Package 'postGGIR'

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Title Data Processing after Running 'GGIR' for Accelerometer Data

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Description

Generate all necessary R/Rmd/shell files for data processing after running 'GGIR' (v2.4.0) for ac-
celerometer data. In part 1, all csv files in the GGIR output directory were read, trans-
formed and then merged. In part 2, the GGIR output files were checked and summa-
rized in one excel sheet. In part 3, the merged data was cleaned according to the num-
ber of valid hours on each night and the number of valid days for each sub-
ject. In part 4, the cleaned activity data was imputed by the average Euclidean norm mi-
nus one (ENMO) over all the valid days for each subject. Finally, a comprehensive re-
port of data processing was created using Rmarkdown, and the report includes few ex-
ploratory plots and multiple commonly used features extracted from minute level actigraphy data.

URL https://github.com/dora201888/postGGIR

BugReports https://github.com/dora201888/postGGIR/issues

License GPL-3

Imports refund, denseFLMM, dplyr, xlsx, survival, stats, tidyr, zoo,
ineq, cosinor, cosinor2, abind, accelerometry, ActCR, ActFrag,
minpack.lm, kableExtra, GGIR

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Suggests knitr, rmarkdown

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R topics documented:

ActCosinor2   *Cosinor Model for Circadian Rhythmicity*

Description

A parametric approach to study circadian rhythmicity assuming cosinor shape.

Usage

```
ActCosinor2(x, window = 1, n1440 = 1440)
```

Arguments

x   vector vector of dimension n*1440 which reprsents n days of 1440 minute activity data

window   The calculation needs the window size of the data. E.g window = 1 means each epoch is in one-minute window.

n1440,   the number of points of a day. Default is 1440 for the minute-level data.

Value

A list with elements

mes   MESOR which is short for midline statistics of rhythm, which is a rhythm adjusted mean. This represents mean activity level.

amp   amplitude, a measure of half the extend of predictable variation within a cycle. This represents the highest activity one can achieve.

acro   acrophase, a meaure of the time of the overall high values recurring in each cycle. Here it has a unit of radian. This represents time to reach the peak.

acrotime   acrophase in the unit of the time (hours)

ndays   Number of days modeled

References

Cornelissen, G. Cosinor-based rhythmometry. Theor Biol Med Model 11, 16 (2014). https://doi.org/10.1186/1742-4682-11-16

ActCosinor_long2   *Cosinor Model for Circadian Rhythmicity for the Whole Dataset*

Description

A parametric approach to study circadian rhythmicity assuming cosinor shape.This function is a whole dataset wrapper for `ActCosinor`.

Usage

```
ActCosinor_long2(count.data, window = 1)
```

Arguments

count.data
: data.frame of dimension n * (p+2) containing the p dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequence of days within each subject.

window
: The calculation needs the window size of the data. E.g window = 1 means each epoch is in one-minute window.

Value

A data.frame with the following 5 columns

ID
: ID

ndays
: number of days

mes
: MESRO, which is short for midline statistics of rhythm, which is a rhythm adjusted mean. This represents mean activity level.

amp
: amplitude, a measure of half the extend of predictable variation within a cycle. This represents the highest activity one can achieve.

acro
: acrophase, a meaure of the time of the overall high values recurring in each cycle. Here it has a unit of radian. This represents time to reach the peak.

acrotime
: acrophase in the unit of the time (hours)

ndays
: Number of days modeled

ActExtendCosinor2   *Extended Cosinor Model for Circadian Rhythmicity*

Description

Extended cosinor model based on sigmoidally transformed cosine curve using anti-logistic transformation

Usage

```
ActExtendCosinor2(
  x,
  window = 1,
  lower = c(0, 0, -1, 0, -3),
  upper = c(Inf, Inf, 1, Inf, 27),
  n1440 = 1440
)
```

Arguments

x	vector vector of dimension n*1440 which represents n days of 1440 minute activity data
window	The calculation needs the window size of the data. E.g window = 1 means each epoch is in one-minute window.
lower	A numeric vector of lower bounds on each of the five parameters (in the order of minimum, amplitude, alpha, beta, acrophase) for the NLS. If not given, the default lower bound for each parameter is set to `-Inf`.
upper	A numeric vector of upper bounds on each of the five parameters (in the order of minimum, amplitude, alpha, beta, acrophase) for the NLS. If not given, the default lower bound for each parameter is set to `Inf`
n1440,	the number of points of a day. Default is 1440 for the minute-level data.

