

# Package ‘soccermatics’

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**Version** 0.9.3

**Title** Visualise tracking and event data from soccer matches

**Description** Provides tools to visualise x,y-coordinates of soccer players and event data (passes, shots). Uses ggplot to draw soccer pitch and overplot expected goal maps, pass maps, average player positions, player heatmaps, individual player paths, player flow fields, and more.

**Depends** R (>= 3.4.1)

**Imports** dplyr, magrittr, ggplot2, ggforce, zoo

**License** GPL (>=3.0) Note: Use of the name 'soccermatics' was kindly permitted by David Sumpter and is protected from commercial use under EU copyright law.

**Encoding** UTF-8

**LazyData** true

**Collate** 'soccerFlipDirection.R'

'soccerPitch.R'

'soccerHeatmap.R'

'soccerPassmap.R'

'soccerPath.R'

'soccerPitchBG.R'

'soccerPitchFG.R'

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'tromso.R'

'tromso\_extra.R'

**RoxygenNote** 6.0.1

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soccerFlipDirection	<i>Flips x,y-coordinates horizontally in one half to account for changing sides at half-time</i>
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## Description

Normalises direction of attack in both halves of both teams by flipping x,y-coordinates horizontally in either the first or second half; i.e. teams attack in the same direction all game despite changing sides at half-time.

## Usage

```
soccerFlipDirection(df, lengthPitch = 105, widthPitch = 68,
  teamToFlip = NULL, periodToFlip = 1, period = "period", team = "team",
  x = "x", y = "y")
```

## Arguments

df	= dataframe containing unnormalised x,y-coordinates
lengthPitch, widthPitch	= length, width of pitch in metres
periodToFlip	= identity of period to flip
period	= name of variable containing period labels
x, y	= name of variables containing x,y-coordinates

## Value

a dataframe

## Examples

```
# fake period data for tromso dataset, and flip direction of '2nd half'
tromso %>%
  mutate(period = if_else(t > as.POSIXct("2013-11-07 21:14:00 GMT"), 1, 2))
  soccerFlipDirection(lengthPitch = 120, widthPitch = 80, periodToFlip = 2)
```

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soccerHeatmap

*Draw a heatmap on a soccer pitch.*


---

## Description

Draws a heatmap showing player position frequency in each area of the pitch and adds soccer pitch outlines.

## Usage

```
soccerHeatmap(df, lengthPitch = 105, widthPitch = 68, xBins = 10,
  yBins = NULL, arrow = c("none", "r", "l"), colLow = "white",
  colHigh = "red", title = NULL, subtitle = NULL, x = "x", y = "y")
```

## Arguments

df	dataframe containing x,y-coordinates of player position
lengthPitch, widthPitch	numeric, length and width of pitch in metres.
xBins, yBins	integer, the number of horizontal (length-wise) and vertical (width-wise) bins the soccer pitch is to be divided up into. If no value for yBins is provided, it will take the value of xBins.
arrow	optional, adds arrow showing team attack direction as right ('r') or left ('l')
colLow, colHigh	character, colours for the low and high ends of the heatmap gradient.
title, subtitle	optional, adds title and subtitle to plot
x, y	= name of variables containing x,y-coordinates

## Details

uses `ggplot2::geom_bin2d` to map 2D bin counts

## Value

a ggplot object of a heatmap on a soccer pitch.

## Examples

```
# Heatmap of Tromso IL #8 position w/ ~5x5m bins (pitchLength / 5 = 21, pitchWidth / 5 = 13.6)
data(tromso)
tromso %>%
  filter(id == 8) %>%
  soccerHeatmap(xBins = 10)

# Heatmap of France w/ 6x3 zones
statsbomb %>%
  filter(type.name == "Pressure" & team.name == "France") %>%
  soccerHeatmap(x = "location.x", y = "location.y", xBins = 6, yBins = 3,
    arrow = "r",
    title = "France (vs Argentina, 30th June 2016)",
```

```
subtitle = "Defensive pressure heatmap")
```

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soccerPassmap

*Draw a passing network using StatsBomb data*


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## Description

Draw an undirected passing network of completed passes on pitch from StatsBomb data. Nodes are scaled by number of successful passes; edge width is scaled by number of successful passes between each node pair. Only passes made until first substitution shown (ability to specify custom minutes will be added soon). Total number of passes attempted and percentage of completed passes shown. Compatibility with other (non-StatsBomb) shot data will be added soon.

