

# Package ‘plot3Drgl’

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**Title** Plotting Multi-Dimensional Data - Using 'rgl'

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## R topics documented:

plot3Drgl-package . . . . .	1
cutrgl . . . . .	2
image2Drgl . . . . .	3
persp3Drgl . . . . .	7
plotrgl . . . . .	10

<b>Index</b>	<b>14</b>
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plot3Drgl-package      *Functions to plot multi-dimensional data using rgl.*

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## Description

Package plot3Drgl provides an interface from package plot3D to package rgl.

It will plot most (but not all) features from plots generated with plot3D, except for the color keys and polygons.

It also also includes rgl implementations of 2-D functions (arrows, points, contours, images), which can be zoomed, moved, and sections selected.

**Author(s)**

Karline Soetaert

**See Also**

Functions from R-package plot3D.

Functions from R-package rgl.

- For 3-D graphs:
  - [plotrgl](#) the main function that translates plot3D graphs to rgl.
- For 2-D graphs:
  - [arrows2Drgl](#) creates 2-D arrow plots.
  - [scatter2Drgl](#) for point and line plots.
  - [image2Drgl](#), [contour2Drgl](#) an rgl implementation of the image and contour functions.

Apart from the usual zooming, it is also possible to move the figure in the rgl window (based on an example in the rgl package).

Rectangular areas can be selected from rgl plots, using [cutrgl](#) while [uncutrgl](#) will restore the original plot.

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cutrgl

*Cutting a rectangular region from an rgl plot.*

---

**Description**

cutrgl zooms in on a selected region of the plot. It overwrites the current plot. Selection is done by dragging over the plot, with the left mousekey clicked.

croprgl zooms in on a region of the plot defined by the axes limits. It overwrites the current plot.

uncutrgl and uncroprgl restore the original plot, but keep the current orientation.

**Usage**

```
cutrgl (...)
croprgl (xlim = NULL, ylim = NULL, zlim = NULL, ...)
uncutrgl (...)
uncroprgl(...)
```

**Arguments**

xlim, ylim, zlim

The limits of the plot.

...

Any argument that can be passed to the function [plotrgl](#), e.g argument `lighting`, or to the rgl functions [par3d](#), [open3d](#) or [material3d](#). Exceptions are `new` and `add` (which are always FALSE).

**Value**

Returns the updated plotting list. See [plotdev](#).

**Note**

Both functions will not work when another active rgl window has been opened. In that case, `cutrgl` will freeze R, and the escape key should be used.

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**See Also**

[plotrgl](#),  
[material3d](#), [par3d](#) for rgl arguments that can be passed to the function.

**Examples**

```
## Not run:
ribbon3D(z = volcano, zlim= c(-100, 200), image = TRUE, plot = FALSE)
plotrgl(new = TRUE) # new window
cutrgl()           # select region with left mouse
cutrgl()           # second selection
uncutrgl()         # original restored

## End(Not run)
```

---

image2Drgl

*2-D image, contour, scatterplots, segments and arrows in rgl.*

---

**Description**

`image2Drgl` plots an image in rgl.

`contour2Drgl` creates a contourplot in rgl.

`scatter2Drgl` creates a scatterplot (lineplot, points, ...) in rgl.

`points2Drgl` is shorthand for `scatter2Drgl(..., type = "p")`

`lines2Drgl` is shorthand for `scatter2Drgl(..., type = "l")`

`arrows2Drgl` and `segments3D` plot arrows and segments in rgl.

`text2Drgl` plots labels in rgl.

These functions were implemented for their side effect that rgl plots can be zoomed, translocated, rectangular selections taken.