Value

A list with elements

minimum	Minimum value of the of the function.
amp	amplitude, a measure of half the extend of predictable variation within a cycle. This represents the highest activity one can achieve.
alpha	It determines whether the peaks of the curve are wider than the troughs: when alpha is small, the troughs are narrow and the peaks are wide; when alpha is large, the troughs are wide and the peaks are narrow.
beta	It dertermines whether the transformed function rises and falls more steeply than the cosine curve: large values of beta produce curves that are nearly square waves.
acrotime	acrophase is the time of day of the peak in the unit of the time (hours)
F_pseudo	Measure the improvement of the fit obtained by the non-linear estimation of the transformed cosine model
UpMesor	Time of day of switch from low to high activity. Represents the timing of the rest- activity rhythm. Lower (earlier) values indicate increase in activity earlier in the day and suggest a more advanced circadian phase.
DownMesor	Time of day of switch from high to low activity. Represents the timing of the rest-activity rhythm. Lower (earlier) values indicate decline in activity earlier in the day, suggesting a more advanced circadian phase.
MESOR	A measure analogous to the MESOR of the cosine model (or half the deflection of the curve) can be obtained from mes=min+amp/2. However, it goes through the middle of the peak, and is therefore not equal to the MESOR of the cosine model, which is the mean of the data.
ndays	Number of days modeled.

References

Marler MR, Gehrman P, Martin JL, Ancoli-Israel S. The sigmoidally transformed cosine curve: a mathematical model for circadian rhythms with symmetric non-sinusoidal shapes. Stat Med.

```
ActExtendCosinor_long2
```
Cosinor Model for Circadian Rhythmicity for the Whole Dataset

---

Description

Extended cosinor model based on sigmoidally transformed cosine curve using anti-logistic transformation.This function is a whole dataset wrapper for `ActExtendCosinor`.

Usage

```
ActExtendCosinor_long2(
  count.data,
  window = 1,
  lower = c(0, 0, -1, 0, -3),
  upper = c(Inf, Inf, 1, Inf, 27)
)
```

Arguments

count.data	data.frame of dimension n * (p+2) containing the p dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either `character` or `numeric`. Day has to be `numeric` indicating the sequence of days within each subject.
window	The calculation needs the window size of the data. E.g window = 1 means each epoch is in one-minute window. window size as an argument.
lower	A numeric vector of lower bounds on each of the five parameters (in the order of minimum, amplitude, alpha, beta, acrophase) for the NLS. If not given, the default lower bound for each parameter is set to `-Inf`.
upper	A numeric vector of upper bounds on each of the five parameters (in the order of minimum, amplitude, alpha, beta, acrophase) for the NLS. If not given, the default lower bound for each parameter is set to `Inf`

Value

A `data.frame` with the following 5 columns

ID	ID
ndays	number of days
minimum	Minimum value of the of the function.
amp	amplitude, a measure of half the extend of predictable variation within a cycle. This represents the highest activity one can achieve.
alpha	It determines whether the peaks of the curve are wider than the troughs: when alpha is small, the troughs are narrow and the peaks are wide; when alpha is large, the troughs are wide and the peaks are narrow.

beta	It dertermines whether the transformed function rises and falls more steeply than the cosine curve: large values of beta produce curves that are nearly square waves.
acrotime	acrophase is the time of day of the peak in the unit of the time (hours)
F_pseudo	Measure the improvement of the fit obtained by the non-linear estimation of the transformed cosine model
UpMesor	Time of day of switch from low to high activity. Represents the timing of the rest- activity rhythm. Lower (earlier) values indicate increase in activity earlier in the day and suggest a more advanced circadian phase.
DownMesor	Time of day of switch from high to low activity. Represents the timing of the rest-activity rhythm. Lower (earlier) values indicate decline in activity earlier in the day, suggesting a more advanced circadian phase.
MESOR	A measure analogous to the MESOR of the cosine model (or half the deflection of the curve) can be obtained from mes=min+amp/2. However, it goes through the middle of the peak, and is therefore not equal to the MESOR of the cosine model, which is the mean of the data.

---

afterggir	*Main Call for Data Processing after Runing GGIR for Accelerometer Data*

Description

This R script will generate all necessary R/Rmd/shell files for data processing after running GGIR for accelerometer data.

Usage

```
afterggir(
  mode,
  useIDs.FN = NULL,
  currentdir,
  studyname,
  bindir = NULL,
  outputdir,
  epochIn = 5,
  epochOut = 5,
  flag.epochOut = 60,
  log.multiplier = 9250,
  use.cluster = TRUE,
  QCdays.alpha = 7,
  QChours.alpha = 16,
  QCnights.feature.alpha = c(0, 0),
  Rversion = "R",
  filename2id = NULL,
```

```
    PA.threshold = c(50, 100, 400),
    desiredtz = "US/Eastern",
    RemoveDaySleeper = FALSE,
    part5FN = "WW_L50M100V400_T5A5",
    NfileEachBundle = 20,
    trace = FALSE
)
```