## Usage

```
soccerPassmap(df, lengthPitch = 105, widthPitch = 68, minPass = 3,
  fill = "red", col = "black", edgeAlpha = 0.6, edgeCol = NULL,
  label = TRUE, shortNames = TRUE, maxNodeSize = 30, maxEdgeSize = 30,
  labelSize = 4, arrow = c("none", "r", "l"), theme = c("light", "dark",
  "grey", "grass"), title = NULL)
```

## Arguments

df	dataframe containing x,y-coordinates of player passes
lengthPitch, widthPitch	numeric, length and width of pitch, in metres
fill, col	fill and border colour of nodes
edgeAlpha	transparency of edge lines, from 0 - 1. Defaults to 0.6 so overlapping edges are visible.
edgeCol	colour of edge lines. Default is complementary to theme colours.
label	boolean, draw labels
shortNames	shorten player names to display last name as label
maxNodeSize	maximum size of nodes
maxEdgeSize	maximum width of edge lines
labelSize	size of player name labels
arrow	optional, adds arrow showing team attack direction as right ('r') or left ('l')
theme	draws a light, dark, grey, or grass coloured pitch
title	adds custom title to plot. Defaults to team name.

## Examples

```
# France vs. Argentina, minimum of three passes
library(dplyr)
library(soccermatics)

# Argentina pass map until first substitution with transparent edges
statsbomb %>%
```

```

filter(team.name == "Argentina") %>%
  soccerPassmap(fill = "lightblue", arrow = "r",
                title = "Argentina (vs France, 30th June 2018)")

# France pass map until first substituton with opaque edges
statsbomb %>%
  filter(team.name == "France") %>%
  soccerPassmap(fill = "blue", minPass = 3,
                maxEdgeSize = 30, edgeCol = "grey40", edgeAlpha = 1,
                title = "France (vs Argentina, 30th June 2018)")

```

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soccerPath	<i>Draw a path of player trajectory on a soccer pitch.</i>
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---

## Description

Draws a path connecting consecutive x,y-coordinates of a player on a soccer pitch.

## Usage

```

soccerPath(df, lengthPitch = 105, widthPitch = 68, col = "black",
  arrow = c("none", "r", "l"), theme = c("light", "dark", "grey", "grass"),
  lwd = 1, title = NULL, subtitle = NULL, legend = FALSE, x = "x",
  y = "y", id = NULL, plot = NULL)

```

## Arguments

df	dataframe containing x,y-coordinates of player position
lengthPitch, widthPitch	length and width of pitch in metres
col	colour of path if no 'id' is provided. If an 'id' is present, colours from Color-Brewer's 'Paired' palette are used
arrow	optional, adds arrow showing team attack direction as right ('r') or left ('l')
theme	draws a light, dark, grey, or grass coloured pitch
lwd	player path thickness
title, subtitle	optional, adds title and subtitle to plot
legend	boolean, include legend
x, y	= name of variables containing x,y-coordinates
id	character, the name of the column containing player identity (only required if 'df' contains multiple players)
plot	plot to add path to, if desired

## Value

a ggplot object

## Examples

```
data(tromso)
# draw path of Tromso #8 over first 3 minutes (1800 frames)
subset(tromso, id == 8)[1:1800,] %>%
  soccerPath(col = "red", grass = TRUE, arrow = "r")

# draw path of all Tromso players over first minute (600 frames)
tromso %>%
  dplyr::group_by(id) %>%
  dplyr::slice(1:1200) %>%
  soccerPath(id = "id")
```

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soccerPitch	<i>Plot a full soccer pitch</i>
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## Description

Draws a soccer pitch as a ggplot object for the purpose of adding layers such as player positions, player trajectories, etc..

