

Package ‘brainR’

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Type Package

Title Helper Functions to 'misc3d' and 'rgl' Packages for Brain Imaging

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Description This includes functions for creating 3D and 4D images using 'WebGL', 'rgl', and 'JavaScript' commands. This package relies on the X toolkit ('XTK', <<https://github.com/xtk/X#readme>>).

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LazyData true

Depends rgl, misc3d, oro.nifti

Imports grDevices

RoxygenNote 7.0.1

Encoding UTF-8

Suggests servr

NeedsCompilation no

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brainR-package	<i>Functions to render 3D brain images in html</i>
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Description

Brain Template from Copyright (C) 1993-2009 Louis Collins, McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University 6th generation non-linear symmetric brain

Author(s)

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References

G. Grabner, A. L. Janke, M. M. Budge, D. Smith, J. Pruessner, and D. L. Collins, "Symmetric atlas and model based segmentation: an application to the hippocampus in older adults", *Med Image Comput Comput Assist Interv Int Conf Med Image Comput Comput Assist Interv*, vol. 9, pp. 58-66, 2006.

See Also

[contour3d](#), [rgl](#)

makeScene	<i>Make Leveled Scene</i>
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Description

Make scene returns a list of levels - but makes them mutually distinct. So if cutoff 0.1, 0.2, then $0.1 \leq x < 0.2$ is an roi, not > 0.1 and > 0.2 . Different than [contour3d](#) as these are mutually exclusive levels.

Usage

```
makeScene(data, cutoffs, alpha, cols)
```

Arguments

data	- 3D array of values (can be nifti-class)
cutoffs	- series of levels to be created
alpha	- alpha levels for each contour
cols	- colors for each contour

Value

scene with multiple objects - can be passed to [write4D](#)

 scene4d

Wrapper to write a 4D scene

Description

This function takes in filenames, levels, and creates an output html file, with 4D elements. The html is based on XTK (<https://github.com/xtk/X#readme>)

Usage

```
scene4d(
  files,
  fnames = NULL,
  outfile = "index_4D_stl.html",
  levels = NULL,
  alpha = NULL,
  color = "white",
  useTemp = FALSE,
  MNITemp = c("1mm", "2mm"),
  objtype = "stl",
  ...
)
```

Arguments

files	(character) vector of filenames (first being a brain file if useTemp=FALSE)
fnames	(character) filenames for the 3D surfaces in the scene - needs to be the same length as files
outfile	(character) html filename
levels	(numeric/list) levels to make contours/surfaces for each file. Either a numeric vector may be passed, one level for each file. Or a list of numeric vectors of multiple levels for each file. Will be coerced to a list.
alpha	(numeric/list) alpha opacities for each contours/surface for each file. Will be coerced to list similarly as levels
color	(character/list) colors for each contours/surface for each file. Will be coerced to list similarly as levels
useTemp	(logical) whether to use template from brainR as the brain figure
MNITemp	(character) if (useTemp = TRUE) either "1mm" or "2mm" denoting the resolution of the template used
objtype	(character) object type to write the files to. Either "stl", "obj", or "ply" to write.
...	other options to be passed to write4D

Examples

```
### Faster - 8mm resampled but very coarse
imgs <- paste("Visit_", 1:5, "_8mm.nii.gz", sep="")
ifiles <- sapply(imgs, system.file, package='brainR')
files = file.path(tempdir(), basename(ifiles))
file.copy(ifiles, files)
outfile <- file.path(tempdir(), "index_4D_stl.html")
scene4d(files, levels=rep(0.99, length(files)),
outfile = outfile, color= rep("blue", length(files)), useTemp=TRUE,
MNITemp = "8mm", alpha = rep(1, length(files)), rescale=TRUE )
## Not run:
imgs <- paste("Visit_", 1:5, ".nii.gz", sep="")
ifiles <- sapply(imgs, system.file, package='brainR')
files = file.path(tempdir(), basename(ifiles))
file.copy(ifiles, files)
scene4d(files, levels=rep(0.99, length(files)),
outfile = outfile,
color= rep("blue", length(files)), useTemp=TRUE,
MNITemp = "8mm", alpha = rep(1, length(files)), rescale=TRUE )

## End(Not run)
```

write4D

Wrapper to write a 4D scene

Description

This function takes in a scene and writes it out to a series of files either with the stl format or obj format (see [writeOBJ](#) and [writeSTL](#))

