Package 'FishDiveR'

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Title Classify Aquatic Animal Behaviours from Vertical Movement Data

Version 1.1.0

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Description Quantitatively analyse depth time-series data from pop-up satellite archival tags (PSATs) through the application of continuous wavelet transformation (CWT) combined with Principal Component Analysis (PCA), and k-means clustering. Import, crop, and plot depth time-depth records (TDRs). Using CWT to detect important signals within the non-stationary data, we create daily wavelet statistics to summarise vertical movements on different wavelet periods and combine with daily and diel depth statistics. Classify depth time-series with unsupervised k-means clustering into 24-hour periods of vertical movement behaviour with distinct patterns of vertical movement. Plot example days from each behaviour cluster, and plot the TDR coloured by cluster. Based on principals of combining CWT with k-means first developed by Sakamoto (2009) <doi:10.1371/journal.pone.0005379> and redeveloped by Beale (2026) <doi:10.21203/rs.3.rs-6907076/v1>.

License GPL (>= 3)

URL https://github.com/calvinsbeale/FishDiveR

BugReports https://github.com/calvinsbeale/FishDiveR/issues

Imports cluster, cowplot, data.table, dplyr, FactoMineR, geometry, ggplot2, gridExtra, lubridate, moments, patchwork, colorspace, rgl, Rfast, rlang, scales, suncalc, tidyr, WaveletComp

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Contents

`combine_data` *Import depth statistics and combine with PC scores*

Description

This function imports the depth statistics from each of the tags listed in tag_vector, and outputs a combined data frame then combines the depth statistics from each tag with the principal component scores, and outputs a data frame with the appropriate unique_tag_ID if necessary, ready for use in k-means clustering.

Usage

```
combine_data(
  tag_vector = tag_list,
  data_folder = NULL,
  pc_scores = scores,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

`tag_vector`	A character vector of tag IDs. E.g. 'c("123456", "456283", "AB98XJ").
`data_folder`	Parent folder path with separate folders for each tag data. E.g. "C:/Tag data". Defaults to 'data_dir'
`pc_scores`	Data frame of principal component scores extracted through PCA on wavelet statistics. Output of 'pca_scores()' function.
`output`	Logical. If TRUE, output is saved to `output_folder`. Defaults to FALSE.

output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A data frame containing the combined depth statistics and principal component scores from each of the tags listed in tag_vector

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load pc_results
pc_scores <- readRDS(file.path(filepath, "data/4_PCA/pc_scores.rds"))

# Run combine_data function
combined_stats <- combine_data(
  tag_vector = "data",
  data_folder = filepath,
  pc_scores = pc_scores,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

---

create_depth_stats *Create depth statistics*

Description

create_depth_stats creates the various daily and diel depth statistics for each day

Usage

```
create_depth_stats(
  archive,
  tag_ID,
  diel = FALSE,
  sunrise_time = NULL,
  sunset_time = NULL,
  GPS = FALSE,
  sunset_type = "civil",
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

archive	Data frame containing processed time series depth data
tag_ID	Unique tag identification number in a vector of characters. E.g. "123456"
diel	Include diel statistics when TRUE
sunrise_time	Sunrise time (local time zone) in 24-hour clock. E.g. "05:45:00"
sunset_time	Sunset time (local time zone) in 24-hour clock. E.g. "18:30:00"
GPS	Either FALSE or the location of the GPS file containing columns 'date', 'lat' (latitude) and 'lon' (longitude) if one exists. 'date' columns must be in a format readable by lubridate::dmy()
sunset_type	Choose which type of sunset to include 'NULL', 'civil', 'nautical', or 'astronomical'
output	Logical. If TRUE, output is saved to output_folder. Defaults to FALSE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A set of statistics calculated daily for the depth data. If diel is 'TRUE', additional diel statistics will be returned. An attribute 'diel' with value 'TRUE' is given when diel statistics are included.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load archive_days
archive_days <- readRDS(file.path(filepath, "data/archive_days.rds"))

# Run create_depth_stats function
depthStats <- create_depth_stats(
  archive = archive_days,
  tag_ID = "data",
  diel = TRUE,
  sunrise_time = "06:00:00",
  sunset_time = "18:00:00",
  GPS = file.path(filepath, "data/GPS.csv"),
  sunset_type = "civil",
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

`create_wavelet` *Create and plot the wavelet power spectrum*

Description

`create_wavelet` creates the a wavelet spectrum using WaveletComp package. Optionally loads and plots an existing my.w object.