## Usage

```
soccerPitch(lengthPitch = 105, widthPitch = 68, arrow = c("none", "r",
  "l"), title = NULL, subtitle = NULL, theme = c("light", "dark", "grey",
  "grass"))
```

## Arguments

lengthPitch, widthPitch	length and width of pitch in metres
arrow	optional, adds arrow showing team attack direction as right ('r') or left ('l')
title, subtitle	optional, adds title and subtitle to plot
theme	draws a light, dark, grey, or grass coloured pitch
fillPitch, colPitch	pitch fill and line colour

## Value

a ggplot object

## Examples

```
# custom plot of France defensive pressure events vs. Argentina
data(statsbomb)
soccerPitch(arrow = "r", theme = "grass",
  title = "France (vs. Argentina)",
  subtitle = "Pressure events") +
  geom_point(data = filter(statsbomb, team.name == "France" & type.name == "Pressure"),
    aes(x = location.x, y = location.y),
    col = "blue", alpha = 0.5)
```

---

soccerPitchFG	<i>Helper function to draw soccer pitch outlines over an existing ggplot object</i>
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---

### Description

Adds soccer pitch outlines (with transparent fill) to an existing ggplot object (e.g. heatmaps, passing maps, etc..)

### Usage

```
soccerPitchFG(plot, lengthPitch = 105, widthPitch = 68,
  colPitch = "black", arrow = c("none", "r", "l"), title = NULL,
  subtitle = NULL)
```

### Arguments

plot	an existing ggplot object to add pitch lines to
lengthPitch, widthPitch	length and width of pitch in metres
colPitch	pitch fill and line colour
arrow	optional, adds arrow showing team attack direction as right ('r') or left ('l')
title, subtitle	optional, adds title and subtitle to plot

### Value

a ggplot object

### See Also

[soccerPitch](#) for plotting a soccer pitch for the purpose of drawing over event data, average position, player trajectories, etc..

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soccerPitchHalf	<i>Draws a vertical half soccer pitch for the purpose of plotting shotmaps</i>
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---

### Description

Adds soccer pitch outlines (with transparent fill) to an existing ggplot object (e.g. heatmaps, passing maps, etc..)

### Usage

```
soccerPitchHalf(lengthPitch = 105, widthPitch = 68, arrow = c("none", "r",
  "l"), theme = c("light", "dark", "grey", "grass"), title = NULL,
  subtitle = NULL)
```

**Arguments**

lengthPitch, widthPitch  
length and width of pitch in metres

arrow  
optional, adds arrow showing team attack direction as right ('r') or left ('l')

theme  
draws a light, dark, grey, or grass coloured pitch

title, subtitle  
optional, adds title and subtitle to plot

**Value**

a ggplot object

**See Also**

[soccerShotmap](#) for plotting a shotmap on a half pitch or [soccerPitch](#) for drawing a full size soccer pitch

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soccerResample	<i>Resample the frequency of x,y,t- time series with linear interpolation of x,y-coordinates.</i>
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**Description**

Downsample or upsample dataframe containing x,y-coordinates and a time variable 't' with linear interpolation of x,y-coordinates and constant interpolation of all other variables.

**Usage**

```
soccerResample(dat, r = 10, x = "x", y = "y", z = "z", t = "t")
```

**Arguments**

dat  
= dataframe containing x,y-coordinates with time variable

r  
resampling rate in frames per second

x, y, z  
= name of variables containing x,y(z)-coordinates

t  
= name of variable containing time data

**Value**

a dataframe

**Examples**

```
# resample tromso dataset from ~21 fps to 10 fps
soccerResample(tromso)
```



---

soccerShortenName	<i>Extract player surname</i>
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**Description**

Helper function to extract last name (including common nobiliary particles) from full player names

**Usage**

```
soccerShortenName(names)
```

**Arguments**

names	vector of strings containing full player name
-------	---

**Examples**

```
attach(statsbomb)
statsbomb$name <- soccerShortenName(statsbomb$player.name)
```

---

soccerShotmap	<i>Draw an individual, team, or two team shotmap using StatsBomb data</i>
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---

**Description**

If df contains two teams, draws a shotmap of each team at either end of a full pitch. If df contains one or more players from a single team, draws a vertical half pitch. Currently only works with StatsBomb data but compatability with other (non-StatsBomb) shot data will be added soon.

