Package 'tlocoh'

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Type Package

Title Constructs homeranges and explores time use patterns from location data

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Author Andy Lyons

Maintainer Andy Lyons <ajlyons@berkeley.edu>

Imports FNN,pbapply,sp,rgdal,rgeos

Suggests maptools,move,png,raster,gpclib,XML

Description Constructs homeranges and explores time use patterns from location data.

License GPL-2

URL http://tlocoh.r-forge.r-project.org

Collate
'aoi.R''aoi2box.R''auto.a.R''chop2plot.R''cube.R''cw.R''dateticks.R''empty2na.R''findonpath.R''formatdf4print.R'

R topics documented:

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aoi   *Select an area of interest on a plot using the mouse*

Description

Allows the user to select an area of interest (box) by clicking on the active plot window

Usage

```
aoi(draw.poly = TRUE, draw.poly.col = "black",
  status = TRUE)
```

Arguments

draw.poly	Whether to draw the box on the plot. T/F.
draw.poly.col	The color to use if drawing the box on the plot. Color value. Ignored if draw.poly=FALSE.
status	Show messages to the user

Value

A two-column xy data frame containing the upper left point and the lower right point in the first and second rows respectively

Note

This function requires a plot window to be open

---

aoi2box	*Converts a dataframe with upper-left / lower-right coordinates of a box to a closed polygon*

Description

Converts a dataframe with upper-left / lower-right coordinates of a box to a closed polygon

Usage

```
aoi2box(aoi)
```

Arguments

aoi	A two-column two-row data frame or matrix with x in the first column and y in the second columm. The upper left point and the lower right point in the first and second rows respectively

Value

Two column dataframe containing the xy coordinates of a closed rectangle that can be plotted using points or polygons

Note

You can use the aoi function to select two coordinates on the active plot window with the mouse. This function facilitates plotting that rectangle.

See Also

aoi

Examples

```
## Not run:
myaoi <- aoi()
polygons(myaoi)

## End(Not run)
```

---

auto.a *Parameters to select a reasonable value of 'a'*

Description

Returns a list of parameters that other functions accept for the 'a' parameter

Usage

```
auto.a(meth = "nn", ptp = 0.98, nnn = 2, tct = 1.05)
```

Arguments

meth	The name of the method for finding a (default is "nn" method for 'nearest neighbor' method.
ptp	The proportion of total points [0..1]
nnn	The number of nearest neighbors
tct	The temporal continuity thresshold, see details.

Details

If multiple values are passed for any of the parameters, the resulting data frame will have multiple rows and other parameters will be recycled as needed.

This function does not actually find nearest neighgors. Rather it returns a list of parameters that can be used as input in other functions such as lxy.nn.add.

Value

A data frame with columns meth, ptp, nnn, and tct which are the settings that other functions will use to find a value for 'a' should be automatically selected. Columns include:

- *meth* The name of the method for finding a
- *ptp* The proportion of parent points that should have at least a.nn neighbors (default 0.98)
- *nnn* The minimum number of nearest neighbors that each point will get (default 2, so each point can be part of a triangle)
- *tct* A time threshhold (expressed as a percentage of the median sampling frequency), such that if a point is temporally disconnected from its 2 nearest temporal neighbors by more than than tct times the median sampling frequency, the point will be be excluded from the computation of a. This is to avoid bias from internal time gaps (default 1.05)

See Also

lxy.nn.add

Examples

```
## Not run:
lxy <- lxy.nn.add(lxy, ptsh=0.5, a=auto.a())

## End(Not run)
```

---

chop2plot   *Divides a long string into separate lines for adding to a plot*

Description

Breaks a long character object into separate lines at specific characters

Usage

chop2plot(str, width, char.break = " ",
    char.break.keep = FALSE, cex = 1)

Arguments

str   The string to format

width   The maximum width of any single line in inches

char.break   The character where the string should be broken

char.break.keep   Whether to keep the char.break character when the string gets broken. T/F

cex   The character expansion factor that will be used to display the text

Value

A two-item character vector containing [1] the formatted character string with \n inserted and [2] number of lines

Note

This function is designed to break up a potentially long character object that is going to be added to a plot either as a title or text. Line breaks will be inserted so that the string will wrap appropriately at width inches when plotted with cex character expansion factor.

The character object will be broken at the char.break characters such that each line will be <= width when plotted. Breaks are replaced with carriage returns. If char.break.keep is TRUE, the break character will be kept, otherwise it will be removed. If no occurrence of the /codechar.break is available, the line will be chopped at the last character that fits.

---

cube   *Cubes a number*

Description

Cubes a number

Usage

cube(x)

Arguments

x   a number

Value

    x^3

| cw | *Console Wrap. Formats a string for printing to the console window* |

Description

Takes a potentially long character object and adds carriage returns and blank spaces for better appearance when printing to the terminal window

Usage

    cw(x, final.cr = TRUE, indent = 0, exdent = 0)

Arguments

x	A character object
final.cr	Whether to add a carriage return at the end. T/F.
indent	First line indent (number of blank spaces)
exdent	Subsequent line(s) indent (number of blank spaces)

Value

character object with embedded \n characters

Note

This function can prevent long messages from extending beyond the width of the R-console. Works with any function that prints to the console (e.g., cat, print, stop)

| findonpath | *findonpath* |

Description

Searches for a file on the system environment path

Usage

    findonpath(fn, status = TRUE)

Arguments

fn	The filename to search for (without a path)
status	Show messages

Value

The full path and name of the found file, or NULL if not found

Note

This will return the first found occurence of file fn, searching 1) the current working directory, 2) the user's R 'home' directory, then 3) the directories on the operating system environment 'path'

---

get.vals   *Get x and/or y values from a plot using the mouse*

Description

Get x and/or y values from a plot using the mouse

Usage

```
get.vals(axis = c("x", "y")[1], round.to = 1,
  print = TRUE)
```

Arguments

axis	Which axes to return values for, character vector
round.to	An integer number that values will be rounded to. For example if round.to=100, values will be rounded to the nearest 100.
print	Whether to print the values in the console, T/F

Details

This function allows you to get the x and/or y values by clicking on the active plot window. When you're done clicking, right-click and select 'Stop' from the pop-up menu.

Value

A vector or matrix of the x and/or y values where the mouse was clicked.

---

hist.locoh.lhs   *Plot histograms of hull metrics*

Description

Plot histograms of hull metrics

Usage

```
## S3 method for class 'locoh.lhs'
hist(x, id = NULL, k = NULL,
    r = NULL, a = NULL, s = NULL, hs.names = NULL,
    metric = "area", include.missing.hulls = TRUE,
    hmap = NULL, hmap.in.title = TRUE,
    hs.name.in.title = TRUE, title = NULL,
    title.show = TRUE, figs.per.page = NULL,
    mar = c(3, 3, if (title.show) 2.8 else 0.7, 0.5),
    mgp = c(1.8, 0.5, 0), same.axes.for.all = FALSE,
    ufat = TRUE, breaks = "Sturges", col = "gray80",
    png.dir = NULL, png.dir.make = TRUE, png.width = 800,
    png.height = png.width, png.overwrite = TRUE,
    png.pointsize = 12 + (png.width - 480)/80,
    title.two.id = FALSE,
    indicate.missing.hulls.in.axis.lbl = TRUE,
    panel.num = NULL, panel.num.inside.plot = !title.show,
    ...)
```

Arguments

x	A LoCoH-hullset object
id	The names of the individual(s) to include in the plot.
k	The k value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
r	The r value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
a	The a value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
s	The s value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
hs.names	The name(s) of saved hullsets to include in the plot
metric	The name(s) of hull metric(s); one histogram will be created for each hull metric.
hmap	A named list of hull metric auxillary parameters, the name of each list element is the name of the variable.
hmap.in.title	Include the hmap value(s) in the plot subtitle. T/F
hs.name.in.title	Include the name of the hullset in the plot subtitle. T/F
title	A title for the plot (over-writes the construction of a title)
title.show	Whether to add a title on the plot. T/F
include.missing.hulls	
	Whether to include missing hulls on the histogram (using the default value assigned to missing hulls by the hull metrics). T/F
figs.per.page	Number of plots per page
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
same.axes.for.all	Whether to use the same range on the axes for all histograms generated (helps to visually see differences)

ufat	User-friendly axis title. T/F
breaks	Number of breaks or a clustring function. See hist.
col	Color value for the bars
png.dir	The directory for a PNG file (filename will be constructed automatically).
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image. Ignored if png.fn is passed.
png.height	The height of the PNG image. Ignored if png.fn is passed.
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
title.two.id	Construct a title with the names of two ids (for so.* and to.* assocation metrics). T/F
indicate.missing.hulls.in.axis.lbl	
	Specify whether missing hulls are excluded in the axes label, T/F
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. Ignored if panel.num is NULL. T/F
png.pointsize	The pointsize (in pixels) for the PNG image (increase to make labels appear larger). Determines the height or width of a character in pixels.
...	Other parameters, including any auxillary parameters to specify particular hull metrics

Value

A named list of values of the hull metrics. There is one list element for each metric.

Note

To see the names of hull metrics, type hm.expr(). Only hull metrics which have been computed can be plotted.

---

hist.locoh.lxy	*Plot histograms of properties of a LoCoH-xy object*

Description

Displays histogram(s) of point-to-point step length, velocity, and sampling frequency for a LoCoH-xy object

Usage

```
## S3 method for class 'locoh.lxy'
hist(x, id = NULL, dt = TRUE,
    d = TRUE, delta.t = TRUE, v = TRUE,
    figs.per.page = NULL, col = "gray80",
    dt.bins.base = c("secs", "mins", "hours", "days")[4],
    dt.bins.width = 3600 * 24 * 7, delta.t.num.sd = NULL,
    d.tct = 1.2, time.unit = "auto", overlay.median = TRUE,
    breaks = 20)
```

Arguments

x	A LoCoH-xy object
id	The id value(s) to be plotted
dt	Include a histogram of the number of locations over time) (T/F)
d	Include a histogram of distance travelled per adjacent points (i.e., step length) (T/F)
delta.t	Include a histogram of the time between points (i.e., sampling frequency) (T/F)
v	Include a histogram of point velocity (distance over delta.t) (T/F)
dt.bins.base	Where to start the first bin ((for histogram of number of points over time): "secs", "mins", "hours", "days"
dt.bins.width	The width of the time bins (for histogram of number of points over time). In seconds.
figs.per.page	Number of plots per page
col	The color of the bars
d.tct	temporal connectivity thsesshold for the distance between two points to be included in the histogram of step length. In other words, detlta.t must be <= median delta.t * d.tct). Ignored if d=F.
delta.t.num.sd	Number of standard deviations for delta.t to be included in the histogram. To omit outliers from appearing in the histogram (which can make the central data more difficult to discern, set delta.t.num.sd to ~2. Ignored if delta.t=F.
time.unit	The unit of time on the x-axis (character). Ignored if delta.t=F.
overlay.median	Plot the median value on the histogram (T/F)
breaks	Argument passed to the hist function, see hist

Value

A list of frequencies with one element for each of the histograms plotted.

---

hm.expr	*Hull metrics expressions*

Description

Returns a list of expression objects that when evaluated in functions will return various hull metrics

Usage

```
hm.expr(names.only = TRUE, desc = names.only,
    print = names.only)
```

Arguments

names.only	Return only the names of hull metrics (not the expressions themselves). T/F.
desc	Include descriptions of the hull metrics in the object returned. T/F.
print	Display the list of hull metrics on the console. T/F.

Details

Hull metrics are used by many functions. This function returns a list of the expressions to 'pull out' hull metric values from the data structure of a LoCoH-hullset object and other properties of hull metrics. These objects are used by other T-LoCoH functions for plotting, exporting, creating isopleths, and other things you can do with hull metrics.

Most users will not need to use this function other than to see a list of hull metric names (which you need to know to specify a hull metric in a plotting function for example) and the hull metric descriptions.

This function does not compute any hull metrics, only provide a comprehensive list of all possible metrics. Some hull metrics are computed by default when you create a hullset (see lxy.lhs). Others metrics must be computed with a special function (e.g., lhs.ellipses.add. To see which hull metrics exist for a specific LoCoH-hullset, use summary.locoh.lhs.

Value

A named list with the following elements:

1. ufat. User-friendly axis title
2. desc. Description (used to build plot captions)
3. def. Definition. If NULL, then the definition is the same as $desc
4. ufipt. User-friendly isopleth plot title. Used when plotting isopleths constructed by sorting hulls on the metric.
5. nhv. No hull value (the value to use for parent points that have no hulls, used to highlight the presence of points without hulls in histograms
6. iso.dec. Sort hulls in descending order when used to create isopleths). T/F
7. expr Expression object that when evaulated returns the hull metric values
8. zero2na Whether 0 values should be colored as NA (i.e., hidden) when classifying hull parent points, T/F
9. discrete Whether the metric assumes discrete (integer) values, used in classifying hull parent points T/F
10. auto.jiggle The maximum value of a uniform distribution used to apply a random offset to the metric when plotted on scatterplots to better see point density
11. spao.x include the metric as a default for the x-axis when the 'auto' option is used in lhs.plot.scatter.auto
12. spao.y include the metric as a default for the y-axis when the 'auto' option is used in lhs.plot.scatter.auto
13. req.metrics The underlying metric(s) that need to be saved in the hullset for successful computation. Character vector. This will usually simply be the name of the metric itself, but may be different in the case of derived metrics such as perimeter-area ratio.
14. req.ap The name(s) of required auxillary variables that are needed to extract the metric. Character vector.
15. req.ap.def A named list of default values of any required auxillary variables
16. req.ap.subtitle A named list of expression objects (one for each hmap) that returns a string of hmap values that will be used in the subtitle of plots
17. req.ap.desc An named list of expression objects (one for each hmap) that returns a string of hmap values that will be used in the description of plots
18. fun The name of the function that creates the hull metric
19. iso.hm2 Second hull metric used to break ties when creating isopleths (used mostly when the metric returns discrete values)
20. iso.hm2.dec Sort second hull metric descending

See Also

lhs.ellipses.add, lhs.visit.add, lhs.revisit.add

---

iso2raster   *Convert isopleths to raster*

Description

Converts isopleths in a SpatialPolygonsDataFrame object to a RasterLayer

Usage

```
iso2raster(polys, raster = NULL, ext = NULL,
   dimSize = 100, cell.size = NULL, sf.cell.size = 2,
   ll.round = TRUE, status = TRUE, debug = FALSE)
```

Arguments

polys	A SpatialPolygonsDataFrame containing isopleths sorted by isopleth level (smallest to largest)
raster	A RasterStack object to be used to set the extent and resolution for the output raster.
ext	An extent object or NULL. Ignored if raster is passed.
dimSize	Numeric value used as the number of cells along the largest dimension of the data is numeric. Ignored if raster is passed.
cell.size	. Ignored if raster is passed.
sf.cell.size	. Ignored if raster is passed.
ll.round	Anchor the lower left coordinate of the raster extent to a multiple of the cell size. Ignored if raster is passed.
status	Show status messages and progress bar
debug	Show debugging info

Details

This presumes the SPDF contains isopleths ordered from lowest level to highest. The cell values of the resulting raster will sum up to the largest isopleth leve. In order for the resulting raster to sum to 1, the 100 must be part of the input.

---

lhs.anv.del   *Delete ancillary variables from a LoCoH-hullset*

Description

Delete ancillary variables from a LoCoH-hullset

Usage

```
lhs.anv.del(lhs, anv = NULL, id = NULL, k = NULL,
    r = NULL, a = NULL, s = NULL, hs.names = NULL,
    status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
anv	The name(s) of ancillary variables to remove
id	The name(s) of individuals to process
k	The k value of hullsets to process
r	The r value of hullsets to process
a	The a value of hullsets to process
s	The s value of hullsets to process
hs.names	The name(s) of hullsets to process
status	Show status messages (T/F)

Value

A LoCoH-hullset object

Note

To see which ancillary variables a hullset contains, use the summary() function.

Copying ancillary variables is optional when creating a hullset with lxy.lhs.

See Also

summary.locoh.lhs

---

lhs.dr.add   *Define directional routes*

Description

Defines 'directional routes' by identifying parent points that are 1) temporally contiguous and 2) have hulls in the top n

Usage

```
lhs.dr.add(lhs, metric = c("ecc", "par")[2],
    thresh.val = 0.95, thresh.type = c("q", "v")[1],
    smooth = 1, status = TRUE, show.elong.hist = FALSE)
```

Arguments

lhs	A LoCoH-hullset object
metric	The name of the hull metric used as a proxy for directionality
thresh.val	The threshhold above which a hull is considered part of a directional route
thresh.type	The type of threshhold used. If 'q' for quantile, then thresh.val is taken to be a percentile of the full range of the directionality metric values (i.e., 0 < thresh.val < 1). If 'v', thresh.val is taken to be an actual value of the threshhold metric.
smooth	The amount of temporal smoothing applied, expressed as the number of points on either side (temporally) of the parent point whose average of the directionality metric is used for determining if the hull constructed around the parent point should be considered a part of a directional route. For no smoothing, set smooth = 0.
status	Display status messages
show.elong.hist	Whether to display histogram(s) of the distribution of the directionality metric before and after smoothing. T/F

Value

A LoCoH-hullset object

Note

Directional routes are line segments defined by connecting temporally contiguous hull parent-points that are in the top N percent of hull elongation. Hull elongation is proxied by one of two hull metrics: perimeter:area ratio ('par') or the eccentricity of the bounding ellipse ('ecc'). Hull perimeter:area ratios are automatically computed when a hullset is created; bounding ellipses must be computed separately using lhs.ellipses.add. Once computed, you can plot directional routes by passing dr=TRUE to plot.locoh.lhs.

---

lhs.ellipses.add   *Compute hull bounding ellipses*

Description

Creates bounding ellipses around each hull and computes the eccentricity as a metric of ellongation

Usage

```
lhs.ellipses.add(lhs, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL, status = TRUE,
  beep = FALSE, save.ellipses = TRUE,
  existing.ellipses = c("overwrite", "abort")[1])
```

Arguments

lhs	A LoCoH-hullset object
save.ellipses	Save ellipses in the lhs object? (T/F). If False, only the eccentricity values of the ellipses are saved as a hull metric.
existing.ellipses	Whether to overwrite or abort if existing ellipses are saved
id	The name(s) of individuals to analyze
k	The k value of hullsets to analyze
r	The r value of hullsets to analyze
a	The a value of hullsets to analyze
s	The s value of hullsets to analyze
hs.names	The name(s) of saved hullsets to analyze
status	Show status messages (T/F)
beep	Beep when done (T/F)

Value

A LoCoH-hullset object

Note

Saving the ellipses is optional. If ellipses are not saved, the eccentricity values will still be computed and saved as a hull metric. The only real reason to save ellipses is if you wish to plot them.

Note creating ellipses is computationally intensive and can take a long time.

---

lhs.exp.csv   *Export a LoCoH-hullset to csv*

Description

Export hull metrics to a csv file / data frame

Usage

```
lhs.exp.csv(lhs, id = NULL, k = NULL, r = NULL, a = NULL,
    s = NULL, hs.names = NULL, csv.save = TRUE, dir = ".",
    csv.fn.pre = NULL,
    csv.fn.mid = c("none", "short", "long")[2], hm = "all",
    anv = NULL, hsp = NULL, status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of individuals to export
k	The k value of hullsets to export
r	The r value of hullsets to export
a	The a value of hullsets to export
s	The s value of hullsets to export
hs.names	The name(s) of saved hullsets to analyze
csv.save	Whether to create csv file(s). If FALSE, a list of data frames will still be returned. T/F
dir	The directory where the csv file(s) will be saved
csv.fn.pre	A prefix for the csv file name(s)
csv.fn.mid	Style of the filename mid-section: none, short, or long
hm	The name of hull metric(s) that will be exported. Character vector or comma separated string.
anv	The name(s) of ancillary variables(s) of the parent point of each hull to be exported. Default is NULL, can also be set to 'all'. Character vector or comma separated string.
hsp	A list containing one hull scatterplot object with regions saved (i.e., object returned by lhs.plot.scatter), or the index of a hull scatter plot saved in the hullset (see lhs.hsp.add). If passed, a column for the region number will be included in the attribute table. Applicable only to hulls and hull parent points.
status	Show messages. T/F

Value

List (one list element for each hullset) of data frames of hull metrics and possibly ancillary variables

Note

This function exports hull metrics only. If you want to export the coordinates of the hulls themselves for further analysis in a GIS, see /link{lhs.exp.shp}.

If file is left blank, no csv file will be written to disk but the function will still return a list of data frames (one for each hullset)

If you have created a scatterplot legend with manually defined regions (see tutorial for details), the region number of each hull parent point can be included in the csv file if you pass the hullscatter plot as parameter hsp.