Usage

```
create_wavelet(
  archive,
  tag_ID,
  wv_period_hours = 24,
  sampling_frequency = NULL,
  allow_irregular_sampling = FALSE,
  load_existing_wavelet = FALSE,
  suboctaves = 12,
  lower_period_mins = 5,
  upper_period_hours = 24,
  pval = FALSE,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE,
  plot_wavelet = TRUE,
  max_period_ticks = 10,
  plot_width = 800,
  plot_height = 400,
  interactive_mode = TRUE
)
```

Arguments

`archive`	Data frame containing processed time series depth data
`tag_ID`	Unique tag identification number in a vector of characters. E.g. "123456"
`wv_period_hours`	Time resolution in hours to calculate wavelet. Currently only supports the default of 24 hours as this package is created to investigate daily diving behaviour. Defaults to 24.
`sampling_frequency`	Sampling frequency of depth data in seconds. Defaults to time between first and second depth record. Recommended to leave blank.
`allow_irregular_sampling`	Allows irregular sampling interval in the dataset. Not recommended. Defaults to FALSE.

`load_existing_wavelet`
: Load an existing my.w wavelet object from the output_folder. Defaults to FALSE.

`suboctaves`
: number of suboctaves between each logarithmic period. E.g. between 24 and 12 hours. Highly recommended to use 12, for easy of interpretation of hours and signal present (daily, diel, tidal).

`lower_period_mins`
: Lower period of the wavelet sampling in minutes. Cannot be less than sampling frequency. Defaults to 5 minutes.

`upper_period_hours`
: Upper period of the wavelet sampling in days. Defaults to 24 hours.

`pval`
: Produce p-values or not. True or False. Default set to FALSE, see `WaveletComp::analyze.wavelet()` for further details. P-values not used in further analysis, and increase computation time and file size.

`output`
: Logical. If TRUE, output is saved to `output_folder`. Defaults to FALSE.

`output_folder`
: Output folder path. If `output = TRUE`, `output_folder` must be provided. Defaults to NULL.

`verbose`
: Logical. If TRUE, progress messages are shown. Defaults to FALSE.

`plot_wavelet`
: TRUE or FALSE. Plot the wavelet spectrum and mean power?

`max_period_ticks`
: Number of ticks displayed on the period (y) axis in plots.

`plot_width`
: Width of the wavelet spectrum plot output. Defaults to 800.

`plot_height`
: Height of the wavelet spectrum plot output. Defaults to 400.

`interactive_mode`
: Used for testing the package only. Defaults to TRUE.

Details

Uses `WaveletComp::analyze.wavelet()` to create a univariate wavelet power spectrum for the depth data imported, see `WaveletComp::analyze.wavelet()` for more details. Plots mean wavelet power using `WaveletComp::wt.avg()`. If you have errors allocating large vectors try using library(bigmemory) and create a big matrix with big_mat <- big.matrix(nrow = 1e7, ncol = 10, type = "double") then run your code again. This allows greater range between lower and upper periods

Value

When output = TRUE, returns an object of class "analyze.wavelet" from package 'WaveletComp'. Additionally outputs a plot of the wavelet spectrum, and a plot of the mean power per period.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load archive_days
archive_days <- readRDS(file.path(filepath, "data/archive_days.rds"))