**Usage**

```
soccerShotmap(df, lengthPitch = 105, widthPitch = 68, homeTeam = NULL,
  theme = c("light", "dark", "grey", "grass"), title = NULL,
  subtitle = NULL)
```

**Arguments**

lengthPitch, widthPitch	length and width of pitch, in metres
homeTeam	if df contains two teams, the name of the home team to be displayed on the left hand side of the pitch. If NULL, infers home team as the team of the first event in df.
theme	draws a light, dark, grey, or grass coloured pitch with appropriate point colours
title, subtitle	optional, adds title and subtitle to half pitch plot. Title defaults to scoreline and team identity when two teams are defined in df.

**Value**

a ggplot object

**Examples**

```
data(statsbomb)

# shot map of two teams on full pitch
statsbomb %>%
  soccerShotmap(theme = "gray")

# shot map of one player on half pitch
statsbomb %>%
  filter(player.name == "Antoine Griezmann") %>%
  soccerShotmap(theme = "grass",
                 title = "Antoine Griezmann",
                 subtitle = "vs. Argentina, World Cup 2018")
```

---

soccerTransform	<i>Normalises x,y-coordinates to metres units for use with soccermatics functions</i>
-----------------	---

---

**Description**

Normalises x,y-coordinates from between any arbitrary bounds to metre units bounded by  $[0 < x < \text{pitchLength}, 0 < y < \text{pitchWidth}]$

**Usage**

```
soccerTransform(dat, xMin, xMax, yMin, yMax, lengthPitch = 105,
                widthPitch = 68, method = c("manual", "statsbomb", "opta"))
```

**Arguments**

```
dat          dataframe containing unnormalised x,y-coordinates named 'x' and 'y'
xMin, xMax, yMin, yMax
              range of x,y-coordinates possible in the raw dataset
pitchLength, pitchWidth
              length, width of pitch in metres
```

**Value**

a dataframe

**Examples**

```
# Three examples with true pitch dimensions (in metres):
lengthPitch <- 101
widthPitch <- 68

# Example 1. Opta-style -----
```

```

# limits = [0 < x < 100, 0 < y < 100]
# centre of pitch = [50,50]

opta_df <- data.frame(t = 1:12,
                      x = c(50,55,61,66,62,58,51,44,45,42,41,32),
                      y = c(50,48,47,40,42,45,49,51,59,75,88,100))

opta_df <- soccerTransform(opta_df, 0, 100, 0, 100, lengthPitch, widthPitch)

soccerPath(opta_df, lengthPitch = lengthPitch, widthPitch = widthPitch)

# Example 2. StrataBet-style -----
# limits = [0 < x < 420, -136 < y < 136]
# centre of pitch = [210,0]

stratabet_df <- data.frame(t = 1:12,
                           x = c(210,222,201,192,178,170,143,122,104,91,75,60),
                           y = c(0,-5,-20,-12,-8,-2,4,8,13,20,30,45))

stratabet_df <- soccerTransform(stratabet_df, 0, 420, -136, 136, lengthPitch, widthPitch)

soccerPath(stratabet_df, lengthPitch = lengthPitch, widthPitch = widthPitch)

# Example 3. Other -----
# limits = [-5250 < x < 5250, -3400 < y < 3400]
# centre of pitch = [0,0]

xMin <- -5250
xMax <- 5250
yMin <- -3400
yMax <- 3400

df <- data.frame(x = c(0,-452,-982,-1099,-1586,-2088,-2422,-2999,-3200,-3857),
                 y = c(0,150,300,550,820,915,750,620,400,264))

df <- soccerTransform(df, -5250, 5250, -3400, 3400, lengthPitch, widthPitch)

soccerPath(df, lengthPitch = lengthPitch, widthPitch = widthPitch)