See Also

[lhs.exp.shp](lhs.exp.shp)

---

lhs.exp.mov   *Create a Quicktime animation from a LoCoH-hullset object*

Description

Create a Quicktime animation from a LoCoH-hullset object

Usage

```
lhs.exp.mov(lhs, id = NULL, k = NULL, r = NULL, a = NULL,
  s = NULL, hs.names = NULL, all.ids.at.once = TRUE,
  all.ids.col.unique = all.ids.at.once,
  all.ids.col = NULL,
 all.ids.legend = c("bottomright", "bottom", "bottomleft", "left", "topleft", "top", "topright", "right", "center
  all.ids.legend.cex = 0.8, dt.start = NULL,
  dt.end = NULL,
  frame.method = c("auto", "time", "location")[1],
  frame.rtd = "auto", rtd.center = TRUE,
  clean.multihull.frames = 4, xlim = NULL, ylim = NULL,
  dt.label = TRUE, dt.label.col = "black",
  dt.label.col.bg = NA, dt.label.x = NULL,
  dt.label.y = NULL, title = NULL, title.show = TRUE,
  axes.show = TRUE, axes.ticks = axes.show,
  axes.titles = FALSE,
 mar.map = c(0.7 + (if (axes.ticks) 0.9 else 0) + (if (axes.titles) 1.3 else 0), 0.5 + (if (axes.ticks) 0.9 else 0) + (if (
  mgp.map = c(0.4 + if (axes.ticks) 1.2 else 0, 0.4, 0),
  col.hull.active = "red", col.hull.alpha = 255,
  tz.local = NULL, tz.local.check = TRUE,
  col.by.hour.of.day = FALSE,
  col.hod = colorRampPalette(colors()[c(24, 30, 553, 121, 26, 121, 553, 30, 24)])(24),
  width = if (screen.test) 7 else 608, height = NULL,
  max.frames = NULL,
  png.pointsize = 16 + (width - 480)/80,
  screen.test = FALSE, tmp.dir = NULL,
  tmp.files.delete = TRUE, prompt.continue = TRUE,
  fn.mov = NULL, fn.mov.dir = getwd(),
  fn.mov.exists = c("auto.increment", "overwrite", "stop", "ask")[1],
```

```
duration = NULL, fps = NULL, skip = NULL,
ffmpeg = "ffmpeg.exe", create.mov = TRUE,
info.only = TRUE, shp.csv = NULL, layers = NULL,
tiff.fn = NULL, tiff.pct = FALSE,
tiff.bands = c(4, 3, 2), tiff.buff = 500,
tiff.fill.plot = TRUE, bg2png = !is.null(layers),
crop.layers.to.extent = TRUE, date.bar = 0.85,
date.bar.bins = 12, col.db = "darkblue",
cex.axis.db = 0.7, beep = FALSE, report.time = TRUE,
status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	The id value(s) to be on the plot
k	The k value of hullsets to export
r	The r value of hullsets to export
a	The a value of hullsets to export
s	The s value of hullsets to export
hs.names	The name(s) of saved hullsets to export
all.ids.at.once	Display all the individual ids simultaneously. If False, an animation will be created for each id. T/F.
all.ids.col.unique	
	Whether to use unique colors for each individual when plotting multiple individuals simultaneously, T/F
all.ids.col	A named list of color values; the element names must match the name(s) of the ids
all.ids.legend	Where to place a legend showing the color of each id (for an animation showing the movement of multiple individuals simultaneously): 'bottomright', 'bottom', 'bottomleft', 'left', 'topleft', 'top', 'topright', 'right', or 'center'. May also be NULL, in which case the legend will not be displayed. Ignored if ids.legend.bln=FALSE or all.ids.col.unique = FALSE.
all.ids.legend.cex	
	The character expansion factor for the id legend. See parameter all.ids.legend above.
dt.start	The starting date-time. An object of class POSIXt or one that can be coerced to POSIXt. If NULL, the earliest date-time in the series will be used.
dt.end	The ending date-time. An object of class POSIXt or one that can be coerced to POSIXt. If NULL, the last date-time in the series will be used.
frame.method	How each frame should be defined temporally, "time" - each frame represents a fixed amount of time, "location" each frame is a point in the series
frame.rtd	The real-time duration of each frame (in seconds). If "auto" (default), the lowest median sampling frequency will be used
xlim	A two-element numeric vector for the range of the x-axis (in map units)
ylim	A two-element numeric vector for the range of the y-axis (in map units)
dt.label	Add a label for the date of the frame
dt.label.col	A color value/name for the date label (ignored if dt.label=FALSE)

dt.label.x	The x-coordinate for the date label (ignored if dt.label=FALSE)
dt.label.y	The y-coordinate for the date label (ignored if dt.label=FALSE)
dt.label.col.bg	The background color for the date label (NA for transparent background, ignored if dt.label=FALSE)
title	A title for the map
title.show	Whether to show the title. T/F.
axes.show	Whether to show the axes (ticks, labels and titles). Can be over-written by axes.ticks and axes.titles. T/F.
axes.ticks	Whether to show the tick marks and labels on the axes. T/F.
axes.titles	Whether to show axes titles. T/F.
mar.map	Margin settings for the map, see par
mgp.map	Locations of the axes elements for the map, see par
tz.local	The name of the time zone of the study area
tz.local.check	Check whether tz.local is a valid timezone name (not implemented) T/F.
col.by.hour.of.day	
	Whether to color the active point by the hour of day (i.e., dark colors at night, orange for day time locations). T/F
col.hod	A vector of 24 color values used to symbolize the color of the active point by the hour of day. Ignored if col.by.hour.of.day = FALSE.
rtd.center	Whether to center the start and end time of the first frame around the time stamp of the first location, to help ensure that each frame has only one hull in it. T/F.
clean.multihull.frames	
	A numeric value that determines whether and how much a hull can be time shifted to avoid having two active hulls in the same frame. Pass 0 to disable cleaning multi-hull frames. See details.
col.hull.active	The color of the active hull
col.hull.alpha	A number 0..255 for the alpha value for the hull color (semi-transparency); 0=completely transparent, 255=opaque
width	The width of each frame in pixels (if screen.test=FALSE) or inches (if screen.test=TRUE).
height	The height of each frame in pixels (if screen.test=FALSE) or inches (if screen.test=TRUE).
max.frames	The maximum number of frames to produce.
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
screen.test	Create up to three sample frame(s) on the screen (instead of PNG files)
tmp.dir	A directory where temporary PNG files for each frame will be created, character.
tmp.files.delete	Delete the temporary PNG files when done, T/F
prompt.continue	Whether to present a summary of the encoding settings and get user confirmation before continuing, T/F
fn.mov	The path and filename of output Quicktime *.mov file. If NULL a filename will be automatically generated
fn.mov.dir	The directory where the animation will be saved (ignored if a value for fn.mov is passed)
fn.mov.exists	What to do if the animation file already exists: "auto.increment", "overwrite", "stop", or "ask".

`duration`	The desired duration of the animation (in seconds)
`fps`	A numeric value for frames per second
`skip`	Output every nth frame. To include every frame set skip=1. Integer.
`ffmpeg`	The name of the ffmpeg file. See notes.
`create.mov`	Whether to actually create the mov file. Set to FALSE preview a few frames without actually encoding them.
`info.only`	Only return info
`shp.csv`	The path and filename of a csv file that contains information about shapefiles, including layer names, file, and symbology.
`layers`	The name(s) of layers in shp.csv to display in the background. Will be displayed using the symbology in shp.csv. Character vector or comma delimited string.
`bg2png`	Save the plot background elements as a static raster image (to improve speed), ignored if screen.test=TRUE
`crop.layers.to.extent`	
	Whether to crop the shapefile layers to the view extent (may speed up drawing time)
`date.bar`	The height of the lower section of the plot to devote to the time bar, in inches. To hide the time bar completely, set date.bar=0.
`date.bar.bins`	The target number of bins (tick marks + 1) on the time bar (integer)
`col.db`	A single color value for the date bar axes / tick labels, character
`cex.axis.db`	Character expansion factor for the labels on the date bar axis.
`beep`	Beep when one, T/F
`report.time`	Show the time taken when done, T/F
`status`	Show progress bar and status messages
`tiff.fn`	The path and name of a GeoTIFF file (e.g., satellite image) that will be displayed in the background. See notes.
`tiff.pct`	Whether or to convert the GeoTIFF to an indexed 256 color RGB image, which may speed up drawing. T/F.
`tiff.bands`	A vector of threee integers corresponding to the bands of the GeoTIFF image that will be mapped to the red, green and blue color guns respectively.
`tiff.buff`	A numeric buffer distance that the range of the plot will be expanded so the points are not right on the edge of the GeoTIFF.
`tiff.fill.plot`	Whether to fill the entire plot area with the GeoTIFF. T/F.

Value

A list with information about each *.mov file created. Each element of the list is another list with two elements: fn (the full filename) and dim (a two-element numeric vector with the frame width and height). If no *.mov file(s) were created, returns NULL.

Note

To create the animation, two and only two of the following parameters must be passed: duration, fps, and skip. The third parameter will be computed. To include every frame, pass fps, set skip=1, and leave duration out.

Larger values for fps will result in the animation running 'faster'. Values between 10 and 20 often work well; beyond 30 fps the eye can't keep up with the motion Note if you pass values for fps and

duration, an appropriate value for skip will be computed but the final duration of the animation may not be exactly equal to duration because only interger values of skip are allowed.

One will normally want to run the function a few times without actually encoding to tweak the frame layout (e.g., where the date label and legend appear). To see what a frame in the output will *approximately* look like, set screen.test=TRUE. Once the screen sample looks good, next set max.frames=3, tmp.dir="." (or another folder), create.mov=FALSE, and tmp.files.delete=FALSE. This will generate a few sample frames in PNG files and not delete them so you can inspect them. Once these look good, create the full animation by setting create.mov=TRUE.

If frame.method is 'auto', the script will use time-based frames when multiple individuals are being animated simultaneously, and location-based frames otherwise.

duration (the duration of the animation in seconds) should not be confused with frame.rtd which is the real-time duration of a single frame in seconds (e.g., frame.rtd=3600 means each frame will represent 1 hour).

Passing a positive value for clean.multihull.frames (default value is 4) enables time-shifting hulls if needed to prevent two hulls appearing in one frame and no hulls in the previous or next frame (which produces jerky playback when animated). The maximum amount of time a hull can be shifted is calculated by frame.rtd / clean.multihull.frames. Thus for example if frame.rtd=7200 (two hours), and clean.multihull.frames=4, then if a frame has two hulls appearing in it and the parent point of one of those hulls lies within 30 minutes (2 hours / 4) of the beginning or end of the frame, *and* there is no hull in the adjacent frame, that hull will be moved to the earlier / later frame. To disable this effect, set clean.multihull.frames = 0.

If date.bar is too small or too large, you might get a 'margins too large' error. Try values around 1, or hide the date bar completely by setting date.bar=0.

The output animation is encoded in QuickTime format. The Quicktime file is encoded using the 'animation' codec, a lossless format that 'scrubs' well (i.e., you can drag the scroll bar to view frame by frame). This requires installing the open source encoding program ffmpeg. ffmpeg is a command line program that Linux and Windows users can download from http://ffmpeg.org/download.html. Windows users should save the ffmpeg.exe file to the working directory or a directory on the path environment variable (e.g., c:\windows). Mac users can download ffmpegX from http://ffmpegx.com/download.html but this has not been tested (pass name to ffmpeg).

If ffmpeg is not available, you can still use this function to generate the individual frames and then use another utility (e.g., ImageMagick, Quicktime Pro) to combine the frames into a video file. For best results use a 'lossless' compression method in the encoding program. To create the individual frames only, set tmp.dir="." (the working directory) and tmp.files.delete=FALSE.

If fn.mov.exists = "auto.increment", a two-digit number will be appended to the *.mov filename to avoid overwriting an existing file

---

lhs.exp.shp   *Export a LoCoH-hullset to shapefile*

Description

Export hulls, hull parent points, and/or isopleths from a locoh-hullset object to ESRI's shapefile format

Usage

```
lhs.exp.shp(lhs, id = NULL, k = NULL, r = NULL, a = NULL,
    s = NULL, hs.names = NULL, hpp = FALSE, hulls = FALSE,
    iso = FALSE, nn = FALSE, ellipses = FALSE,
    allpts = FALSE, iso.idx = NULL, iso.metric = NULL,
    dir = ".", file.base = "", file.base.auto = TRUE,
    avl.file = NULL, status = TRUE, show.time = TRUE,
    hm = "all", anv = NULL, hsp = NULL, metadata = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of individuals to export
k	The k value of hullsets to export
r	The r value of hullsets to export
a	The a value of hullsets to export
s	The s value of hullsets to export
hs.names	The name(s) of saved hullsets to export
hulls	Export hulls (as a polygon shapefile). T/F
hpp	Export hull parent points (as a point shapefile). T/F
iso	Export isopleths (as a polygon shapefile). T/F
iso.metric	Hull sort metric(s) for the isopleths that will be exported (acts a filter). Character vector.
iso.idx	Numeric vector of the indices of the isopleths that will be exported (acts a filter)
ellipses	Export ellipses (as a polygon shapefile). T/F
allpts	Export all points (as a point shapefile). T/F
nn	Export nearest neighbors (as a multipoint shapefile). T/F
dir	The directory where the shapefiles will be placed (use "." for the working directory, and "~" for the user directory)
file.base	The base of the file name without any extension (the script will append to this)
file.base.auto	Whether to automatically generate the file name base from the id, s-value, and k-a-r value. Ignored if file.base is passed. T/F
avl.file	The name of an existing avl (ArcView legend) file
status	Show messages. T/F
show.time	Report time for script to complete. T/F
hm	The name of hull metric(s) that will be included in the attribute table. Default is 'all'. Applicable only to hulls and hull parent points. Character vector or comma separated string.
anv	The name of ancillary variables(s) of the parent point that will be included in the attribute table. Default is NULL. Applicable only to hulls and hull parent points. Character vector or comma separated string.
hsp	A list containing one hull scatterplot object with regions saved (i.e., object returned by lhs.plot.scatter), or the index of a hull scatter plot saved in the hullset (see lhs.hsp.add). If passed, a column for the region number will be included in the attribute table. Applicable only to hulls and hull parent points.
metadata	Export field descriptions in a meta data file (not yet supported)

Note

Filenames are automatically generated, but the user can specify the directory. Constructed filenames will consist of the file.base (if provided) followed by the name of the hullset and a suffix indicating the type of feature saved (e.g., '.hulls', '.pts', ".iso", etc.). If a shapefile already exists with this, a unique filename will be constructed using two-digit numeric extension

Most of the time, exporting hull parent points (hpp=T) is the same as exporting all points (allpts=T), however in some cases not all points have enough neighbors to make a hull so they wouldn't be included in exported of hull parent points. Only hull parent points will have the corresponding hull metrics included in the attribute table.

avl.file is an ArcView 3.x file that contains symbology info. If a value is passed, the script will make a copy of prj.file with the same base name as the shapefile, so that symbology will automatically created in ArcMap. avl.file is presumed to be relative to the working folder

See Also

lhs.exp.csv

---

lhs.filter.anv   *Define subsets of hulls based on an ancillary variable*

Description

Define subsets of hulls based on an ancillary variable

Usage

```
lhs.filter.anv(lhs, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL, anv.var = NULL,
  anv.val = NULL, label = NULL, col = NULL,
  status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of the individual(s) to include. Character vector or comma-delimited character.
k	The k value of hullsets to include
r	The r value of hullsets to include
a	The a value of hullsets to include
s	The s value of hullsets to include
hs.names	The name(s) of saved hullsets to include
anv.var	The name of a single ancillary variable in the LoCoH-hullset object
anv.val	The value(s) of the ancillary variable that define each group
label	Character vector for the labels for each subset. If omitted the value of the ancillary variable will be used
col	Vector of color values (one per group). If omitted colors drawn from a rainbow pallete will be used
status	Show status messages. T/F

Details

This will return a list that defines subsets of hulls based on the hull parent point's value of an ancillary variable. This can be passed to several functions, including plot.locoh.lhs (future), and lhs.plot.scatter, to create plots of subsets of hulls.

anv.val is a vector of values of anv.var that will be used to define the group(s). For a hull to be included in a group, its value of anv.var must equal one of the values in anv.val. If anv.val is omitted, one group will be created for each unique value of anv.var. Defining groups based on a range of values (lower and upper limits) is not yet supported, but you could create a new ancillary variable that classifies ranges of values into discrete groups.

Note that this function can only return subsets for *one* hullset. This means that either lhs must contain a single hullset, or other parameters (e.g., id, hs.names, k, r, and/or a) are passed to select one and only one of the hullsets in lhs.

Value

A list that defines subsets of hulls, with one element for each region in hsp. Each element is a list with three elements:

idx indices of the hull parent points

label the label for the subset

col the color

---

lhs.filter.hsp | *Define subsets of hulls based on the location of the parent point in hull scatterplot space*

Description

Define subsets of hulls based on the location of the parent point in hull scatterplot space

Usage

```
lhs.filter.hsp(lhs, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL, hsp = NULL,
  reg.idx = NULL, label = NULL, col = NULL)
```

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of the individual(s) to include in the plot. Character vector or comma-delimited character.
k	The k value of hullsets to create isopleths for
r	The r value of hullsets to create isopleths for
a	The a value of hullsets to create isopleths for
s	The s value of hullsets to create isopleths for
hs.names	The name(s) of saved hullsets to create isopleths for

hsp   Either the index of a hull scatterplot(s) saved in lhs (use summary.locoh.lhs
                to which how many hsp objects have been saved), or a list of objects of class
                locoh.hsp (i.e., the return value of lhs.plot.scatter.

reg.idx   A numeric vector of the indices of the regions in hsp to include in the filter

label   Character vector of the labels to use for each subset. If not passed, the saved
                label values in hsp will be used

col   Vector of color values (one per region). If omitted the colors saved in hsp will
                be used

Details

This will return a list that defines subsets of hulls grouped according to which manually-digitized
region in scatterplot space the hull parent point falls. This can be passed to several functions,
including plot.locoh.lhs (future), and lhs.plot.scatter, to create plots of subsets of hulls.

The scatterplot space, including the manually defined regions, are saved in a locoh.hsp object.
Typically hsp will be created using the lhs.plot.scatter function. hsp objects can also be saved in
the lhs object (see lhs.hsp.add.

Note that this function can only return subsets for *one* hullset and *one* hsp object. This means
that either lhs must contain a single hullset, or other parameters (e.g., id, hs.names, k, r, and/or a)
are passed to select one and only one of the hullsets in lhs.

Value

A list that defines subsets of hulls, with one element for each region in hsp. Each element is a list
with three elements:

idx indices of the hull parent points

label the label of the region of hsp

col the color of the region in hsp

---

lhs.hsp.add   *Adds a hull scatterplot to a LoCoH-hullset object*

Description

Adds a hull scatterplot to a LoCoH-hullset object

Usage

```
lhs.hsp.add(lhs, hsp.lst)
```

Arguments

lhs   A LoCoH-hullset object
hsp.lst   A list of object(s) of class locoh.hsp

Note

hsp objects are typically created with lhs.plot.scatter function. They can then be 'saved' in a
LoCoH-hullset object with this function.

Examples

```
## Display a scatter plot and manually draw four regions on it
## hsp <- lhs.plot.scatter(lhs, x="area", y="par", regions=4)

## Save hull scatter plot as part of the hullset
## lhs <- lhs.hsp.add(lhs, hsp.lst=hsp)
## summary(lhs)
```

---

lhs.hsp.del   *Delete a hull scatterplot from a LoCoH-hullset object*

Description

Deletes a saved hull scatterplot from a LoCoH-hullset object

Usage

```
lhs.hsp.del(lhs, hsp.idx = "all", status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
hsp.idx	The index(s) of the hullsets to delete. A numeric vector or 'all'
status	Show messages, T/F

Value

A LoCoH-hullset object

Note

Use the summary() command to see the indices of saved hull scatterplots

---

lhs.iso.add   *Compute isopleths*

Description

Adds isopleth(s) to a LoCoH-hullset object

Usage

```
lhs.iso.add(lhs, id = NULL, k = NULL, r = NULL, a = NULL,
  s = NULL, hs.names = NULL,
  sort.metric = c("auto", hm.expr(names.only = T, desc = F, print = F))[1],
  iso.levels = c(0.1, 0.25, 0.5, 0.75, 0.95),
  iso.method = c("pt.quantiles", "hm.vals")[1],
  iso.cap.method = c(">=", "<=")[1],
  scale.iso.levels.to.hm.vals = (iso.method == "hm.vals" && max(iso.levels <= 1)),
  subset.metric = NULL, subset.vals = NULL,
  allow.gpc = TRUE, beep = FALSE, status = TRUE, ...)
```

Arguments

lhs	A LoCoH-hullset object
id	The id(s) of the hullsets to create isopleths for
k	The k value of hullsets to create isopleths for
r	The r value of hullsets to create isopleths for
a	The a value of hullsets to create isopleths for
s	The s value of hullsets to create isopleths for
hs.names	The name(s) of saved hullsets to create isopleths for
sort.metric	The name of a hull metric that will be used to sort the hulls prior to merging into isopleths
iso.method	The method used to define isopleths. Default is "pt.quantiles" which defines isopleths as containing a quantile of points (e.g., the 0.1th isopleth contains 10% of the points). Can also be "hm.vals", in which case the isopleth level represents not a proportion of points enclosed but a value of the hull metric (e.g., the 0.1 isopleth contains hulls whose hull metric is <= 0.1)
iso.levels	A numeric vector of the levels of the isopleths. See details.
iso.cap.method	A character object specifying how isopleths defined by proportions of enclosed points will be 'capped'. Ignored when iso.method="hm.vals". See details.
scale.iso.levels.to.hm.vals	
	Whether to linearly scale iso.levels (presumed to be 0..1) to the minimum and maximum of the sort.metric value. This is used in conjunction iso.method='hm.vals', to produce isopleths as the aggregation of hulls whose sort.metric value is >= i% of the maximum, where i is the isopleth level. T/F
subset.metric	The name of a hull metric that will be used to create subsets of isopleths
subset.vals	A two-column data frame (or matrix) containing the lower and upper bounds of the hull metric in subset.metric, from which subsets of hulls will be extract for separate isopleth construction. Ignored if subset.metric is not provided. Can also be a character string in the form of "equal intervals, n", or "quantitles, n" where n is the number of strata desired (shorthand versions of these commands are "ei,n" and "q,n" where n is a number). The script will compute the break points either spread equally between the minimum and maximum subset metric value (equal interval) or so an equal number of hulls is in each strata
allow.gpc	Allow functions from the gpclib package if the functions from rgeos fail. See details. T/F
beep	Beep when done. T/F
status	Show status messages. T/F
...	Additional auxillary parameters for the hull sort metric

Details

This function creates isopleth(s) for a LoCoH-hullset object. This involves sorting hulls by one of the hull metrics, and then cummulative unioning them together until you reach a certain level at which point the union is saved as an isopleth. By default, hulls will be sorted according to the area (for k-method) or number of enclosed points (r- and a-methods), producing density isopleths (i.e., utilization distributions).

When iso.method=="pt.quantiles" (the default), isopleths will be defined by the proportion of points they enclose (given in iso.levels). Thus for example the 50 points. The default isopleth levels

are 0.15, 0.25, ..., 0.95. To get an isopleth that encloses all points in the dataset, iso.levels must include '1'.

