Package 'DiceView'

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Title Methods for Visualization of Computer Experiments Design and Surrogate

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Description View 2D/3D sections, contour plots, mesh of excursion sets for computer experiments designs, surrogates or test functions.

Depends methods, utils, stats, grDevices, graphics

Imports DiceDesign, R.cache, geometry, scatterplot3d, parallel

Suggests rlibkriging, DiceKriging, DiceEval

Enhances rgl, arrangements

License GPL-3

URL https://github.com/IRSN/DiceView

Repository CRAN

RoxygenNote 7.2.1

Encoding UTF-8

NeedsCompilation no

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R topics documented:

`Apply.function` *Apply Functions Over Array Margins, using custom vectorization (possibly using parallel)*

Description

Emulate parallel apply on a function, from mclapply. Returns a vector or array or list of values obtained by applying a function to margins of an array or matrix.

Usage

```
Apply.function(
  FUN,
  X,
  MARGIN = 1,
  .combine = c,
  .lapply = parallel::mclapply,
  ...
)
```

Arguments

`FUN`	function to apply on X
`X`	array of input values for FUN
`MARGIN`	1 indicates to apply on rows (default), 2 on columns
`.combine`	how to combine results (default using c(.))
`.lapply`	how to vectorize FUN call (default is parallel::mclapply)
`...`	optional arguments to FUN.

Value

array of values taken by FUN on each row/column of X

Examples

```
X = matrix(runif(10),ncol=2);
  rowSums(X) == apply(X,1,sum)
  apply(X,1,sum) == Apply.function(sum,X)

X = matrix(runif(10),ncol=1)
  rowSums(X) == apply(X,1,sum)
  apply(X,1,sum) == Apply.function(sum,X)

X = matrix(runif(10),ncol=2)
f = function(X) X[1]/X[2]
apply(X,1,f) == Apply.function(f,X)
```

`are_in.mesh` *Checks if some points belong to a given mesh*

Description

Checks if some points belong to a given mesh

Usage

```
are_in.mesh(X, mesh)
```

Arguments

`X`	points to check
`mesh`	mesh identifying the set which X may belong

Examples

```
X = matrix(runif(100),ncol=2);
inside = are_in.mesh(X,mesh=geometry::delaunayn(matrix(c(0,0,1,1,0,0),ncol=2),output.options =TRUE))
print(inside)
plot(X,col=rgb(1-inside,0,0+inside))
```

`branin` *This is a simple copy of the Branin-Hoo 2-dimensional test function, as provided in DiceKriging package. The Branin-Hoo function is defined here over [0,1] x [0,1], instead of [-5,0] x [10,15] as usual. It has 3 global minima : x1 = c(0.9616520, 0.15); x2 = c(0.1238946, 0.8166644); x3 = c(0.5427730, 0.15)*

Description

This is a simple copy of the Branin-Hoo 2-dimensional test function, as provided in DiceKriging package. The Branin-Hoo function is defined here over [0,1] x [0,1], instead of [-5,0] x [10,15] as usual. It has 3 global minima : x1 = c(0.9616520, 0.15); x2 = c(0.1238946, 0.8166644); x3 = c(0.5427730, 0.15)

Usage

```
branin(x)
```

Arguments

`x` a 2-dimensional vector specifying the location where the function is to be evaluated.

Value

A real number equal to the Branin-Hoo function values at x

`combn.design` *Generalize expand.grid() for multi-columns data. Build all combinations of lines from X1 and X2. Each line may hold multiple columns.*

Description

Generalize expand.grid() for multi-columns data. Build all combinations of lines from X1 and X2. Each line may hold multiple columns.

Usage

```
combn.design(X1, X2)
```

Arguments

`X1` variable values, possibly with many columns

`X2` variable values, possibly with many columns combn.design(matrix(c(10,20),ncol=1),matrix(c(1,2,3,4,5,6) combn.design(matrix(c(10,20,30,40),ncol=2),matrix(c(1,2,3,4,5,6),ncol=2)) contourview.function *Plot a contour view of a prediction model or function, including design points if available.*

Description

Plot a contour view of a prediction model or function, including design points if available.