# Run create_wavelet function
```

```
my.w <- create_wavelet(
  archive = archive_days,
  tag_ID = "data",
  wv_period_hours = 24,
  sampling_frequency = NULL,
  allow_irregular_sampling = FALSE,
  load_existing_wavelet = FALSE,
  suboctaves = 12,
  lower_period_mins = 30,
  upper_period_hours = 24,
  pval = FALSE,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE,
  plot_wavelet = FALSE,
  max_period_ticks = 10,
  plot_width = 800,
  plot_height = 400,
  interactive_mode = FALSE
)
```

`create_wavelet_stats` *create_wavelet_stats*

Description

`create_wavelet_stats` aggregates the wavelet variables over the specified time periods

Usage

```
create_wavelet_stats(
  wavelet,
  tag_ID,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

`wavelet`	An object of class "analyze.wavelet" from package 'WaveletComp'
`tag_ID`	Unique tag identification number in a vector of characters. E.g. "123456"
`output`	Logical. If TRUE, output is saved to `output_folder`. Defaults to FALSE.
`output_folder`	Output folder path. If `output = TRUE`, `output_folder` must be provided. Defaults to NULL.
`verbose`	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A data frame containing the seven wavelet statistics for each period. One observation is available per period per day:

- Amplitude_mean
- Amplitude_variance
- Mean_sq_power
- Power_mean
- Power_variance
- Phase_mean
- Phase_variance

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load my.w wavelet object
my.w <- readRDS(file.path(filepath, "data/1_Wavelets/data_wavelet.rds"))

# Run create_wavelet_stats function on wavelet object
waveStats <- create_wavelet_stats(
  wavelet = my.w,
  tag_ID = "data",
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

---

import_tag_data *Load time-depth series data from csv file*

Description

`import_tag_data` processes the time-series depth data of marine animal tags. Data to import should be a csv file with a 'date_time' column and a depth column. Data is cropped by deployment and release times.

Usage

```
import_tag_data(
  tag_ID,
  tag_deploy_UTC,
  tag_release_UTC,
  archive,
```

```
  date_time_col = 1,
  depth_col = 2,
  temp_col = NA,
  time_zone,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

tag_ID	Unique tag identification number in a vector of characters. E.g. "123456"
tag_deploy_UTC	UTC deployment time in the allowed POSIXct format: E.g. "2013-10-25 02:46:00"
tag_release_UTC	UTC release time in the allowed POSIXct format: E.g. "2014-04-23 23:17:35"
archive	File path of the time-series depth archive. E.g. ("C:/Tag data/123456/123456-Archive.csv")
date_time_col	Column number of the date time series
depth_col	Column number of the depth series
temp_col	(Optional) Column number of temperature series
time_zone	Time zone of the data. E.g. "Asia/Tokyo"
output	Logical. If TRUE, output is saved to output_folder. Defaults to FALSE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Details

Data are cropped to full days from midnight to midnight in local time based on the time zone supplied. If output = TRUE, the cropped data are saved as archive_days.rds within output_folder.

Value

A data frame of processed tag data. Columns kept are:

- 'date' a POSIXct date_time object in format "yyyy-mm-dd hh:mm:ss"
- 'depth' numerical depth data
- 'temp' numerical temperature data
- 'date_only' an as.Date version of the 'date' column
- An attribute 'time_zone' is added to the date frame containing the time zone of the 'date'

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Run import_tag_data function on tag archive csv file
archive_days <- import_tag_data(
  tag_ID = "data",
  tag_deploy_UTC = "2000-01-01 00:00:00",
  tag_release_UTC = "2000-01-11 23:59:00",
  archive = file.path(filepath, "data/data-Archive.csv"),
  date_time_col = 1,
  depth_col = 2,
  temp_col = NA,
  time_zone = "Asia/Tokyo",
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

---

k_clustering *Perform k-means*

Description

k_clustering performs k-means clustering on the PC scores with the selected value of k

Usage