Usage

```
write4D(
  scene,
  outfile,
  fnames = NULL,
  captions = NULL,
  writefiles = TRUE,
  reprint = TRUE,
  ...
)
```

Arguments

scene	list of 3D triangles (see contour3d). If a multicolored object is to be rendered (multiple contours with one control) - it must be in a list
outfile	html filename that is to be exported
fnames	filenames for the 3D surfaces in the scene - needs to be the same length as scene

captions	labels for checkboxes on html webpage
writefiles	(experimental) simply run the code to create the html and not write the .obj or .stl files
reprint	(logical, experimental) do you want to reprint the rgl before saving (common use by rgl functions)
...	other options to be passed to write4D.file

Examples

```
#Brain Template from Copyright (C) 1993-2009 Louis Collins,
#McConnell Brain Imaging Centre,
#Montreal Neurological Institute, McGill University
#6th generation non-linear symmetric brain
##Downsampled to 8mm using FSL fslmaths -subsamp2

template <- readNIfTI(system.file("MNI152_T1_8mm_brain.nii.gz", package="brainR"),
, reorient=FALSE)
dtemp <- dim(template)
### 4500 - value that empirically value that presented a brain with gyri
### lower values result in a smoother surface
brain <- contour3d(template, x=1:dtemp[1], y=1:dtemp[2],
z=1:dtemp[3], level = 4500, alpha = 0.8, draw = FALSE)

### Example data courtesy of Daniel Reich
### Each visit is a binary mask of lesions in the brain
imgs <- paste("Visit_", 1:5, "_8mm.nii.gz", sep="")
files <- sapply(imgs, system.file, package='brainR')
scene <- list(brain)
## loop through images and thresh
nimgs <- length(imgs)
cols <- rainbow(nimgs)
for (iimg in 1:nimgs) {
mask <- readNIfTI(files[iimg], reorient=FALSE)
if (length(dim(mask)) > 3) mask <- mask[,,1]
### use 0.99 for level of mask - binary
activation <- contour3d(mask, level = c(0.99), alpha = 1,
add = TRUE, color=cols[iimg], draw=FALSE)
## add these triangles to the list
scene <- c(scene, list(activation))
}
## make output image names from image names
fnames <- c("brain.stl", gsub(".nii.gz", ".stl", imgs, fixed=TRUE))
fnames = file.path(tempdir(), fnames)
outfile <- file.path(tempdir(), "index.html")
write4D(scene=scene, fnames=fnames, outfile=outfile, standalone=TRUE,
rescale=TRUE)
if (interactive()) {
if (requireNamespace("servr", quietly = TRUE)) {
servr::httd(tempdir())
}
}
}
```

```
unlink(outfile)
```

```
write4D.file
```

```
Write a 4D scene
```

Description

This function takes in a scene and writes it out to a series of files either with the stl format or obj format

Usage

```
write4D.file(
  scene = NULL,
  outfile = "index_4D.html",
  fnames,
  visible = TRUE,
  opacity = 1,
  colors = NULL,
  captions = "",
  standalone = FALSE,
  rescale = FALSE,
  index.file = system.file("index_template.html", package = "brainR"),
  toggle = "checkbox",
  xtkgui = FALSE
)
```

Arguments

scene	- list of 3D triangles (see contour3d). If a multicolored object is to be rendered (multiple contours with one control) - it must be in a list
outfile	- html filename that is to be exported
fnames	- filenames for the 3D surfaces in the scene - needs to be the same length as scene
visible	- logical vector indicating which structures are visible in html file
opacity	- list of alpha values - same length as scene; if sub-structures are present, then the each list element has length the number of structures
colors	- character vector of colors (col2rgb is applied)
captions	- labels for checkboxes on html webpage
standalone	- logical - should this be able to be rendered offline?
rescale	- rescale the scene? - in beta
index.file	- template html file used
toggle	- (experimental) "checkbox" (default) or "radio" for radio or checkboxes to switch thing
xtkgui	- (experimental) Logical to use xtkgui for objects

See Also

[writeOBJ](#), [writeSTL](#), [contour3d](#)