When iso.method=="hm.vals", isopleths will be defined by the value of the hull metrics (provided in iso.levels). So if for example sort.metric="scg.nn.mean" (average speed of all points identified as nearest neighbors), and scg.nn.mean varied from 0.01 to 3.2, the 0.6 isopleth would be the union of all hulls whose average nearest neighbor speed was 0.6 or less. If you would like hulls to be identified by hull metric values, but don't know the range of hull metric values, you can set isopleth levels between 0..1 and set scale.iso.levels.to.hm.vals=TRUE.

By default, isopleths defined by quantiles of enclosed points are 'capped' as the smallest number of progressively unioned hulls that enclose a number of points equal to or greater than the isopleth level. For example, if there are 1000 points in the dataset, the 50 isopleth would be the smallest union of hulls that encloses 500 or more points. Alternately, when iso.cap.method = "<-", the isopleth will be the largest number of hulls which enclose up to but not more than the isopleth level. The actual number of points enclosed by each isopleth is included in the data table for the isopleth (which you can view by setting iso.details=TRUE when calling summary.locoh.lhs).

The hull metric used for sorting must already have been computed. Several hull metrics (e.g., hull area, number of enclosed points) are 'automatically' computed when a hullset is initially generated (see lxy.lhs). Other hull metrics must be created separately with functions such as lhs.ellipses.add and lhs.visit.add. You can use the summary.locoh.lhs function to see which isopleths have been saved in a LoCoH-hullset object.

Hulls are unioned using the gUnion and gUnaryUnion functions from the rgeos package, which in general is very fast. These functions occasionally fail when lines are too close together or there are other topological conditions. This is not a problem with the data, but an inherent limitation of the algorithms / processing. If allow.gpc=TRUE, functions from the gpclib package will be used as backup.

Value

A LoCoH-hullset object

Examples

```
# Create 0.5 and 0.95 isopleths. By not specifying the sort.metric, density isopleths will be created
# by default, with hulls sorted by area (k-method) or number of enclosed points (r and a method)
# lhs <- lhs.iso.add(lhs, iso.levels=c(0.5, 0.95))

# Compute hull metrics for a 24 hour inter-visit gap, then produce isopleths with hulls sorted by
# the number of separate visits (e.g., visitation)
# lhs <- lhs.visit.add(lhs, ivg=3600.24)
# lhs <- lhs.iso.add(lhs, sort.metric="nsv", ivg=3600*24)
```

---

lhs.iso.del   *Delete an isopleth*

Description

Delete isopleth(s) from a LoCoH-hullset object

Usage

```
lhs.iso.del(lhs, iso.idx = "all")
```

Arguments

lhs	A LoCoH-hullset object
iso.idx	The index(s) of isopleths to delete (numeric vector or 'all')

Value

A LoCoH-hullset object

Note

To see the indices of isopleths, run summary.locoh.lhs

---

lhs.iso.rast   *Convert isopleths to rasters*

Description

Adds rasterized version of isopleth(s) to a LoCoH-hullset object

Usage

```
lhs.iso.rast(lhs, id = NULL, k = NULL, r = NULL,
    a = NULL, s = NULL, hs.names = NULL,
    sort.metric = NULL, iso.method = "pt.quantiles",
    raster = NULL, dimSize = 100, cell.size = NULL,
    sf.cell.size = 2, ll.round = TRUE, status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	The id(s) of the hullsets to create isopleths for
k	The k value of hullsets to create isopleths for
r	The r value of hullsets to create isopleths for
a	The a value of hullsets to create isopleths for
s	The s value of hullsets to create isopleths for
hs.names	The name(s) of saved hullsets to create isopleths for
sort.metric	The name(s) of hull metric(s) used to form isopleths that rasters should be created for
iso.method	The method(s) used to define isopleths that will be converted to raster
raster	A RasterLayer object that will be used to set the extent and cell size of the rasterized isopleth
dimSize	The number of cells along the largest dimension of the track. The according raster will be calculated internally. Default is 100. Ignored if raster is passed.
cell.size	The size of each square cell in map units. Ignored if raster is passed.
sf.cell.size	The number of significant figures to use if the cell size has be computed based on dimSize. Default=2. Ignored if raster is passed.
ll.round	Whether to round the lower left coordinate to the lowest multiple of cell.size. Ignored if raster is passed. (T/F)
status	Show status messages. T/F

Details

This will take exising isopleths and create raster versions of them.

Value

A LoCoH-hullset object

See Also

lhs.iso.add

Examples

```
## Not run:
lhs <- lhs.iso.add(lhs)
lhs <- lhs.iso.rast(lhs)

## End(Not run)
```

---

lhs.merge   *Merge LoCoH-hullsets*

Description

Merge LoCoH-hullsets

Usage

```
lhs.merge(..., check.class = TRUE)
```

Arguments

...	Two or more LoCoH-hullset objects
check.class	Whether to enforce that all objects merged belong to class locoh.lhs (T/F)

Value

A LoCoH-hullset object

Note

Hullsets in different objects can be merged together, but the hullsets themselves remain separate. If duplicate hullsets are detected (e.g., same id, same mode, same parameter value), an error message will appear.

`lhs.pep.add`	*Add hull metrics for proportion of enclosed points by each hull for an ancillary variable*

Description

Computes proportion of enclosed points of a second set of points

Usage

```
lhs.pep.add(lhs, pep.var, pep.val = NULL, npep = TRUE,
   status = TRUE)
```

Arguments

`lhs`	A LoCoH-hullset object
`pep.var`	Name(s) of ancillary variable(s) saved with the LoCoH-hullset.
`pep.val`	Vector of value(s) for which the percentage of enclosed points will be calculated. If NULL, all unique values of pep.var will be used.
`npep`	Whether to compute the normalized proportion of enclosed points hull metric (normalized by the proportion of points in the entire dataset), T/F
`status`	Show messages, T/F

Value

A LoCoH-hullset object

Note

Normally `pep.var` should be a factor or character vector. To see which ancillary variables are saved in a LoCoH-hullset use summary.locoh.lhs

---

`lhs.plot.isoarea`	*Plot the area of isopleths as a function of the k/a/r parameter*

Description

Creates a plot of the area of isopleths in a LoCoH-hullset area

Usage

```
lhs.plot.isoarea(lhs, id = NULL, k = NULL, r = NULL,
   a = NULL, s = NULL, hs.names = NULL,
   sort.metric = NULL, iso.idx = NULL, figs.per.page = 1,
   legend = TRUE, title = NULL, title.show = TRUE,
   subtitle = TRUE,
   mar = c(3.3, 3.2, if (title.show) (if (subtitle) 3.2 else 2.3) else 0.5, 0.5),
   mgp = c(2, 0.7, 0), png.fn = NULL, png.dir = NULL,
   png.dir.make = TRUE, png.width = 800,
```

```
png.height = png.width,
png.pointsize = 12 + (png.width - 480)/80,
png.fn.pre = NULL, png.fn.suf = NULL,
png.overwrite = TRUE, panel.num = NULL,
panel.num.inside.plot = !title.show, bg = "white",
legend.space = if (legend) 0.05 else 0, ...)
```

Arguments

lhs	A LoCoH-hullset object
id	The id(s) of the individual(s) to include in the plot
k	A k-value for the number of nearest neighbors around each point to include in the plot
r	A r-value for the number of nearest neighbors around each point to include in the plot
a	A a-value for the number of nearest neighbors around each point to include in the plot
s	The s value(s) of nearest neighbor sets to include in the plot. If NULL, all values will be used
hs.names	The name(s) of saved hullsets to analyze
sort.metric	The name(s) of isopleth sort metrics to include in the plot
iso.idx	The indices of isopleths to include in the plot
figs.per.page	Number of plots per page
legend	Whether to include a legend. T/F.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
subtitle	Whether to add a subtitle to the automatically constructed title (when title=NULL, otherwise ignored)
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
png.fn	A filename for a PNG file
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
png.fn.pre	A prefix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.fn.suf	A suffix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F.

panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. Ignored if panel.num is NULL. T/F
bg	Background color
legend.space	The amount of additional space on the lower end of the x-axis to make room for the legend. Expressed as a proportion of the range of the x-axis values
...	Additional parameters that will be passed to the plot function

---

lhs.plot.isoear	*Plot the isopleth edge:area ratio as a function of k/a/r*

Description

Creates a plot of the ratio of edge to area for isopleths

Usage

```
lhs.plot.isoear(lhs, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL,
  sort.metric = NULL, iso.idx = NULL, figs.per.page = 1,
  legend = TRUE, title = NULL, title.show = TRUE,
  subtitle = TRUE,
  mar = c(3.3, 3.2, if (title.show) (if (subtitle) 3.2 else 2.3) else 0.5, 0.5),
  mgp = c(2, 0.7, 0), png.fn = NULL, png.dir = NULL,
  png.dir.make = TRUE, png.width = 800,
  png.height = png.width,
  png.pointsize = 12 + (png.width - 480)/80,
  png.fn.pre = NULL, png.fn.suf = NULL,
  png.overwrite = TRUE, panel.num = NULL,
  panel.num.inside.plot = !title.show, bg = "white",
  legend.space = if (legend) 0.05 else 0, ...)
```

Arguments

lhs	A LoCoH-hullset object
id	The id(s) of the individual(s) to include in the plot
k	A k-value for the number of nearest neighbors around each point to include in the plot
r	A r-value for the number of nearest neighbors around each point to include in the plot
a	A a-value for the number of nearest neighbors around each point to include in the plot
s	The s value(s) of nearest neighbor sets to include in the plot. If NULL, all values will be used
hs.names	The name(s) of saved hullsets to analyze
sort.metric	The name(s) of isopleth sort metrics to include in the plot

iso.idx	The indices of isopleths to include in the plot
figs.per.page	Number of plots per page
legend	Whether to include a legend. T/F.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
subtitle	Whether to add a subtitle to the automatically constructed title (when title=NULL, otherwise ignored)
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
png.fn	A filename for a PNG file
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
png.fn.pre	A prefix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.fn.suf	A suffix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F.
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. Ignored if panel.num is NULL. T/F
bg	Background color
legend.space	The amount of additional space on the lower end of the x-axis to make room for the legend. Expressed as a proportion of the range of the x-axis values
...	Additional parameters that will be passed to the plot function

---

lhs.plot.revisit *Plot distribution of revisit times*

Description

Plots a histogram of the revisit times a LoCoH-hullset area

Usage

```
lhs.plot.revisit(lhs, id = NULL, k = NULL, r = NULL,
    a = NULL, s = NULL, hs.names = NULL, ta.min = "auto",
    ta.max = NULL, breaks = 40, xaxis.vals = NULL,
    ta.min.auto.tau = 4, col = "gray80", figs.per.page = 1,
    title = NULL, title.show = TRUE, subtitle = TRUE,
    mar = c(2.8, 3.2, if (title.show) (if (subtitle) 3.2 else 2.3) else 0.5, 0.5),
    mgp = c(1, 0.7, 0), png.fn = NULL, png.dir = NULL,
    png.dir.make = TRUE, png.width = 800,
    png.height = png.width,
    png.pointsize = 12 + (png.width - 480)/80,
    png.fn.pre = NULL, png.fn.suf = NULL,
    png.overwrite = TRUE, panel.num = NULL,
    panel.num.inside.plot = !title.show, bg = "white",
    legend.space = if (legend) 0.05 else 0, ...)
```

Arguments

lhs	A LoCoH-hullset object
id	The id(s) of the individual(s) to include in the plot
k	A k-value for the number of nearest neighbors around each point to include in the plot
r	A r-value for the number of nearest neighbors around each point to include in the plot
a	A a-value for the number of nearest neighbors around each point to include in the plot
s	The s value(s) of nearest neighbor sets to include in the plot. If NULL, all values will be used
hs.names	The name(s) of saved hullsets to plot
ta.min	The minimum time away (in seconds) to include on the histogram , can also be 'auto'
ta.max	The maximum time away (in seconds) to include. If NULL then no upper limit will be imposed
ta.min.auto.tau	The minimum time away to include in 'auto' expressed as the number of median sampling intervals. Ignored if ta.min is not 'auto'.
xaxis.vals	A numeric vector of time-away values (in seconds) that will be labeled on the x-axis.
breaks	A value for 'breaks' that will be passed to the hist function (see help function for breaks)
col	A color value for the histogram bars
bg	A color value for the plot background
figs.per.page	Number of plots per page
legend	Whether to include a legend. T/F.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
subtitle	Whether to add a subtitle to the automatically constructed title (when title=NULL, otherwise ignored)

mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
png.fn	A filename for a PNG file
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
png.fn.pre	A prefix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.fn.suf	A suffix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F.
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. Ignored if panel.num is NULL. T/F
legend.space	The amount of additional space on the lower end of the x-axis to make room for the legend. Expressed as a proportion of the range of the x-axis values
...	Additional parameters that will be passed to the hist function

Details

This function will plot a histogram of the revisitation times for a hullset. Revisitation time is simply the time between points enclosed in a hull. Basically, all points enclosed by each hull are examined and their time intervals computed. This may help reveal where there are natural temporal cycles in revisitation, for example if you see a spike in revisitation around 24 hours there may be daily revisitation pattern in some of the hulls. You can specify the minimum amount of time-away to show in the histogram (e.g., if enclosed points that are separated by the median sampling interval are of little interest), as well as the maximum time-away period. Note that revision metrics do *not* have to be computed for the hullset for the histogram to be computed.

Value

A list of objects of class histogram (one for each hullset plotted)

See Also

lhs.visit.add

lhs.plot.scatter	*Create scatterplot of hull metrics*

Description

Multi-purpose scatterplot function for the hull metrics in a LoCoH-hullset

Usage

```
lhs.plot.scatter(lhs, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL, x.axis = NULL,
  y.axis = NULL, limx = NULL, limy = NULL,
  trans.x = NULL, trans.y = NULL, jiggle.x = "auto",
  jiggle.y = "auto", filter = NULL,
  filter.label.in.subtitle = TRUE,
  filter.sampsize.in.subtitle = TRUE,
  filter.col.use = TRUE, filter.axes.uniform = TRUE,
  title = NULL, title.show = TRUE,
  title.hs.name.include = TRUE, title.two.id = FALSE,
  title.axes = TRUE, col = c("gray50", "spiral")[1],
  bg = NULL,
  mar = c(4, 3.2, if (title.show) (if (title.hs.name.include) 3.9 else 3.2) else 0.5, 0.5),
  mgp = c(2.1, 0.8, 0), lo.save = TRUE,
  lo.margins.set = TRUE, lo.colors.set = TRUE,
  lo.bg.as.box = FALSE, sat.base = NULL, val.base = NULL,
  hue.offset = NULL,
  center.method = c("bbox", "mean")[2], cex = 0.6,
  type = c("p", "l", "b")[1], ufat = NULL,
  figs.per.page = 1, add = FALSE, regions = NULL,
  prompt.labels = TRUE, hsp = NULL, hsp.reg.col = TRUE,
  hsp.reg.out = FALSE, hsp.reg.lbl = FALSE,
  hsp.override = TRUE, png.fn = NULL, png.dir = NULL,
  png.dir.make = TRUE, png.width = 800,
  png.height = png.width,
  png.pointsize = 12 + (png.width - 480)/80,
  png.fn.pre = NULL, png.fn.mid = NULL,
  png.fn.suf = NULL,
  png.exists = c("overwrite", "skip", "abort")[1],
  status = TRUE,
  desc = c(NONE <- 0, BOTTOM <- 1, TOP <- 3)[ifelse(figs.per.page == 1, 2, 1)],
  cex.desc = 0.8, col.desc = NULL, panel.num = NULL,
  panel.num.inside.plot = !title.show, hmap = NULL,
  hmap.in.subtitle = TRUE,
  check.ap.value.in.hmparams = TRUE, ...)
```

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of the individual(s) to include in the plot. Character vector or comma-delimited character.

k	The k value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
r	The r value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
a	The a value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
s	The s value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
hs.names	The name(s) of saved hullsets to include in the plot.
x.axis	The name of a hull metric (see hm.expr)
y.axis	The name of a hull metric
limx	The lower and upper limits of the x-axis. Two-element numeric vector.
limy	The lower and upper limits of the y-axis. Two-element numeric vector.
trans.x	The name of a function that will be used to transform the x-axis values. Can be any R function (e.g., "log", "sqrt"), also "square" and "cube"
trans.y	The name of a function that will be used to transform the y-axis values
jiggle.x	"auto" or a numeric value which will be used to add a normally distributed stochastic value (mean 0, sd=jiggle.x) to the x-axis values for better visualization of the number of points in each group (helpful when the x-values take on discrete values)
jiggle.y	"auto" or a numeric value which will be used to add a normally distributed stochastic value (mean 0, sd=jiggle.y) to the y-axis values
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
title.hs.name.include	Whether to include the hullset name as part of the title. Ignored if title is passed. T/F.
title.axes	Whether to include the names of the hull metrics on the axes as part of the subtitle. Ignored if title is passed. T/F.
title.two.id	An ad-hoc way to construct a title consisting of the ids of the hullset and hs2
filter	NULL or a list of filter parameters. The code will loop through these parameters and generate scatterplots for each subsets of points. Each element of the filter list must be another list with the following elements: $idx = a vector of the indices of the hulls; $label = a label.
filter.label.in.subtitle	Whether to add the filter label to the plot subtitle. Ignored if title is passed or filter is NULL. T/F.
filter.sampsize.in.subtitle	Whether to add the filter sample size to the plot subtitle. Ignored if title is passed or filter is NULL. T/F.
filter.col.use	Whether the points will be displayed with the color(s) saved in the filter (overriding the 'col' parameter). Ignored if filter is NULL. T/F.
filter.axes.uniform	Whether the upper and lower limits of the axes for each plot will be set as the limit for the entire combined dataset. Ignored if filter is NULL or values are passed for limx or limy. T/F.

col	A single color value, or a vector of color values of the same length as the number of hulls, or "spiral" (see additional parameters below). Ignored if filter.col.use=T or something is passed for hsp (in which case col will be extracted from hsp).
bg	Background color
lo.colors.set	Whether to set the background, foreground color on the plot device. T/F.
lo.bg.as.box	Whether to display the background color as a box on the plot (needed by some wrapper function that want the axes and margins to be a different color). This overrides the setting of lo.colors.set. T/F.
mar	The plot margins. A four item numeric vector.
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector.
lo.save	Whether to save and reset the plot device margin settings (some wrapper functions that call this function don't want device settings reset). T/F.
lo.margins.set	Whether to save and reset the plot device margin settings (some wrapper functions that call this function don't want device settings reset). T/F.
desc	Which side to display automatically generated desciptive text (e.g. caption). 0=none, 1=bottom, 3=top.
cex.desc	The expansion factor for the descriptive text. Numeric value.
col.desc	The color of the descriptive text. Color value.
sat.base	A number between 0 and 1 for the base staturation (how much of the color is present) of the center color (s=0.4 gives pastels), ramping up to 1 (full color) at edges.
val.base	A number between 0 and 1 controlling how much black is in the center color (0 is total black), ramping out to no blackness at the edges
hue.offset	A number between 0 and 2*pi for the color wheel rotation (in radians), which controls the color of points directly to the right of the center.
center.method	Determines how the center of the color will be computed. "bbox" = the center of the bounding box of the full range of points; "mean" = the mean of the data splot
cex	Expansion factor for the points on the scatterplot
type	The type of plot: 'p'=points only, 'l'=line, 'b'=both
ufat	Whether to substitute user-friendly axis titles. T/F.
figs.per.page	The number of plots per page
add	Whether to add to the current plot device. T/F.
regions	Determines whether the user will be prompted to draw regions (polygons) on the scatterplot window with the mouse, that will be saved as part of the scatterplot objecr returned. Values can be 1) a number whereby the user will be prompted to create N regions with randomly assigned colors, or 2) a vector of color values in which case the regions will be assigned those colors.
prompt.labels	Whether the user should be prompted to also enter labels for each of the regions drawn. Ignored if regions = NULL. T/F.
hsp	Either the index(s) of a hull scatterplot(s) saved in lhs (use summary() command to which how many hsp objects have been saved), or a list of objects of class locoh.hsp. When passed, the parameters in hsp will be used to create the scatterplot

hsp.reg.col	Whether to use the colors assigned to the regions in hsp. Ignored if hsp is NULL. T/F.
hsp.reg.out	Whether to display the outline of the regions in hsp. Ignored if hsp is NULL. T/F.
hsp.reg.lbl	Whether to display the labels of the regions in hsp. Ignored if hsp is NULL. T/F.
hsp.override	Whether the parameters in hsp should override other parameters passed. Ignored if hsp is NULL. T/F.
png.fn	The path and name of the PNG file to create (instead of displaying in a plot window).
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed.
png.dir.make	Whether to create png.dir if it doesn't exist. T/F.
png.width	The width of the PNG image. Ignored if png.fn is passed.
png.height	The height of the PNG image. Ignored if png.fn is passed.
png.pointsize	The pointsize (in pixels) for the PNG image (increase to make labels appear larger). Equivalent to the height or width of a character in pixels.
png.fn.pre	A prefix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.fn.mid	A mid-fix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.fn.suf	A suffix that will be used in the construction of the PNG filename. Ignored if png.fn is passed.
png.exists	What to do if a PNG with the same filename already exists: "overwrite", "skip", or "abort"
status	Whether to show messages. T/F.
panel.num	A number or letter to display in the upper left hand corner of the plot, used when the plot will be part of a multi-frame graphic (as in publications). Character.
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself (as opposed to the title area). T/F.
hmap	A named list of hull metric auxillary parameters, the name of each list element is the name of the variable.
hmap.in.subtitle	Include the hmap value(s) in the plot subtitle. T/F
check.ap.value.in.hmparams	
	Check to make sure that hull metrics have been computed for the hull metric auxillary parameter values passed (either as separate arguments or in hmap)
...	Other parameters, including any auxillary parameters required by certain hull metrics

Value

If png.fn or png.dir is passed, exports the plots to a PNG file(s) and returns a list of file names, dimensions of the images produced. Otherwise returns a named list of objects of class 'locoh.hsp'.

Note

This function has two main purposes. 1) To make scatterplot graphics either in a plot window or PNG file 2) To create a list of objects of class "locoh.hsp", which are basically a collection of the parameters that were used to create the scatterplot and any manually digitized regions created by the user. When not being used to create PNG files, this function returns a list of "locoh.hsp" objects which can then be 'permanently' saved in the LoCoH-hullset object using lhs.hsp.add, and/or fed into other functions such as plot.locoh.lhs. Note that hull metrics must already have been computed. Several hull metrics are 'automatically' computed when the hullset is defined (e.g., hull area, number of enclosed points). Other hull metrics must be created separately with functions such as lhs.ellipses.add and lhs.visit.add.

Auxillary parameters required for hull metrics can be passed either as individual parameters (e.g., ivg=3600*12) or as a list element hmap=list(ivg=86400)

See Also

lhs.plot.scatter.auto, hm.expr, lhs.hsp.add

---

lhs.plot.scatter.auto   *Generate multiple scatterplots of hull metrics*

Description

This is a wrapper function for lhs.plot.scatter that creates scatterplots for pairs of hull metrics. It can quickly generate several few dozen scatterplots for the purpose of visually looking for novel associations between hull metrics.

Usage

