Package 'beats'

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Type Package

Title Heartbeat Detection in Electrocardiogram Data

Version 0.1.1

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Description Import and process electrocardiogram (ECG) data.
Reads binary data files from UFI devices (.ube files) and provides a
Shiny app for finding and exporting heart beats.

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URL https://github.com/FlukeAndFeather/beats

BugReports https://github.com/FlukeAndFeather/beats/issues

Depends R (>= 2.10)

Imports dplyr, ggplot2, lubridate, purrr, readr, shiny, zoo

Suggests gganimate, gifski, plotly, png, testthat (>= 2.1.0)

Encoding UTF-8

LazyData true

RoxygenNote 7.0.2

NeedsCompilation no

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Repository CRAN

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R topics documented:

`animate_hr` *Animate ECG data and heart beats*

Description

`animate_hr` produces a GIF of heart beats in (close to) real time.

Usage

```
animate_hr(ecg, beats, which_beats = NULL, big = FALSE)
```

Arguments

`ecg` A data.frame with columns timestamp (POSIXct) and ecg (numeric) (see `read_ube`)

`beats` A data.frame with columns timestamp (POSIXct), ecg, period_s, freq_hz, and freq_bpm (see `find_hr`)

`which_beats` Indices of the heart beats (in param `beats`) to be animated. If NULL (default), all beats will be animated.

`big` If FALSE (default) then throw an error if the animation will last more than 20s. This prevents R from crashing if it tries to animate too much.

Value

A `gif_image` object

Examples

```
animate_hr(ecg_bw190918_62R, beats_bw190918_62R, which_beats = 44:50, big = TRUE)
```

`beats_bw190918_62R` *Heart rate of a blue whale*

Description

A dataset containing the heart rate record of a blue whale, collected 2019-09-18 off the coast of Big Sur, CA under NMFS permit no. 16111.

Usage

```
beats_bw190918_62R
```

Format

A data frame with 59 rows and five variables:

timestamp time of heart beat, in POSIXct format

ecg value from ECG recorder at peak voltage (see ecg_bw190918_62R)

period_s period in seconds to next heart beat. NA if followed by a gap.

freq_hz frequency of heart beat in Hz (inverse of period_s)

freq_bpm frequency of heart beat in beats-per-minute

References

Goldbogen, J. A., Cade, D. E., Calambokidis, J., Czapanskiy, M. F., Fahlbusch, J., Friedlaender, A. S., … Ponganis, P. J. (2019). Extreme bradycardia and tachycardia in the world's largest animal. *Proceedings of the National Academy of Sciences, 116*(50), 25329–25332. doi: 10.1073/pnas.1914273116

`ecg_bw190918_62R` *ECG of a blue whale*

Description

A dataset containing the ECG record of a blue whale, collected 2019-09-18 off the coast of Big Sur, CA under NMFS permit no. 16111.

Usage

```
ecg_bw190918_62R
```

Format

A data frame with 234,001 rows and two variables:

timestamp time of record, in POSIXct format

ecg value from ECG recorder in engineering units, ranges 0-4095

References

Goldbogen, J. A., Cade, D. E., Calambokidis, J., Czapanskiy, M. F., Fahlbusch, J., Friedlaender, A. S., … Ponganis, P. J. (2019). Extreme bradycardia and tachycardia in the world's largest animal. *Proceedings of the National Academy of Sciences, 116*(50), 25329–25332. doi: 10.1073/pnas.1914273116

find_hr *Find heart rate from ECG data*

Description

find_hr is an interactive tool for processing ECG data to get heart rate profiles. Use it to identify individual heart beats and gaps in ECG the ECG data.

Usage

```
find_hr(data)
```

Arguments

data	A data.frame with columns timestamp (POSIXct) and ecg (numeric)

Details

The GUI is divided into a side panel with controls and a main panel with plots. The side panel has controls for choosing the interaction mode, exporting results, and exiting. The main panel shows up to three plots for viewing and interacting with the data. As you interact with the plots, more detailed views appear.

1. The top plot shows the entire ECG profile, including data before and after deployment. Brush (click and drag) the part of the profile with the deployment itself.
2. The middle plot is a profile of the deployment. Brush it to zoom in to shorter periods so you can see individual heart beats.
3. The bottom plot shows data in the most detailed view. Clicking and brushing the data will add/clear heart beats and gaps.

There are five interaction modes. In "Add heart beat" mode, clicking will add a heart beat on the nearest peak (should be the QRS complex). "Clear heart beat" will remove the nearest beat. Use "Add gap" to brush areas with unusable data, to avoid artificially low heart rates. Overlapping gaps are merged automatically. In "Clear gap" mode, click on gaps to clear them. "Set beat threshold" adds heart beats in bulk. Clicking will add a heart beat to every peak higher than the click point. This will only add beats to the part of the data visible in the detail plot.

There are two buttons at the bottom of the side panel for when you're done using the tool. "Download heart beats" exports the heart rate data to CSV and "Finish and return data.frame" quits the tool and returns the result.

Value

A data.frame with columns

- timestamp (time of heart beat, POSIXct)
- ecg (raw value of ECG peak)
- period_s (period in seconds to next heart beat)

- freq_hz (heart rate in Hz)
- freq_bpm (heart rate in beats per minute)

Examples

```
if (interactive()) {
  # File path to sample data
  fp <- system.file("extdata", "max_ecg_190826b.ube", package = "beats")
  # Read ube file
  ecg_data <- read_ube(fp)
  # Launch GUI
  heartbeats <- find_hr(ecg_data)
  # In this heart rate profile, zoom into 12:53:20 - 12:54:25 to see actual beats
}
```

`plot_ecg` *Plot a heartrate profile*

Description

`plot_ecg` plots a heat rate profile.

Usage

```
plot_ecg(data, max_points = 10000, interactive = FALSE)
```

Arguments

`data`	A data.frame with columns timestamp (POSIXct) and ecg (numeric)
`max_points`	Maximum number of points to decimate `data` (10,000 by default)
`interactive`	Should the plot be interactive? FALSE by default. Requires package "plotly".

Value

A ggplot object if not interactive, a plotly object otherwise.

read_ube *Read data from a UBE file*

Description

read_ube parses a binary UBE file, returning a data frame with ECG records and timestamps

Usage

```
read_ube(ube_path)
```

Arguments

ube_path	Path to UBE file.

Value

A data.frame with columns timestamp (POSIXct) and ecg (numeric)

Examples

```
# File path to sample data
fp <- system.file("extdata", "max_ecg_190826b.ube", package = "beats")
# Read ube file
ecg_data <- read_ube(fp)
```

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