assistant Advanced™ (AAA)
export files and plot tongue contour data from any system.

URL <https://github.com/stefanocoretta/rticulate>

BugReports <https://github.com/stefanocoretta/rticulate/issues>

Depends R (>= 3.0.0)

Encoding UTF-8

LazyData true

Imports dplyr, ggplot2, glue, magrittr, mgcv, purrr, readr, rlang,
stats, tibble, tidymv, tidyr, tidyselect

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Suggests knitr, rmarkdown, stringr

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NeedsCompilation no

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Contents

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get_origin   *Get the origin of spline data*

Description

It returns the Cartesian x, y coordinates of the virtual origin of the ultrasonic waves/probe surface (see Details).

Usage

```
get_origin(data, fan_lines = c(10, 25))
```

Arguments

data	The spline data (the cartesian coordinates must be in two columns named X and Y).
fan_lines	A numeric vector with two fan lines (the default is c(10, 25)).

Details

The function estimates the origin of the ultrasond waves from the probe using the spline data and the provided fan lines. The estimation method is based on Heyne, Matthias & Donald Derrick (2015) Using a radial ultrasound probe's virtual origin to compute midsagittal smoothing splines in polar coordinates. *The Journal of the Acoustical Society of America* 138(6), EL509–EL514, DOI:10.1121/1.4937168.

Value

A numeric vector with the Cartesian (x, y) coordinates of the virtual origin of the ultrasonic waves/probe surface.

Origin estimation

The equations of the two fan lines (10 and 25 by default) are set equal to find their intersection. The intersection is the origin. In some cases, the linear estimation of the equation fails, and an error related to fit is returned. In these cases, try different fan lines by increasing the minimum fan line and/or changing the maximum fan line (for example, if `c(10, 25)` returns an error, try `c(15, 30)`).

---

palate *Palate profile dataset.*

Description

A dataset containing the palate profile of a single speaker.

Usage

```
palate
```

Format

A data frame with 42 rows and 14 variables.

speaker speaker ID

seconds time of coordinate, in seconds

rec_date date and time of recording

prompt prompt string

label label of annotation

TT_displacement smoothed displacement of tongue tip

TT_velocity velocity of tongue tip displacement

TT_abs_velocity absolute velocity of tongue tip displacement

TD_displacement smoothed displacement of tongue dorsum

TD_velocity velocity of tongue dorsum displacement

TD_abs_velocity absolute velocity of tongue dorsum displacement

fan_line fan line number

X horizontal coordinate at time `seconds`

Y vertical coordinate at time `seconds`

---

plot_polar_smooths   *Plot smooths from a polar* gam

Description

It plots the smooths of a polar GAM fitted with `polar_gam()`.

Usage

```
plot_polar_smooths(
  model,
  series,
  comparison = NULL,
  origin = NULL,
  facet_terms = NULL,
  conditions = NULL,
  exclude_random = TRUE,
  series_length = 100,
  split = NULL,
  sep = "\\.",
  time_series
)
```

Arguments

`model`	A gam or bam model object.
`series`	An unquoted expression indicating the model term that defines the series on which smoothing is applied. This is the term that is displayed on the x-axis when plotting.
`comparison`	An unquoted expression indicating the model term for which the comparison will be plotted.
`origin`	The coordinates of the origin as a vector of `c(x, y)` coordinates.
`facet_terms`	An unquoted formula with the terms used for faceting.
`conditions`	A list of quosures with quos specifying the levels to plot from the model terms not among `series`, `comparison`, or `facet_terms`.
`exclude_random`	Whether to exclude random smooths (the default is TRUE).
`series_length`	An integer indicating how many values along the time series to use for predicting the outcome term.
`split`	Columns to separate as a named list.
`sep`	Separator between columns (default is `"\."`, which is the default with). If character, it is interpreted as a regular expression.
`time_series`	Deprecated, use `series` instead.

Value

An object of class [ggplot](#).

Examples

```
library(dplyr)
tongue_it01 <- filter(tongue, speaker == "it01")
pgam <- polar_gam(Y ~ s(X, by = as.factor(label)), data = tongue_it01)

plot_polar_smooths(pgam, X, label)
```

---

plot_tongue   *Plot tongue contours from spline data.*

Description

It plots tongue contours from data imported from AAA.