Arguments

mode	number Specify which of the five parts need to be run, e.g. mode = 0 makes that all R/Rmd/sh files are generated for other parts. When mode = 1, all csv files in the GGIR output directory were read, transformed and then merged. When mode = 2, the GGIR output files were checked and summarized in one excel sheet. When mode = 3, the merged data was cleaned according to the number of valid hours on each night and the number of valid days for each subject. When mode = 4, the cleaned data was imputed.
useIDs.FN	character Filename with or without directory for sample information in CSV format, which including "filename" and "duplicate" in the headlines at least. If duplicate="remove", the accelerometer files will not be used in the data analysis of part 5-7. Defaut is NULL, which makes all accelerometer files will be used in part 5-7.
currentdir	character Directory where the output needs to be stored. Note that this directory must exist.
studyname	character Specify the study name that used in the output file names
bindir	character Directory where the accelerometer files are stored or list
outputdir	character Directory where the GGIR output was stored.
epochIn	number Epoch size to which acceleration was averaged (seconds) in GGIR output. Defaut is 5 seconds.
epochOut	number Epoch size to which acceleration was averaged (seconds) in part1. Defaut is 5 seconds.
flag.epochOut	number Epoch size to which acceleration was averaged (seconds) in part 3. Defaut is 60 seconds.
log.multiplier	number The coefficient used in the log transformation of the ENMO data, i.e. log(log.multiplier * ENMO + 1), which have been used in part 5-7. Defaut is 9250.
use.cluster	logical Specify if part1 will be done by parallel computing. Default is TRUE, and the CSV file in GGIR output will be merged for every 20 files first, and then combined for all.
QCdays.alpha	number Minimum required number of valid days in subject specific analysis as a quality control step in part2. Default is 7 days.
QChours.alpha	number Minimum required number of valid hours in day specific analysis as a quality control step in part2. Default is 16 hours.

QCnights.feature.alpha	
	number Minimum required number of valid nights in day specific mean and SD analysis as a quality control step in the JIVE analysis. Default is c(0,0), i.e. no additional data cleaning in this step.
Rversion	character R version, eg. "R/3.6.3". Default is "R".
filename2id	R function User defined function for converting filename to sample IDs. Default is NULL.
PA.threshold	number Threshold for light, moderate and vigorous physical activity. Default is c(50,100,400).
desiredtz	charcter desired timezone: see also http://en.wikipedia.org/wiki/Zone.tab. Used in g.inspectfile(). Default is "US/Eastern". Used in g.inspectfile() function to inspect acceleromether file for brand, sample frequency in part 2.
RemoveDaySleeper	
	logical Specify if the daysleeper nights are removed from the calculation of number of valid days for each subject. Default is FALSE.
part5FN	character Specify which output is used in the GGIR part5 results. Defaut is "WW_L50M100V400_T5A5", which means that part5_daysummary_WW_L50M100V400_T5A5.csv and part5_personsummary_WW_L50M100V400_T5A5.csv are used in the analysis.
NfileEachBundle	
	number Number of files in each bundle when the csv data were read and processed in a cluster. Default is 20.
trace	logical Specify if the intermediate results is printed when the function was executed. Default is FALSE.

Value

See postGGIR manual for details.

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bin_data2	*Bin data into longer windows*

Description

Bin minute level data into different time resolutions

Usage

```
bin_data2(x = x, window = 1, method = c("average", "sum"))
```

Arguments

x	vector of activity data.
window	window size used to bin the original 1440 dimensional data into. Window size should be an integer factor of 1440
method	character of "sum" or "average", function used to bin the data

Value

a vector of binned data

---

create.postGGIR   *Create a template shell script of postGGIR*

Description

Create a template shell script of postGGIR, named as STUDYNAME_part0.maincall.R.

Usage

```
create.postGGIR()
```

Value

The function will create a template shell script of postGGIR in the current directory, names as STUDYNAME_part0.maincall.R

---

data.imputation   *Data imputation for the cleaned data with annotation*

Description

Data imputation for the merged ENMO data with annotation. The missing values were imputated by the average ENMO over all the valid days for each subject.

Usage

```
data.imputation(workdir, csvInput)
```

Arguments

workdir	character Directory where the output needs to be stored. Note that this directory must exist.
csvInput	character File name with or without directory for sample information in CSV format. The ENMO data will be read through read.csv(csvInput,header=1) command, and the missing values were imputated by the average ENMO over all the valid days for each subject at each time point. In this package, csvInput = flag_All_studyname_ENMO.data.Xs.csv.

Value

Files were written to the specified sub-directory, named as impu.flag_All_studyname_ENMO.data.Xs.csv, which Xs is the epoch size to which acceleration was averaged (seconds) in GGIR output. This excel file includs the following columns,