```
k_clustering(
  kmeans_data,
  standardise = TRUE,
  k,
  nstart = 50,
  polygon = FALSE,
  output = TRUE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

kmeans_data	Data frame containing the combined PC scores and depth statistics to perform k-means on. Output from the 'combine_data()' function.
standardise	TRUE or FALSE. Whether or not to standardise the data. Defaults to TRUE.
k	Numerical. Value of k to use for analysis.
nstart	Numerical. Value of nstart for k-means analysis.

polygon	TRUE or FALSE. Plot polygons for cluster with more than 3 data points. Defaults to FALSE.
output	TRUE or FALSE. Whether or not to output the results. Defaults to TRUE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Details

This function relies on random initialisation in k-means clustering. For reproducible results, users may wish to set a random seed prior to calling this function using set.seed().

Value

An object of class 'kmeans' containing the k-means clustering data for the data frame. Additionally plots a 3D cluster plot of the top three Principal Components.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load kmeans_data
kmeans_data <- readRDS(file.path(filepath, "data/5_k-means/combined_stats.rds"))


# Full example using the complete dataset.
# Set output to TRUE for real use!

kmeans_result <- k_clustering(
  kmeans_data = kmeans_data,
  standardise = TRUE,
  k = 4,
  nstart = 50,
  polygon = FALSE,
  output = FALSE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

---

pca_data *Prepare all data for Principal Component Analysis*

Description

pca_data loads the wavelet statistics for each of the tags listed in 'tag_vector'. Performs various checks to ensure compatibility of wavelets, and combines them into a data frame containing only the chosen statistics.

Usage

```
pca_data(
  tag_vector,
  data_folder = data_dir,
  phase_mean = FALSE,
  phase_variance = FALSE,
  power_mean = TRUE,
  power_variance = TRUE,
  mean_sq_power = FALSE,
  amplitude_mean = TRUE,
  amplitude_variance = FALSE,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

tag_vector	A character vector of tag IDs. E.g. 'c("123456", "456283", "AB98XJ").
data_folder	Parent folder path with separate folders for each tag data. E.g. "C:/Tag data". Defaults to 'data_dir'
phase_mean	TRUE or FALSE to include this wavelet statistic. Default FALSE
phase_variance	TRUE or FALSE to include this wavelet statistic. Default FALSE
power_mean	TRUE or FALSE to include this wavelet statistic. Default TRUE
power_variance	TRUE or FALSE to include this wavelet statistic. Default TRUE
mean_sq_power	TRUE or FALSE to include this wavelet statistic. Default FALSE
amplitude_mean	TRUE or FALSE to include this wavelet statistic. Default TRUE
amplitude_variance	TRUE or FALSE to include this wavelet statistic. Default FALSE
output	Logical. If TRUE, output is saved to output_folder. Defaults to FALSE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A data frame with the combined data for all tag ID's listed, containing the wavelet statistics to be used in Principal Component Analysis.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Run pca_data function
pc_data <- pca_data(
```

```
  tag_vector = c("data"),
  data_folder = filepath,
  phase_mean = FALSE,
  phase_variance = FALSE,
  power_mean = TRUE,
  power_variance = TRUE,
  mean_sq_power = FALSE,
  amplitude_mean = TRUE,
  amplitude_variance = FALSE,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

`pca_results` *Perform Principal Component Analysis*

Description

`pca_results` performs Principal Component Analysis on the pc_data data frame containing statistics from wavelet analysis

Usage