```
lhs.plot.scatter.auto(hs, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL,
  x.metrics = c("auto", "all")[1],
  y.metrics = c("auto", "all")[1],
  metrics.exclude = c("bearing", "sgf.nn.mean", "sgf.enc.mean"),
  exclude.same.pair = TRUE, exclude.reverse.pair = TRUE,
  png.dir = NULL, png.dir.make = TRUE, png.width = 800,
  png.height = png.width,
  png.pointsize = 12 + (png.width - 480)/80,
  png.fn.pre = NULL, png.fn.mid = NULL,
  png.fn.suf = NULL,
  png.exists = c("skip", "overwrite")[1],
  progress.bar = TRUE, test.sample = NULL,
  enumerate.pairs.only = FALSE, new.plot.window = TRUE,
  hmap = NULL, ...)
```

Arguments

hs	A LoCoH-hullset object
id	The names of the individual(s) to include in the plot. Character vector or comma-delimited character.

k	The k value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
r	The r value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
a	The a value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
s	The s value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
hs.names	The name(s) of saved hullsets to include in the plot.
x.metrics	The name(s) of hull metric(s) to plot on the x-axis. Can also be "auto" for the most common ones, or "all"
y.metrics	The name(s) of hull metric(s) to plot on the y-axis. Can also be "auto" for the most common ones, or "all"
metrics.exclude	The name(s) of hull metrics to exclude from both the x and y axes
exclude.same.pair	Whether to exclude a hull metric being plotted against itself. T/F
exclude.reverse.pair	Whether to exclude opposite pairs of metrics. T/F
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed.
png.dir.make	Whether to create png.dir if it doesn't exist. T/F.
png.width	The width of the PNG image. Ignored if png.fn is passed.
png.height	The height of the PNG image. Ignored if png.fn is passed.
png.pointsize	The pointsize (in pixels) for the PNG image (increase to make labels appear larger). Equivalent to the height or width of a character in pixels.
png.fn.pre	A prefix that will be used in the construction of the PNG filename
png.fn.mid	A mid-fix that will be used in the construction of the PNG filename
png.fn.suf	A suffix that will be used in the construction of the PNG filename
png.exists	What to do if a PNG with the same filename already exists: "overwrite" or "skip"
progress.bar	Display a progress bar. T/F
test.sample	An optional number of randomly selected pairs of hull metrics to generate for testing purposes. Or NULL.
enumerate.pairs.only	Whether to only return a two-column data frame of the names of hull metrics. T/F
new.plot.window	Whether to start a new plot window and turn recording on. T/F
hmap	A named list of hull metric auxillary parameters (for hull metrics that involve additional parameters such as an intervisit gap period). These can also be passed on their own (e.g., ivg=3600*24)
...	Additional parameters that will be passed to the [hist](#) function

Value

A data frame containing the pairs of hull metrics

Note

This function generates a list of pairs of hull metrics, and then calls lhs.plot.scatter repeatedly to generate the histograms. This is a quick way to visualize the relationships between hull metrics.

If new.plot.window is TRUE (default), a new plot window will be opened and plot recording turned on so you can flip through the histograms using the PgUp and PgDn keys. You may also pass a value for png.dir) which will create a bunch of PNG files which you can then view them as a slideshow.

See Also

lhs.plot.scatter, hm.expr

---

lhs.revisit.add   *Add revisitation hull metrics to a LoCoH-hullset object*

Description

Computes revisitation rate based on a minimum and maximum time away period

Usage

```
lhs.revisit.add(lhs, ta.min = NULL, ta.max = NULL,
    ta.cuts = NULL, status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
ta.min	Minimum value(s) for time away in seconds (numeric vector)
ta.max	Maximum value(s) for time away in seconds (numeric vector)
ta.cuts	A numeric vector of time values in seconds that define the time-away intervals
status	Show status messages. T/F

Details

ta.min and ta.max define the minimum and maximum period of time (in seconds) which must pass for another occurence in the hull to be considered a 'revisit'. They should be the same lengths. If ta.max is NULL, no upper bound will be set

ta.cuts is an alternative way of specifying the time-away intervals. The time values in ta.cuts will serve as the values between time away intervals. For example if ta.cuts = c(1000,4000,7000,10000), three time-away intervals will be examined: 1000 to 4000 seconds, 4000 to 7000 seconds, and 7000 to 10000 seconds. One way to get the values for ta.cuts is to plot the distribution of revisit times using lhs.plot.revisit, and then use the get.vals function to select time values between clusters of revisit times.

Value

A LoCoH-hullset object

See Also

lhs.plot.revisit, get.vals

---

lhs.revisit.del   *Delete all revisitation hull metrics in a LoCoH-hullset object*

Description

Delete all revisitation hull metrics in a LoCoH-hullset object

Usage

lhs.revisit.del(lhs, status = TRUE)

Arguments

lhs	A LoCoH-hullset object
status	Display summary, T/F

Value

A LoCoH-hullset object

See Also

[lhs.revisit.add](#)

---

lhs.save   *Save a LoCoH-hullset object to disk*

Description

Saves a LoCoH-hullset object to disk, constructing a filename if needed that reflects the contents

Usage

lhs.save(lhs, file = NULL, dir = ".", suf = NULL,
  compress = TRUE, auto.num.files = TRUE, width = 2,
  save.as = NULL)

Arguments

lhs	A LoCoH-hullset object
file	Optional filename. If omitted a sensible filename will be constructed
dir	Directory for the output file (relative to the working directory), ignored if file passed
suf	A suffix that will be used in the construction of the filename, ignored if file is passed
compress	Compress file. T/F
auto.num.files	Use a number as part of the constructed filename. T/F
width	The number of digits of the auto-number token in the filename (ignored if auto.num.files=F)
save.as	The name of the object when saved (default is the same as the original)

See Also

lxy.save

---

lhs.select   *Select hullsets*

Description

Select hullsets

Usage

lhs.select(lhs, id = NULL, k = NULL, r = NULL, a = NULL,
    s = NULL, hs.names = NULL, hs.idx = NULL,
    status = TRUE)

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of individuals to extract
k	The k value of hullsets to extract
r	The r value of hullsets to extract
a	The a value of hullsets to extract
s	The s value of hullsets to extract
hs.names	The name(s) of saved hullsets to extract
hs.idx	The indices of saved hullsets to extract
status	Show status messages (T/F)

Value

A LoCoH-hullset object

---

lhs.so.add   *Add hull metrics for association analysis*

Description

Add hull metrics for association analysis

Usage

lhs.so.add(lhs, id = "all", hs2.id = "all", tbuff = 0,
    ivg = NULL, test = 0, skip.dups = TRUE,
    save.hso = TRUE, status = TRUE,
    piFUN = c("pIntersect", "pIntersectSat")[1])

Arguments

lhs	A LoCoH-hullset object
save.hso	Whether to save the hull intersection list, T/F
skip.dups	Skip duplicate hulls (faster)
id	A character vector of the hullset ids to compute metrics for. Can also be 'all'.
hs2.id	A character vector of the hullset ids to use as the comparison hullsets. Can also be 'all'.
tbuff	A temporal overlap threshhold (in seconds). See details.
ivg	The intervisit gap period used to collapse intersecting hulls into discrete visits, see details
test	A two-element numeric vector containing the number of hulls in hullset 1 and hullset 2 respectively to identify intersections
status	Show status messages. T/F
piFUN	The function to use to identify which pairs of hulls intersect: 'pIntersect' or 'pIntersectSat'

Details

This function computes hull metrics for the spatially overlapping hulls from two ids. Typically this would be used when you have hullset from two individuals (i.e., two animals) and you want to see the spatial and temporal patterns of shared space use.

You can impose a temporal overlap requirement as well by passing a value for tbuff. Two hulls will be considered spatially overlapping only if their parent points also were recorded within tbuff seconds of each other. This essentially produces metrics for spatially and temporally overlapping hulls.

Hullset metrics are computed for each pair of ids. Thus if a hullset has hulls for three unique ids, each hull will have spatial overlap metrics computed for each of the other two hullsets. You can narrow which id(s) to compute metrics for, and which hullset(s) to use as the comparison, with the id and hs2.id arguments.

Up to three spatial overlap metrics are computed. so.count is simply the number of hulls in hullset 2 that overlap. so.dtmin is the minimum amount of time (expressed in seconds) that passes between overlapping hulls. This reflects temporal partitioning of shared space - low values of so.dtmin suggest the two individuals don't mind being in the same area at the same time. so.nsv (number of separate visits) is similiar to so.count, but collapses overlapping hulls into discrete visits based on an intervisit gap period ivg. so.nsv is only computed if a value for ivg is passed.

pIntersect and pIntersectSat are two functions that identify which pairs of hulls actually intersect. Neither are terribly fast, but pIntersect appears to work faster than pIntersectSat.

Value

A LoCoH-hullset object

`lhs.to.add` *Compute hull metrics for temporally overlapping hulls*

Description

Compute hull metrics for pairs of temporally overlapping hulls of separate individuals

Usage

```
lhs.to.add(lhs, id = "all", hs2.id = "all",
    maxdt = "auto", save.hto = TRUE, status = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	A character vector of the hullset ids to compute metrics for. Can also be 'all'.
hs2.id	A character vector of the hullset ids to use as the comparison hullsets. Can also be 'all'.
maxdt	The maximum difference in time (in seconds) for two hulls to be considered 'overlapping' in time. Can also be 'auto', in which case half of the smallest of the two median sampling intervals will be used.
save.hto	Whether to save the list of hull indices that temporally overlap in the hullset, T/F
status	Show status messages, T/F

Details

This will compute hull metrics for pairs of hulls from two individuals. This only works for a LoCoH-hullset object that contains hulls from two or more individuals (id's). For each hull for individual A, for example, it will identify the hulls in individual B that temporally overlap, and compute the mean centroid distance (hull metric name = to.mcd). By default *to.mcd* is computed for all pairs of individuals, but you can specify specific pairs by passing values for id and hs2.id.

This metric is used for association analysis. You can use this metric for example to look for spatial and temporal patterns in how close individuals get to each other. Other association metrics exist for spatially overlapping hulls (see lhs.so.add).

Value

A LoCoH-hullset object

See Also

lhs.so.add, lhs.merge

lhs.to.stats *Computes statistics on the centroid distances for time-overlapped hulls*

Description

Computes statistics on the hull-to-hull centroid distance for time-overlapped hulls, with an option to plot and overlay the distribution of centroid distances for random pairs of hulls

Usage

```
lhs.to.stats(lhs, id1 = "all", id2 = "all", n = "all",
  iso.lower = NULL, iso.upper = NULL, iso.oz = TRUE,
  iso.sort.metric = "auto", to.comp.hist = TRUE,
  breaks = 20, to.mcd.outline.only = FALSE,
  lwd.outline = 3, hist.type = c("density", "counts")[1],
  col.to.mcd = "blue", col.h2h.cd = "red", title = NULL,
  title.show = TRUE, title.id.only = FALSE,
  title.sub.iso.enc = TRUE,
  mar = c(3, 3, if (title.show) 1.5 + (if (title.sub.iso.enc) 1.3 else 0) else 0.5, 0.5),
  mgp = c(1.8, 0.5, 0), figs.per.page = 1,
  panel.num = NULL, panel.num.inside.plot = !title.show,
  png.dir = NULL, png.dir.make = TRUE, png.width = 800,
  png.height = png.width, png.overwrite = TRUE,
  png.pointsize = 12 + (png.width - 480)/80,
  status = TRUE, ...)
```

Arguments

lhs	A LoCoH-hullset object
id1	Hullset 1 id value(s). Can also be 'all'.
id2	Hullset 2 id value(s). Can also be 'all'.
n	The number of randomly selected paired hulls to use as the NULL model of no association. Can also be "all"
iso.oz	Apply isopleth filter to hs1 using the isopleths from hs2. T/F.
iso.lower	The lower level isopleth for the isopleth filter
iso.upper	The upper level isopleth for the isopleth filter
iso.sort.metric	The name of a hull metric that was used to sort hulls in the construction of the isopleths to be used as filters. If auto (default) it will pick the default sort metric used for density isopleths (i.e., area for the k-method, and number of enclosed points for the a and r methods)
to.comp.hist	Draw a histogram of the centroid distances of temporally overlapping hulls
breaks	The number of breaks in the histgram (or another valid value for breaks, see hist).
to.mcd.outline.only	Show the outline only of the histogram of the mean centroid distance for temporally overlapping hulls. T/F.
lwd.outline	The line width of the histogram outline (ignored if to.mcd.outline.only=F).

hist.type	The type of histogram to plot: 'density' or 'counts'.
col.to.mcd	The color of the outline of the histogram of the distribution of the centroid distances of temporally overlapping hulls.
col.h2h.cd	The color of the outline of the histogram of the distribution of the centroid distances for randomly paired hulls.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
title.id.only	Whether to construct the title from the id values only. T/F. Ignored if title is passed or title.show=FALSE
title.sub.iso.enc	Whether to include the isopleth filter information as the second line of the title, T/F.
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
figs.per.page	The number of plots per page.
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. T/F
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
status	Display status messages. T/F
...	Additional parameters that will be passed to the plot function

Details

This returns a list object containing the centroid-to-centroid distances of a random selection of hulls from two individuals, which serves as a NULL model of no interaction. It can also plot the histogram of mean-centroid-distance of time-overlapped hulls with the outline of the centroid distance of random-pairs of hulls overlain on top, to visually see how close the distributions match.

It will also compute the Welch Two Sample t-test to see if the distribution for time-overlapped and randomly paired hulls have statistically significant means, and the Two-sample Kolmogorov-Smirnov test which tells you how likely the two distributions are the same.

Note that before you can use this function, the mean-centroid-distance for time-overlapped hulls must be computed using lhs.to.add

You can apply an isopleth filter by passing values for iso.lower and iso.upper. These should be the isopleth level (normally between 0 and 1) that the hull parent point must fall in to be included in the analysis. If, for example, you wanted to see whether association in the core area is significantly different from nuetral interaction, you would pass iso.upper=0.5 and leave iso.lower NULL. Note that the isopleths with matching isopleth levels must already be present.

Value

A list object

See Also

lhs.to.add, lhs.iso.add

---

lhs.visit.add   *Add time use hull metrics to a LoCoH-hullset object*

Description

Computes visitation and duration hull metrics based on inter-visit gap value(s)

Usage

lhs.visit.add(lhs, ivg = NULL, status = TRUE)

Arguments

lhs   A LoCoH-hullset object

ivg   Value(s) for inter-visit gap (in seconds) (numeric vector)

status   Show status messages. T/F.

Value

A LoCoH-hullset object

Note

The inter-visit gap is the period of time (in seconds) which must pass before another occurrence in the hull can be considered a separate visit. Occurences in the hull are considered a separate visit only if the animal was absent from the hull for a period of time >= ivg.

For each ivg value, the function examines each hull and computes the number of separate visits to the hull (visitation, hull metric name = "nsv") and the mean number of locations per visit (visit duration, hull metric name = "mnlv")

---

locoh.lhs   *Class for a hullsets*

Description

Class for a collection of hullsets and associated objects including hull metrics and isopleths

Details

An object of class locoh.lhs is a list of hullsets

Data structure of class locoh.lhs coming soon. Please contact the package author for details.

See Also

lxy.lhs, summary.locoh.lhs, plot.locoh.lhs, lhs.merge, lhs.iso.add, lhs.save, lhs.exp.shp

---

locoh.lxy   *Class for location data*

Description

Data class for locations with associated dates, nearest neighbor info, parameters for a random walk null model, and assorted meta-data

Details

An object of class LoCoH.lxy is a list containing a series of point locations and ancillary variables that go with those locations (e.g., time stamps, point IDs, animal IDs). These items are bundled together and 'ready to go' as inputs into T-LoCoH functions. The benefits of bundling all of the objects related to a set of point locations in a single list object includes:

- cleaning and error checking only has to be done once when the lxy object is created (e.g., with xyt.lxy)

- having all of the ancillary variables together simplifies the task of passing parameters to other functions as well as saving/retrieving your work to disk

- the nearest neighbor lookup-table (which can take a long time to compute) can be reused

- locations for multiple individuals can be saved in one object

In code examples, objects of class LoCoH.lxy are often named 'lxy'.

Data Structure

The named elements in the list include:

pts a [SpatialPointsDataFrame](#) of the locations. Columns in the associated data frame vary but typically include:

- *ptid* - an integer vector of unique id values for each point
- *id* - a character vector or factor containing the ids of the individuals (e.g., name of the animal, GPS device) associated with each point
- *dt* - a vector of date-stamps (class POSIXct) for each point
- *col* - a vector (or factor) of color values
- various other ancillary variables associated with each location

anv A data frame of meta data of the ancillary variables associated with each point (or NULL if none). Column names are *anv* (corresponding to the column name in `pts` and *desc* (description)

dt.int a four-column data frame containing a frequency table of the time interval between points. Columns include: id, interval, count, and rtn (where rtn is the round-to-nearest value (in seconds) that was used in binning the delta.t values).

rw.params a four-column data frame containing the parameters used to compute the predicted 'diffusion distance' for any pair of points as a function of the difference in time. Columns of the data frame includ: *id*, *time.step.median*, *d.bar* (median step-length), and *vmax* (maximum observed velocity)

comment a named list of descriptive text. One list element per id; the item name is the id. The default is a constructed string consisting of the ID(s) and number of points per ID. May also be NULL.

nn Nearest neighbor lookup table. Can also be NULL. Before hulls can be constructed, nearest neighbors have to be identified using [lxy.nn.add](#). Note:

- A different set of nearest neighbors will exist for each value of s, because s determines how point-to-point distance is computed.
- Once nearest neighbors have been identified, they can be used to construct hulls for a variety of parameters and nearest neighbor selection method (e.g., k, r, or a method).
- For a set of nearest neighbors, the maximum possible value for k, r, and a are saved as list elements. If you want to construct hulls for a larger value of k, r, or a, you must first identify additional nearest neighbors using [lxy.nn.add](#).

The nearest neighbor lookup table is a list of lists. The name of each list element is a pipe-delimited character string that uniquely identifies the parameters for that list. Each element of this list is another list with the following elements:

- id
- s
- kmax
- rmax
- amax
- ptid (a vector of ptid values that have nearest neighbors identified for the current ID)
- auto.a.df - a data frame of the auto-a values that have been calculated. See [auto.a](#). Columns include:
  1. a.meth
  2. a.pp
  3. a.nn

4. a.h
5. a.tct
6. auto.a
- time.taken = time taken to find the nearest neighbors (in seconds)
- nn.df = a data frame with the following five columns:
  1. pp.idx = index of the parent point from lxy$xys
  2. nn.rank = nearest neighbor rank (integer), starting from 0 for the parent point. Points with no eligible parent points will be have only the parent point itself as the 0th neighbor
  3. nn.idx = index of the nearest neighbor point from lxy$xys. Integer. For the 0th neighbor this will be the parent point index
  4. tsd = time-scaled-distance
  5. tsd.cumsum = the cumulative tsd

ptsh List of the proportion of time-selected hulls for different values of s (created with lxy.ptsh.add), based on a random sample of hulls. One list element for each id, and in each of those there will be an (unnamed) list element for each time lxy.ptsh was run. Each of those will be a list containing elements: *id, samp.idx, n, k, target.ptsh, target.s, s.ptsh, time.taken*. See lxy.ptsh.add.

See Also

xyt.lxy, move.lxy, lxy.repair, lxy.subset, lxy.merge, lxy.exp.csv

---

lxy.amin.add   *Finds the value of a such that p percent of points are a nearest neighbor for at least one hull*

Description

Finds the value of a such that p percent of points are a nearest neighbor for at least one hull

Usage

```
lxy.amin.add(lxy, id = NULL, s = NULL, ptp = 0.98,
    nnn = 2, prec = NULL, max.iter = 20, status = TRUE)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) to analyze. If NULL all ids will be used.
s	Value(s) for the s term in the time-scaled-distance equation for point-to-point distance
ptp	The proportion of total points that should be a nearest neighbor for at least one hull (0..1]
nnn	The minimum number of nearest neighbors each point should have (can pass a vector of several values)
prec	A numeric value in map units to which the value of 'a' will be found. If NULL, will default to one-half of the median step legnth of the entire dataset
max.iter	The maximum number of iterations to try to get within prec of the minimum value
status	Show messages, T/F

Details

This function finds the value of 'a' (within a specified threshhold `prec`) such that the proportion `ptp` of all points will be a nearest neighbor for at least one hull. This value of 'a' is intended to be a reasonable lower bound for a home range that includes as many points as desired, but minimizes areas where the individual was not observed. This assumes that duplicate points will be offset by a random amount when creating hullset(s).

Note that the value of 'a' such that `ptp` of points are nearest neighbors does not mean that `ptp` points are enclosed. Points can be enclosed by hulls that are not a nearest neighbor of any hull parent point.

---

lxy.anv.add   *Add ancillary variable(s) to a LoCoH-xy object*

Description

Add ancillary variable(s) to a LoCoH-xy object

Usage

lxy.anv.add(lxy, anv, anv.desc = NULL, overwrite = FALSE)

Arguments

lxy	LoCoH-xy object
anv	vector, named list or data frame with the same number of values as points
anv.desc	A character vector of descriptions
overwrite	Whether to overwrite existing variables with the same names (T/F)

Value

A LoCoH-xy object

---

lxy.exp.csv   *Export coordinates to a csv file*

Description

Exports coordinates and date-stamps from a LoCoH-xy object to a csv file

Usage

lxy.exp.csv(lxy, file = NULL, id = NULL,
    file.overwrite = FALSE, quote = FALSE)

Arguments

lxy	A LoCoH-xy object
file	Filename (with extension .csv)
id	The id(s) of the locations to export
file.overwrite	Overwrite existing file, T/F
quote	Delimit strings in quotes, T/F

Note

This function will export the id value (i.e., animal name) point-id value (ptid), coordinates, and date stamp (if exists) of a LoCoH-xy object to a csv file

If file is not passed, a filename will be automatically constructed.