filename	accelerometer file name
Date	date recored from the GGIR part2.summary file
id	IDs recored from the GGIR part2.summary file
calender_date	date in the format of yyyy-mm-dd
N.valid.hours	number of hours with valid data recored from the part2_daysummary.csv file in the GGIR output
N.hours	number of hours of measurement recored from the part2_daysummary.csv file in the GGIR output
weekday	day of the week-Day of the week
measurementday	
	day of measurement-Day number relative to start of the measurement
newID	new IDs defined as the user-defined function of filename2id(), e.g. substrings of the filename
Nmiss_c9_c31	number of NAs from the 9th to 31th column in the part2_daysummary.csv file in the GGIR output
missing	"M" indicates missing for an invalid day, and "C" indicates completeness for a valid day
Ndays	number of days of measurement
ith_day	rank of the measurementday, for example, the value is 1,2,3,4,-3,-2,-1 for measurementday = 1,...,7
Nmiss	number of missing (invalid) days
Nnonmiss	number of non-missing (valid) days
misspattern	indicators of missing/nonmissing for all measurement days at the subject level
RowNonWear	number of columnns in the non-wearing matrix
NonWearMin	number of minutes of non-wearing
daysleeper	If 0 then the person is a nightsleeper (sleep period did not overlap with noon) if value=1 then the person is a daysleeper (sleep period did overlap with noon).
remove16h7day	indicator of a key qulity control output. If remove16h7day=1, the day need to be removed. If remove16h7day=0, the day need to be kept.
duplicate	If duplicate="remove", the accelerometer files will not be used in the data analysis of part5.
ImpuMiss.b	number of missing values on the ENMO data before imputation
ImpuMiss.a	number of missing values on the ENMO data after imputation
KEEP	The value is "keep"/"remove", e.g. KEEP="remove" if remove16h7day=1 or duplicate="remove" or ImpuMiss.a>0

DataShrink   *Annotating the merged data for all accelerometer files in the GGIR*
                              output

Description

Annotating the merged ENMO/ANGLEZ data by adding some descriptive variables such as number
of valid days and missing pattern.

Usage

```
DataShrink(
  studyname,
  outputdir,
  workdir,
  QCdays.alpha = 7,
  QChours.alpha = 16,
  summaryFN = "../summary/part24daysummary.info.csv",
  epochIn = 5,
  epochOut = 60,
  useIDs.FN = NULL,
  RemoveDaySleeper = FALSE,
  trace = FALSE,
  Step = 1
)
```

Arguments

studyname	character Specify the study name that used in the output file names
outputdir	character Directory where the GGIR output was stored.
workdir	character Directory where the output needs to be stored. Note that this directory must exist.
QCdays.alpha	number Minimum required number of valid days in subject specific analysis as a quality control step in part2. Default is 7 days.
QChours.alpha	number Minimum required number of valid hours in day specific analysis as a quality control step in part2. Default is 16 hours.
summaryFN	character Filename with or without directory for sample information in CSV format, which includes summary description of each accelerometer file. Some description will be extracted and merged into the ENMO/ANGLEZ data.
epochIn	number Epoch size to which acceleration was averaged (seconds) in GGIR output. Defaut is 5 seconds.
epochOut	number Epoch size to which acceleration was averaged (seconds) in part1. Defaut is 60 seconds.

useIDs.FN	character Filename with or without directory for sample information in CSV format, which inclues "filename" and "duplicate" in the headlines at least. If duplicate="remove", the accelerometer files will not be used in the data analysis of part 5-7. Defaut is NULL, which makes all accelerometer files will be used in part 5-7.
RemoveDaySleeper	
	logical Specify if the daysleeper nights are removed from the calculation of number of valid days for each subject. Default is FALSE.
trace	logical Specify if the intermediate results is printed when the function was executed. Default is FALSE.
Step	number Specify which of the varaible need to be cleaned. For example, Step = 1 for the "anglez" variable, and Step = 2 for the "enmo" variable.

Value

Files were written to the specified sub-directory, named as flag_ALL_studyname_ENMO.data.Xs.csv and flag_ALL_studyname_ANGLEZ.data.Xs.csv, which Xs is the epoch size to which acceleration was averaged (seconds) in GGIR output. This excel file includs the following columns,

filename	accelerometer file name
Date	date recored from the GGIR part2.summary file
id	IDs recored from the GGIR part2.summary file
calender_date	date in the format of yyyy-mm-dd
N.valid.hours	number of hours with valid data recored from the part2_daysummary.csv file in the GGIR output
N.hours	number of hours of measurement recored from the part2_daysummary.csv file in the GGIR output
weekday	day of the week-Day of the week
measurementday	
	day of measurement-Day number relative to start of the measurement
newID	new IDs defined as the user-defined function of filename2id(), e.g. substrings of the filename
Nmiss_c9_c31	number of NAs from the 9th to 31th column in the part2_daysummary.csv file in the GGIR output
missing	"M" indicates missing for an invalid day, and "C" indicates completeness for a valid day
Ndays	number of days of measurement
ith_day	rank of the measurementday, for example, the value is 1,2,3,4,-3,-2,-1 for measurementday = 1,...,7
Nmiss	number of missing (invalid) days
Nnonmiss	number of non-missing (valid) days
misspattern	indicators of missing/nonmissing for all measurement days at the subject level
RowNonWear	number of columnns in the non-wearing matrix

NonWearMin	number of minutes of non-wearing
Nvalid.day	number of valid days with/without removing daysleeper nights; It is equal to Nnonmiss when RemoveDaySleeper=FALSE.
daysleeper	If 0 then the person is a nightsleeper (sleep period did not overlap with noon) if value=1 then the person is a daysleeper (sleep period did overlap with noon).
remove16h7day	indicator of a key qulity control output. If remove16h7day=1, the day need to be removed. If remove16h7day=0, the day need to be kept.
duplicate	If duplicate="remove", the accelerometer files will not be used in the data analysis of part5-7.