**Usage**

```

image2Drgl (z, x = seq(0, 1, length.out = nrow(z)),
           y = seq(0, 1, length.out = ncol(z)), ...,
           col = NULL, NAcol = "white", breaks = NULL, border = NA,
           facets = TRUE, colkey = NULL, contour = FALSE,
           smooth = FALSE, clim = NULL, clab = NULL, shade = NA,
           inttype = 1, dz = 0, add = FALSE)

contour2Drgl (z, x = seq(0, 1, length.out = nrow(z)),
             y = seq(0, 1, length.out = ncol(z)), ...,
             col = NULL, colkey = NULL, clim = NULL, clab = NULL, dz = 0.1,
             add = FALSE)

scatter2Drgl (x, y, colvar = NULL, ...,
             col = NULL, NAcol = "white", breaks = NULL, colkey = NULL,
             clim = NULL, clab = NULL, CI = NULL, dz = 0.1, add = FALSE)

text2Drgl (x, y, labels, colvar = NULL, ...,
          col = NULL, NAcol = "white", breaks = NULL, colkey = NULL,
          clim = NULL, clab = NULL, dz = 0.1, add = FALSE)

arrows2Drgl (x0, y0, x1, y1, colvar = NULL, ...,
            col = NULL, NAcol = "white", breaks = NULL, colkey = NULL,
            clim = NULL, clab = NULL, type = "simple", dz = 0.1, add = FALSE)

segments2Drgl (x0, y0, x1, y1, colvar = NULL, ...,
              col = NULL, NAcol = "white", breaks = NULL, colkey = NULL,
              clim = NULL, clab = NULL, dz = 0.1, add = FALSE)

rect2Drgl (x0, y0, x1, y1, colvar = NULL, ...,
          col = NULL, NAcol = "white", breaks = NULL, colkey = NULL,
          clim = NULL, clab = NULL, dz = 0.1, add = FALSE)

lines2Drgl(x, y, ...)

points2Drgl(x, y, ...)

```

**Arguments**

x, y	Vectors with the x- and y- values.
z	The variable used for coloring the image plot, or containing the values to be plotted for the contour plot.
x0, y0	coordinates of points <i>from</i> which to draw the arrows.
x1, y1	coordinates of points <i>to</i> which to draw the arrows. At least one must be supplied.
colvar	The variable used for coloring the scatter plot or the arrows. If NULL, then col will be used as such.

labels	The text to be written. A vector of length equal to length of x, y.
col	Color palette to be used for the z or colvar variable. If colvar is NULL, then the colors are used as such.
NAcol	Color to be used for NA values; default is "white".
breaks	a set of finite numeric breakpoints for the colors; must have one more breakpoint than color and be in increasing order. Unsorted vectors will be sorted, with a warning.
border	The color of the lines drawn around the surface facets. The default, NA, will disable the drawing of borders.
facets	If TRUE, then col denotes the color of the surface facets. If FALSE, then the surface facets are colored "white" and the border will be colored as specified by col. If NA then the facets will be transparent.
shade	the degree of shading of the surface facets. Values of shade close to one yield shading similar to a point light source model and values close to zero produce no shading. Creates the illusion of perspective. See <a href="#">persp</a> .
contour	If TRUE, then a <a href="#">contour</a> plot will be added to the image plot. Also allowed is to pass a list with arguments for the <a href="#">contour2D</a> function.
smooth	Logical, specifying whether Gouraud shading (smooth) or flat shading should be used. (if TRUE then function <a href="#">cutrgl</a> will not work).
colkey	A logical, NULL (default), or a list with parameters for the color key (legend). Not all arguments from the original <a href="#">colkey</a> function from <a href="#">plot3D</a> are supported. For instance, color keys will always be put on the 4th margin.
clim	Only if colvar is specified, the range of the color variable used. Values of colvar that extend the range will be put to NA.
clab	Only if colkey = TRUE, the label to be written on top of the color key. The label will be written at the same level as the main title. to lower it, clab can be made a vector, with the first values empty strings.
inttype	The interpolation type to create the polygons, either interpolating the z (inttype = 1 or the x, y values (inttype = 2) - see <a href="#">persp3D</a> .
CI	A list with parameters and values for the confidence intervals or NULL. If a list it should contain at least the item x or y. Other parameters should be one of (with defaults): alen = 0.01, lty = par("lty"), lwd = par("lwd"), col = NULL, to set the length of the arrow head, the line type and width, and the color. If col is NULL, then the colors of the scatter points are used.
type	The type of the arrow head, one of "simple" (the default, which uses R-function <a href="#">arrows</a> ) or "triangle".
dz	The 'layer depth', The z-position is defined as 1 + dz.
add	Logical. If TRUE, then the image, contour or points will be added to the current plot. If FALSE a new plot is started.
...	additional arguments passed to the plotting methods. The following <a href="#">persp</a> arguments can be specified: xlim, ylim, zlim, xlab, ylab, zlab, main, sub, r, d, scale, expand, box, axes, nticks, ticktype, shade, ltheta, lphi. In addition, the <a href="#">perspbox</a> arguments col.axis, col.panel, lwd.panel, col.grid, lwd.grid can also be given a value.