---

lxy.exp.kml   *Export a lxy object to kml (Google Earth)*

Description

Export a lxy object to a format that can be animated in Google Earth

Usage

```
lxy.exp.kml(lxy, file, id = NULL, skip = 1,
    overwrite = TRUE, compress = TRUE, pt.scale = 0.5,
    col = NULL, show.path = TRUE, path.col = NULL,
    path.opaque = 80, path.lwd = 3)
```

Arguments

lxy	A LoCoH-xy object
file	The name of the kml file to be created (relative to the working folder). The .kml extension will be added if needed.
id	The id(s) of the individual(s) to include in the plot
skip	The skip factor to use to reduce the number of points exported (i.e., every nth point exported where n=skip)
overwrite	Whether to overwrite an existing kml file (T/F)
compress	Whether to copmress the kml file and create a kmz file (T/F)
pt.scale	The relative size of the placemark symbols
col	The point colors (one per id)
show.path	Whether to include the point path in the kml file (T/F)
path.col	The path colors (one per id), ignored if show.path=FALSE
path.opaque	The opacity of the path (0=transparent, 255=fully opaque), ignored if show.path=FALSE
path.lwd	The width of the path, ignored if show.path=FALSE

Value

The file name of the kml/kmz file

Note

This function will export the locations in a LoCoH-xy object to a kml file that can be opened in Google Earth for animation. The kml format is not optimized for large datasets, but this works reasonably well for moderate datasets (e.g., <1000). To create animations of larger datasets, use a skip value > 1 or see lxy.exp.mov.

Adapated from plotKML package

See Also

lxy.exp.mov

---

lxy.exp.mov   *Create a Quicktime animation from a LoCoH-xy object*

Description

Create a Quicktime animation from a LoCoH-xy object

Usage

```
lxy.exp.mov(lxy, id = NULL, all.ids.at.once = TRUE,
  all.ids.col.unique = all.ids.at.once,
  all.ids.col = NULL,
 all.ids.legend = c("bottomright", "bottom", "bottomleft", "left", "topleft", "top", "topright", "right", "center
  all.ids.legend.cex = 0.8, dt.start = NULL,
  dt.end = NULL,
  frame.method = c("auto", "time", "location")[1],
  frame.rtd = "auto", xlim = NULL, ylim = NULL,
  dt.label = TRUE, dt.label.col = "black",
  dt.label.x = NULL, dt.label.y = NULL, title = NULL,
  title.show = TRUE, axes.show = TRUE,
  axes.ticks = axes.show, axes.titles = FALSE,
 mar.map = c(0.7 + (if (axes.ticks) 0.9 else 0) + (if (axes.titles) 1.3 else 0), 0.5 + (if (axes.ticks) 0.9 else 0) + (if (
  mgp.map = c(0.4 + if (axes.ticks) 1.2 else 0, 0.4, 0),
  col.xys.active = "red", col.xys.background = "gray80",
  cex.xys.active = 1.5, cex.xys.background = 0.5,
  tz.local = NULL, tz.local.check = TRUE,
  col.by.hour.of.day = FALSE,
  col.hod = colorRampPalette(colors()[c(24, 30, 553, 121, 26, 121, 553, 30, 24)])(24),
  width = if (screen.test) 7 else 608, height = NULL,
  max.frames = NULL,
  png.pointsize = 16 + (width - 480)/80,
  screen.test = FALSE, tmp.dir = NULL,
  tmp.files.delete = TRUE, prompt.continue = TRUE,
  fn.mov = NULL, fn.mov.dir = getwd(),
  fn.mov.exists = c("auto.increment", "overwrite", "stop", "ask")[1],
  duration = NULL, fps = NULL, skip = NULL,
  ffmpeg = "ffmpeg.exe", create.mov = TRUE,
  info.only = TRUE, shp.csv = NULL, layers = NULL,
  bg2png = !is.null(layers),
```

```
crop.layers.to.extent = TRUE, date.bar = 0.85,
date.bar.bins = 12, col.db = "darkblue",
cex.axis.db = 0.7, beep = FALSE, report.time = TRUE,
status = TRUE)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) to be on the plot
all.ids.at.once	Display all the individual ids simultaneously. If False, an animation will be created for each id. T/F.
all.ids.col.unique	
	Whether to use unique colors for each individual when plotting multiple individuals simultaneously, T/F
all.ids.col	A named list of color values; the element names must match the name(s) of the ids
all.ids.legend	Where to place a legend showing the color of each id (for an animation showing the movement of multiple individuals simultaneously): 'bottomright', 'bottom', 'bottomleft', 'left', 'topleft', 'top', 'topright', 'right', or 'center'. May also be NULL, in which case the legend will not be displayed. Ignored if ids.legend.bln=FALSE or all.ids.col.unique = FALSE.
all.ids.legend.cex	
	The character expansion factor for the id legend. See parameter all.ids.legend above.
dt.start	The starting date-time. An object of class POSIXt or one that can be coerced to POSIXt. If NULL, the earliest date-time in the series will be used.
dt.end	The ending date-time. An object of class POSIXt or one that can be coerced to POSIXt. If NULL, the last date-time in the series will be used.
frame.method	How each frame should be defined temporally, "time" - each frame represents a fixed amount of time, "location" each frame is a point in the series
frame.rtd	The real-time duration of each frame (in seconds). If "auto" (default), the lowest median sampling frequency will be used
xlim	A two-element numeric vector for the range of the x-axis (in map units)
ylim	A two-element numeric vector for the range of the y-axis (in map units)
dt.label	Add a label for the date of the frame
dt.label.col	A color value/name for the date label (ignored if dt.label=FALSE)
dt.label.x	The x-coordinate for the date label (ignored if dt.label=FALSE)
dt.label.y	The y-coordinate for the date label (ignored if dt.label=FALSE)
title	A title for the map
title.show	Whether to show the title. T/F.
axes.show	Whether to show the axes (ticks, labels and titles). Can be over-written by axes.ticks and axes.titles. T/F.
axes.ticks	Whether to show the tick marks and labels on the axes. T/F.
axes.titles	Whether to show axes titles. T/F.
mar.map	Margin settings for the map, see par
mgp.map	Locations of the axes elements for the map, see par

col.xys.active	Color of the active point. Ignored if col.by.hour.of.day = TRUE.
col.xys.background	
	Color of the non-active points. To hide non-active points, set to NA.
cex.xys.active	The character expansion factor of the active point
cex.xys.background	
	The character expansion factor of non-active points
tz.local	The name of the time zone of the study area
tz.local.check	Check whether tz.local is a valid timezone name (not implemented) T/F.
col.by.hour.of.day	
	Whether to color the active point by the hour of day (i.e., dark colors at night, orange for day time locations). T/F
col.hod	A vector of 24 color values used to symbolize the color of the active point by the hour of day. Ignored if col.by.hour.of.day = FALSE.
screen.test	Create up to three sample frame(s) on the screen (instead of PNG files)
width	The width of each frame in pixels (if screen.test=FALSE) or inches (if screen.test=TRUE).
height	The height of each frame in pixels (if screen.test=FALSE) or inches (if screen.test=TRUE).
max.frames	The maximum number of frames to produce.
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
tmp.dir	A directory where temporary PNG files for each frame will be created, character.
tmp.files.delete	Delete the temporary PNG files when done, T/F
prompt.continue	Whether to present a summary of the encoding settings and get user confirmation before continuing, T/F
fn.mov	The path and filename of output Quicktime *.mov file. If NULL a filename will be automatically generated
fn.mov.dir	The directory where the animation will be saved (ignored if a value for fn.mov is passed)
fn.mov.exists	What to do if the animation file already exists: "auto.increment", "overwrite", "stop", or "ask".
duration	The desired duration of the animation (in seconds)
fps	A numeric value for frames per second
skip	Output every nth frame. To include every frame set skip=1. Integer.
ffmpeg	The name of the ffmpeg file. See notes.
create.mov	Whether to actually create the mov file. Set to FALSE preview a few frames without actually encoding them.
info.only	Only return info
shp.csv	The path and filename of a csv file that contains information about shapefiles, including layer names, file, and symbology.
layers	The name(s) of layers in shp.csv to display in the background. Will be displayed using the symbology in shp.csv. Character vector or comma delimited string.
bg2png	Save the plot background elements as a static raster image (to improve speed), ignored if screen.test=TRUE
crop.layers.to.extent	
	Whether to crop the shapefile layers to the view extent (may speed up drawing time)

date.bar	The height of the lower section of the plot to devote to the time bar, in inches. To hide the time bar completely, set date.bar=0.
date.bar.bins	The target number of bins (tick marks + 1) on the time bar (integer)
col.db	A single color value for the date bar axes / tick labels, character
cex.axis.db	Character expansion factor for the labels on the date bar axis.
beep	Beep when one, T/F
report.time	Show the time taken when done, T/F
status	Show progress bar and status messages

Value

A list with information about each *.mov file created. Each element of the list is another list with two elements: fn (the full filename) and dim (a two-element numeric vector with the frame width and height). If no *.mov file(s) were created, returns NULL.

Note

To create the animation, two and only two of the following parameters must be passed: duration, fps, and skip. The third parameter will be computed based on the other two. To include every frame, pass fps, set skip=1, and leave duration out.

Larger values for fps will result in the animation running 'faster'. Values between 10 and 20 often work well; beyond 30 fps the eye can't keep up with the motion Note if you pass values for fps and duration, an appropriate value for skip will be computed but the final duration of the animation may not be exactly equal to duration because only interger values of skip are allowed.

One will normally want to run the function a few times without actually encoding to tweak the frame design (e.g., where the date label and legend appear). To see what a frame in the output will *approximately* look like, set screen.test=TRUE. Once the screen sample looks good, next set max.frames=3, tmp.dir="." (or another folder), create.mov=FALSE, and tmp.files.delete=FALSE. This will generate a few sample frames as PNG files but not delete them so you can inspect them using an image viewer. Once these look good, create the full animation by setting create.mov=TRUE and max.frames=NULL.

If frame.method is 'auto', the script will use time-based frames when multiple individuals are being animated simultaneously, and location-based frames otherwise.

duration (the duration of the animation in seconds) should not be confused with frame.rtd which is the real-time duration of a single frame in seconds (e.g., frame.rtd=3600 means each frame will represent 1 hour).

If date.bar is too small or too large, you might get a 'margins too large' error. Try values around 1, or hide the date bar completely by setting date.bar=0.

The output animation is encoded in QuickTime format. The Quicktime file is encoded using Quicktime's 'animation' codec, a lossless format that 'scrubs' well (i.e., you can drag the scroll bar to view frame by frame). Encoding requires installing the open source encoding program ffmpeg. ffmpeg is a command line program that Linux and Windows users can download from http://ffmpeg.org/download.html. Windows users should save the ffmpeg.exe file to the working directory or a directory on Window's path environment variable (e.g., c:\windows). Mac users can download ffmpegX from http://ffmpegx.com/download.html but this has not been tested (pass a value to ffmpeg).

If ffmpeg is not available, you can still use this function to generate the individual frames and then use another utility (e.g., ImageMagick, Quicktime Pro) to combine the frames into a video file. For best results use a 'lossless' compression method in the encoding program. To create the

individual frames only for encoding with another utility, set tmp.dir=".." (the working directory) and tmp.files.delete=FALSE.

If fn.mov.exists = "auto.increment", a two-digit number will be appended to the *.mov filename to avoid overwriting an existing file

---

lxy.exp.shp   *Export a LoCoH-xy to shapefile*

Description

Export hulls, hull parent points, and/or isopleths from a locoh-hullset object to ESRI's shapefile format

Usage

```
lxy.exp.shp(lhs, id = NULL, k = NULL, r = NULL, a = NULL,
   s = NULL, hs.names = NULL, hpp = FALSE, hulls = FALSE,
   iso = FALSE, nn = FALSE, ellipses = FALSE,
   allpts = FALSE, iso.idx = NULL, iso.metric = NULL,
   dir = ".", file.base = "", file.base.auto = TRUE,
   avl.file = NULL, status = TRUE, show.time = TRUE,
   hm = "all", anv = NULL, hsp = NULL, metadata = TRUE)
```

Arguments

lhs	A LoCoH-hullset object
id	The name(s) of individuals to export
k	The k value of hullsets to export
r	The r value of hullsets to export
a	The a value of hullsets to export
s	The s value of hullsets to export
hs.names	The name(s) of saved hullsets to export
hulls	Export hulls (as a polygon shapefile). T/F
hpp	Export hull parent points (as a point shapefile). T/F
iso	Export isopleths (as a polygon shapefile). T/F
iso.metric	Hull sort metric(s) for the isopleths that will be exported (acts a filter). Character vector.
iso.idx	Numeric vector of the indices of the isopleths that will be exported (acts a filter)
ellipses	Export ellipses (as a polygon shapefile). T/F
allpts	Export all points (as a point shapefile). T/F
nn	Export nearest neighbors (as a multipoint shapefile). T/F
dir	The directory where the shapefiles will be placed (use "." for the working directory, and "~" for the user directory)
file.base	The base of the file name without any extension (the script will append to this)
file.base.auto	Whether to automatically generate the file name base from the id, s-value, and k-a-r value. Ignored if file.base is passed. T/F

avl.file	The name of an existing avl (ArcView legend) file
status	Show messages. T/F
show.time	Report time for script to complete. T/F
hm	The name of hull metric(s) that will be included in the attribute table. Default is 'all'. Applicable only to hulls and hull parent points. Character vector or comma separated string.
anv	The name of ancillary variables(s) of the parent point that will be included in the attribute table. Default is NULL. Applicable only to hulls and hull parent points. Character vector or comma separated string.
hsp	A list containing one hull scatterplot object with regions saved (i.e., object returned by lhs.plot.scatter), or the index of a hull scatter plot saved in the hullset (see lhs.hsp.add). If passed, a column for the region number will be included in the attribute table. Applicable only to hulls and hull parent points.
metadata	Export field descriptions in a meta data file (not yet supported)

Note

Filenames are automatically generated, but the user can specify the directory. Constructed filenames will consist of the file.base (if provided) followed by the name of the hullset and a suffix indicating the type of feature saved (e.g., '.hulls', '.pts', ".iso", etc.). If a shapefile already exists with this, a unique filename will be constructed using two-digit numeric extension

Most of the time, exporting hull parent points (hpp=T) is the same as exporting all points (allpts=T), however in some cases not all points have enough neighbors to make a hull so they wouldn't be included in exported of hull parent points. Only hull parent points will have the corresponding hull metrics included in the attribute table.

avl.file is an ArcView 3.x file that contains symbology info. If a value is passed, the script will make a copy of prj.file with the same base name as the shapefile, so that symbology will automatically created in ArcMap. avl.file is presumed to be relative to the working folder

See Also

lhs.exp.csv

---

lxy.gridanv.add   *Add ancillary variable(s) to a LoCoH-xy object from a raster*

Description

Add ancillary variable(s) to a LoCoH-xy object from a raster

Usage

```
lxy.gridanv.add(lxy, band = 1, dtfn = NULL, fn = NULL,
    anv.name = NULL, anv.desc = NULL,
    date.match = c("closest", "before")[1])
```

Arguments

lxy	LoCoH-xy object
band	Numeric vector of which band(s) to read
dtfn	A two-column data frame containing a date and filename
fn	Filename of a raster
anv.name	The name(s) of the ancillary variable(s) (one per band)
anv.desc	A character vector of descriptions
date.match	How to match dates when dtfn is used: 'closest' or 'before'. See note.

Value

A LoCoH-xy object

Note

This function will create new ancillary variables and fill it with the value of the pixel at each point. The image should be in the same coordinate system as the points. Current the script does not check this. Any points that fall beyond the edges of the image will be given 'NA' values. If an ancillary variable with the same name already exists, it will be overwritten.

The image / raster specified by fn be in a format supported by the readGDAL function in the rdgal package. Multi-band formats are support. If the image has multiple bands, you can specify which band(s) to read using the band parameter. A separate ancillary variable will be created for each band. You can provide name(s) for the ancillary variable(s) with the anv.name parameter.

You can also pass a time-series of images, and the function will use the image that is the closest match in time for each location. To do this, pass a two column data frame to the parameter dtfn. The first column of dtfn must be a date (one of the POSIXt date-time classes), and the second column must be a valid raster filename. If each image is a time composite, (e.g., two-week NDVI), the date should either be the mid-point or the beginning date. Two options for time matching are available: closest = select the image whose date is closest in time, and before = pick the closest image that comes before the location.

---

lxy.id.new   *Change the id value(s) in a LoCoH-xy object*

Description

Changes the id values in a LoCoH-xy object, with option to save the 'old' id values as an ancillary variable

Usage

```
lxy.id.new(lxy, id.new, save.old.id = NULL,
  dup.dt = c("check", "offset", "ignore")[1],
  dup.dt.offset = 5, dt.int.round.to = 0.1,
  tau.diff.max = 0.02, status = TRUE)
```

Arguments

lxy	A LoCoH-xy object
id.new	New value(s) for the id (i.e., name of the individual(s)). Can be either a single character object 'broken_tooth', or factor or character vector of the same length as the number of points
save.old.id	Whether to save the old ids as an ancillary variable. Can be T/F, or the name of a column in the ancillary variables data frame, see Details
dup.dt	What to do if duplicate dt values are encountered in the merged object, see details
dup.dt.offset	The maximum offset in seconds to offset duplicate dt values, used only if $dup.dt =$ "offset"
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (the median delta.t of the entire dataset), expressed as a proportion of tau, that time difference between two points must fall for the distance between those two points to be included in the calculation of the median step length
status	Show status messages. T/F

Details

This function can be used to change the id value for each point. Note that the id value is the name of the individual animal or device, as opposed to ptid which is a unique numeric integer for each point.

tau.diff.max exists to eliminate the inclusion of temporal outliers in the computation of the median step length. The time difference betwen points must be withint tau.diff.max of tau for that pair of points to be included in step length calculation.

One can also use this function to change the id (name of the individual), rebuild the rw.params or table of sampling frequencies

Value

A LoCoH-xy object containing the original xys, dt, ptid and ancillary values for each point. Other items and attributes (including the comment) will be recreated or set to NULL

---

lxy.identify.aoi	*Identify the points that fall within a bounding box*

Description

Identify the points that fall within a bounding box

Usage

```
lxy.identify.aoi(lxy, aoi)
```

Arguments

lxy	A LoCoH-xy object
aoi	Area-of-interest, a two-column xy data frame containing the upper left point and the lower right point in the first and second rows respectively.

Value

A dataframe containing the ptid values and indices of the points from lxy that fall within aoi

Note

This function can be used to identify specific points on a plot. For example, you see a cluster of points on a locoh-xy plot, and want to know when those points were recorded, and so on. To do this, you can use the aoi function to define an area of interest box on the plot window, and then use lxy.identify.aoi to grab the indices and ptid values for that cluster of points. You can then use this information as a parameter in lxy.subset function to create a locoh-xy object containing just that cluster of points.

See Also

aoi, plot.locoh.lxy, lxy.subset

---

lxy.lhs	*Create a LoCoH-hullset object from a LoCoH-xy object*

Description

Creates a LoCoH-hullset object (class "locoh.lhs") containing one or more sets of hulls.

Usage

```
lxy.lhs(lxy, id = NULL, s = 0, a = NULL, r = NULL,
  k = NULL, kmin = 0, anv.copy = TRUE,
  decimal.places = 1, offset.dups = 1,
  velocity.metrics = TRUE, ud = FALSE,
  iso.levels = c(0.1, 0.25, 0.5, 0.75, 0.95),
  pbo.style = 3, beep = FALSE, status = TRUE,
  save.hulls = TRUE, save.enc.pts = TRUE)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) of lxy for which hullsets will be created. If NULL all ids will be used.
s	Value(s) for the s term in the time-scaled-distance equation for point-to-point distance. When s=0 time is excluded and TSD is equivalent to Euclidean distance. Numeric vector or comma-separated string. Can also be 'all'
a	Value(s) for the adaptive method. Numeric vector or comma-separated string. a also be the results of the auto.a function, see notes.
r	Value(s) for the r method. Numeric vector or comma separate list of values.

k	Value(s) for the k method. Numeric vector or comma separate list of values.
kmin	A minimum number of nearest neighbors for each parent point regardless of the method used. Set $k=2$ to ensure that every point is part of a hull. Integer.
decimal.places	Yhe number of decimal places for the k/r/a parameter value used when constructing the name of a hullset. Note this has no effect on hull creation or the precision of values used, only the name of the hullset.
offset.dups	A number of map units to randomly offset duplicate points. Set $offset.dups=0$ to ignore duplicate points
anv.copy	Copy the ancillary variables data frame (if exists), T/F
velocity.metrics	Compute the velocity hull metrics
ud	Whether to also create the default utilization distributions (density isopleths), T/F
iso.levels	Isopleth levels (see also lhs.iso.add), numeric vector. Ignored if |codeud=FALSE.
pbo.style	Progress bar style (see pbapply package)
beep	Beep when done. T/F
status	Show messages. T/F
save.hulls	Whether to save the hulls. T/F
save.enc.pts	Whether to save the enclosed points. T/F

Value

A LoCoH-hullset object (class "locoh.lhs")

Note

This is main function that creates a LoCoH-hullset object. Other functions allow you to do things with the these hulls, including computing additional hull metrics, constructing isopleths, directional routes, generating scatterplots, etc. Note that a nearest neighbors points must have already been identified and saved in the input LoCoH-xy object.

When working with a large dataset where memory limts may affect performance, you can choose to not save the hulls or enclosed points by setting save.hulls=FALSE and save.enc.pts=FALSE. See the workflow for working with large datasets.