---

fragmentation2	*Fragmentation Metrics*

Description

Fragmentation methods to study the transition between two states, e.g. sedentary v.s. active.

Usage

```
fragmentation2(
  x,
  w,
  thresh,
  bout.length = 1,
  metrics = c("mean_bout", "TP", "Gini", "power", "hazard", "all")
)
```

Arguments

x	integer vector of activity data.
w	vector of wear flag data with same dimension as x.
thresh	threshold to binarize the data.
bout.length	minimum duration of defining an active bout; defaults to 1.
metrics	What is the fragmentation metrics to exract. Can be "mean_bout","TP","Gini","power","hazard",or all the above metrics "all".

Details

Metrics include mean_bout (mean bout duration), TP (between states transition probability), Gini (gini index), power (alapha parameter for power law distribution) hazard (average hazard function)

Value

A list with elements

`mean_r`	mean sedentary bout duration
`mean_a`	mean active bout duration
`SATP`	sedentary to active transition probability
`ASTP`	bactive to sedentary transition probability
`Gini_r`	Gini index for active bout
`Gini_a`	Gini index for sedentary bout
`h_r`	hazard function for sedentary bout
`h_a`	hazard function for active bout
`alpha_r`	power law parameter for sedentary bout
`alpha_a`	power law parameter for active bout

References

Junrui Di, Andrew Leroux, Jacek Urbanek, Ravi Varadhan, Adam P. Spira, Jennifer Schrack, Vadim Zipunnikov. Patterns of sedentary and active time accumulation are associated with mortality in US adults: The NHANES study. bioRxiv 182337; doi: https://doi.org/10.1101/182337

---

fragmentation_long2 *Fragmentation Metrics for Whole Dataset*

Description

Fragmentation methods to study the transition between two states, e.g. sedentary v.s. active.This function is a whole dataset wrapper for `fragmentation`

Usage

```
fragmentation_long2(
  count.data,
  weartime,
  thresh,
  bout.length = 1,
  metrics = c("mean_bout", "TP", "Gini", "power", "hazard", "all"),
  by = c("day", "subject")
)
```

Arguments

`count.data`	data.frame of dimension n*1442 containing the 1440 minutes of activity data for all n subject days. The first two columns have to be ID and Day. ID can be either `character` or `numeric`. Day has to be `numeric` indicating the sequency of days within each subject.
`weartime`	data.frame with dimension of `count.data`. The first two columns have to be ID and Day.ID can be either `character` or `numeric`. Day has to be `numeric` indicating the sequencey of days within each subject.
`thresh`	threshold to define the two states.
`bout.length`	minimum duration of defining an active bout; defaults to 1.
`metrics`	What is the fragmentation metrics to exract. Can be "mean_bout","TP","Gini","power","hazard",or all the above metrics "all".
`by`	Determine whether fragmentation is calcualted by day or by subjects (i.e. aggregate bouts across days). by-subject is recommended to gain more power.

Details

Metrics include mean_bout (mean bout duration), TP (between states transition probability), Gini (gini index), power (alapha parameter for power law distribution) hazard (average hazard function)

Value

A dataframe with some of the following columns

`ID`	identifier of the person
`Day`	`numeric` vector indicating the sequencey of days within each subject.
`mean_r`	mean sedentary bout duration
`mean_a`	mean active bout duration
`SATP`	sedentary to active transition probability
`ASTP`	bactive to sedentary transition probability
`Gini_r`	Gini index for active bout
`Gini_a`	Gini index for sedentary bout
`h_r`	hazard function for sedentary bout
`h_a`	hazard function for active bout
`alpha_r`	power law parameter for sedentary bout
`alpha_a`	power law parameter for active bout

---

ggir.datatransform	*Transform the data and merge all accelerometer files in the GGIR output*

Description

An accelerometer file was transformed into wide data matrix, in which the rows represent available days and the columns including all timestamps for 24 hours. Further, the wide data was merged together.