Usage

```
## S3 method for class '`function`'
contourview(
  fun,
  vectorized = FALSE,
  dim = NULL,
  center = NULL,
  axis = NULL,
  npoints = 20,
  nlevels = 10,
  col_surf = "blue",
  filled = FALSE,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'matrix'
contourview(
  X,
  y,
  sdy = NULL,
  center = NULL,
  axis = NULL,
  col_points = "red",
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  title = NULL,
  add = FALSE,
  ...
)
```

```
## S3 method for class 'km'
contourview(
  km_model,
  type = "UK",
  center = NULL,
  axis = NULL,
  npoints = 20,
  nlevels = 10,
  col_points = "red",
  col_surf = "blue",
  filled = FALSE,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'Kriging'
contourview(
  Kriging_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  nlevels = 10,
  col_points = "red",
  col_surf = "blue",
  filled = FALSE,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'NuggetKriging'
contourview(
  NuggetKriging_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
```

```
    nlevels = 10,
    col_points = "red",
    col_surf = "blue",
    filled = FALSE,
    bg_blend = 1,
    mfrow = NULL,
    Xlab = NULL,
    ylab = NULL,
    Xlim = NULL,
    title = NULL,
    add = FALSE,
    ...
  )

  ## S3 method for class 'NoiseKriging'
  contourview(
    NoiseKriging_model,
    center = NULL,
    axis = NULL,
    npoints = 20,
    nlevels = 10,
    col_points = "red",
    col_surf = "blue",
    filled = FALSE,
    bg_blend = 1,
    mfrow = NULL,
    Xlab = NULL,
    ylab = NULL,
    Xlim = NULL,
    title = NULL,
    add = FALSE,
    ...
  )

  ## S3 method for class 'glm'
  contourview(
    glm_model,
    center = NULL,
    axis = NULL,
    npoints = 20,
    nlevels = 10,
    col_points = "red",
    col_surf = "blue",
    filled = FALSE,
    bg_blend = 1,
    mfrow = NULL,
    Xlab = NULL,
    ylab = NULL,
```

```
  Xlim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'list'
contourview(
  modelFit_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  nlevels = 10,
  col_points = "red",
  col_surf = "blue",
  bg_blend = 1,
  filled = FALSE,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

contourview(...)
```

Arguments

`fun`	a function or 'predict()'-like function that returns a simple numeric or mean and standard error: list(mean=...,se=...).
`vectorized`	is fun vectorized?
`dim`	input variables dimension of the model or function.
`center`	optional coordinates (as a list or data frame) of the center of the section view if the model's dimension is > 2.
`axis`	optional matrix of 2-axis combinations to plot, one by row. The value `NULL` leads to all possible combinations i.e. `choose(D, 2)`.
`npoints`	an optional number of points to discretize plot of response surface and uncertainties.
`nlevels`	number of contour levels to display.
`col_surf`	color for the surface.
`filled`	use filled.contour
`mfrow`	an optional list to force `par(mfrow = ...)` call. The default value `NULL` is automatically set for compact view.
`Xlab`	an optional list of string to overload names for X.

ylab	an optional string to overload name for y.
Xlim	an optional list to force x range for all plots. The default value NULL is automatically set to include all design points.
title	an optional overload of main title.
add	to print graphics on an existing window.
...	arguments of the contourview.km, contourview.glm, contourview.Kriging or contourview.function function
X	the matrix of input design.
y	the array of output values.
sdy	optional array of output standard error.
col_points	color of points.
bg_blend	an optional factor of alpha (color channel) blending used to plot design points outside from this section.
km_model	an object of class "km".
type	the kriging type to use for model prediction.
Kriging_model	an object of class "Kriging".
NuggetKriging_model	an object of class "Kriging".
NoiseKriging_model	an object of class "Kriging".
glm_model	an object of class "glm".
modelFit_model	an object returned by DiceEval::modelFit.