See Also

xyt.lxy for creating LoCoH-xy objects lhs.iso.add for adding isopleths lhs.ellipses.add for computing bounding ellipses lhs.visit.add for computing time-use metrics lhs.plot.scatter for creating scatterplots of hull metrics plot.locoh.lhs for plotting a LoCoH-hullset

---

lxy.merge	*Merges LoCoH-xy object*

Description

Merges LoCoH-xy objects together

Usage

```
lxy.merge(..., pts.flds = "all", save.ptid = FALSE,
   new.id = NULL, save.old.id = NULL,
   dt.int.round.to = 0.1, tau.diff.max = 0.02)
```

Arguments

...	LoCoH-xy objects
pts.flds	A character vector of column names to include in the merged object, can also be "all" or NULL
save.ptid	If duplicate ptid values are encounted in the merged object, whether to save the original ptid values as an ancillary variable, T/F
new.id	A new id value for the merged object
save.old.id	A boolean or the name of a ancillary variable where the old id values will be saved
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (the median delta.t of the entire dataset), expressed as a proportion of tau, that time difference between two points must fall for the distance between those two points to be included in the calculation of the median step length

Details

The coordinate system of the LoCoH-xy objects being merged must be the same. Also each lxy object must have the same data columns present, e.g., dt, col, ancillary variables, etc. To merge a subset of the attribute fields, use the pts.flds parameter.

Because LoCoH-xy object must have unique ptid values for each location, if the merged object contains duplicate ptid values new one will be created. If save.ptid=TRUE, the 'old' ptid values will be saved as ptid.orig.

The merged object will no have nearest neighbors table and the random walk parameters will be recomputed.

See Also

lxy.id.new

---

lxy.nn.add *Identifies nearest neighbors for a LoCoH-xy object*

Description

Identifies nearest neighbors for a LoCoH-xy object

Usage

```
lxy.nn.add(lxy, id = NULL, ptid = NULL, k = NULL,
   r = NULL, a = NULL, s = NULL, kmin = 0, ptsh = NULL,
   ptsh.idx = 1,
   nn.exists = c("append", "replace", "skip")[1],
   time.term = c("vmax", "dif")[1],
   FNN.algorithm = c("cover_tree", "kd_tree", "VR", "CR")[2],
   dec.places = 1, ra.init.samp.size = 30,
   ra.init.quant = 0.8, tct = 0.05, beep = FALSE,
   status = TRUE)
```

Arguments

lxy	A LoCoH-xy object
id	The name(s) of individuals to analyze
k	Value for the fixed-k method (identify k nearest neighbors of each point)
r	Value for the fixed-r method (identify all points within radius r)
a	Value for the a method (identify all points within cummulative distance a). Can also be a data frame of parameters returned by the auto.a function.
s	The value for s for the time-scaled distance metric
ptid	A vector of ptid indicating which points should have nearest neighbors identified (can be used to speed up processing during testing)
kmin	A minimum number of neighbors to identify for each point
ptsh	The desired proportion of time-selected hulls [0..1], may also be 'all' if the s-ptsh map has already been computed. See details.
ptsh.idx	The index of the saved ptsh-s table. See also summary.locoh.lhs
nn.exists	What to do if nearest neighbors have already been saved: "append", "replace", or "skip"
time.term	The space-time transformation to use in the TSD distance metric: 'vmax' for the maximum velocity transformation (default) or 'dif' for the diffusion transformation
FNN.algorithm	The algorithm to be used in the get.knnx() function in the package FNN
dec.places	The number of decimal places that rmax and amax should be rounded to
ra.init.samp.size	How many randomly selected points to use to come up with the first guess for how many neighbors to find for each point to satisify a (a-method only)
ra.init.quant	The proportion of randomly selected to points to use for the a value when coming up with an initial guess at the number of neighbors to find for each point to satisify a (a-method only)
tct	Temporal continuity threshhold used when a=auto.a
beep	Beep when done (T/F)
status	Show status messages (T/F)

Details

When s > 0, the 'distance' (as defined by the time-scaled distance metric') between two points is a function of their separation in time as well as space.

If ptsh is provided, the script will find a value of 's' such that the proportion of hulls which are time-selected (e.g, consecutive points in time) is equal to ptsh. In this case, no value for s should be passed. If ptsh="all" and the proportion of time selected hulls has already been computed, those values of 's' will be used.

Value

A LoCoH-xy object object with saved information about each points' nearest neighbors

See Also

summary.locoh.lxy to see what nearest neighbors have already been identified auto.a lxy.ptsh.add

Examples

```
# lxy <- lxy.nn.add(lxy, k=10, s=0.01)
```

---

lxy.plot.freq   *Plots of sampling frequency*

Description

Creates plots of the temporal extent and sampling frequency of a LoCoH-xy object

Usage

```
lxy.plot.freq(lxy, id = NULL, deltat.by.date = F,
  samp.by.date = F, cp = F, cp.min = 0, cp.max = 1,
  time.unit = c("auto", "sec", "min", "hour", "day", "week", "month", "year")[1],
  xlim = NULL, ylim = NULL,
  ylim.deltat.by.date = c(0, 0.999), sbd.y.jiggle = 0.1,
  sbd.vline = NULL,
  sbd.vline.trunc.units.to = c("secs", "mins", "hours", "days")[4],
  cex.pts = 0.3, desc = c(0, 1, 3)[2], cex.desc = 0.8,
  col.desc = "darkgreen", title = NULL,
  title.show = TRUE, subtitle = "auto",
  mar = c(2.8, 2.8, if (title.show) 2.8 else 0.5, 0.5),
  mgp = c(1.8, 0.5, 0), figs.per.page = NULL,
  status = TRUE, panel.num = NULL,
  panel.num.inside.plot = !title.show, png.dir = NULL,
  png.dir.make = TRUE, png.width = 800,
  png.height = png.width, png.overwrite = TRUE,
  png.pointsize = 12 + (png.width - 480)/80, ...)
```

Arguments

lxy	A LoCoH-xy object
id	The id(s) of the individual(s) to include in the plot
deltat.by.date	Produce a plot of the sampling interval by date. T/F
samp.by.date	Produce a scatterplot showing the number of samples by date. T/F
cp	Produce a plot of the cummulative proportion of sampling frequencies. T/F
cp.min	The minimum sampling frequency (expressed as a proportion of tau) shown on the plot
cp.max	The maximum sampling frequency (expressed as a proportion of tau) shown on the plot
time.unit	A unit of time that will be used on the y-axis when plotting frequency by date
xlim	The range for the x-axis. Can be a two-element vector (min, max), NULL (range will be computed from the data), or "same" (same range will be used for all individuals).
ylim	The range for the y-axis.
ylim.deltat.by.date	
	A two-element numeric vector with values 0..1. Will interpret these values as the first and last percentiles of delta.t to plot
sbd.y.jiggle	An amount to 'jiggle' the y values to better see point density
sbd.vline	An interval of time (in seconds) for which vertical lines will be included on the sampling interval by date plot, to help see the dates
sbd.vline.trunc.units.to	
	A character "secs", "mins", "hours" or "days" specifying where to draw the first vertical lines. quantiles of delta.t when setting the range of ylim when deltat.by.date=TRUE
cex.pts	The expansion factor for points on the plot
desc	Which side to display automatically generated desciptive text (e.g. caption). 0=none, 1=bottom, 3=top.
cex.desc	The expansion factor for the descriptive text. Numeric value.
col.desc	The color of the descriptive text. Color value.
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
figs.per.page	The number of plots per page.
status	Show status messages. T/F
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F
subtitle	The plot subtitle. If 'auto' a default subtitle will be used, or pass an empty string '' to omit. Character
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. T/F

png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
...	Additional parameters that will be passed to the plot function

Value

A list of lists, one for each plot containing the filename (NULL if no png made), the image dimensions (NULL), descriptive text, and id

Note

Plotting the cummulative percentage of sampling frequencies (codecp=TRUE) can help determine a threshhold below which pairs of points should be considered to be part of the same 'burst' (see lxy.thin.bursts). For example, if most points are sampled 1 hour apart, but there are a few bursts of points that were only 2 minutes apart, the cumuulative percentage of sampling frequencies will reveal a cluster of sampling intervals around 2 minutes and the majority around 1 hour.

Plotting the sampling frequency over time can help identify gaps in the data as well as frequencies for harmonising sampling frequency

See Also

lxy.thin.bursts, lxy.thin.byfreq

| lxy.plot.mtdr | *Plot distribution of the ratio the maximum theoretical distance ratio for nearest neighbors* |

Description

Plot distributions of the ratio of maximum theoretical distance times 's' over TSD for all unique pairs of nearest neighbors

Usage

```
lxy.plot.mtdr(lxy, s = NULL, k = NULL, a = NULL,
  r = NULL, type = c("mtd.tsd", "mtd.ed")[1],
  offset.dups = 1, id = NULL, show.samp.size = TRUE,
  outline = FALSE, desc = c(0, 1, 3)[2], cex.desc = 0.8,
  col.desc = "darkgreen",
  mar = c(3, 3, if (title.show) 3 else 0.7, 0.5),
  mgp = c(1.9, 0.5, 0), figs.per.page = NULL,
  title = NULL, title.show = TRUE,
  title.obj.name = FALSE, panel.num = NULL,
```

```
    panel.num.inside.plot = !title.show,
    no.sci.notation = FALSE, png.dir = NULL,
    png.dir.make = TRUE, png.width = 800,
    png.height = png.width, png.overwrite = TRUE,
    png.pointsize = 12 + (png.width - 480)/80,
    status = TRUE, ...)
```

Arguments

lxy	A LoCoH-xy object
s	The s value(s) of nearest neighbor sets to include in the plot. If NULL, all values will be used
k	A k-value for the number of nearest neighbors around each point to include in the plot
r	A r-value for the number of nearest neighbors around each point to include in the plot
a	A a-value for the number of nearest neighbors around each point to include in the plot
type	Which ratio to plot: maximum theoretical distance over TSD, or maximum theoretical distance over Euclidean distance
offset.dups	An amount in map units for which pairs of points with the same location but different times will be offset so that a TSD or Euclidean distance can be calculated (see also lxy.lhs)
id	The id(s) of the individual(s) to include in the plot
show.samp.size	Whether to display the sample size of the number of unique pairs of points for each value of s, T/F
outline	Show outliers in the box plots T/F
desc	Which side to display automatically generated desciptive text (e.g. caption). 0=none, 1=bottom, 3=top.
cex.desc	The expansion factor for the descriptive text. Numeric value.
col.desc	The color of the descriptive text. Color value.
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
figs.per.page	The number of plots per page.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F
title.obj.name	Whether to add the name of the lxy object to the plot title (ignored if title is passed). T/F
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	Whether to display panel.num inside the plot area itself, as opposed to the title area. T/F
no.sci.notation	Whether to avoid the use of scientific notation on labels on the x-axis. T/F

png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
status	Display status messages. T/F
...	Additional parameters that will be passed to the plot function

Details

This function plots the ratio of the maximum theoretical distance the individual could have traveled (multiplied by 's') over the total TSD distance metric for all nearests neighbors for the specified value of k/a/r for different values of s. This ratio will of course never be greater than one because the maximum theoretical distance is one of the terms in TSD. The purpose of this function is to see the effect of s on the relative contribution of the time term in the TSD metric.

This function requires that nearest neighbors already be computed. To identify nearest neighbors for a range of 's' values, use lxy.ptsh.add (see examples).

Value

A list of plots created, with one element per id, and each element consisting of another list with elements for the filename (or NULL), filename dimensions in pixels (or NULL), the MTD ratios (as a list with one element for each value of s), descriptive text, and the k/a/r value

Examples

```
## Identify a range of 's' values from space-selection to time-selection, and find 10 nearest neighbors for each value of 's'
# lxy <- lxy.ptsh(lxy, nn=TRUE)
## Plot the ratio of maximum theoretical distance travel to TSD
# lxy.plot.mtdr(lxy)
```

---

lxy.plot.pt2ctr   *Plot distance to centroid over time*

Description

Produces a plot of the distance of each point to the centroid over time to see 'natural' periodicities in the data

Usage

```
lxy.plot.pt2ctr(lxy, id = NULL, idx = NULL, vline = NULL,
    vline.trunc.units.to = c("secs", "mins", "hours", "days")[4],
    figs.per.page = NULL, ...)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) to include on the plot
idx	An optional vector of indices of points that the plot will be restricted to. See notes
vline	An interval of time (in seconds) for the vertical grid lines
vline.trunc.units.to	
	A character value: "secs", "mins", "hours", or "days". Determines where the first vertical grid lines will appear
figs.per.page	The number of figures per page
...	Additional parameters that will be passed to the plot function

Note

The purpose of this graph is to help see the 'natural' movement cycles in a dataset, when no *a priori* information exists that helps identify the time scale of interest. In T-locoh, defining the timescale of interest helps to select a value for s.

To 'zoom in' to a section of the timeline, pass a value for idx. For example, if there are 5000 points in the dataset

If a value is passed for vline, the first vertical line will coincide with a multiple of vline.trunc.units.to. For example, if vline=3600*24(24 hours), and vline.trunc.units.to="days", the first vertical line will be the beginning of a day regardless of when the point series started. This can be helpful for seeing cycles of a specific frequency.

See Also

lxy.plot.sfinder

---

lxy.plot.ptsh   *Plots the proportion of time-selected hulls over 's'*

Description

Plots the proportion of time-selected hulls over 's'

Usage

```
lxy.plot.ptsh(lxy, id = NULL, ptsh.idx = NULL,
  use.nn = FALSE, k = NULL, r = NULL, a = NULL,
  slim = NULL, desc = c(0, 1, 3)[2], cex.desc = 0.8,
  col.desc = "darkgreen", title = NULL,
  title.show = TRUE,
 legend = c("none", "bottomright", "bottom", "bottomleft", "left", "topleft", "top", "topright", "right", "cent
  mar = c(3, 3, if (title.show) 2.8 else 0.7, 0.5),
  mgp = c(1.8, 0.5, 0), figs.per.page = NULL,
  panel.num = NULL, panel.num.inside.plot = !title.show,
  png.dir = NULL, png.dir.make = TRUE, png.width = 800,
  png.height = png.width, png.overwrite = TRUE,
  png.pointsize = 12 + (png.width - 480)/80, ...)
```

Arguments

lxy	A LoCoH-xy object
id	The name(s) of individuals to plot
ptsh.idx	The index number of the saved ptsh table to use (ignored if use.nn=TRUE)
use.nn	Whether to create the plot based on nearest neighbor sets (as opposed to saved ptsh tables, see Details). T/F.
k	Value for the k method if creating the plot based on nearest neighbor tables (ignored if use.nn=FALSE)
r	Value for the r method if creating the plot based on nearest neighbor tables (ignored if use.nn=FALSE)
a	Value for the a method if creating the plot based on nearest neighbor tables (ignored if use.nn=FALSE)
slim	The lower and upper bounds for s, two-element numeric vector
desc	Which side to display automatically generated desciptive text (e.g. caption). 0=none, 1=bottom, 3=top.
cex.desc	The expansion factor for the descriptive text. Numeric value.
col.desc	The color of the descriptive text. Color value.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
legend	A character object specifying where to put the legend (ignored when use.nn=TRUE)
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
figs.per.page	The number of plots per page.
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. T/F
png.dir	The directory for a PNG file (filename will be constructed automatically).
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
...	Additional parameters that will be passed to the plot function

Details

This function will plot the proportion of total hulls that are 'time-selected'. Time-selected means all of the nearest neighbors are were sampled sequentially in time. This is one end of the spectrum as far as nearest neighbor identification goes, the other being space-selected (i.e., time has no bearing). The s parameter in the TSD equation determines the degree to which time plays a role in the point-to-point 'distance'. When $s=0$, time plays no role in TSD and TSD is equivalent to Euclidean

distance. As s increases, time plays a bigger and bigger role until eventually nearest neighbor selection is equivalent to selection points based only on their separation in time.

In order to plot the proportion of time-selected hulls (ptsh), nearest neighbors must have already been identified. This can be done in one of two ways. The lxy.ptsh.add function will compute ptsh for different values of s using a random sample of points (to save time), automatically picking values of s such that ptsh is close to target values provided by the user. Alternately, one can identify nearest neighbors for different values of s using lxy.nn.add and then run this function with use.nn=TRUE. The main difference between lxy.ptsh.add and lxy.nn.add is that lxy.ptsh.add finds nearest neighbors for a random sample of points, and doesn't actually save the nearest neighbor information for individual points, whereas lxy.nn.add identifies and saves nearest neighbor information for each and every point.

Value

A list of lists, one for each plot containing the filename (NULL if no png made), the image dimensions (or NULL), the descriptive text, the id, and a matrix of the values

See Also

lxy.ptsh.add, lxy.nn.add

Examples

```
# data(toni.lxy)
# toni.lxy <- lxy.ptsh.add(toni.lxy)
# lxy.plot.ptsh(toni.lxy)
```

---

lxy.plot.sfinder   *Plot distributions of 's' such that the vmax/diffusion term in TSD are equivalent to the actual displacement*

Description

This will find the value of s that will result in the time term of TSD being approximately equal to the distance term

Usage

```
lxy.plot.sfinder(lxy, id = NULL, delta.t = "auto",
    delta.t.auto.n = 8, delta.t.err = 0.01,
    outline = FALSE, desc = c(0, 1, 3)[2], cex.desc = 0.8,
    col.desc = "darkgreen",
    time.term = c("vmax", "dif")[1],
    mar = c(3, 3, if (title.show) 2.8 else 0.7, 0.5),
    mgp = c(1.8, 0.5, 0), figs.per.page = NULL,
    title = NULL, title.show = TRUE, panel.num = NULL,
    panel.num.inside.plot = !title.show, png.dir = NULL,
    png.dir.make = TRUE, png.width = 800,
    png.height = png.width, png.overwrite = TRUE,
    png.pointsize = 12 + (png.width - 480)/80, ...)
```

Arguments

lxy	A LoCoH-xy object
id	The id(s) of the individual(s) to include in the plot
delta.t	numeric vector of delta.t values (in seconds) for which a s-values will be computed. Can also be 'auto' in which case delta.t.auto.n delta.t values will be computed ranging from 3 * tau to the 80th percent point-to-point interval for the entire dataset
delta.t.auto.n	The number of delta-ts to use when delta.t="auto"
delta.t.err	The proportion of delta.t within which the interval between two points must fall to be included in the plot
outline	Show outliers in the box plots T/F
desc	Which side to display automatically generated desciptive text (e.g. caption). 0=none, 1=bottom, 3=top.
cex.desc	The expansion factor for the descriptive text. Numeric value.
time.term	The type of time term to use ('vmax' is computed as deltaT * maximum possible velocity, while 'dif' computes Gauusian diffusion distance)
col.desc	The color of the descriptive text. Color value.
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
figs.per.page	The number of plots per page.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. T/F
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
...	Additional parameters that will be passed to the plot function

Value

A list of lists, one for each plot containing the filename (NULL if no png made), the image dimensions (or NULL), the descriptive text, the id, and a list of the svals

| lxy.plot.tspan | *Plot distributions of the time span of nearest neighbors* |

Description

Plot distributions of the time span of nearest neighbors as a proportion of the median sampling interval

Usage

```
lxy.plot.tspan(lxy, s = NULL, k = NULL, a = NULL,
   r = NULL, id = NULL,
   type = c("hist", "boxplot", "mean")[1],
   outline = FALSE, breaks = 20, desc = c(0, 1, 3)[2],
   cex.desc = 0.8, col.desc = "darkgreen",
   col.hist = "gray80",
 mar = c(if (type == "hist") 1.5 else 3, 3, if (type == "hist") 2 else if (title.show) 3 else 0.5, 0.5),
   mgp = c(1.9, 0.5, 0), figs.per.page = NULL,
   title = NULL, title.show = TRUE,
   title.obj.name = FALSE, panel.num = NULL,
   panel.num.inside.plot = !title.show, panel.num.cex = 2,
   no.sci.notation = FALSE, png.dir = NULL,
   png.dir.make = TRUE, png.width = 800,
   png.height = png.width, png.overwrite = TRUE,
   png.pointsize = 12 + (png.width - 480)/80,
   status = TRUE, ...)
```

Arguments

lxy	A LoCoH-xy object
s	The s value(s) of nearest neighbor sets to include in the plot. If NULL, all values will be used
k	A k-value for the number of nearest neighbors around each point to include in the plot
r	A r-value for the number of nearest neighbors around each point to include in the plot
a	A a-value for the number of nearest neighbors around each point to include in the plot
id	The id(s) of the individual(s) to include in the plot
type	The type of plot for the time span: 'hist', 'boxplot', or 'mean'
outline	Show outliers in the box plots T/F
breaks	The breaks parameter for a histogram, see hist
desc	Which side to display automatically generated desciptive text (e.g. caption). 0=none, 1=bottom, 3=top.
cex.desc	The expansion factor for the descriptive text. Numeric value.
col.desc	The color of the descriptive text. Color value.
col.hist	The color of the histogram bars. Color value.

mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
figs.per.page	The number of plots per page.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F
title.obj.name	Whether to add the name of the lxy object to the plot title (ignored if title is passed). T/F
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. Ignored if panel.num is NULL. T/F
panel.num.cex	The expansion factor for the panel number. Ignored if panel.num is NULL.
no.sci.notation	Whether to avoid the use of scientific notation on labels on the x-axis. T/F
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
status	Show progress bar and status messages. T/F
...	Additional parameters that will be passed to the plot function

Value

A list of plots created, with one element per id, and each element consisting of another list with elements for the filename (or NULL), filename dimensions in pixels (or NULL), the timespan values (as a list with one element for each value of s), descriptive text, and the k/a/r value

---

lxy.proj.add | *Specify the projection system for a LoCoH-xy object*

Description

Specify the projection system for a LoCoH-xy object

Usage

```
lxy.proj.add(lxy, proj4string = CRS(as.character(NA)))
```

Arguments

lxy	LoCoH-xy object
proj4string	An object of class "CRS", projection string

Details

This function will add projection information to a [LoCoH-xy](#) object. Note this does not reproject coordinates, it only adds or changes the projection information. Any existing projection information will be overwritten.

Value

A [LoCoH-xy](#) object

See Also

[CRS-class](#) for arguments accepted by the [CRS](#) function.

Examples