Usage

```
plot_tongue(data, geom = "line", ..., palate = NULL, palate_col = "green")
```

Arguments

data	A data frame with splines data.
geom	Type of geom to plot. Possible values are: line (the default), point, path.
...	List of arguments to be passed to geom.
palate	An optional data frame with the palate spline. If provided, the palate is plotted.
palate_col	The colour of the palate spline (the default is green).

Value

An object of class [ggplot](#).

Examples

```
plot_tongue(tongue, geom = "point")
```

---

polar_gam   *Polar generalised additive model (polar GAM)*

Description

It fits a generalised additive model (GAM) to transformed polar tongue data and it returns a model in polar coordinates. Use `plot_polar_smooths()` for plotting.

Usage

```
polar_gam(
  formula,
  data,
  origin = NULL,
  fan_lines = c(10, 25),
  AR_start = NULL,
  ...
)
```

Arguments

formula	A GAM formula.
data	A data set containing the spline coordinates (cartesian coordinates must be in columns named X and Y, polar coordinates in columns named `angle` and `radius`; these are the defaults in data imported with `read_aaa()`).
origin	The coordinates of the origin as a vector of `c(x, y)` coordinates.
fan_lines	A numeric vector with two fan lines (the default is `c(10, 25)`).
AR_start	The `AR.start` argument to be passed to `mgcv::bam()`.
...	Arguments to be passed to `mgcv::bam()`.

Details

It is advised to fit a separate model per speaker, unless you have a working method for inter-speaker normalisation of the coordinates.

Value

An object of class "gam" as described in [gamObject](#).

Examples

```
library(dplyr)
tongue_it01 <- filter(tongue, speaker == "it01")
pgam <- polar_gam(Y ~ s(X, by = c2_place) + s(X, word, bs = "fs"),
data = tongue_it01)
```

predict_polar_gam *Get all predictions from a polar GAM model*

Description

It returns a tibble with the predictions from all the terms in a [polar_gam](#) model.

Usage

```
predict_polar_gam(
  model,
  origin = NULL,
  exclude_terms = NULL,
  length_out = 50,
  values = NULL,
  return_ci = FALSE,
  ci_z = 1.96
)
```

Arguments

model	A [polar_gam](#) model object.
origin	The coordinates of the origin as a vector of `c(x, y)` coordinates.
exclude_terms	Terms to be excluded from the prediction. Term names should be given as they appear in the model summary (for example, `"s(x0,x1)"`).
length_out	An integer indicating how many values along the numeric predictors to use for predicting the outcome term (the default is `50`).
values	User supplied values for numeric terms as a named list.
return_ci	Whether to return a tibble with cartesian confidence intervals (for use with [geom_polar_ci](#)).
ci_z	The z-value for calculating the CIs (the default is `1.96` for 95 percent CI).

Details

The function behaves like [predict_gam](#) but it converts the coordinates from polar to cartesian automatically. Check `vignette("predict-gam", package = "tidymv")` to an overview of the predict method.

To see an example of plotting, see the examples in [geom_polar_ci](#).

Value

A tibble with predictions from a [polar_gam](#) model.

Examples

```
library(dplyr)
tongue_it01 <- filter(tongue, speaker == "it01")
it01_pol <- polar_gam(Y ~ s(X, by = c2_place) + s(X, word, bs = "fs"),
data = tongue_it01)

# get predictions
it01_pred <- predict_polar_gam(it01_pol)

# get predictions excluding the random smooth for word (the coefficient for
# the random smooth is set to 0)
it01_excl_rand <- predict_polar_gam(it01_pol, exclude_terms = "s(X,word)")
```

---

read_aaa   *Read tab separated files with AAA spline data.*

Description

It reads a file or a list of files with data exported from AAA. The data are automatically transformed from a wide to a long format (each row has values of X or Y axes for each fan line). The imported tibble can then be used for plotting and statistical analysis.