Usage

```
ggir.datatransform(
  outputdir,
  subdir,
  studyname,
  numericID = FALSE,
  sortByid = "newID",
  f0 = 1,
  f1 = 1e+06,
  epochIn = 5,
  epochOut = 600,
  mergeVar = 1
)
```

Arguments

outputdir	character Directory where the GGIR output was stored.
subdir	character Sub-directory where the summary output was stored under the current directory. Defaut is "data".
studyname	character Specify the study name that used in the output file names
numericID	logical Specify if the ID is numeric when checking ID errors in part2. Default is FALSE.
sortByid	character Specify the name of "ID" for each accelerometer file in the report of part5. The value could be "newID","id" and "filename". Defaut is "filename".
f0	number File index to start with (default = 1). Index refers to the filenames sorted in increasing order.
f1	number File index to finish with. Note that file ends with the minimum of f1 and the number of files available. Default = 1000000.
epochIn	number Epoch size to which acceleration was averaged (seconds) in GGIR output. Defaut is 5 seconds.
epochOut	number Epoch size to which acceleration was averaged (seconds) in part1. Defaut is 600 seconds.

mergeVar   number Specify which of the varaible need to be processed and merged. For
                    example, mergeVar = 1 makes that the M$metalong varialbes were read from
                    R data on the directory of /meta/basic under GGIR ourput directory, which in-
                    cludes "nonwearscore","clippingscore","lightmean","lightpeak","temperaturemean"
                    and "EN". When mergeVar = 2, makes that the "enmo" and "anglez" varialbes
                    were read from csv data on the directory of /meta/csv under GGIR ourput direc-
                    tory.

Value

mergeVar = 1   Six files were written to the specified sub-directory as follows,

nonwearscore_studyname_f0_f1_Xs.xlsx
                    Data matrix of nonwearscore, where f0 and f1 are the file index to start and finish
                    with and Xs is the epoch size to which acceleration was averaged (seconds) in
                    GGIR output.

clippingscore_studyname_f0_f1_Xs.xlsx
                    Data matrix of clippingscore

lightmean_studyname_f0_f1_Xs.xlsx
                    Data matrix of lightmean

lightpeak_studyname_f0_f1_Xs.xlsx
                    Data matrix of lightpeak

temperaturemean_studyname_f0_f1_Xs.xlsx
                    Data matrix of temperaturemean

EN_studyname_f0_f1_Xs.xlsx
                    Data matrix of EN

mergeVar = 2   Two files were written to the specified sub-directory as follows,

studyname_ENMO.dataf0_f1_Xs.xlsx
                    Data matrix of ENMO, where f0 and f1 are the file index to start and finish with
                    and Xs is the epoch size to which acceleration was averaged (seconds) in GGIR
                    output.

studyname_ANGLEZ.dataf0_f1_Xs.xlsx
                    Data matrix of ANGLEZ

---

ggir.summary   *Description of all accelerometer files in the GGIR output*

Description

Description of all accelerometer files in the GGIR output and this script was executed when mode=2
in the main call.

Usage

```
ggir.summary(
  bindir = NULL,
  outputdir,
  studyname,
  numericID = FALSE,
  sortByid = "filename",
  subdir = "summary",
  part5FN = "WW_L50M125V500_T5A5",
  QChours.alpha = 16,
  filename2id = NULL,
  desiredtz = "US/Eastern",
  trace = FALSE
)
```

Arguments

bindir	character Directory where the accelerometer files are stored or list for the purpose of extracting the bin file list. Default=NULL when it is not available and therefore the bin file list is extracted from the /meta/basic folder of the GGIR output.
outputdir	character Directory where the GGIR output was stored.
studyname	character Specify the study name that used in the output file names
numericID	logical Specify if the ID is numeric when checking ID errors in part2. Default is FALSE.
sortByid	character Specify the name of "ID" for each accelerometer file in the report of part2. The value could be "newID","id" and "filename". Defaut is "filename".
subdir	character Sub-directory where the summary output was stored under the current directory. Defaut is "summary".
part5FN	character Specify which output is used in the GGIR part5 results. Defaut is "WW_L50M125V500_T5A5", which means that part5_daysummary_WW_L50M125V500_T5A5.csv and part5_personsummary_WW_L50M125V500_T5A5.csv are used in the analysis.
QChours.alpha	number Minimum required number of valid hours in day specific analysis as a quality control step in part2. Default is 16 hours.
filename2id	R function User defined function for converting filename to sample IDs. Default is NULL.
desiredtz	charcter desired timezone: see also http://en.wikipedia.org/wiki/Zone.tab. Used in g.inspectfile(). Default is "US/Eastern".
trace	logical Specify if the intermediate results is printed when the function was executed. Default is FALSE.

Value

Four files were written to the specified sub-directory

`studyname_ggir_output_summary.xlsx`

This excel file includs 9 pages as follows,

`page 1`	List of files in the GGIR output
`page 2`	Summary of files
`page 3`	List of duplicate IDs
`page 4`	ID errors
`page 5`	Number of valid days
`page 6`	Table of number of valid/missing days
`page 7`	Missing patten
`page 8`	Frequency of the missing pattern
`page 9`	Description of all accelerometer files
`page 10`	Inspects accelerometer file for key information, including: monitor brand, sample frequency and file header

`studyname_ggir_output_summary_plot.pdf`

Some plots such as the number of valid days, which were included in the part2a_studyname_postGGIR.rep file as well.

`part24daysummary.info.csv`

Intermediate results for description of each accelerometer file.