Details

If available, experimental points are plotted with fading colors. Points that fall in the specified section (if any) have the color specified col_points while points far away from the center have shaded versions of the same color. The amount of fading is determined using the Euclidean distance between the plotted point and center.

Author(s)

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See Also

sectionview.function for a section plot, and sectionview3d.function for a 2D section plot. Vectorize.function to wrap as vectorized a non-vectorized function.

sectionview.matrix for a section plot, and sectionview3d.matrix for a 2D section plot.

sectionview.km for a section plot, and sectionview3d.km for a 2D section plot.

sectionview.Kriging for a section plot, and sectionview3d.Kriging for a 2D section plot.

sectionview.NuggetKriging for a section plot, and sectionview3d.NuggetKriging for a 2D section plot.

sectionview.NoiseKriging for a section plot, and sectionview3d.NoiseKriging for a 2D section plot.

sectionview.glm for a section plot, and sectionview3d.glm for a 2D section plot.

sectionview.glm for a section plot, and sectionview3d.glm for a 2D section plot.

Examples

```
x1 <- rnorm(15)
x2 <- rnorm(15)


y <- x1 + x2 + rnorm(15)
model <- lm(y ~ x1 + x2)

contourview(function(x) sum(x),
                     dim=2, Xlim=cbind(range(x1),range(x2)), col='black')
points(x1,x2)

contourview(function(x) {
                      x = as.data.frame(x)
                      colnames(x) <- names(model$coefficients[-1])
                      p = predict.lm(model, newdata=x, se.fit=TRUE)
                      list(mean=p$fit, se=p$se.fit)
                   }, vectorized=TRUE, dim=2, Xlim=cbind(range(x1),range(x2)), add=TRUE)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

contourview(X, y)

if (requireNamespace("DiceKriging")) { library(DiceKriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- km(design = X, response = y, covtype="matern3_2")

contourview(model)

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- Kriging(X = X, y = y, kernel="matern3_2")

contourview(model)

}
```

```
if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin) + 5*rnorm(15)

model <- NuggetKriging(X = X, y = y, kernel="matern3_2")

contourview(model)

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin) + 5*rnorm(15)

model <- NoiseKriging(X = X, y = y, kernel="matern3_2", noise=rep(5^2,15))

contourview(model)

}

x1 <- rnorm(15)
x2 <- rnorm(15)

y <- x1 + x2^2 + rnorm(15)
model <- glm(y ~ x1 + I(x2^2))

contourview(model)

if (requireNamespace("DiceEval")) { library(DiceEval)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- modelFit(X, y, type = "StepLinear")

contourview(model)

}

## A 2D example - Branin-Hoo function
contourview(branin, dim=2, nlevels=30, col='black')

## Not run:
## a 16-points factorial design, and the corresponding response
d <- 2; n <- 16
design.fact <- expand.grid(seq(0, 1, length = 4), seq(0, 1, length = 4))
design.fact <- data.frame(design.fact); names(design.fact) <- c("x1", "x2")
y <- branin(design.fact); names(y) <- "y"

if (requireNamespace("DiceKriging")) { library(DiceKriging)
## model: km
```

```
model <- DiceKriging::km(design = design.fact, response = y)
contourview(model, nlevels=30)
contourview(branin, dim=2, nlevels=30, col='red', add=TRUE)
}

## model: Kriging
if (requireNamespace("rlibkriging")) { library(rlibkriging)
model <- Kriging(X = as.matrix(design.fact), y = as.matrix(y), kernel="matern3_2")
contourview(model, nlevels=30)
contourview(branin, dim=2, nlevels=30, col='red', add=TRUE)
}

## model: glm
model <- glm(y ~ 1+ x1 + x2 + I(x1^2) + I(x2^2) + x1*x2, data=cbind(y,design.fact))
contourview(model, nlevels=30)
contourview(branin, dim=2, nlevels=30, col='red', add=TRUE)

if (requireNamespace("DiceEval")) { library(DiceEval)
## model: StepLinear
model <- modelFit(design.fact, y, type = "StepLinear")
contourview(model, nlevels=30)
contourview(branin, dim=2, nlevels=30, col='red', add=TRUE)
}

## End(Not run)
```