Usage

```
read_aaa(
  file,
  column_names,
  fan_lines = 42,
  coordinates = "cartesian",
  na_rm = FALSE,
  format = "long"
)
```

Arguments

file	The path of the file with AAA data. It can also be a character vector with multiple paths as separate strings..
column_names	The names of the columns without including the splines columns.
fan_lines	The number of fan lines (the default is 42).
coordinates	A string specifying the coordinate system. Possible values are "cartesian" (the default) and "polar".
na_rm	Remove NAs (the default is FALSE).
format	A string specifying the data format. Possible values are "long" and "wide" (the default is "long").

Value

A tibble. An `.index` column is added which indexes (groups) each tongue contour.

Examples

```
columns <- c("speaker","seconds","rec_date","prompt","label",
"TT_displacement","TT_velocity","TT_abs_velocity","TD_displacement",
"TD_velocity","TD_abs_velocity")
file_path <- system.file("extdata", "it01.tsv", package = "rticulate")

tongue <- read_aaa(file_path, columns, na_rm = TRUE)
```

---

stimuli   *Stimuli dataset.*

Description

A dataset with linguistic information on the stimuli.

Usage

```
stimuli
```

Format

A data frame with 12 rows and 11 variables.

item item ID

word words of the form CVCV

ipa IPA transcription of the words

c1 first consonant

c1_phonation phonation of the first consonant, `voiceless`

vowel first and second vowel

anteropost backness of the vowel, `back` or `central`

height height of the vowel, `high`, `mid` or `low`

c2 second consonant

c2_phonation phonation of the second consonant, `voiceless` or `voiced`

c2_place place of the second consonant, `coronal` or `velar`

---

tongue   *Tongue contours dataset.*

Description

A dataset containing tongue contour coordinates of a single speaker.

Usage

```
tongue
```

Format

A data frame with 3612 rows and 28 variables.

speaker speaker ID

seconds time of coordinate, in seconds

rec_date date and time of recording

prompt prompt string

label label of annotation

TT_displacement smoothed displacement of tongue tip

TT_velocity velocity of tongue tip displacement

TT_abs_velocity absolute velocity of tongue tip displacement

TD_displacement smoothed displacement of tongue dorsum

TD_velocity velocity of tongue dorsum displacement

TD_abs_velocity absolute velocity of tongue dorsum displacement

TR_displacement smoothed displacement of tongue root

TR_velocity velocity of tongue root displacement

TR_abs_velocity absolute velocity of tongue root displacement

fan_line fan line number

X horizontal coordinate at time `seconds`

Y vertical coordinate at time `seconds`

word words of the form CVCV

item item ID

ipa IPA transcription of the words

c1 first consonant

c1_phonation phonation of the first consonant, `voiceless`

vowel first and second vowel

anteropost backness of the vowel, `back` or `central`

height height of the vowel, `high`, `mid` or `low`

c2 second consonant

c2_phonation phonation of the second consonant, `voiceless` or `voiced`

c2_place place of the second consonant, `coronal` or `velar`

---

transform_coord *Transform the coordinates of spline data*

Description

This function transforms the coordinates of spline data between Cartesian and polar coordinate systems. The origin x and y coordinates can be supplied by the user, or calculated automatically (see Details).

Usage

```
transform_coord(
  data,
  to = "polar",
  origin = NULL,
  fan_lines = c(10, 25),
  use_XY = FALSE
)
```

Arguments

data	A data set containing the spline coordinates (cartesian coordinates must be in columns named X and Y, polar coordinates in columns named angle and radius; these are the defaults in data imported with read_aaa()).
to	Which system to convert to, as a string, either "polar" or "cartesian" (the default is "polar").
origin	The coordinates of the origin as a vector of c(x, y) coordinates.
fan_lines	A numeric vector with two fan lines (the default is c(10, 25)).
use_XY	Whether to use the column names X and Y when converting to and from polar coordinates, rather than the default angle and radius (the default is FALSE. If TRUE, the columns X and Y are overwritten with the converted values. If converting to polar, X is the angle and Y the radius.

Details

The transformation between the coordinate systems require the selection of an origin in Cartesian coordinates (x and y). The origin ideally corresponds to the virtual origin of the ultrasound waves from the probe. The origin coordinates can be supplied by the user as a vector with the origin argument, or they can be estimated automatically if origin = NULL (the default). The estimation is performed by get_origin (see that function documentation for details).

Value

An object of class tbl_df-class (a tibble).

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