`studyname_samples_remove_temp.csv`

Create studyname_samples_remove.csv file by filling "remove" in the "duplicate" column in this template. If duplicate="remove", the accelerometer files will not be used in the data analysis of part 5-7.

IS2	*Interdaily Statbility*

Description

This function calcualte interdaily stability, a nonparametric metric of circadian rhtymicity

Usage

```
IS2(x)
```

Arguments

x	`data.frame` of dimension ndays by p, where p is the dimension of the data.

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. Statistics in Biosciences.

IS_long2   *Interdaily Statbility for the Whole Dataset*

Description

This function calcualte interdaily stability, a nonparametric metric of circadian rhtymicity. This function is a whole dataset wrapper for `IS`

Usage

```
IS_long2(count.data, window = 1, method = c("average", "sum"))
```

Arguments

`count.data`	data.frame of dimension n * (1440+2) containing the 1440 dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either `character` or `numeric`. Day has to be `numeric` indicating the sequency of days within each subject.
`window`	an `integer` indicating what is the window to bin the data before the function can be apply to the dataset. For details, see `bin_data`.
`method`	`character` of "sum" or "average", function used to bin the data

Value

A data.frame with the following 2 columns

ID	ID
IS	IS

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. Statistics in Biosciences.

IV2   *Intradaily Variability*

Description

This function calcualte intradaily variability, a nonparametric metric reprsenting fragmentation of circadian rhtymicity

Usage

```
IV2(x)
```

Arguments

x	vector of activity data

Value

IV

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. Statistics in Biosciences.

IV_long2   *Intradaily Variability for the Whole Dataset*

Description

This function calcualte intradaily variability, a nonparametric metric reprsenting fragmentation of circadian rhtymicity. This function is a whole dataset wrapper for IV.

Usage

```
IV_long2(count.data, window = 1, method = c("average", "sum"))
```

Arguments

count.data	data.frame of dimension n * (1440+2) containing the 1440 dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequency of days within each subject.
window	an integer indicating what is the window to bin the data before the function can be apply to the dataset. For details, see bin_data.
method	character of "sum" or "average", function used to bin the data

Value

A data.frame with the following 5 columns

ID	ID
Day	Day
IV	IV

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. Statistics in Biosciences.

---

jive.predict2 *Modified jive.predict function (package: r.jive)*

Description

Replace SVDmiss by SVDmiss2 in the function

Usage

```
jive.predict2(data.new, jive.output)
```

Arguments

data.new	data.new A list of two or more linked data matrices on which to estimate JIVE scores. These matrices must have the same column dimension N, which is assumed to be common.
jive.output	jive.output An object of class "jive", with row dimensions matching those for data.new.

Details

See jive.predict(package:r.jive) for details.

Value

See r.jive:: jive.predict for details

PAfun *Timne Metrics for Whole Dataset*

Description

This function is a whole dataset wrapper for `Time`

Usage

```
PAfun(count.data, weartime, PA.threshold = c(50, 100, 400))
```

Arguments

count.data	data.frame of dimension n*1442 containing the 1440 minute activity data for all n subject days. The first two columns have to be ID and Day.
weartime	data.frame with dimension of count.data. The first two columns have to be ID and Day.
PA.threshold	threshold to calculate the time in minutes of sedentary, light, moderate and vigorous activity the data.

Value

A dataframe with some of the following columns

ID	identifier of the person
Day	indicator of which day of activity it is, can be a numeric vector of sequence 1,2,... or a string of date
time	time of certain state

---

pheno.plot   *View phenotype variables*

Description

This R script will generate plot for each variable and write description to a log file.

Usage

```
pheno.plot(
  inputFN,
  outFN = paste("plot_", inputFN, ".pdf", sep = ""),
  csv = TRUE,
  sep = " ",
  start = 3,
  read = TRUE,
  logFN = NULL,
  track = TRUE
)
```

Arguments

inputFN	character Input file name or input data
outFN	character Output pdf file name for the plots
csv	logical Specify if input file is a CSV file. Default is TRUE.
sep	character Separator between columns. Default is space. If csv=TRUE, this will not be used.
start	number The location of the first phenotype variable starts in the input file.
read	logical Specify if inputFN is a file name or a data. Default is TRUE when inputFN is a file name.
logFN	character File name of the log file. Default is NULL, while logFN=paste(inputFN,".log",sep="") in the function.
track	logical Specify if the intermediate results is printed when the function was executed. Default is TRUE.

Value

Files were written to the current directory. One is .pdf file for plots and the other is .log file for variable description.

RA2 *Relative Amplitude*

Description

This function calcualte relative amplitude, a nonparametric metric reprsenting fragmentation of circadian rhtymicity

Usage

```
RA2(x, window = 1, method = c("average", "sum"))
```

Arguments

x	vector vector of activity data
window	since the caculation of M10 and L5 depends on the dimension of data, we need to include window size as an argument.
method	character of "sum" or "average", function used to bin the data

Value

RA

References

Junrui Di et al. Joint and individual representation of domains of physical activity, sleep, and circadian rhythmicity. Statistics in Biosciences.

