plot3Drgl : Tools for plotting 3-D and 2-D data in openGL.

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Abstract

R package **plot3Drgl** (Soetaert 2013c) contains functions for plotting multi-dimensional data in openGl, starting from functions as in **plot3D** (Soetaert 2013b).

A related package that depends on **plot3Drgl**is **OceanView** (Soetaert 2013a) which contains functions for visualing oceanographic data.

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1. Introduction

The R package **plot3D** (Soetaert 2013b) provides functions for plotting 2- and 3-D data. Package **plot3Drgl** allows to plot these functions also in openGL, as made available by package **rgl** (Adler and Murdoch 2013).

One possibility is to first create a plot in base R-graphics, and then uses function `plotrgl` to depict the same figure in rgl.

The main advantage of rgl over base graphics is that it allows to interactively rotate, zoom, and shift the graphics, and even select regions. However, in contrast to the base R functions, it does not plot a colorkey.

2. Function plotrgl

Typically we start by making a 3D plot using functions from package **plot3D**. Although not necessary, we can postpone plotting by setting argument `plot = FALSE`

```
persp3D(z = volcano, plot = FALSE)
```

The figure is then plotting in openGL by function `plotrgl`, whose arguments are:

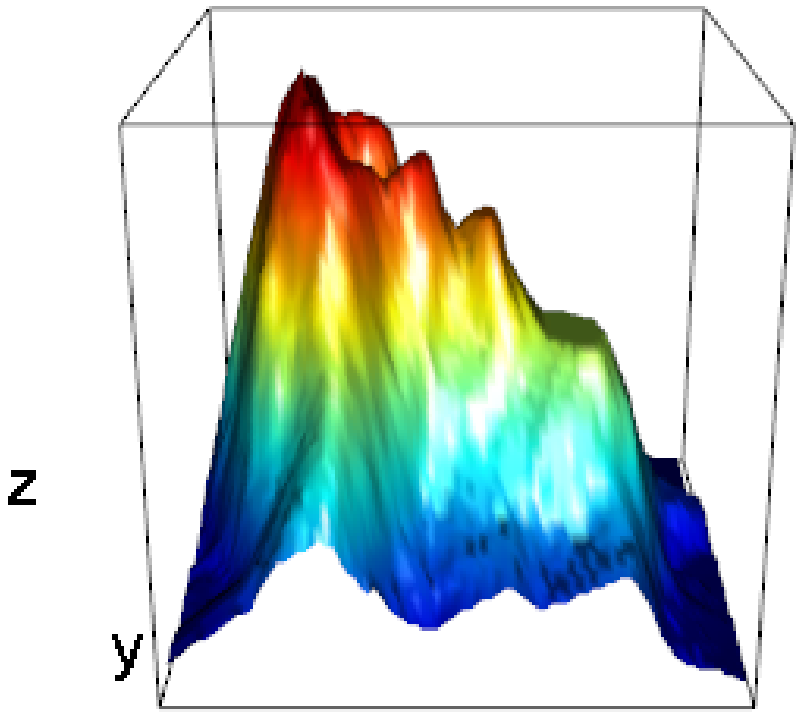
```
args(plotrgl)
```

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

Here the `...` are any parameter that would be passed to **rgl** functions `par3d`, `open3d` of `material3d`.

Argument `smooth` adds Gouraud shading, while `lighting` adds a light source.

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



Now you can use the left mouse key to rotate the plot, the middle key to move it, and the right key to zoom. You may also want to try function `cutrgl`, which allows you to cut parts of the plot.

An alternative, shorter version to do the same is:

```
persp3Drgl(z = volcano, smooth = TRUE, lighting = TRUE)
```

Function `croprgl` can be used to adapt the ranges (not shown)

```
cutrgl()                      # requires selection using left mouse
croprgl(xlim = c(0.2, 0.8))
uncutrgl()                    # restores original plot
```

The same figure in base R-graphics looks less nice but has a colorkey:

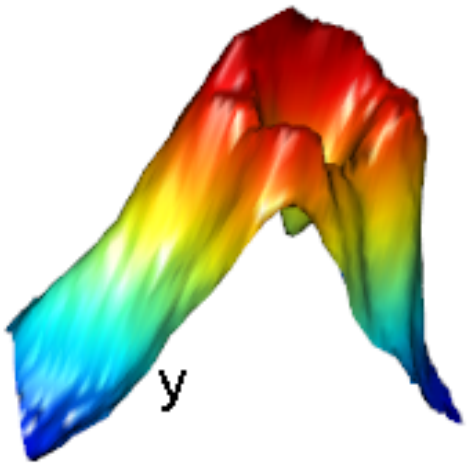


Figure 1: The volcano, after a region has been cutted

```
plotdev(shade = 0.1)
```

3. scatter plot example

A linear regression of the mtcars data:

```
attach(mtcars)
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"))
# fitted points for droplines to surface
fitpoints <- predict(fit)

scatter3D(z = mpg, x = wt, y = disp, colvar = abs(mpg - fitpoints),
       pch = 18, cex = 2, theta = 20, phi = 20, ticktype = "detailed",
       xlab = "wt", ylab = "disp", zlab = "mpg", main = "mtcars",
```

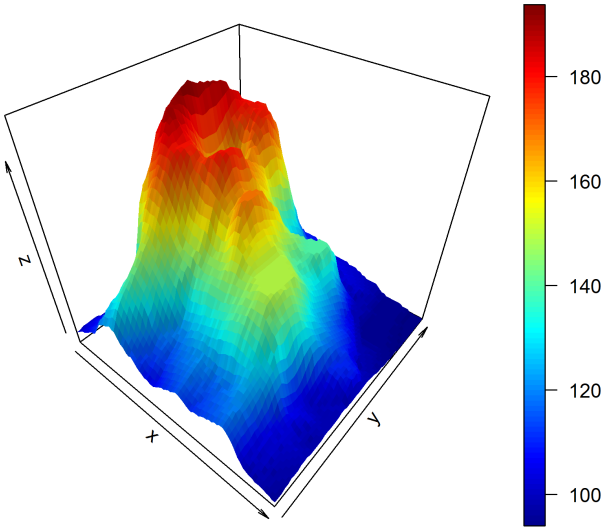
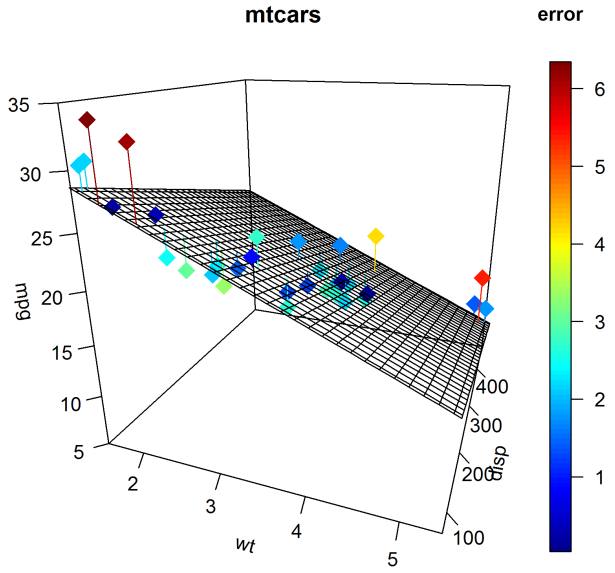


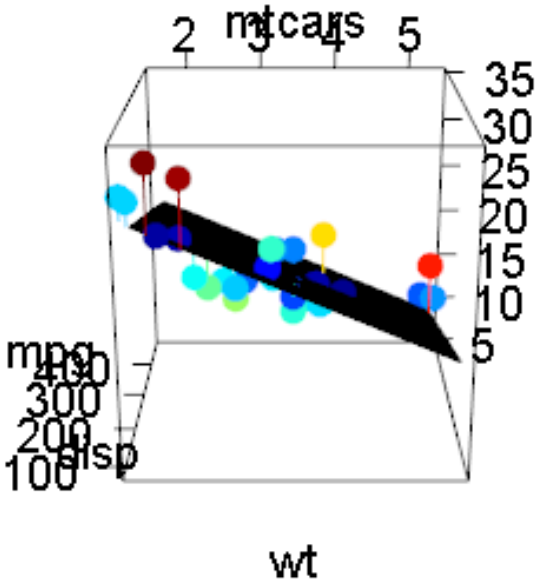
Figure 2: The volcano, using base R graphics

```
clab = "error", zlim = c(5, 35),
surf = list(x = wt.pred, y = disp.pred, z = mpg.pred,
            facets = NA, border = "black", fit = fitpoints)
)
```

```
detach(mtcars)
```