Also the arguments `lty`, `lwd` can be specified.  
The arguments after ... must be matched exactly.

### Details

The first step in 2D rgl plotting consists in calling a 3-D function from package `plot3D` with argument `plot` set to `FALSE`.

`image2Drgl` and `contour2Drgl` call the `image3D` and `contour3D` functions of R-package `plot3D`, with `colvar` equal to `z`. Functions `scatter2Drgl` and `arrows2Drgl` call `scatter3D` and `arrows3D`.

The `z` value argument to the 3-D functions is set equal to `1 + dz`; For `contour3D`, `scatter3D` and `arrows3D`, it is by default equal to `1.1`, while for `image3D` it is `1`. This way, contours, points, segments and arrows will be drawn on top of the image.

The next step is to create a 3-D rgl plot, by calling `plotrgl`. After that, the viewing arguments are set equal to `view3d(phi = 0, fov = 0)`, i.e. the plot is viewed at from the top.

The actions of the mouse on the plots is to zoom (left, middle), and to move it (right key).

### Author(s)

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### See Also

`image3D`, `contour3D`, `scatter3D`, `segments3D`, `text3D` and `arrows3D` on which the functions are based.

`image2D`, `contour2D`, `scatter2D`, `segments2D`, `text2D`, `arrows2D` for `plot3D`'s functions, to plot in ordinary R graphics.

`cutrgl` for cutting a rectangular region from the 2D plot.

### Examples

```
## =====
## image and points
## =====
image2Drgl(z = volcano, contour = TRUE, main = "volcano")
scatter2Drgl(x = seq(0, 1, by = 0.2), y = seq(0, 1, by = 0.2),
             cex = 3, add = TRUE)

## Not run:
cutrgl()    # select a rectangle
uncutrgl()

## End(Not run)

## =====
## scatter points, and lines
## =====

scatter2Drgl(cars[,1], cars[,2], xlab = "speed", ylab = "dist")
```

```

## Not run:
  cutrgl()

## End(Not run)
  lc <- lowess(cars)
  scatter2Drgl(lc$x, lc$y, type = "l", add = TRUE, lwd = 4)
## Not run:
  cutrgl()
  uncutrgl()

## End(Not run)

## =====
## confidence intervals
## =====
  x <- sort(rnorm(10))
  y <- runif(10)
  cv <- sqrt(x^2 + y^2)

  CI <- list(lwd = 2)
  CI$x <- matrix (nrow = length(x), ncol = 2, data = rep(0.125, 2*length(x)))
  scatter2D(x, y, colvar = cv, pch = 16, cex = 2, CI = CI)

  scatter2Drgl(x, y, colvar = cv, cex = 2, CI = CI)

## =====
## arrows
## =====

  arrows2Drgl(x0 = 100*runif(30), y0 = runif(30), x1 = 100*runif(30),
    y1 = runif(30), length = 0.1*runif(30), col = 1:30, angle = 15:45,
    type = c("simple", "triangle"), lwd = 2)

  x0 <- 1:30
  x1 <- 2:31
  arrows2Drgl(x0 = x0, y0 = sin(x0), x1 = x1, y1 = sin(x1),
    colvar = x1, lwd = 2)

```

---

persp3Drgl

*3-D plotting functions using rgl.*

---

## Description

Functions `persp3Drgl`, `ribbon3Drgl`, `hist3Drgl` produce perspective plots using `rgl`; they are similar to functions [persp3D](#), [ribbon3D](#), [hist3D](#) from package `plot3D`.

Functions `scatter3Drgl`, `points3Drgl`, `lines3D`, `segments3Drgl` produce scatter plots and line plots using `rgl`; they are similar to functions [scatter3D](#), [points3D](#), [lines3D](#), [segments3D](#) from package `plot3D`.

Functions `slice3Drgl`, `points3Drgl`, `isosurf3Drgl`, `voxel3Drgl` can visualise volumetric (3D) data using rgl; they are similar to functions [slice3D](#), [slicecont3D](#), [isosurf3D](#), [voxel3D](#) from package `plot3D`.