```
# lxy <- lxy.proj.add(lxy, CRS("+proj=utm +south +zone=34"))
```

---

lxy.ptsh.add   *Compute s vs. proportion-time-selected hulls table*

Description

Identify the values of s that result in proportion p of hulls being time-selected

Usage

```
lxy.ptsh.add(lxy, id = NULL, k = 10, n = 200,
    samp.idx = NULL, sinit = 0.005, ptsh.target = 1:9/10,
    ptsh.max = 0.98, ptsh.buf = 0.01, max.iter = 15,
    max.loops = 10, time.term = c("vmax", "dif")[1],
    FNN.algorithm = c("cover_tree", "kd_tree", "VR", "CR")[2],
    use.nn = FALSE, plotme = TRUE, save = TRUE,
    nn.add = FALSE, use.pb.n = 200,
    ptsh.exists = c("replace", "append")[2], beep = FALSE,
    status = TRUE)
```

Arguments

lxy	A [LoCoH-xy](#) object
id	The name(s) of individuals to analyze
k	Value for the k-method that will be used to create hulls for the sample points (and then used to find the proportion of time-selected hulls)
n	Number of randomly selected points to use as samples (ignored if samp.idx is passed)
samp.idx	A vector of indices of the points to use as samples
sinit	The initial value of *s* that will be used to start the iteration to find that value of *s* that produces a proportion of time selected hulls >= ptsh.max
ptsh.target	A vector of values 0..1 that will serve as the target *ptsh* values. For each ptsh target, script will try to find a value of *s* that generates the targeted proportion of time selected hulls (within ptsh.buf)

`ptsh.max`	The highest value of ptsh for which a value of *s* will be computed. It is generally recommended that this be less than 1.
`ptsh.buf`	The level of accuracy or precison to which the found values of 's' return the targetted ptsh.
`max.iter`	The maximum number of times the script will double sinit in an effort to find the value of s that produces ptsh.max
`max.loops`	The maximum number of intermediate values of s the script will try when 'zooming' in on the target ptsh levels
`time.term`	The space-time transformation to use in the TSD distance metric: 'vmax' for the maximum velocity transformation (default) or 'dif' for the diffusion transformation.
`FNN.algorithm`	The algorithm to be used in the get.knnx() function in the package FNN
`use.nn`	Whether to use saved nearest neighbor sets for the ptsh computations. T/F
`plotme`	Whether to plot the ptsh vs. s curve. T/F
`save`	Whether to save the ptsh-s table in the LoCoH-xy object. T/F
`nn.add`	Whether to also identify and save nearest neighbor sets for all points for *k*=k and the values of *s* identified. T/F
`use.pb.n`	The sample size (i.e., n) above which a progress bar will be displayed
`ptsh.exists`	What to do if there is already a ptsh table in the LoCoH-xy object: 'replace' or 'append'
`beep`	Whether to beep when done. T/F
`status`	Display status messages. T/F

Details

When *s*=0, nearest neighbors are space-selected (i.e., point-to-point distance is merely Euclidean distance). For large values of *s*, nearest neighbors are effectively time-selected (e.g., temporally contiguous). One approach to selecting a value of *s* between these two ends of the spectrum is to pick a *s* value that returns an intermediate proportion of time-selected-hulls representing the desired balance between space and time selection (which in turn is shaped by the research question / objective). This function will find the value(s) of *s* that produce a desired proportion of time-selected-hulls using a randomly-selected subset of points. A general rule of thumb is to pick a value of *s* that results in a proportion of time-selected hulls from 0.4 to 0.6.

The script iteratively tries a variety of *s* values until it finds one that produces the desired proportion of time-selected hulls within a tolerance of `ptsh.buf`. If for example the vector of target values `ptsh.target` includes 0.5, and `ptsh.buf` $= 0.01$, the script will try to find a value of *s* that produces 0.49 to 0.51 time-selected hulls.

See Also

[lxy.nn.add](lxy.nn.add)

---

lxy.repair   *Repair a LoCoH-xy object*

Description

Recreates a LoCoH-xy object

Usage

```
lxy.repair(lxy, fix.dup.ptid = FALSE,
    dt.int.round.to = 0.1, tau.diff.max = 0.02)
```

Arguments

lxy	A LoCoH-xy object
fix.dup.ptid	Generate new ptid value(s) if there are any duplicates
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (the median delta.t of the entire dataset), expressed as a proportion of tau, that time difference between two points must fall for the distance between those two points to be included in the calculation of the median step length

Details

This will return a new lxy object containing the original xys, dt, and ptid from lxy. All other items and attributes (including the comment) will be recreated or set to NULL

Set fix.dup.ptid=TRUE to automatically generate new ptid values if any duplcates are detected. If fix.dup.ptid=FALSE and duplicate ptid values are detected, an error message will result.

tau.diff.max exists to eliminate the inclusion of temporal outliers in the computation of the median step length. The time difference betwen points must be withint tau.diff.max of tau for that pair of points to be included in step length calculation.

Value

A LoCoH-xy object

See Also

xyt.lxy, lxy.id.new, lxy.merge

---

lxy.reproject   *Project or reproject coordinates*

Description

Project or reproject coordinates of a LoCoH-xy object

Usage

```
lxy.reproject(lxy, proj, dt.int.round.to = 0.1,
    tau.diff.max = 0.02, status = TRUE)
```

Arguments

lxy	A LoCoH-xy object
proj	Projection object of class CRS-class
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (expressed as a proportion of tau) that a point-to-point time difference must fall within for the point-to-point distance to be included in the calculation of the median step length
status	Show status messages (T/F)

Details

This function will reproject the locations to a new coordinate system. In order for this to work,

- The coordinate system of the current locations must be recorded. To see the current coordinate system, run summary.locoh.lxy. To add projection information (which you need to get from the source of the data), use lxy.proj.add.
- Argument proj4string which is an object of class CRS-class containing information about the new projection system

Note that not all coordinate systems can be projected into all other coordinate systems. If you get an error message like *'non finite transformation detected'*, the coordinate system you are trying to project into may not be compatible with the existing coordinate system.

See Also

lxy.proj.add, summary.locoh.lxy, CRS

Examples

```
## Not run:
lxy.utm <- lxy.reproject(lxy, CRS("+proj=utm +north +zone=18 +ellps=WGS84"))

## End(Not run)
```

---

lxy.save   *Save a LoCoH-xy object to disk*

Description

Saves a LoCoH-xy object to disk, constructing a file name if needed that reflects the contents

Usage

```
lxy.save(lxy, file = NULL, save.as = NULL, dir = ".",
    suf = NULL, compress = TRUE, auto.num.files = TRUE,
    width = 2)
```

Arguments

lxy	A LoCoH-xy object
file	Optional file name
save.as	The name of the saved object, if NULL the original object name will be used
dir	Directory for the output file (relative to the working directory), ignored if file passed
suf	A suffix that will be used in the construction of the file name, ignored if file is passed
compress	Compress file (T/F)
auto.num.files	Use a numeric token as part of the constructed file name to get a unique file name(T/F)
width	The number of digits in auto.num.files

See Also

xyt.lxy, lhs.save

---

lxy.subset   *Take a subset of a LoCoH-xy object*

Description

Returns a subset of a LoCoH-xy object based on the id, ptid, idx, or dates

Usage

```
lxy.subset(lxy, id = NULL, ptid = NULL, idx = NULL,
    dt.start = NULL, dt.end = NULL, dt.int.round.to = 0.1,
    tau.diff.max = 0.02)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) to include in the subset
ptid	A vector of ptid values for the subset of points
idx	A vector of indices for the subset of points
dt.start	A starting date for the subset. POSIXct object (or something that can be coered to POSIXct)
dt.end	An ending date for the subset. POSIXct object (or something that can be coered to POSIXct)
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (expressed as a proportion of tau) that a point-to-point time difference must fall within for the point-to-point distance to be included in the calculation of the median step length

Value

A LoCoH-xy object

See Also

xyt.lxy, lxy.repair, lxy.thin.byfreq, lxy.thin.bursts, lxy.merge

---

lxy.thin.bursts   *Thins out the 'bursts' in a GPS dataset*

Description

Thin out closely-timed bursts of locations

Usage

```
lxy.thin.bursts(lxy, id = NULL, thresh = NULL,
    replace = c("mean", "median")[2], info.only = FALSE,
    dt.int.round.to = 0.1, tau.diff.max = 0.02,
    status = TRUE)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) to be thinned
thresh	The threshhold for delta.t below which a pair of points is considered to be part of a burst, expressed either as a proportion of the median sampling frequency (0..1) or an absolute unit of time (in seconds)
replace	The burst replacement method ('mean' or 'median')
info.only	Show information about number of bursts (only)

dt.int.round.to   The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)

tau.diff.max   The maximum deviation from tau (the median delta.t of the entire dataset), expressed as a proportion of tau, that time difference between two points must fall for the distance between those two points to be included in the calculation of the median step length

status   Show status messages. T/F

Value

a LoCoH-xy object

Note

This function processes 'bursts' of locations, where a 'burst' is a series of locations captured close together in time. Each group of points in a burst is replaced with a single point. This of course presumes the burst of locations is an artifact of data collection and not desirable.

Many GPS devices have a feature to save 'bursts' of points close together in time (relative to the dominant sampling frequency) The 'burst' feature should not be confused with point averaging, whereby a GPS device internally averages locations for a period of time (e.g., 2 minutes) but saves a single location.

thresh is a value for the sampling interval for identifying which points should be considered part of a burst. thresh can be a proportion of the median sampling frequency (0..1) or an absolute unit of time (in seconds).

To identify whether there are bursts in a LoCoH-xy dataset, and the sampling frequency of those bursts (i.e., the value

The two replacement methods are /codereplace="mean", in which case a burst of locations is replaced by a single point consisting of the spatial and temporal average of the burst, or /codereplace="median" in which case a burst of locations is replaced by the location at the temporal median of the burst. If /codereplace="mean", then any ancillary variables for the 'new' points will be set to NA.

Because this function deletes points, the nearest neighbor lookup table of the LoCoH-xy object (if any) will be deleted, and the parameters for random walk model will be recomputed.

See Also

lxy.plot.freq, lxy.thin.byfreq

---

lxy.thin.byfreq   *Delete locations to harmonize the sampling frequency and time duration*

Description

Standardize the sampling frequency and duration across individuals in a LoCoH-xy object by deleting points

Usage

```
lxy.thin.byfreq(lxy, id = NULL, trim.ends = TRUE,
   dt.start = NULL, dt.end = NULL, byfreq = TRUE,
   samp.freq = "lcm", lcm.round = 120, lcm.max.iter = 300,
   status = TRUE, dt.int.round.to = 0.1,
   tau.diff.max = 0.02)
```

Arguments

lxy	A LoCoH-xy object
id	The id value(s) to be harmonized
trim.ends	Truncate points from either end of the timeline to achieve a common time window, T/F
dt.start	The starting date-time that all individual trajectories will be truncated to. If NULL, the first date-time that all points have in common will be used.
dt.end	The end date-time that all individual trajectories will be truncated to. If NULL, the last date-time that all points have in common will be used.
byfreq	Delete points to achieve a common sampling frequency (samp.freq), T/F
samp.freq	The common time step for the output (in seconds). Can also be set to "lcm", in which case the least common multiple of the median time step of each individual will be computed
lcm.round	When samp.freq="lcm", the median time step for each individual will be rounded to the nearest interval of lcm.round (in seconds)
lcm.max.iter	The maximum number of iterations to be used in the algorithm that finds the least common multiple of the median time steps
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (the median delta.t of the entire dataset), expressed as a proportion of tau, that time difference between two points must fall for the distance between those two points to be included in the calculation of the median step length
status	Show messages, T/F

Value

a LoCoH-xy object

Note

This function processes a LoCoH-xy object that contains movement data for several individuals, and removes points such that the output contains a fixed start and end date for each individual, as well as an approximately uniform sampling frequency (time step).

Before using this function, you should clean your data of all abnormally short time intervals (e.g., bursts). See lxy.thin.bursts.

If you know the time interval the data was *supposed* to be sampled (e.g., every 20 minutes), you should pass that value for samp.freq (expressed in seconds). If samp.freq="lcm", the function will automatically compute the common time step for the individuals by taking the least common

multiple of the median time steps of each individual. You can deal with noise by rounding the median sampling interval to the value of $\mathrm{lcm.round}$ (expressed in seconds).

The function $\mathrm{lxy.plot.freq}$ can help you see the 'actual' sampling intervals in the data (set $\mathrm{by.date}{=}\mathrm{TRUE}$).

Because this function deletes points, the nearest-neighbors lookup table of the LoCoH-xy object (if any) will be deleted.

See Also

xyt.lxy, lxy.plot.freq, lxy.thin.bursts

$\mathrm{matperim}$ *matperim*

Description

matperim

Usage

$\mathrm{matperim(mat)}$

Arguments

mat   2-column matrix representing the xy coordinates of a closed polygon or line
                     segment

Value

The length of the perimeter

---

move.lxy   *Converts a Move object to a LoCoH-xy object*

Description

Converts a Move or MoveStack object from the move package to a LoCoH-xy object

Usage

$\mathrm{move.lxy(move.obj,\ use.utm\ =\ FALSE,\ xcoord\ =\ NULL,}$
$\mathrm{ycoord\ =\ NULL,\ proj\ =\ NULL,\ anv.flds\ =\ NULL,}$
$\mathrm{ptid\ =\ NULL,\ del.dup.xyt\ =\ TRUE,\ dup.dt.check\ =\ TRUE,}$
$\mathrm{dt.int.round.to\ =\ 0.1,\ tau.diff.max\ =\ 0.02,}$
$\mathrm{req.id\ =\ TRUE,\ warn.latlong\ =\ TRUE,\ status\ =\ TRUE)}$

Arguments

`move.obj`	A object of class Move or MoveStack.
`use.utm`	Import UTM coordinates if found *and* all points fall within the same UTM zone (T/F).
`xcoord`	The name of a field in the data table for the x-coordinates. If NULL, the default coordinates will be used.
`ycoord`	The name of a field in the data table for the y-coordinates. If NULL, the default coordinates will be used.
`proj`	Projection object of class CRS-class. Used *only* to specify the coordinate system when the coordinates being imported are coming from the data table
`anv.flds`	The name of field(s) in the Move object data table that will be imported as ancillary variables. Can also be 'all'.
`ptid`	The name of a numeric field in the Move object data table containing unique numeric values for each point. If NULL new point id values will be created.
`del.dup.xyt`	Whether to delete duplicate rows with the same x, y, dt, and id value (T/F).
`dup.dt.check`	Whether to check to make sure there are no duplicate date values for the same id.
`dt.int.round.to`	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps).
`tau.diff.max`	The maximum deviation from tau (expressed as a proportion of tau) that a point-to-point time difference must fall within for the point-to-point distance to be included in the calculation of the median step length.
`req.id`	Require a value for id (T/F).
`warn.latlong`	Show a warning message if it detects coordinates may be in latitude-longitude (T/F).
`status`	Show status messages (T/F).

Value

A LoCoH-xy object

Note

Move and MoveStack are formal classes from the *Move* package for storage of movement data for a single (Move) or multiple (MoveStack) indviduals. `move.lxy` will convert these objects to LoCoH-xy objects. To import the attribute data associated with each point (termed ancillary variables in T-LoCoH), set `anv.flds` to the names of the field(s) you wish to import (or `anv.flds="all"`). Note that the Move and MoveStack classes store a lot more metadata than LoCoH-xy objects, including unused records, which are not supported by the LoCoH-xy data class and are not imported.

See Also

`xyt.lxy`

Examples

```
require(move)
leroy.move <- move(system.file("extdata","leroy.csv.gz",package="move"))
class(leroy.move)
leroy.lxy <- move.lxy(leroy.move, anv.flds=c("ground.speed", "heading"))
summary(leroy.lxy)
```

---

mvee   *mvee*

Description

Computes the minimum volume enclosing ellipsoid around a set of points using the Khachiyan Algorithm. In two dimensions, this is equivalent to the bounding ellipse

Usage

```
mvee(xy = NULL, tolerance = 0.005, plotme = FALSE,
    max.iter = 500, shiftxy = TRUE, no.ellipse.val = 1,
    checks = TRUE)
```

Arguments

xy	a two-column data frame containing x and y coordinates. If NULL then a random sample set of 10 points will be generated
tolerance	a tolerance value
plotme	Plot the points and ellipse (T/F)
max.iter	Maximum number of iterations before giving up. If the script tries this number of iterations but still can't get to the tolerance value, it displays an error message and returns NULL
shiftxy	Apply a shift to the coordinates to make them smaller and speed up the matrix calculations, then reverse the shift to the center point of the resulting ellipoid (T/F)
no.ellipse.val	Determines what the function returns if a mvee can not be found (e.g., if the points are colinear). The default value 1 means a NULL will be returned. A value of 2 means a list of NAs will be returned which is more useful if these values will be stored in a data frame.
checks	Check xy object for the correct data type and remove any duplicate points. T/F

Value

A list containing the "center form" matrix equation of the ellipse. i.e. a 2x2 matrix "A" and a 2x1 vector "C" representing the center of the ellipse such that: (x - C)' A (x - C) <= 1 List elements include A - 2x2 matrix C - 2x1 vector of the center coordinates elps.axes.lngth - 2x1 vector whose elements are one-half the lengths of the major and minor axes (i.e., variables a and b in the standard ellipse equation) alpha - angle of rotation

Note

Adapted by Andy Lyons from Matlab code by Nima Moshtagh. Copyright (c) 2009, Nima Moshtagh http://www.mathworks.com/matlabcentral/fileexchange/9542 http://www.mathworks.com/matlabcentral/fileexchange http://stackoverflow.com/questions/1768197/bounding-ellipse

---

n2z *Convert NULL to a zero*

Description

Convert NULL to a zero

Usage

    n2z(x)

Arguments

    x   Input object

---

plot.locoh.lhs *Plot a LoCoH-hullset object*

Description

Multi-purpose plotting function for a LoCoH-hullset object

Usage

```
plot.locoh.lhs(x, id = NULL, k = NULL, r = NULL,
  a = NULL, s = NULL, hs.names = NULL, iso = FALSE,
  hulls = FALSE, hpp = FALSE, dr = FALSE, nn = FALSE,
  ellipses = FALSE, allpts = FALSE, ptid = NULL,
  ptid.highlight = TRUE, add = FALSE, aoi = NULL,
  iso.idx = NULL, iso.sort.metric = NULL,
  iso.legend = TRUE, legend.space = 0.25,
  dr.metric = NULL, dr.thresh.val = NULL,
  dr.thresh.type = NULL, dr.smooth = NULL, lwd.dr = 2,
  pch.allpts = 16, cex.nn = 2, cex.hpp = 0.6,
  cex.allpts = 0.5, cex.pp = 2, cex.axis = 0.8,
  cex.legend = 0.8, col.hpp = "gray50",
  col.hpp.na = "yellow", col.hulls.border = "gray50",
  col.hulls.fill = NA, col.ellipses = "red",
  col.allpts = c("auto", "gray")[1], col.nn = "black",
  col.nn.pp = "blue", col.iso.fill = 1,
  col.iso.border = NA, col.iso.scale = TRUE,
  col.dr = "red",
  hpp.classify = c("none", "hsp", hm.expr(names.only = TRUE, print = FALSE, desc = FALSE))[1],
  hpp.classify.bins = 10, hpp.classify.chop = 0.01,
  hpp.classify.legend = TRUE,
  hpp.classify.common.scale.discrete = TRUE,
  col.ramp = c("gray10,gray90", "rainbow")[1],
  col.ramp.bins = 10, hsp = NULL, record = FALSE,
  figs.per.page = 1, same.axes.4all = NULL, ufat = TRUE,
```