```

---

soccerVelocity	<i>Compute instantaneous distance, speed and direction from x,y-coordinates</i>
----------------	---

---

## Description

Compute instantaneous distance moved (in metres), speed (in metres per second), and direction (in radians) between subsequent frames in a dataframe of x,y-coordinates.

## Usage

```
soccerVelocity(dat)
```

**Arguments**

`dat` dataframe containing unnormalised x,y-coordinates 'x' and 'y', time variable 't', and identifier 'id'

**Value**

a dataframe

**Examples**

```
# calculate distance, speed, and direction for tromso dataset
soccerVelocity(tromso)
```

---

statsbomb	<i>Sample StatsBomb event data containing the x,y-locations and identity of players involved in pass events, shot events, defensive actions, and more.</i>
-----------	--

---

**Description**

Sample StatsBomb event data from the France vs. Argentina World Cup 2018 game on the 30th June 2018, made publicly available by StatsBomb [here](#). Data contains 145 variables in total, including x,y-coordinates (location.x, location.y). StatsBomb pitch dimensions are 120m long and 80m wide, meaning lengthPitch should be specified as 120 and widthPitch as 80. Event data for all World Cup games (and other competitions) are accessible via the StatsBombR package available [here](#).

**Usage**

```
data(statsbomb)
```

**Format**

A dataframe containing 12000 frames of x,y-coordinates and timestamps from 11 players.

**Source**

[ZXY Sport Tracking](#)

**References**

[StatsBomb Open Data](#)

**Examples**

```
data(statsbomb)

# heatmap of France defensive pressure vs. Argentina (2018-06-30)
statsbomb %>%
  filter(type.name == "Pressure" & team.name == "France") %>%
  soccerHeatmap(x = "location.x", y = "location.y")
```

---

tromso	<i>x,y-coordinates of 11 soccer players over 12000 frames each</i>
--------	--

---

### Description

x,y-coordinates of 11 soccer players over 10 minutes (Tromsø IL vs. Anzhi, 2013-11-07), captured at 20 Hz using the ZXY Sport Tracking system and made available in the publication [ZXY Sport Tracking](#).

### Usage

```
data(tromso)
```

### Format

A dataframe containing 12000 frames of x,y-coordinates and timestamps from 11 players.

### Source

[ZXY Sport Tracking](#)

### References

[Pettersen et al. \(2014\)](#) Proceedings of the International Conference on Multimedia Systems (MM-Sys)

### Examples

```
data(tromso)
# draw path of player #8 on a soccer pitch
soccerPitchBG(lengthPitch = 105, widthPitch = 68, grass = TRUE) +
  geom_path(data = subset(tromso, id == 8), aes(x, y), lwd = 2)
```

---

tromso_extra	<i>x,y-coordinates and additional positional information on 11 soccer players over 12000 frames each</i>
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---

### Description

x,y-coordinates of 11 soccer players over 10 minutes (Tromsø IL vs. Anzhi, 2013-11-07), plus additional information on player heading, direction, energy, speed, and total distance. Data captured at 20 Hz using the ZXY Sport Tracking system and made available in the publication [ZXY Sport Tracking](#).

### Usage

```
data(tromso_extra)
```

**Format**

A dataframe containing 12000 frames of x,y-coordinates and timestamps from 11 players.

**Source**

[ZXY Sport Tracking](#)

**References**

Pettersen et al. (2014) Proceedings of the International Conference on Multimedia Systems (MM-Sys) ([pdf](#))

**Examples**

```
data(tromso_extra)
# draw flow field showing mean direction of player #8's movement
soccerFlow(subset(tromso_extra, id == 8), bins = 5, grass = TRUE)
```

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