Functions `surf3Drgl`, `spheresurf3Drgl` produce surface plots using rgl; they are similar to functions [surf3D](#), [spheresurf3D](#) from package `plot3D`.

Functions `box3Drgl`, `border3Drgl`, `rect3Drgl`, `text3Drgl` produce boxes, rectangles, texts to 3D plots using rgl; they are similar to functions [box3D](#), [border3D](#), [rect3D](#), [text3Drgl](#) from package `plot3D`.

## Usage

```
persp3Drgl(...)
ribbon3Drgl(...)
hist3Drgl(...)
scatter3Drgl(...)
points3Drgl(...)
lines3Drgl(...)
slice3Drgl(...)
slicecont3Drgl(...)
isosurf3Drgl(...)
voxel3Drgl(...)
triangle3Drgl(...)
surf3Drgl(...)
spheresurf3Drgl(...)
segments3Drgl(...)
image3Drgl(...)
contour3Drgl(...)
box3Drgl(...)
border3Drgl(...)
rect3Drgl(...)
text3Drgl(...)
```

## Arguments

... arguments passed to the plotting methods of package `plot3D`, or to the [plotrgl](#) method. The following [persp](#) arguments can be specified: `xlim`, `ylim`, `zlim`, `xlab`, `ylab`, `zlab`, `main`, `sub`, `r`, `d`, `scale`, `expand`, `box`, `axes`, `nticks`, `ticktype`, `shade`, `ltheta`, `lphi`. In addition, the [perspbox](#) arguments `col.axis`, `col.panel`, `lwd.panel`, `col.grid`, `lwd.grid` can also be given a value.

## Details

The first step in 3D rgl plotting consists in calling the corresponding 3-D function from package `plot3D` with argument `plot` set to `FALSE`.

The next step is to create a 3-D rgl plot, by calling [plotrgl](#).

The actions of the mouse on the plots is to zoom (left, middle), and to move it (right key).



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**See Also**

[plotdev](#) to plot first in ordinary R graphics and then in rgl  
 for [plotrgl](#) to plot first in ordinary R graphics and then in rgl  
[cutrgl](#) for cutting a rectangular region from the rgl plot.

**Examples**

```
## =====
## perspective plots
## =====
persp3Drgl(z = volcano, contour = list(side = "zmax"))

# ribbon, in x--direction
V <- volcano[seq(1, nrow(volcano), by = 5),
              seq(1, ncol(volcano), by = 5)] # lower resolution
ribbon3Drgl(z = V, ticktype = "detailed")
hist3Drgl(z = V, col = "grey", border = "black", lighting = TRUE)

## Not run:
  cutrgl() # select a rectangle
  uncutrgl()

## End(Not run)

## =====
## scatter points
## =====

with(quakes, scatter3Drgl(x = long, y = lat, z = -depth,
  colvar = mag, cex = 3))

plotdev() # plots same on ordinary device...

## =====
## 3D surface
## =====

M <- mesh(seq(0, 2*pi, length.out = 50),
          seq(0, 2*pi, length.out = 50))
u <- M$x ; v <- M$y

x <- sin(u)
y <- sin(v)
z <- sin(u + v)

# alpha makes colors transparent
```

```

surf3Drgl(x, y, z, colvar = z, border = "black", smooth = TRUE,
          alpha = 0.2)

## =====
## volumetric data
## =====
x <- y <- z <- seq(-4, 4, by = 0.2)
M <- mesh(x, y, z)

R <- with (M, sqrt(x^2 + y^2 + z^2))
p <- sin(2*R) / (R+1e-3)

slice3Drgl(x, y, z, colvar = p, col = jet.col(alpha = 0.5),
           xs = 0, ys = c(-4, 0, 4), zs = NULL, d = 2)

```

---

plotrgl

*Plot 3D graphs in rgl window.*


---

## Description

plotrgl plots objects created with functions from package plot3D in an rgl window.