```
   ufipt = TRUE, axes.show = TRUE, axes.ticks = axes.show,
   axes.titles = axes.show, title = NULL,
   title.show = TRUE,
 title.inc = c("title", "hs.name", "id", "kar", "features", "hpp.classify", "hmap", "ptid")[if (is.null(title)) 3:4 el
 subtitle.inc = c("title", "hs.name", "id", "kar", "features", "hpp.classify", "hmap", "ptid")[if (is.null(title)) 5:
 mar = c(if (axes.titles || axes.ticks) 3.3 else 0.5, if (axes.titles || axes.ticks) 3.2 else 0.5, if (title.show) 3.2 else 0.5
   mgp = c(2, 0.7, 0), lo.save = TRUE,
   lo.margins.set = TRUE,
   desc = c(NONE <- 0, BOTTOM <- 1, TOP <- 3)[ifelse(figs.per.page == 1, 2, 1)],
   cex.desc = 0.8, col.desc = "darkgreen", tiff.fn = NULL,
   tiff.pct = FALSE, tiff.bands = c(4, 3, 2),
   tiff.buff = 500, tiff.fill.plot = TRUE, shp.csv = NULL,
   layers = NULL, png.fn = NULL, png.dir = NULL,
   png.dir.make = TRUE, png.fn.pre = NULL,
   png.fn.mid = NULL, png.fn.suf = NULL,
   png.fn.incld.hs.name = TRUE,
   png.each.plot.separate = TRUE, png.width = 800,
   png.height = png.width,
   png.pointsize = 12 + (png.width - 480)/80,
   png.overwrite = TRUE, sp = 0, status = TRUE,
   panel.num = NULL, panel.num.inside.plot = !title.show,
   hmap = NULL, iso.level = NULL, xlim = NULL,
   ylim = NULL, check.ap.value.in.hmparams = TRUE, ...)
```

Arguments

x	A LoCoH-hullset object
id	The names of the individual(s) to include in the plot.
k	The k value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
r	The r value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
a	The a value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
s	The s value(s) of the hullset(s) to include in the plot. Numeric vector or comma-delimited character object.
hs.names	The name(s) of saved hullsets to include in the plot
iso	Whether to display isopleths. T/F.
hulls	Whether to display hulls. T/F.
hpp	Whether to display hull parent-points. T/F.
dr	Whether to display directional routes. T/F.
nn	Whether to display nearest neighbors (requires that a value for ptid is passed and nearest neighbors were saved when creating the hullset object). T/F.
ellipses	Whether to display bounding ellipses (requires that ellipses were saved when computing ellipses for the hullset). T/F.
allpts	Whether to display all points. T/F.
ptid	One or more ptid (point id) values. A separate plot will be drawn 'zoomed in' to each point indicated. Can also be "auto", in which case ptid will be selected at random. Used primarily to inspect the hull, nearest neighbors, and/or ellipse for specific hulls.

ptid.highlight	Whether to highlight the point specified by ptid. T/F.
add	Whether to add to the existing plot. T/F.
aoi	An area-of-interest object (e.g., box), used to 'zoom in' to specific parts of the plot. aoi objects may be created by the function aoi().
iso.idx	The index(s) of the isopleths to plot. Use the summary() function to see the indices of the isopleths.
iso.sort.metric	The sort metric(s) of the isopleths that will be displayed. Character.
iso.legend	Whether to include a legend for the isopleths.
legend.space	An expansion factor for the x-axis that will be used to make room for the legend.
dr.metric	The name of the metric for the directional routes to be displayed (acts to filter on which directional routes are displayed). See lhs.dr.add
dr.thresh.val	The threshhold value for the directional routes to be displayed (acts to filter on which directional routes are displayed). See lhs.dr.add
dr.thresh.type	The threshhold type for the directional routes to be displayed (acts to filter on which directional routes are displayed). See lhs.dr.add
dr.smooth	The smoothing factor for the directional routes to be displayed (acts to filter on which directional routes are displayed). See lhs.dr.add
lwd.dr	The line width of directional routes.
pch.allpts	The plot character for all points
cex.nn	The expansion factor for nearest neighbor points.
cex.hpp	The expansion factor for hull parent-points.
cex.allpts	The expansion factor for all points.
cex.pp	The expansion factor for the parent point.
cex.axis	The expansion factor for axis labels.
cex.legend	The expansion factor for the legend.
col.hpp	The color of hull parent points. Either a single color value or a vector of color values of the same length as the number of hulls.
col.hpp.na	The color of hull parent points that have no value of the metric specified by hpp.classify. Single color value.
col.hulls.border	The outline color of hulls. Either a single color value or a vector of color values of the same length as the number of hulls.
col.hulls.fill	The fill color of hulls.
col.ellipses	The outline color of bounding ellipses. Either a single color value or a vector of color values of the same length as the number of hulls.
col.allpts	The color of all points. Single color value.
col.nn	The color of nearest neighbors. Single color value.
col.nn.pp	The color of parent-points. Used only when ptid is passed. Single color value.
col.iso.fill	A number corresponding to a preset color ramp that will be used to display the isopleths. 1=red to blue, 2=yellow to red, 3=blue to red, 4=red to yellow. Alternately, a character vector of color values of the same length as the number of isopleth levels.
col.iso.border	Color value of the isopleth border. Color value (use NA for no border).
col.iso.scale	When plotting a subset of isopleths (by ecc or par), whether to scale the isopleth colors to the values of the subset. Not being used.

col.dr   The color of directional routes.

hpp.classify   How to classify hull parent points. May be "none", the name of a hull metric, or
                    "hsp" (hull scatterplot)

hpp.classify.common.scale.discrete
                    Whether to classify hull parent points using a common scale when there are
                    multiple maps produced. Ignored if hpp.classify is 'none' or 'hsp'. T/F.

hpp.classify.bins   The number of equal-interval bins of the hull metric value to create when clas-
                    sifying hull parent-points by a hull metric.

hpp.classify.chop

                    The proportion of hull parent-points at the tails of the distribution to remove
                    when calculating the bins.

hpp.classify.legend

                    Whether to include a legend for the classification of hull parent-points. T/F.

col.ramp   The first and last values of the color ramp to use when classifying hull parent-
                    points by a hull metric. Two-item vector with color values.

col.ramp.bins   The number of bins in the color ramp when classifying hull parent-points by a
                    hull-metric

hsp   The hull scatterplot object to use when displaying hull parent points by a hull
                    scatterplot. May be a hull scatterplot object or the index of a hull scatterplot
                    saved in the hullset.

record   Whether to open a new plot window and turn on recording. T/F.

figs.per.page   The number of plots per page.

same.axes.4all   Whether to use the same axes ranges for all plots. T/F.

ufat   Whether to use user-friendly-axis-titles. T/F.

ufipt   Whether to use user-friendly-isopleth-plot-titles. T/F.

axes.show   Whether to show the axes. T/F.

axes.ticks   Whether to show the tick marks and labels on the axes. T/F.

axes.titles   Whether to show axes titles. T/F.

title   The title to be displayed. Character. If NULL a title will be constructed.

title.show   Whether to show the title. T/F.

title.inc   The element(s) to include in the title (ignored if title is passed)

subtitle.inc   The element(s) to include in the subtitle (ignored if title is passed)

mar   The plot margins. A four item numeric vector.

mgp   The distance away from the edge of the plot for the 1) label, 2) tick marks, and
                    3) axis line. A three-item numeric vector.

lo.save   Whether to save and reset the plot device margin settings (some wrapper func-
                    tions that call this function don't want device settings reset). T/F.

lo.margins.set   Whether to save and reset the plot device margin settings (some wrapper func-
                    tions that call this function don't want device settings reset). T/F.

desc   Which side to display automatically generated desciptive text (e.g. caption).
                    0=none, 1=bottom, 3=top.

cex.desc   The expansion factor for the descriptive text. Numeric value.

col.desc   The color of the descriptive text. Color value.

tiff.fn	The path and name of a GeoTIFF file (e.g., satellite image) that will be displayed in the background. See notes.
tiff.pct	Whether or to convert the GeoTIFF to an indexed 256 color RGB image, which may speed up drawing. T/F.
tiff.bands	A vector of threee integers corresponding to the bands of the GeoTIFF image that will be mapped to the red, green and blue color guns respectively.
tiff.buff	A numeric buffer distance that the range of the plot will be expanded so the points are not right on the edge of the GeoTIFF.
tiff.fill.plot	Whether to fill the entire plot area with the GeoTIFF. T/F.
shp.csv	The path and filename of a csv file that contains information about shapefiles, including layer names, file, and symbology.
layers	The name(s) of layers in shp.csv to display in the background. Will be displayed using the symbology in shp.csv. Character vector or comma delimited string
png.fn	The path and name of the PNG file to create (instead of displaying in a plot window)
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.fn.pre	A prefix that will be used in the construction of the PNG filename. Ignored if png.fn is passed
png.fn.mid	A mid-fix that will be used in the construction of the PNG filename. Ignored if png.fn is passed
png.fn.suf	A suffix that will be used in the construction of the PNG filename. Ignored if png.fn is passed
png.fn.incld.hs.name	
	Whether to include the hullset name as part of the PNG filename. (T/F). Ignored if png.fn is passed
png.each.plot.separate	
	Whether to make each plot in a separate plot / PNG. T/F. Ignored if png.fn is passed
png.width	The width of the PNG image. Ignored if png.fn is passed
png.height	The height of the PNG image. Ignored if png.fn is passed
png.pointsize	The pointsize (in pixels) for the PNG image (increase to make labels appear larger). Equivalent to the height or width of a character in pixels.
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
sp	Special plot number (not used)
status	Whether to show messages. T/F
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area
hmap	A named list of hull metric auxillary parameters, the name of each list element is the name of the variable
iso.level	The isopleth levels to plot, numeric vector

xlim	The lower and upper limit of the x-axis, two-element numeric vector
ylim	The lower and upper limit of the y-axis, two-element numeric vector
check.ap.value.in.hmparams	
	Whether to check if hull metrics exist for the auxillary parameters passed. T/F
...	Other parameters, including any auxillary parameters required by certain hull metrics

Value

If png.fn or png.dir is passed, a list object where each element is a three-element list of the properties of the PNG file(s) created: $fn, $dim, $desc. Otherwise, returns a vector of desc

Note

This is a multi-purpose plotting function for LoCoH-hullset objects. You specify which objects in the hullset to include on the plot by passing parameters.

All hullsets have hulls and hull parent points that can be plotted (e.g., codehulls=TRUE, hpp=TRUE. All hullsets also have the original locations saved and these can be added to the plot by setting allpts=TRUE. Depending how the hullset was created (see lxy.lhs), some hullsets may also have the nearest neighbors for each parent point saved, which can also be plotted (nn=TRUE).

Hullsets for which have bounding ellipses (lhs.ellipses.add) or directional routes (lhs.dr.add) have been computed can have these elements plotted by setting ellipses=TRUE) and dr=TRUE) respectively. If isopleths have been constructed (lhs.iso.add), these can be plotted by setting iso=TRUE. If you only want to plot some of the isopleths, you can specify which one(s) to plot with the parameters iso.idx (the index(s) of the isopleths to plot, see summary.locoh.lhs) or iso.sort.metric.

The plot title can be manually set with the title parameter. If no value for title is passed, a title will be constructed. You can define what elements will go in the title and subtitle (i.e., the second line of the title) with the title.inc and subtitle.inc parameters. To omit the plot title completely, set title.show=FALSE.

tiff.fn, tiff.pct, tiff.buff, tiff.bands, and tiff.fill.plot control the display of a GeoTIFF image in the plot background. The GeoTIFF image must be georeferenced in the same coordinate system as the locoh-hullset object, and the pixel values must be 'prestretched' for display. tiff.bands controls which bands in the TIFF file will be displayed using the red, green, and blue color guns. In a Landsat TM image, for example, the first four bands are blue, green, red, and infrared. To display a TM GeoTIFF image as 'natural colors', you would set tiff.bands=c(3,2,1). If tiff.pct=T, the script will create a indexed 256-color version of the image, which may result in quicker drawing time particularly if several plots are being drawn. tiff.buff can be used to expand the range of values on the x and y axis so that you see a bit of the background image beyond the extent of the points.

---

plot.locoh.lxy	*Plot LoCoH-xy object*

Description

Multi-purpose plotting function for a LoCoH-xy object

Usage

```
 ## S3 method for class 'locoh.lxy'
plot(x, id = NULL, cex = 0.8,
   show.start = TRUE, show.end = TRUE,
   col = c("auto", "gray80")[1], connect.dots = TRUE,
   overlay = FALSE, status = TRUE, title = NULL,
   title.show = TRUE, axes.show = TRUE,
   axes.titles = axes.show, axes.ticks = axes.show,
  mar = c(if (axes.titles || axes.ticks) 3.3 else 0.5, if (axes.titles || axes.ticks) 3.2 else 0.5, if (title.show) 3.2 else 0.5
   mgp = c(2, 0.7, 0), lo.save = TRUE, panel.num = NULL,
   panel.num.inside.plot = !title.show, png.fn = NULL,
   png.dir = NULL, png.dir.make = TRUE, png.width = 800,
   png.height = png.width, png.overwrite = TRUE,
   png.pointsize = 12 + (png.width - 480)/80,
   tiff.fn = NULL, tiff.bands = c(3, 2, 1),
   tiff.pct = FALSE, tiff.buff = 500,
   tiff.fill.plot = TRUE, layers = NULL, shp.csv = NULL,
   xlim = NULL, ylim = NULL, ...)
```

Arguments

x	A LoCoH-xy object
id	A vector of the id value(s) to plot
cex	Character expansion factor for the points
show.start	Whether to highlight the starting location (if time stamps are present) in green. T/F.
show.end	Whether to highlight the end location (if time stamps are present) in red. T/F.
col	A single value or vector of color values. Can also be 'auto' in which case the colors saved in lxy will be used (which are rainbow by default).
connect.dots	Whether to draw line segments between consecutive locations. T/F.
overlay	Whether to overlay the plots of all individuals in lxy on one pair of axes (map). T/F.
status	Display status messages. T/F.
title	The title to be displayed. Character. If NULL a title will be constructed.
title.show	Whether to show the title. T/F.
axes.show	Whether to show the axes. T/F.
axes.titles	Whether to show axes titles. T/F.
axes.ticks	Whether to show the tick marks and labels on the axes. T/F.
mar	The plot margins. A four item numeric vector
mgp	The distance away from the edge of the plot for the 1) label, 2) tick marks, and 3) axis line. A three-item numeric vector
lo.save	Whether to save and reset the plot device margin settings (some wrapper functions that call this function don't want device settings reset). T/F.
panel.num	A number or letter to display in the upper left hand corner of the plot when the plot will be used as part of a multi-frame graphic (as in publications). Character
panel.num.inside.plot	
	Whether to display panel.num inside the plot area itself, as opposed to the title area. T/F

png.fn	The path and name of the PNG file to create (instead of displaying in a plot window)
png.dir	The directory for a PNG file (filename will be constructed automatically). Ignored if png.fn is passed
png.dir.make	Whether to create png.dir if it doesn't exist. T/F
png.width	The width of the PNG image
png.height	The height of the PNG image
png.overwrite	Whether to overwrite an existing PNG file if it exists. T/F
png.pointsize	The pointsize (in pixels) for the PNG image, equivalent to the height or width of a character in pixels (increase to make labels appear larger)
tiff.fn	The path and name of a GeoTIFF file (e.g., satellite image) that will be displayed in the background. See notes.
tiff.bands	A vector of threee integers corresponding to the bands of the GeoTIFF image that will be mapped to the red, green and blue color guns respectively.
tiff.pct	Whether or to convert the GeoTIFF to an indexed 256 color RGB image, which may speed up drawing. T/F.
tiff.buff	A numeric buffer distance that the range of the plot will be expanded so the points are not right on the edge of the GeoTIFF.
tiff.fill.plot	Whether to fill the entire plot area with the GeoTIFF. T/F.
layers	The name(s) of layers in shp.csv to display in the background. Will be displayed using the symbology in shp.csv. Character vector or comma delimited string
shp.csv	The path and filename of a csv file that contains information about shapefiles, including layer names, file, and symbology.
xlim	The lower and upper limit of the x-axis, two-element numeric vector
ylim	The lower and upper limit of the y-axis, two-element numeric vector
...	Additional parameters that will be passed to the plot function

---

| secs.fmt | *Format a number of seconds as minutes, hours or days* |

Description

Returns a formated version of a time value

Usage

```
secs.fmt(secsVal, round.pos = 1)
```

Arguments

| secsVal | a time value (in seconds) |
| round.pos | The number of decimal places in the formatted string |

Value

a character string

Note

This function only works with a single value. To format a multiple time values stored in a vector, use sapply or lapply

Based on the value of secsVal, the formatted version will be converted to days, hours, minutes, or seconds

---

square | *square*

Description

square

Usage

square(x)

Arguments

x   Input object

---

strSplitAtChar | *Split a character object into multiple lines*

Description

Split a character object at a specific character to wrap to multiple lines for plotting

Usage

strSplitAtChar(object, size, char = ".",
    separator = paste("\n", char, sep = ""), ...)

Arguments

object	Input character vector (should be length 1)
size	The maximum number of characters in one piece
char	The character to split the input string at
separator	The character to use as a separator in the returned object
...	Other arguments (unused)

Details

This will take a long character object and split it into pieces at character char such that the length of each piece is <= size. If separator is passed, the individual pieces will be concatenated using the separator character and returned as a character vector of length 1. Otherwise each piece will be returned as a separate element of a character vector.

---

strTrim   *Trim leading and/or trailing blanks from a character object*

Description

Trim leading and/or trailing blanks from a character object

Usage

strTrim(str, side = "both")

Arguments

str   Input string

side   Which side(s) of the input string to trim: 'left', 'right', or 'both'

---

summary.locoh.lhs   *Show summary of a LoCoH-hullset*

Description

Displays a summary of a LoCoH-hullset object

Usage

```
## S3 method for class 'locoh.lhs'
summary(lhs, file = "", id = NULL,
    k = NULL, r = NULL, a = NULL, s = NULL,
    hs.names = NULL, iso.details = FALSE, desc = FALSE,
    compact = FALSE, ...)
```

Arguments

lhs   A LoCoH-hullset object

file   A file name

id   The name(s) of individuals to summarize

k   The k value of hullsets to summarize

r   The r value of hullsets to summarize

a   The a value of hullsets to summarize

s   The s value of hullsets to summarize

hs.names   The name(s) of hullsets to summarize

iso.details   Display details of the isopleths. T/F

desc   Display the hullset description. T/F

compact   Use a compact format. T/F

...   Other arguments

---

summary.locoh.lxy *Show a summary of a LoCoH-xy object*

Description

Prints a summary of a locoh xy object (set of locations)

Usage

```
## S3 method for class 'locoh.lxy'
summary(lxy, file = "",
  dt.int = FALSE, round.coords = 1, ptsh = FALSE, ...)
```

Arguments

lxy	A LoCoH-xy object
file	A file name where the results will be saved
dt.int	Whether to show a summary of the sampling interval
round.coords	The number of digits to display for the coordinates of the spatial extent
ptsh	Show table of 's' and proportion of time selected hulls values (if available)
...	Other arguments

See Also

lxy.plot.freq, lxy.ptsh.add

---

textContrastColor *Choose a white or black plot background for a particular color of text*

Description

Choose a white or black plot background for a particular color of text

Usage

```
textContrastColor(x, ...)
```

Arguments

x	A color value
...	Other arguments (not used)

---

toni   *Tracking data for one buffalo in South Africa*

Description

This dataframe contains the locations from a GPS collar fitted to a buffalo in Kruger National Park, South Africa in 2005-06.

Format

A dataframe with 6371 rows. Columns are id, lat, long, and timestamp (in UTC). Datum presumed to be WGS84.

Source

MoveBank http://www.movebank.org

Name: Kruger African Buffalo, GPS tracking, South Africa

Acknowledgements: Collection of Kruger Park Buffalo data funded by NSF Grant DEB-0090323 to Wayne M. Getz

Principal Investigator Name: Paul Cross

Examples

```
data(toni)
head(toni)
plot(toni[,2:3])
```

---

tsd.zvals   *Space-time transformation term for TSD*

Description

Returns the values for the "time axis" of the TSD distance metric

Usage

```
tsd.zvals(delta.t, sVal, type, d.bar = NULL, tau = NULL,
    vmax = NULL)
```

Arguments

delta.t	is the time difference in seconds
sVal	is the value of S
type	The type of space-time transformation: 'vamx' for the maximum velocity transformation, or 'dif' for diffusion
d.bar	is the median step length (for the entire dataset)
tau	is the median sampling interval (for the entire dataset)
vmax	The maximum velocity parameter (used only when type='vmax')

---

xyt.lxy   *Create a LoCoH-xy object*

Description

Creates a LoCoH-xy object from a set of location data

Usage

```
xyt.lxy(xy, dt = NULL, tz = NULL, id = NULL, ptid = NULL,
    proj4string = CRS(NA), anv = NULL, anv.desc = NULL,
    col = NULL, del.dup.xyt = TRUE, dup.dt.check = TRUE,
    dt.int.round.to = 0.1, tau.diff.max = 0.02,
    req.id = TRUE, warn.latlong = TRUE, status = TRUE)
```

Arguments

xy	A two-column matrix or data frame containing the xy coordinates of the points
dt	Optional vector of date-time values (either POSIXct objects or objects that can be coerced to POSIXct)
id	Optional character vector or factor containing the name(s) of the individual(s) of each location.
ptid	Optional integer vector of point id values
proj4string	Projection string object of class CRS-class
anv	Optional ancillary variables for each point (data frame with same number of records as xy)
anv.desc	Optional character vector with descriptions of the ancillary variables (in the same order as they appear in anv)
tz	The name of the time zone that will be assigned if not explicit in dt.
del.dup.xyt	Whether to delete duplicate rows with the same x, y, dt, and id value. (T/F)
dup.dt.check	Whether to check to make sure there are no duplicate date values for the same id
col	Optional vector of color values (one for each point), or a single color value
dt.int.round.to	The proportion of the median sampling frequency that time intervals will be rounded to when computing the frequency table of sampling intervals (no change is made to the time stamps)
tau.diff.max	The maximum deviation from tau (expressed as a proportion of tau) that a point-to-point time difference must fall within for the point-to-point distance to be included in the calculation of the median step length
req.id	Require a value for id (T/F)
warn.latlong	Show a warning message if coordinates appear to be in geographic coordinates (T/F)
status	Show status messages (T/F)

Value

A object of class locoh.lxy

Note

At a minimum, a locoh-xy object contains a set of points. It can also contain date-time values for each point, the name of the individual(s) associated with each point, and a nearest nieghbors lookup table.

Providing values for ptid enables linking the hulls and hull metrics generated by tlocoh to other variables assoicated with each point that are not used by T-locoh (e.g., humidity)

Importing date-time values into R is often a painful process. You may want to try exporting your date-time values from your spreadsheet or database as a character field that is formatted in a style that R will recognize as a time. To see a date-time format that R will be able to convert to a date- time object (class POSIXct), type in R $Sys.time()$. Once you've noted the date-time format recognized by R, try to format the date field in your spreadsheet or database in a similar manner, then export the values in a text format (e.g., csv). For example in MS Access, you can use the $format()$ function as part of a query to format a date field, e.g. $format(PointDate, "yyyy-mm-dd hh:nn:ss")$. In Excel, you can go to Format - Cells and give the date-time cells a custom format $yyyy-mm-dd$ $hh:mm:ss$.

The time zone paramter tz is optional. If tz is omitted, R will try to get the timezone from dt, and if there is no timezone specified set it to UTC. Valid timezone names are to some extent OS specific, see http://en.wikipedia.org/wiki/List_of_zoneinfo_time_zones. If dt is of class POSIXct (which stores the time zone) and a different value for tz is passed, a prompt will ask whether date values should be converted.

Other variables, including environmental variables or biometric variables can be brought in using the anv parameter. These variables can then be used in hull metrics (see also xxx).

See Also

lxy.nn.add, lxy.repair, lxy.subset

Examples

```
## Not run:
#Create an unbounded random walk as a sample dataset
n <- 500; stepsize <- 5
theta <- runif(n, min=0, max=2*pi)
start <- c(100,100)
xy <- data.frame(x=start[1]+cumsum(stepsize * cos(theta)), y=start[2]+cumsum(stepsize*sin(theta)))
plot(xy, pch=20, type="b", lty=1)
timestamps <- Sys.time() + 3600 * (1:n-1)

#Combine the xy locations and timestamps into a \link{LoCoH-xy} object
lxy <- xyt.lxy(xy=xy, dt=timestamps, id="broken_tooth")
summary(lxy)

## End(Not run)
```