Examples

```

template <- readNIfTI(system.file("MNI152_T1_8mm_brain.nii.gz", package="brainR")
, reorient=FALSE)
dtemp <- dim(template)
### 4500 - value that empirically value that presented a brain with gyri
### lower values result in a smoother surface
brain <- contour3d(template, x=1:dtemp[1], y=1:dtemp[2],
z=1:dtemp[3], level = 4500, alpha = 0.8, draw = FALSE)

### Example data courtesy of Daniel Reich
### Each visit is a binary mask of lesions in the brain
imgs <- paste("Visit_", 1:5, "_8mm.nii.gz", sep="")
files <- sapply(imgs, system.file, package='brainR')
scene <- list(brain)
## loop through images and thresh
nimgs <- length(imgs)
cols <- rainbow(nimgs)
for (iimg in 1:nimgs) {
mask <- readNIfTI(files[iimg], reorient=FALSE)
if (length(dim(mask)) > 3) mask <- mask[,,1]
### use 0.99 for level of mask - binary
activation <- contour3d(mask, level = c(0.99), alpha = 1,
add = TRUE, color=cols[iimg], draw=FALSE)
## add these triangles to the list
scene <- c(scene, list(activation))
}
## make output image names from image names
fnames <- c("brain.stl", gsub(".nii.gz", ".stl", imgs, fixed=TRUE))
fnames = file.path(tempdir(), fnames)
outfile <- file.path(tempdir(), "index.html")
write4D.file(
scene=scene, fnames=fnames,
visible = FALSE,
outfile=outfile, standalone=TRUE, rescale=TRUE)

unlink(outfile)
unlink(fnames)

```

Description

This is code extracted from [writeSTL](#) in `rgl`. This allows users to write the triangles in STL without reprinting the `rgl` (which takes time)

Usage

```
writeTrianglesSTL(scene, con, ascii = FALSE)
```

Arguments

<code>scene</code>	list of triangles (that have class <code>Triangles3D</code>)
<code>con</code>	filename or connection of stl file to write
<code>ascii</code>	indicator if the file should be written in ascii or binary

Value

filename (invisible) of stl object

<code>writeWebGL_split</code>	<i>Write WebGL with split triangles</i>
-------------------------------	---

Description

Adapted [writeWebGL](#) function that splits the triangles into 65535 vertices

Usage

```
writeWebGL_split(ids = rgl.ids())$id, writeIt = TRUE, verb = FALSE, ...)
```

Arguments

<code>ids</code>	- <code>rgl</code> ids (see rgl.ids)
<code>writeIt</code>	- (logical) write the file out
<code>verb</code>	- verbose output
<code>...</code>	- further arguments passed to writeWebGL

Value

if `writeIt` is `TRUE`, then returns the value from [writeWebGL](#). Otherwise, returns the split triangles from the `rgl` objects

Examples

```
## Not run:
#Brain Template from Copyright (C) 1993-2009 Louis Collins,
#McConnell Brain Imaging Centre,
#Montreal Neurological Institute, McGill University
#6th generation non-linear symmetric brain
template <- readNIfTI(system.file("MNI152_T1_2mm_brain.nii.gz", package="brainR")
, reorient=FALSE)
dtemp <- dim(template)
### 4500 - value that empirically value that presented a brain with gyri
### lower values result in a smoother surface
brain <- contour3d(template, x=1:dtemp[1], y=1:dtemp[2],
z=1:dtemp[3], level = 4500, alpha = 0.1, draw = FALSE)
drawScene.rgl(brain)
### this would be the ``activation'' or surface you want to render -
# hyper-intense white matter
contour3d(template, level = c(8200, 8250),
alpha = c(0.5, 0.8), add = TRUE, color=c("yellow", "red"))
### add text
text3d(x=dtemp[1]/2, y=dtemp[2]/2, z = dtemp[3]*0.98, text="Top")
text3d(x=-0.98, y=dtemp[2]/2, z = dtemp[3]/2, text="Right")
fname <- "knitted_webGL.html"
writeWebGL_split(dir=getwd(), filename =fname,
template = system.file("my_template.html", package="brainR"), width=500,
writeIt=TRUE)
browseURL(fname)

## End(Not run)
```

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