```
pca_results(
  pc_data,
  standardise = TRUE,
  No_pcs = NULL,
  PCV = NULL,
  plot_eigenvalues = TRUE,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE,
  interactive_mode = TRUE
)
```

Arguments

`pc_data`	Data frame containing the output of the pca_data() function.
`standardise`	TRUE or FALSE. Whether or not to standardise the data. Default TRUE.
`No_pcs`	Numerical. Number of principal components to retain. Null by default
`PCV`	Numerical. Percentage of cumulative variance to retain. Null by default
`plot_eigenvalues`	TRUE or FALSE. Plot PC eigenvalues and general loadings. Default TRUE.
`output`	Logical. If TRUE, output is saved to `output_folder`. Defaults to FALSE.

output_folder Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.

verbose Logical. If TRUE, progress messages are shown. Defaults to FALSE.

interactive_mode TRUE or FALSE. Used for testing the package. Default FALSE.

Value

A PCA object from 'FactoMineR' package containing the output of the Principal Component Analysis.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load pc_data
pc_data <- readRDS(file.path(filepath, "data/4_PCA/pc_data.rds"))


# Run a minimal, fast pca_results example
pc_results <- pca_results(
  pc_data = pc_data,
  standardise = TRUE,
  No_pcs = 1,
  PCV = NULL,
  plot_eigenvalues = FALSE,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE,
  interactive_mode = FALSE
)


# Full example using the complete dataset
# Run pca_results function
pc_results <- pca_results(
  pc_data = pc_data,
  standardise = TRUE,
  No_pcs = 3,
  PCV = NULL,
  plot_eigenvalues = TRUE,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE,
  interactive_mode = FALSE
)
```

pca_scores *Calculate Principal Component Analysis Scores not including depth statistics*

Description

This function extracts the PCA scores from the PCA results and plots the loadings. This function is to be use on output from the `pca_data()` function not including depth statistics.

Usage

```
pca_scores(
  pc_results = results,
  plot_loadings = TRUE,
  every_nth = 12,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

`pc_results`	PCA class object containing the output from the 'pca_results()' function.
`plot_loadings`	TRUE or FALSE. Plot PC loadings figures. Default TRUE.
`every_nth`	Numeric. Sequence of labels to show on mean power plot. Default is 12.
`output`	Logical. If TRUE, output is saved to `output_folder`. Defaults to FALSE.
`output_folder`	Output folder path. If `output = TRUE`, `output_folder` must be provided. Defaults to NULL.
`verbose`	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A data frame of pc scores containing one column for each Principal Component kept. If processing just one tag, the attribute 'unique_tag_ID' is given to the data frame with the tag_ID. Plots the PC loadings for each row of pc_data

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load pc_results
pc_results <- readRDS(file.path(filepath, "data/4_PCA/pc_results.rds"))

# Run pca_scores function
pc_scores <- pca_scores(
  pc_results = pc_results,
```

```
  plot_loadings = FALSE,
  every_nth = 12,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

`plot_clusters` *Plot the time-series depth records of the days closest to the centre of each cluster*

Description

`plot_clusters` plots the time-depth records of the days closest to the centre of each of the clusters. Each cluster is plotted both individually, and faceted together, with both a fixed y-axis and a free y-axis (depth).

Usage

```
plot_clusters(
  tag_vector = tag_list,
  data_folder = NULL,
  kmeans_result,
  No_days = 1,
  every_nth = 10,
  every_s = 0,
  Y_lim = c(0, 250, 50),
  color = TRUE,
  diel_shade = FALSE,
  dpi = 300,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

`tag_vector`	A character vector of tag IDs. E.g. 'c("123456", "456283", "AB98XJ").
`data_folder`	Parent folder path with separate folders for each tag data. E.g. "C:/Tag data". Defaults to 'data_dir'
`kmeans_result`	An object of class 'kmeans' containing the k-means clustering data. Output of 'k_clustering()' function.
`No_days`	Numerical. Number of days of each cluster to plot. Defaults to 1.
`every_nth`	Numerical. Optional down-sampling of data points to plot. Defaults to 10, plotting every 10th record.

every_s	Numerical. Alternative to every_nth. Optional down-sampling of data points to plot by number of seconds, as opposed to records. E.g. plots every 60th second, rather than 10th row of data. Must be a multiple of the sampling frequency. Overrides every_nth if != 0.
Y_lim	Character vector with minimum depth, maximum depth, and sequence for ticks on Y-axis. Must be numeric, positive and 3 elements long. E.g. c(0,1500,100).
color	TRUE or FALSE. Output clusters coloured by cluster assignment. Defaults to TRUE.
diel_shade	TRUE or FALSE. Output plot with night-time shading. Can be slow! Defaults to FALSE.
dpi	Numerical. DPI to use for 'ggsave()' output. E.g, 600
output	Logical. If TRUE, output is saved to output_folder. Defaults to FALSE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A plot list of all plots created of each cluster in the data. When output == TRUE this prints to file one figure for each Cluster with a fixed y-axis. Additionally outputs a facet plot of all clusters, and a free y-axis version of all plots.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load kmeans_result
kmeans_result <- readRDS(file.path(filepath, "data/5_k-means/kmeans_result.rds"))

