

Package ‘`impactr`’

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Title Mechanical Loading Prediction Through Accelerometer Data

Version 0.3.0

Description Functions to read, process and analyse accelerometer data related to mechanical loading variables. This package is developed and tested for use with raw accelerometer data from triaxial 'ActiGraph' <<https://actigraphcorp.com>> accelerometers.

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URL <https://lveras.com/impactr/>

BugReports <https://github.com/verasls/impactr/issues>

Encoding UTF-8

RoxygenNote 7.1.2

Imports glue, lubridate, lvmisc, pillar, pracma, purrr, Rcpp, rlang (>= 0.4.6), signal, stringr, tibble, toOrdinal, utils, vroom

Suggests covr, knitr, rmarkdown, testthat (>= 3.0.0)

Config/testthat/edition 3

LinkingTo Rcpp

VignetteBuilder knitr

NeedsCompilation yes

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define_region	<i>Define region of interest</i>
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Description

Define the region of interest for data analysis based on the accelerometer data timestamp.

Usage

```
define_region(data, start_time, end_time)
```

Arguments

data An impactr_data object, as obtained with [read_acc\(\)](#).

start_time, end_time A character string with the start and end times of the region of interest in the "YYYY-MM-DD HH:MM:SS" format.

Value

An object of class `impactr_data`.

Examples

```
data <- read_acc(impactr_example("hip-raw.csv"))
define_region(
  data, start_time = "2021-04-06 15:45:00", end_time = "2021-04-06 15:46:00"
)
```

filter_acc	<i>Filter the acceleration signal</i>
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Description

Filter the acceleration signal using a butterworth digital filter.

Usage

```
filter_acc(data, order = 4, cutoff = 20, type = "lowpass")
```

Arguments

data	An impactr_data object, as obtained with read_acc() .
order	The order of the filter. Defaults to 4.
cutoff	The filter cut-off frequency in Hz. Defaults to 20. For low- and high-pass filters, must be a scalar. For band-pass and band- stop, a vector of length two.
type	The type of filter. Defaults to "lowpass". Can be "lowpass", "highpass", "band-pass" or "bandstop".

Details

The default values of the filter parameters are matching the filter used in the paper by Veras et al. that developed the mechanical loading prediction equations (see References).

Value

An object of class impactr_data.

References

- Veras L, Diniz-Sousa F, Boppre G, Devezas V, Santos-Sousa H, Preto J, Machado L, Vilas-Boas JP, Oliveira J, Fonseca H. Accelerometer-based prediction of skeletal mechanical loading during walking in normal weight to severely obese subjects. Osteoporosis International. 2020. 31(7):1239- 1250. doi: [10.1007/s00198020052952](https://doi.org/10.1007/s00198020052952).

Examples

```
data <- read_acc(impactr_example("hip-raw.csv"))
filter_acc(data)
```

find_peaks	<i>Find peaks in a signal</i>
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Description

Find peaks in the acceleration signal.

Usage

```
find_peaks(data, vector, min_height = 1.3, min_dist = 0.4)
```

Arguments

data	An <code>impactr_data</code> object, as obtained with <code>read_acc()</code> .
vector	A character string indicating in which acceleration vector to find the peaks. Can be "resultant", "vertical" or "all".
min_height	The minimum height of the peaks (in g).
min_dist	The minimum horizontal distance between peaks (in seconds).

Details

The default values of the filter parameters are matching the filter used in the paper by Veras et al. that developed the mechanical loading prediction equations (see References). When the vector parameter is set to "all", there may contain NA values in the `resultant_peak_acc` and/or `vertical_peak_acc` at the timestamps in which a peak value for that vector could not be identified.

The default values of `min_height` and `min_dist` are matching the criteria used in the paper by Veras et al. that developed the mechanical loading prediction equations (see References)

Value

An object of class `impactr_peaks` with the peaks magnitude stored in the columns.

