

Package ‘saccades’

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Type Package

Title Detection of Fixations in Eye-Tracking Data

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Description Functions for detecting eye fixations in raw eye-tracking data. The detection is done using a velocity-based algorithm for saccade detection proposed by Ralf Engbert and Reinhold Kliegl in 2003. The algorithm labels segments as saccades when the velocity of the eye movement exceeds a certain threshold. Anything between two saccades is considered a fixation. Thus the algorithm is not appropriate for data containing episodes of smooth pursuit eye movements.

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URL <https://github.com/tmalsburg/saccades>

BugReports <https://github.com/tmalsburg/saccades/issues>

Depends R (>= 2.10), zoom

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calculate.summary *Calculate Summary Statistics for a Set of Fixations.*

Description

Calculates summary statistics about the trials and fixations in the given data frame.

Usage

```
calculate.summary(fixations)
```

Arguments

`fixations` a data frame containing the fixations that were detected in the samples. See [detect.fixations](#) for details about the format.

Value

A data frame containing the statistics.

Details

Calculates the number of trials, the average duration of trials, the average number of fixations in trials, the average duration of the fixations, the average spatial dispersion in the fixations, and the average peak velocity that occurred during fixations. Where appropriate standard deviations are given as well. Use `round` to obtain a more readable version of the resulting data frame.

Author(s)

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See Also

[diagnostic.plot](#), [detect.fixations](#)

Examples

```
data(fixations)
stats <- calculate.summary(fixations)
round(stats, digits=2)
```

detect.fixations *Detect Fixations in a Stream of Raw Eye-Tracking Samples*

Description

Takes a data frame containing raw eye-tracking samples and returns a data frame containing fixations.

Usage

```
detect.fixations(samples, lambda = 15, smooth.coordinates = T,  
                smooth.saccades = T)
```

Arguments

samples a data frame containing the raw samples as recorded by the eye-tracker. This data frame has four columns:
time: the time at which the sample was recorded
trial: the trial to which the sample belongs
x: the x-coordinate of the sample
y: the y-coordinate of the sample
Samples have to be listed in chronological order. The velocity calculations assume that the sampling frequency is constant.

lambda a parameter for tuning the saccade detection. It specifies which multiple of the standard deviation of the velocity distribution should be used as the detection threshold.

smooth.coordinates logical. If true the x- and y-coordinates will be smoothed using a moving average with window size 3 prior to saccade detection.

smooth.saccades logical. If true, consecutive saccades that are separated only by a few samples will be joined. This avoids the situation where swing-backs at the end of longer saccades are recognized as separate saccades. Whether this works well, depends to some degree on the sampling rate of the eye-tracker. If the sampling rate is very high, the gaps between the main saccade and the swing-back might become too large and look like genuine fixations. Likewise, if the sampling frequency is very low, genuine fixations may be regarded as spurious. Both cases are unlikely to occur with current eye-trackers.

Value

a data frame containing the detected fixations. This data frame has the following columns:

trial the trial to which the fixation belongs
start the time at which the fixation started

<code>end</code>	the time at which the fixation ended
<code>x</code>	the x-coordinate of the fixation
<code>y</code>	the y-coordinate of the fixation
<code>sd.x</code>	the standard deviation of the sample x-coordinates within the fixation
<code>sd.y</code>	the standard deviation of the sample y-coordinates within the fixation
<code>peak.vx</code>	the horizontal peak velocity that was reached within the fixation
<code>peak.vy</code>	the vertical peak velocity that was reached within the fixation
<code>dur</code>	the duration of the fixation

Details

This function uses a velocity-based detection algorithm for saccades proposed by Engbert and Kliegl. Anything between two saccades is considered to be a fixation. Thus, the algorithm is not suitable for data sets containing episodes of smooth pursuit eye movements.

Author(s)

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References

Ralf Engbert, Reinhold Kliegl: Microsaccades uncover the orientation of covert attention, Vision Research, 2003.

See Also

[diagnostic.plot](#), [calculate.summary](#)

Examples

```
data(samples)
head(samples)
fixations <- detect.fixations(samples)
head(fixations)
## Not run:
first.trial <- samples$trial[1]
first.trial.samples <- subset(samples, trial==first.trial)
first.trial.fixations <- subset(fixations, trial==first.trial)
with(first.trial.samples, plot(x, y, pch=20, cex=0.2, col="red"))
with(first.trial.fixations, points(x, y, cex=1+sqrt(dur/1000)))

## End(Not run)
```

diagnostic.plot *Interactive Diagnostic Plot of Samples and Fixations*

Description

Shows the raw samples and the detected fixations in an interactive plot. This plot can be used to screen the data and to diagnose problems with the fixation detection.

Usage

```
diagnostic.plot(samples, fixations)
```

Arguments

samples	a data frame containing the raw samples as recorded by the eye-tracker. This data frame has to have the following columns: time: the time at which the sample was recorded x: the x-coordinate of the sample y: the y-coordinate of the sample Samples have to be listed in chronological order. The velocity calculations assume that the sampling frequency is constant.
fixations	a data frame containing the fixations that were detected in the samples. This data frame has to have the following columns: start: the time at which the fixations started end: the time at which the fixation ended x: the x-coordinate of the fixation y: the y-coordinate of the fixation

Value

A recording of the final plot. Can be re-plotted using [replayPlot](#).

Details

The function will open an interactive plot showing the samples and fixations. Red dots represent the x-coordinate and orange dots the y-coordinate. The gray vertical lines indicate the on- and offsets of saccades and horizontal lines the coordinates of the fixations. Instructions for navigating the plot are displayed on the console.

Author(s)

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See Also

[detect.fixations](#), [calculate.summary](#)

Examples

```
## Not run:  
data(samples)  
fixations <- detect.fixations(samples)  
diagnostic.plot(samples, fixations)  
  
## End(Not run)
```

fixations	<i>Fixations Detected in a Stream of Raw Positions</i>
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Description

Fixations detected in a stream of raw eye positions. The corresponding raw eye positions samples are found in the data frame `samples` also part of this package.

Usage

```
fixations
```

Format

a data frame containing one line per fixation. The fixations are sorted in chronological order. Time is given in milliseconds, x- and y-coordinates in screen pixels.

Author(s)

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Source

Recorded with an iViewX Eye-Tracker by SMI at approximately 250 Hz.

saccades	<i>Detection of Fixations in Raw Eye-Tracking Data</i>
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Description

Functions for the detection of fixations in raw eye-tracking data.

Details

Offers a function for detecting fixations in a stream of eye positions recorded by an eye-tracker. The detection is done using an algorithm for saccade detection proposed by Ralf Engbert and Reinhold Kliegl (see reference below). Anything that happens between two saccades is considered to be a fixation. This software is therefore not suited for data sets with smooth-pursuit eye movements.

Author(s)

Titus von der Malsburg <malsburg@posteo.de>

References

Ralf Engbert, Reinhold Kliegl: Microsaccades uncover the orientation of covert attention, Vision Research, 2003.

See Also

[detect.fixations](#), [diagnostic.plot](#), [calculate.summary](#)

samples

Samples of Eye Positions as Recorded with an Eye-Tracker

Description

Samples of eye positions as recorded with an iViewX eye-tracker recording at approx. 250 Hz. The data quality is low on purpose and contains episodes of track-loss and blinks.

Usage

samples

Format

a data frame containing one line per sample. The samples are sorted in chronological order. Time is given in milliseconds, x- and y-coordinates in screen pixels.

Author(s)

Titus von der Malsburg <malsburg@posteo.de>

Source

Recorded with an iViewX Eye-Tracker by SMI at approximately 250 Hz.

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