## Usage

```
plotrgl (lighting = FALSE, new = TRUE, add = FALSE, smooth = FALSE, ...)
```

## Arguments

lighting	Logical, when TRUE will add light. Default is with lighting toggled off; this is similar to shading
new	Logical, when TRUE will open a new window. When FALSE will start a new plot in the same window. Is overruled (to FALSE) if add is TRUE.
add	Logical, when TRUE will add to the current plot.
smooth	Logical, specifying whether Gouraud shading (smooth) or flat shading should be used. See <a href="#">material3d</a> from R-package rgl. (note: if TRUE then <a href="#">cutrgl</a> will not work). This only affects images.
...	Any argument to the rgl functions, e.g arguments from <a href="#">par3d</a> , <a href="#">open3d</a> or <a href="#">material3d</a> .

## Note

Arrows are best reproduced with argument type from the [arrows3D](#) function (package plot3D) set equal to "cone", although this does not always work well (there is probably a flaw in how it is implemented). Another option is to use type = "triangle", which simply maps the arrows on the xy-plane, ignoring the z-axis. In this case, only a view from above ( $\phi = 0$ ) will produce symmetric arrowheads (when scale = TRUE and expand = 1).

The translation of [scatter3D](#) ignores the pch argument but displays all symbols as squares (if pch = ".") or as filled circles.

The color key is not (cannot be) plotted in rgl.

In rgl, both lty and lwd have to be one number. For lwd, this has been overruled, i.e. line widths can be a vector. It is still not possible to use different line types in one type of object.

The actions of the mouse on the plots is to rotate (left), to move (middle), and to zoom it (right).

### Author(s)

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### See Also

[material3d](#), [par3d](#) for rgl arguments that can be passed to the function.

A similar function, [plotdev](#), from package plot3D plots the 3D graphs to the current device (other than a rgl-device).

Any function of package plot3D: see e.g. help files of [persp3D](#), [scatter3D](#), [arrows3D](#), [slice3D](#), [surf3D](#).

Direct rgl functions, see [persp3Drgl](#), [scatter3Drgl](#), etc....

### Examples

```
# save plotting parameters
pm <- par("mfrow")
pmar <- par("mar")

## =====
## Composite image and contour in 3D
## =====
# plot reduced resolution (for speed) volcano to traditional window:
VV <- volcano[seq(1, nrow(volcano), by = 3), seq(1, ncol(volcano), by = 3)]
persp3D(z = VV, contour = list(side = "zmax"))

plotrgl(new = TRUE) # new window

# add light, smooth surface change x-axis limits
plotrgl(new = FALSE, lighting = TRUE,
        xlim = c(0.2, 0.8), smooth = TRUE)

# same:
# persp3Drgl(z = volcano, contour = list(side = "zmax"),
# lighting = TRUE, xlim = c(0.2, 0.8), smooth = TRUE)

## =====
## scatters with fitted surface and droplines (see ?scatter3D)
## =====

par (mfrow = c(1, 1))
with (mtcars, {
```

```

# linear regression
fit <- lm(mpg ~ wt + disp)

# predict values on regular xy grid
wt.pred <- seq(1.5, 5.5, length.out = 30)
disp.pred <- seq(71, 472, length.out = 30)
xy <- expand.grid(wt = wt.pred,
                 disp = disp.pred)

mpg.pred <- matrix (nrow = 30, ncol = 30,
                  data = predict(fit, newdata = data.frame(xy),
                              interval = "prediction")[,1])

# fitted points for droplines to surface
fitpoints <- predict(fit)

scatter3D(z = mpg, x = wt, y = disp, pch = 18, cex = 2,
         theta = 20, phi = 20, ticktype = "detailed",
         xlab = "wt", ylab = "disp", zlab = "mpg",
         surf = list(x = wt.pred, y = disp.pred, z = mpg.pred,
                   facets = NA, fit = fitpoints),
         main = "mtcars")

})

plotrgl()

## =====
## scatter3D with text
## =====

with(USArrests, text3D(Murder, Assault, Rape,
  colvar = UrbanPop, col = gg.col(100), theta = 60, phi = 20,
  xlab = "Murder", ylab = "Assault", zlab = "Rape",
  main = "USA arrests",
  labels = rownames(USArrests), cex = 0.8,
  bty = "g", ticktype = "detailed", d = 2,
  clab = c("Urban", "Pop"), adj = 0.5, font = 2))

with(USArrests, scatter3D(Murder, Assault, Rape - 1,
  colvar = UrbanPop, col = gg.col(100),
  type = "h", pch = ".", add = TRUE))

plotrgl()

## =====
## spheresurf3D
## =====

AA <- Hypsometry$z

# log transformation of color variable; full = TRUE to plot both halves

