Package 'ChaosGame'

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Type Package

Title Chaos Game

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Description
The main objective of the package is to enter a word of at least two letters based on which an Iterated Function System with Probabilities is constructed, and a two-dimensional fractal containing the chosen word infinitely often is generated via the Chaos Game. Additionally, the package allows to project the two-dimensional fractal on several three-dimensional surfaces and to transform the fractal into another fractal with uniform marginals.

Imports ggplot2, gridExtra, sphereplot, plot3D

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ChaosGame-package   *Chaos game generation of fractal words*

Description

The main objective of the package is to enter a word of at least two letters based on which an Iterated Function System with Probabilities (IFSP) is constructed, and a two-dimensional fractal containing the chosen word infinitely often is generated via the Chaos Game. Additionally, the package allows to project the two-dimensional fractal on several three-dimensional surfaces and to transform the fractal into another fractal with uniform marginals.

Details

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Author(s)

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Examples

```
# function with word as input, runs the chaos game and
# projects the result on the Enneper Minimal Surface:

# for nice results use, for example, R = 20 and orbit = 3000
A <- plot_word3D(word = "copula", R = 50, orbit = 100, copula = FALSE,
                 plot.surface = "EnneperMinimalSurface", histogram = FALSE)

# further examples:

# same example as before, now with histogram = TRUE
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                  plot.surface = "EnneperMinimalSurface")
# same example as before, now (approximately) probability-integral-transformed
# (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                  plot.surface = "EnneperMinimalSurface")


# projection of the fractal on a Catalan Surface
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
```

```
#                    color.rgl.plot = "blue2green", plot.surface = "CatalanSurface")
# Catalan Surface (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "blue2green", plot.surface = "CatalanSurface")


# projection of the fractal on a Helix
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "green2red", plot.surface = "Helix")
# Helix (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "green2red", plot.surface = "Helix")


# projection of the fractal on a Torus
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "blue2yellow", plot.surface = "Torus")
# Torus (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "blue2yellow", plot.surface = "Torus")


# projection of the fractal on a Sphere
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "ygobb", plot.surface = "Sphere")
# Sphere (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "ygobb", plot.surface = "Sphere")
```

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plot_word   *Plot the 2D fractal containing the chosen word*

Description

The function allows to enter a word of at least two letters based on which an Iterated Function System with Probabilities (IFSP) is constructed. This IFSP is then used to generate a two-dimensional fractal containing the chosen word infinitely often, which is then plotted (and optionally probability-integral-transformed).

Usage

```
plot_word(word = "copula", R = 20, phi = 0, copula = FALSE,
          portion = 0.2, shift = 1.2, orbit = 3000)
```

Arguments

word   Word which the fractal should contain infinitely often.

R	Number of runs of the chaos game.
phi	Angle of the rotation.
copula	If copula = TRUE the sample is (approximately) probability-integral-transformed.
portion	Portion based on which the empirical distribution functions are calculated, if copula = TRUE.
shift	Distance between letters.
orbit	Number of steps in each run of the chaos game.

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Examples

```
# function with word as input, constructs the IFSP and runs the chaos game:
# for nice results use, for example, R = 20 and orbit = 3000
A <- plot_word(word = "copula", R = 50, orbit = 100)

# plot without histograms of the marginal distributions
plot(A, pch =19, col = 4, cex = 0.1)


# further examples:

# with rotation
# A <- plot_word(word = "copula", R = 100, orbit = 300, phi = pi/8)
# A <- plot_word(word = "fractal", R = 100, orbit = 300, phi = pi/6)

# (approximately) probability-integral-transformed
# A <- plot_word(word = "copula", R = 100, orbit = 300, phi = pi/8, copula = TRUE)
# A <- plot_word(word = "fractal", R = 100, orbit = 300, phi = pi/6, copula = TRUE)
```

---

plot_word3D   *Plot the 3D fractal containing the chosen word*

Description

The function allows to enter a word of at least two letters based on which an Iterated Function System with Probabilities (IFSP) is constructed. This IFSP is then used to generate a two-dimensional fractal containing the chosen word infinitely often, which is then projected onto several three-dimensional surfaces. Optionally, the projection is transformed into another fractal with uniform marginals.