References

- Veras L, Diniz-Sousa F, Boppre G, Devezas V, Santos-Sousa H, Preto J, Machado L, Vilas-Boas JP, Oliveira J, Fonseca H. Accelerometer-based prediction of skeletal mechanical loading during walking in normal weight to severely obese subjects. *Osteoporosis International*. 2020. 31(7):1239- 1250. doi: [10.1007/s00198020052952](https://doi.org/10.1007/s00198020052952).

Examples

```
data <- read_acc(impactr_example("hip-raw.csv"))
data <- use_resultant(data)
find_peaks(data, vector = "resultant")
```

impactr_example *Get path to example data*

Description

impactr comes with some example ActiGraph accelerometer raw data files in its inst/extdata directory. This function make them easy to access.

Usage

```
impactr_example(file = NULL)
```

Arguments

file A character string with the file name. If NULL, the example files will be listed.

Value

If file = NULL, it returns the file names of the example data files, else it returns the path to the example data.

Examples

```
impactr_example()
impactr_example("hip-raw.csv")
```

is_impactr *Test if the object is from the impactr package*

Description

Test if the object is from the impactr package

Usage

```
is_impactr_data(x)
```

```
is_impactr_peaks(x)
```

Arguments

x An object.

Value

TRUE if the object inherits the class being evaluated.

predict_loading	<i>Predict mechanical loading</i>
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Description

Predict either ground reaction force or loading rate, or both, based on accelerometer data.

Usage

```
predict_loading(data, outcome, vector, model)
```

Arguments

data	An <code>impacetr_data</code> object, as obtained with <code>read_acc()</code> .
outcome	A character string. Can be either "grf" (for ground reaction force), or "lr" (for loading rate) or "all" (for both mechanical loading variables).
vector	A character string indicating in which acceleration vector to find the peaks. Can be "resultant", "vertical" or "all".
model	A character string indicating which model to use to make the predictions. The values currently supported are "walking", "walking/running" and "jumping".

Value

An object of class `impacetr_peaks` with the ground reaction force and/or loading rate peaks magnitude stored in the columns.

Examples

```
data <- read_acc(impacetr_example("hip-raw.csv"))
data <- specify_parameters(data, acc_placement = "hip", subj_body_mass = 78)
data <- find_peaks(data, vector = "vertical")
predict_loading(
  data,
  outcome = "grf",
  vector = "vertical",
  model = "walking/running"
)
```

read_acc	<i>Read raw accelerometer data</i>
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Description

Reads raw accelerometer data files into an `impactr_data` object.

Usage

```
read_acc(file)
```

Arguments

`file` Path to a raw accelerometer data file.

Value

An object of class `impactr_data`.

Examples

```
read_acc(impactr_example("hip-raw.csv"))
```

specify_parameters	<i>Specify prediction model parameters</i>
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Description

Specify the accelerometer placement used and the subject body mass. These data is needed in order to use the mechanical loading prediction models.

Usage

```
specify_parameters(data, acc_placement, subj_body_mass)
```

Arguments

`data` An `impactr_data` object, as obtained with `read_acc()`.

`acc_placement` A character string indicating the accelerometer placement. Can be either "ankle", "back", or "hip".

`subj_body_mass` A double scalar indicating the subject body mass in kilograms.

Value

An object of class `impactr_data` with the specified parameters as attributes.

Examples

```
data <- read_acc(impactr_example("hip-raw.csv"))
specify_parameters(data, acc_placement = "hip", subj_body_mass = 79.2)
```

use_resultant	<i>Use resultant vector</i>
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Description

Computes the acceleration resultant vector.

Usage

```
use_resultant(data)
```

Arguments

data An impactr_data object, as obtained with

Value

An object of class impactr_data with the acc_R column containing the acceleration resultant vector.

Examples

```
data <- read_acc(impactr_example("hip-raw.csv"))
use_resultant(data)
```


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