```

```
spheresurf3D(AA, theta = 90, phi = 30, box = FALSE,
             full = TRUE, plot = FALSE)

# change the way the left mouse reacts
plotrgl(mouseMode = c("zAxis", "zoom", "fov"))

## =====
## Arrows - has a flaw
## =====

z <- seq(0, 2*pi, length.out = 100)
x <- cos(z)
y <- sin(z)

z0 <- z[seq(1, by = 10, length.out = 10)]
z1 <- z[seq(9, by = 10, length.out = 10)]

# cone arrow heads
arrows3D(x0 = 10*cos(z0), y0 = sin(z0), z0 = z0,
         x1 = 10*cos(z1), y1 = sin(z1), z1 = z1,
         type = "cone", length = 0.4, lwd = 4,
         angle = 20, col = 1:10, plot = FALSE)

plotrgl(lightning = TRUE)

## =====
## 2D plot
## =====

image2D(z = volcano)
plotrgl()

# reset plotting parameters
par(mfrow = pm)
par(mar = pmar)
```

# Index

- \* **hplot**
  - cutrgl, 2
  - image2Drgl, 3
  - persp3Drgl, 7
  - plotrgl, 10
- \* **package**
  - plot3Drgl-package, 1
- arrows, 5
- arrows2D, 6
- arrows2Drgl, 2
- arrows2Drgl (image2Drgl), 3
- arrows3D, 6, 10, 11
  
- border3D, 8
- border3Drgl (persp3Drgl), 7
- box3D, 8
- box3Drgl (persp3Drgl), 7
  
- colkey, 5
- contour, 5
- contour2D, 5, 6
- contour2Drgl, 2
- contour2Drgl (image2Drgl), 3
- contour3D, 6
- contour3Drgl (persp3Drgl), 7
- croprgl (cutrgl), 2
- cutrgl, 2, 2, 5, 6, 9, 10
  
- hist3D, 7
- hist3Drgl (persp3Drgl), 7
  
- image2D, 6
- image2Drgl, 2, 3
- image3D, 6
- image3Drgl (persp3Drgl), 7
- isosurf3D, 8
- isosurf3Drgl (persp3Drgl), 7
  
- lines2Drgl (image2Drgl), 3
- lines3D, 7
  
- lines3Drgl (persp3Drgl), 7
  
- material3d, 2, 3, 10, 11
  
- open3d, 2, 10
  
- par3d, 2, 3, 10, 11
- persp, 5, 8
- persp3D, 5, 7, 11
- persp3Drgl, 7, 11
- perspbox, 5, 8
- plot3Drgl (plot3Drgl-package), 1
- plot3Drgl-package, 1
- plotdev, 3, 9, 11
- plotrgl, 2, 3, 6, 8, 9, 10
- points2Drgl (image2Drgl), 3
- points3D, 7
- points3Drgl (persp3Drgl), 7
  
- rect2Drgl (image2Drgl), 3
- rect3D, 8
- rect3Drgl (persp3Drgl), 7
- ribbon3D, 7
- ribbon3Drgl (persp3Drgl), 7
  
- scatter2D, 6
- scatter2Drgl, 2
- scatter2Drgl (image2Drgl), 3
- scatter3D, 6, 7, 11
- scatter3Drgl (persp3Drgl), 7
- segments2D, 6
- segments2Drgl (image2Drgl), 3
- segments3D, 6, 7
- segments3Drgl (persp3Drgl), 7
- slice3D, 8, 11
- slice3Drgl (persp3Drgl), 7
- slicecont3D, 8
- slicecont3Drgl (persp3Drgl), 7
- spheresurf3D, 8
- spheresurf3Drgl (persp3Drgl), 7
- surf3D, 8, 11

surf3Drgl (persp3Drgl), 7

text2D, 6

text2Drgl (image2Drgl), 3

text3D, 6

text3Drgl, 8

text3Drgl (persp3Drgl), 7

triangle3Drgl (persp3Drgl), 7

uncroprgl (cutrgl), 2

uncutrgl, 2

uncutrgl (cutrgl), 2

voxel3D, 8

voxel3Drgl (persp3Drgl), 7