# Run plot_clusters function
plot_clusters(
  tag_vector = "data",
  data_folder = filepath,
  kmeans_result = kmeans_result,
  No_days = 1,
  every_nth = 10,
  every_s = 0,
  Y_lim = c(0, 300, 50),
  color = TRUE,
  diel_shade = FALSE,
  dpi = 100,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

`plot_cluster_TDR` *Plot the time-series depth records of the selected tag. Colour days by cluster*

Description

`plot_cluster_TDR` plots the time-series depth record of the selected archival tag. Each day of data is coloured by the assigned cluster, this helps to visualise changes in vertical movement behaviour over time.

Usage

```
plot_cluster_TDR(
  tag_ID,
  data_folder = NULL,
  kmeans_result,
  every_nth = 10,
  every_s = 0,
  X_lim = NULL,
  Y_lim = c(0, 250, 50),
  date_breaks = "14 day",
  legend = TRUE,
  plot_size = c(12, 6),
  dpi = 300,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

`tag_ID`	Unique tag identification number in a vector of characters. E.g. "123456".
`data_folder`	Parent folder path with separate folders for each tag data. E.g. "C:/Tag data". Defaults to 'data_dir'
`kmeans_result`	An object of class 'kmeans' containing the k-means clustering data. Output of 'k_clustering()' function.
`every_nth`	Numerical. Optional down-sampling of data points to plot. Defaults to 10, plotting every 10th record.
`every_s`	Numerical. Alternative to every_nth. Optional down-sampling of data points to plot by number of seconds, as opposed to records. E.g. plots every 60th second, rather than 10th row of data. Must be a multiple of the sampling frequency. Overrides every_nth if != 0.
`X_lim`	Optional. Vector with two dates delimiting the time-depth record to plot. E.g. c("2000-01-01", "2000-11-23")
`Y_lim`	Character vector with minimum depth, maximum depth, and sequence for ticks on Y-axis. Must be numeric, positive and 3 elements long. E.g. c(0,1500,100).

date_breaks	X-axis ggplot2 date breaks. E.g, "24 hour, "3 day", "2 week".
legend	TRUE or FALSE. Whether or not to plot the figure legend. Defaults to TRUE.
plot_size	ggSave height and width for saving the output plot. Must be numeric, positive and 2 elements long. Default to 'c(12,6)'
dpi	Numerical. DPI to use for 'ggsave()' output. E.g, 600
output	Logical. If TRUE, output is saved to output_folder. Defaults to FALSE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

Returns the cluster TDR plot. Additionally prints to file the TDR plot. Additionally outputs a facet plot of all tag_IDs.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load kmeans_result
kmeans_result <- readRDS(file.path(filepath, "data/5_k-means/kmeans_result.rds"))

# Run plot_clusters function
plot_cluster_TDR(
  tag_ID = "data",
  data_folder = filepath,
  kmeans_result = kmeans_result,
  every_nth = 10,
  every_s = 0,
  X_lim = NULL,
  Y_lim = c(0, 300, 50),
  date_breaks = "1 day",
  legend = TRUE,
  plot_size = c(12, 6),
  dpi = 100,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

---

plot_TDR *Plot the time-series depth dataset*

Description

This function plots the time-series depth data from the imported tag.

Usage