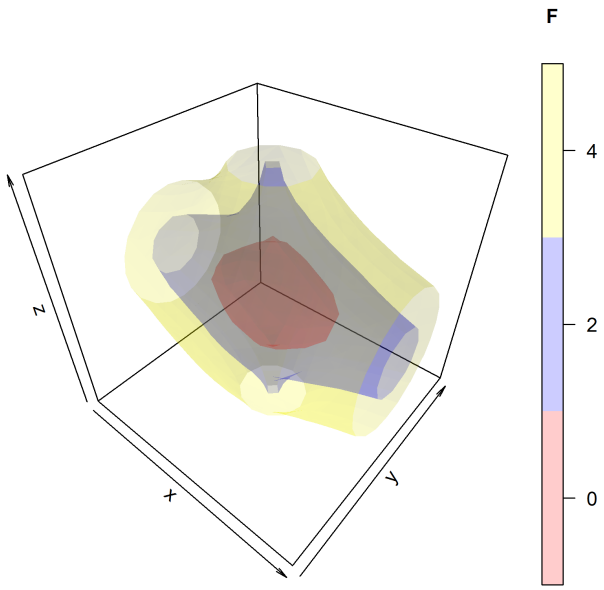
```
plotrgl(new = FALSE)
```





4. isosurfaces

Function `isosurf3D` from **plot3D** creates surfaces of equal scalar value from a volumetric data



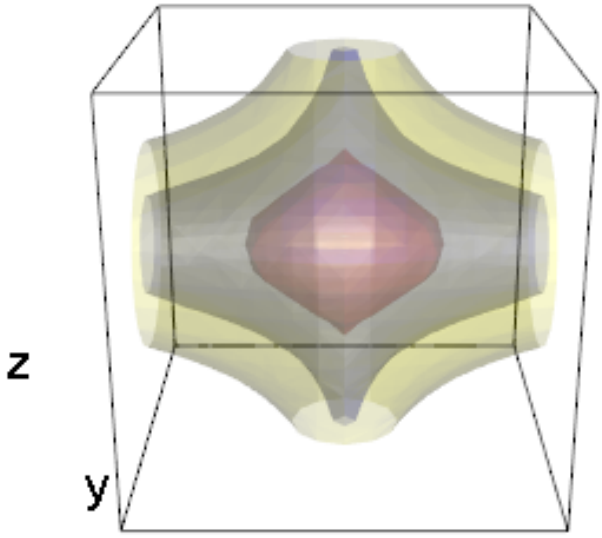
set. It makes use of a function from package **misc3d** (Feng and Tierney 2008).

If we depict several isosurfaces, it is best to use transparent colors by setting argument `alpha` smaller than 1. Plotting transparent surfaces is very slow in base graphics, but not so in openGL.

```
 x <- y <- z <- seq(-2, 2, length.out = 15)
 xyz <- mesh(x, y, z)
 F <- with(xyz, log(x^2 + y^2 + z^2 +
                 10*(x^2 + y^2) * (y^2 + z^2) ^2))
# three levels, transparency added
 isosurf3D(x, y, z, F, level = seq(0, 4, by = 2),
    col = c("red", "blue", "yellow"),
    clab = "F", alpha = 0.2, plot = FALSE)
```

```
plotdev()
```

```
plotrgl(new = FALSE, lighting = TRUE)
```



5. Issues

- Often the axes are not drawn in `rgl` plots. This is only in the most recent version of the **rgl** package. If you want axes, just type

  ```
  decorate3d()
  ```

- I created a function to visualise arrows in rgl as cones. But it has a flaw, as the arrows are distorted, if not perpendicular to the z-axis. Use with care

6. Finally

This vignette was made with Sweave (Leisch 2002).

References

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