Usage

```
plot_word3D(word = "copula", R = 20, plot.rgl = TRUE,
            copula = TRUE, portion = 0.2, color.rgl.plot = "green2magenta",
            plot.surface = "Sphere", histogram = TRUE, shift = 1.2,
            orbit = 3000, cex.label = 0.7, size.lines = 0.1,
            Theta = 40, Phi = 30, Box = TRUE, projection = TRUE)
```

Arguments

word	Word which the fractal should contain infinitely often.
R	Number of runs of the chaos game.
plot.rgl	If plot.rgl = TRUE a rgl-plot is generated. Otherwise a scatter-plot with plot3D is produced.
copula	If copula = TRUE the sample is (approximately) probability-integral-transformed.
portion	Portion based on which the empirical distribution functions are calculated, if copula = TRUE.
color.rgl.plot	Plotting color/color-range for the rgl-plot. One can choose between "gray", "blue2green", "green2red", "blue2yellow", "ygobb", "magenta2green" and "green2magenta".
plot.surface	Three-dimensional surface on which the two-dimensional fractal is projected. Options are "Sphere", "Helix", "Torus", "EnneperMinimalSurface" and "CatalanSurface".
histogram	It is an option available only under the rgl-plot option (i.e if plot.rgl = TRUE). If histogram = TRUE, two-dimensional and one-dimensional marginal histograms are plotted in the rgl-plot.
shift	Distance between letters.
orbit	Number of steps in each run of the chaos game.
cex.label	Font size, for exporting as a pdf or png file (see examples).
size.lines	Line width, for exporting as a pdf or png file (see examples).
Theta, Phi	Angles defining the viewing direction. Theta gives the azimuthal direction and Phi the colatitude in the scatter-plot (see Package plot3D). Can be chosen only under the scatter-plot option (i.e if plot.rgl = FALSE).
Box	If TRUE, axis, two-dimensional projections (if projection = TRUE) and marginal histograms are plotted.
projection	An option available only if Box = TRUE. If projection = TRUE, the two-dimensional projections are plotted together with axis and marginal histograms.

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Examples

```
# function with a word as input, runs the chaos game, calculates the
# copula transformation and projects the result on a sphere:

# for nice results use, for example, R = 20 and orbit = 3000
A <- plot_word3D(word = "copula", copula = FALSE, R = 50, orbit = 100)


# further examples:

# projection of the fractal on the Enneper Minimal Surface:
# A <- plot_word3D(word = "copula", R = 75, orbit = 300, copula = FALSE,
#                    plot.surface = "EnneperMinimalSurface", histogram = FALSE)
# same example as before, now with histogram = TRUE
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    plot.surface = "EnneperMinimalSurface")
# same example as before (approximately) probability-integral-transformed
# (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    plot.surface = "EnneperMinimalSurface")


# projection of the fractal on a Catalan Surface
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "blue2green", plot.surface = "CatalanSurface")
# Catalan Surface (approximately) probability-integral-transformed
# (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "blue2green", plot.surface = "CatalanSurface")


# projection of the fractal on a Helix
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "green2red", plot.surface = "Helix")
# Helix (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "green2red", plot.surface = "Helix")


# projection of the fractal on a Torus
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "blue2yellow", plot.surface = "Torus")
# Torus (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
#                    color.rgl.plot = "blue2yellow", plot.surface = "Torus")


# projection of the fractal on a Sphere
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE,
#                    color.rgl.plot = "ygobb", plot.surface = "Sphere")
# Sphere (approximately) probability-integral-transformed (i.e. copula = TRUE)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = TRUE,
```

```
#                        color.rgl.plot = "ygobb", plot.surface = "Sphere")



# scatter-plot with plot3D (i.e. plot.rgl = FALSE)
# A <- plot_word3D(word = "copula", R = 10, orbit = 300, copula = FALSE,
#                  plot.surface = "Sphere", plot.rgl = FALSE)



# scatter-plot with plot3D (i.e. plot.rgl = FALSE) for exporting as a pdf file
# setwd("working_directory")
# pdf(file = "Sphere.pdf", width = 30, height = 25)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE, plot.rgl = FALSE,
#                  plot.surface = "Sphere", cex.label = 1.8, size.lines = 0.001)
# dev.off()



# scatter-plot with plot3D (i.e. plot.rgl = FALSE) for exporting as a png file
# setwd("working_directory")
# png(file = "Sphere.png", width = 5000, height = 4000)
# A <- plot_word3D(word = "copula", R = 100, orbit = 300, copula = FALSE, plot.rgl = FALSE,
#                  plot.surface = "Sphere", cex.label = 5, size.lines = 2)
# dev.off()
```

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