```
plot_TDR(
  rds_file,
  data_folder = NULL,
  every_nth = 20,
  every_s = 0,
  plot_size = c(12, 6),
  X_lim = NULL,
  Y_lim = c(0, 1500, 100),
  date_breaks = "14 day",
  dpi = 300,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

rds_file	Character vector file path of rds file. E.g. ("E:/data/archive_days.rds")
data_folder	Parent folder path with separate folders for each tag data. E.g. "C:/Tag data". Defaults to 'data_dir'
every_nth	Numerical. Optional down-sampling of data points to plot. Defaults to 10, plotting every 10th record.
every_s	Numerical. Alternative to every_nth. Optional down-sampling of data points to plot by number of seconds, as opposed to records. E.g. plots every 60th second, rather than 10th row of data. Must be a multiple of the sampling frequency. Overrides every_nth if != 0.
plot_size	ggSave height and width for saving the output plot. Must be numeric, positive and 2 elements long. Default to 'c(12,6)'
X_lim	Optional. Vector with two dates delimiting the time-depth record to plot. E.g. c("2000-01-01", "2000-11-23")
Y_lim	Character vector with minimum depth, maximum depth, and sequence for ticks on Y-axis. Must be numeric, positive and 3 elements long. E.g. c(0,1500,100).
date_breaks	X-axis ggplot2 date breaks. E.g, "24 hour, "3 day", "2 week".
dpi	Numerical. DPI to use for 'ggsave()' output. E.g, 600
output	Logical. If TRUE, a plot file is saved to `output_folder`. Defaults to FALSE.
output_folder	Output folder path used when `output = TRUE`. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Value

A data frame of plot data

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Run plot_TDR function
TDR_plot <- plot_TDR(
  rds_file = "data/archive_days.rds",
  data_folder = filepath,
  every_nth = 10,
  every_s = 0,
  plot_size = c(12, 6),
  X_lim = NULL,
  Y_lim = c(0, 300, 50),
  date_breaks = "24 hour",
  dpi = 100,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

---

select_k *Perform k selection*

Description

select_k creates the elbow plot and silhouette width plot for assistance with selection of k

Usage

```
select_k(
  kmeans_data,
  standardise = TRUE,
  Max.k = 15,
  v_line = NULL,
  calc_gap = FALSE,
  plot_gap = FALSE,
  output = FALSE,
  output_folder = NULL,
  verbose = FALSE
)
```

Arguments

kmeans_data	Data frame containing the combined PC scores and depth statistics to perform k-means on. Output from the 'combine_data()' function.
standardise	TRUE or FALSE. Whether or not to standardise the data. Defaults to TRUE.
Max.k	Numerical. Maximum value of k to try. Defaults to 15.

v_line	Numerical. Option to add a vertical line to plot at a specific value of k. Defaults to NULL.
calc_gap	TRUE or FALSE. Whether or not to calculate the gap statistic. Defaults to FALSE
plot_gap	TRUE or FALSE. Whether or not to plot the gap statistic. Defaults to FALSE.
output	Logical. If TRUE, output is saved to output_folder. Defaults to FALSE.
output_folder	Output folder path. If output = TRUE, output_folder must be provided. Defaults to NULL.
verbose	Logical. If TRUE, progress messages are shown. Defaults to FALSE.

Details

This function relies on random initialisation in k-means clustering. For reproducible results, users may wish to set a random seed prior to calling this function using set.seed().

Value

A 'ggplot' class object and creates a figure containing both the within-cluster sum of squares plot (elbow) and the average silhouette width plot for 1 to 'Max.k' clusters.

Examples

```
# Set file path
filepath <- system.file("extdata", package = "FishDiveR")

# Load kmeans_data
kmeans_data <- readRDS(file.path(filepath, "data/5_k-means/combined_stats.rds"))

# Run select_k function
selecting_k <- select_k(
  kmeans_data = kmeans_data,
  standardise = TRUE,
  Max.k = 8,
  v_line = 4,
  calc_gap = FALSE,
  plot_gap = FALSE,
  output = TRUE,
  output_folder = tempdir(),
  verbose = TRUE
)
```

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