RA_long2 *Relative Amplitude for the Whole Datset*

Description

This function calcualte relative amplitude, a nonparametric metric of circadian rhtymicity. This function is a whole dataset wrapper for RA.

Usage

```
RA_long2(count.data, window = 1, method = c("average", "sum"))
```

Arguments

count.data	data.frame of dimension n * (p+2) containing the p dimensional activity data for all n subject days. The first two columns have to be ID and Day. ID can be either character or numeric. Day has to be numeric indicating the sequency of days within each subject.
window	since the caculation of M10 and L5 depends on the dimension of data, we need to include window size as an argument. This function is a whole dataset wrapper for RA.
method	character of "sum" or "average", function used to bin the data

Value

A data.frame with the following 3 columns

ID	ID
Day	Day
RA	RA

SVDmiss2	*Modified SVDmiss function (package SpatioTemporal)*

Description

Modify ncomp = min(ncol(X),nrow(X),ncomp) for the matrix with nrow(X)<ncol(X)

Usage

```
SVDmiss2(X, niter = 200, ncomp = dim(X)[2], conv.reldiff = 0.001)
```

Arguments

X	X Data matrix, with missing values marked by 'NA'.
niter	niter Maximum number of iterations to run before exiting, 'Inf' will run until the 'conv.reldiff' criteria is met.
ncomp	ncomp Number of SVD components to use in the reconstruction (>0).
conv.reldiff	conv.reldiff Assume the iterative procedure has converged when the relative difference between two consecutive iterations is less than 'conv.reldiff'.

Details

See SVDmiss(package:SpatioTemporal) for details.

Value

See SpatioTemporal:: SVDmiss for details

Time2 *Time of A Certain activity State*

Description

Calculate the total time of being in certain state, e.g. sedentary, active, MVPA, etc.

Usage

```
Time2(x, w, thresh, smallerthan = TRUE, bout.length = 1)
```

Arguments

x	vector of activity data.
w	vector of wear flag data with same dimension as x.
thresh	threshold to binarize the data.
smallerthan	Find a state that is smaller than a threshold, or greater than or equal to.
bout.length	minimum duration of defining an active bout; defaults to 1.

Value

Time

Time_long2 *Timne Metrics for Whole Dataset*

Description

This function is a whole dataset wrapper for Time

Usage

```
Time_long2(count.data, weartime, thresh, smallerthan = TRUE, bout.length = 1)
```

Arguments

count.data	data.frame of dimension n*1442 containing the 1440 minute activity data for all n subject days. The first two columns have to be ID and Day.
weartime	data.frame with dimension of count.data. The first two columns have to be ID and Day.
thresh	threshold to binarize the data.
smallerthan	Find a state that is smaller than a threshold, or greater than or equal to.
bout.length	minimum duration of defining an active bout; defaults to 1.

Value

A dataframe with some of the following columns

ID	identifier of the person
Day	indicator of which day of activity it is, can be a numeric vector of sequence 1,2,... or a string of date
time	time of certain state

Tvol2   *Total Volumen of Activity for Whole Dataset*

Description

Calculate total volume of activity level, which includes TLAC (total log transfored activity counts), TAC (total activity counts).

Usage

```
Tvol2(count.data, weartime, logtransform = FALSE, log.multiplier = 9250)
```

Arguments

count.data	data.frame of dimension n*1442 containing the 1440 minute activity data for all n subject days. The first two columns have to be ID and Day.
weartime	data.frame with dimension of count.data. The first two columns have to be ID and Day.
logtransform	if TRUE, then calcualte TLAC. Or calculate TAC.
log.multiplier	number The coefficient used in the log transformation of the ENMO data, i.e. log(log.multiplier * ENMO + 1). Defaut is 9250.

Details

log transormation is defined as log(x+1).

Value

A dataframe with some of the following columns

ID	identifier of the person
Day	indicator of which day of activity it is, can be a numeric vector of sequence 1,2,... or a string of date
TAC	total activity count
TLAC	total log activity count

---

wear_flag   *Create Wear/Nonwear Flags*

Description

Determine during which time period, subject should wear the device. It is preferable that user provide their own wear/non wear flag which should has the same dimension as the activity data. This function provide wear/non wear flag based on time of day.

Usage

```
wear_flag(count.data, start = "05:00", end = "23:00")
```

Arguments

count.data   data.frame of dimension n*1442 containing the 1440 minute activity data for all n subject days. The first two columns have to be ID and Day.

start   start time, a string in the format of 24hr, e.g. "05:00"; defaults to "05:00".

end   end time, a string in the format of 24hr, e.g. "23:00"; defaults to "23:00"

Details

Fragmentation metrics are usually defined when subject is awake. The weartime provide time periods on which those features should be extracted. This can be also used as indication of wake/sleep.

Value

A data.frame with same dimension and column name as the count.data, with 0/1 as the elments reprensting wear, nonwear respectively.

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