---

is_in.mesh *Checks if some point belongs to a given mesh*

Description

Checks if some point belongs to a given mesh

Usage

```
is_in.mesh(x, mesh)
```

Arguments

x	point to check
mesh	mesh identifying the set which X may belong

Examples

```
is_in.mesh(-0.5,mesh=geometry::delaunayn(matrix(c(0,1),ncol=1),output.options =TRUE))
is_in.mesh(0.5,mesh=geometry::delaunayn(matrix(c(0,1),ncol=1),output.options =TRUE))

x =matrix(-.5,ncol=2,nrow=1)
is_in.mesh(x,mesh=geometry::delaunayn(matrix(c(0,0,1,1,0,0),ncol=2),output.options =TRUE))
```

```
x =matrix(.5,ncol=2,nrow=1)
is_in.mesh(x,mesh=geometry::delaunayn(matrix(c(0,0,1,1,0,0),ncol=2),output.options =TRUE))
```

`is_in.p` *Test if points are in a hull*

Description

Test if points are in a hull

Usage

```
is_in.p(x, p, h = NULL)
```

Arguments

x	points to test
p	points defining the hull
h	hull itself (built from p if given as NULL (default))

Examples

```
is_in.p(x=-0.5,p=matrix(c(0,1),ncol=1))
is_in.p(x=0.5,p=matrix(c(0,1),ncol=1))
is_in.p(x=matrix(-.5,ncol=2,nrow=1),p=matrix(c(0,0,1,1,0,0),ncol=2))
is_in.p(x=matrix(.25,ncol=2,nrow=1),p=matrix(c(0,0,1,1,0,0),ncol=2))
is_in.p(x=matrix(-.5,ncol=3,nrow=1),p=matrix(c(0,0,0,1,0,0,0,1,0,0,0,1),ncol=3,byrow = TRUE))
is_in.p(x=matrix(.25,ncol=3,nrow=1),p=matrix(c(0,0,0,1,0,0,0,1,0,0,0,1),ncol=3,byrow = TRUE))
```

`Memoize.function` *Memoize a function*

Description

Before each call of a function, check that the cache holds the results and returns it if available. Otherwise, compute f and cache the result for next evluations.

Usage

```
Memoize.function(fun)
```

Arguments

fun	function to memoize

Value

a function with same behavior than argument one, but using cache.

Examples

```
f=function(n) rnorm(n);
F=Memoize.function(f);
F(5); F(6); F(5)
```

---

mesh_exsets *Search excursion set of nD function, sampled by a mesh*

Description

Search excursion set of nD function, sampled by a mesh

Usage

```
mesh_exsets(
  f,
  vectorized = FALSE,
  threshold,
  sign,
  intervals,
  mesh = "seq",
  mesh.sizes = 11,
  maxerror_f = 1e-09,
  tol = .Machine$double.eps^0.25,
  ex_filter.tri = all,
  ...
)
```

Arguments

`f`	Function to inverse at 'threshold'
`vectorized`	is f already vectorized ? (default: no)
`threshold`	target value to inverse
`sign`	focus at conservative for above (sign=1) or below (sign=-1) the threshold
`intervals`	bounds to inverse in, each column contains min and max of each dimension
`mesh`	function or "unif" or "seq" (default) to preform interval partition
`mesh.sizes`	number of parts for mesh (duplicate for each dimension if using "seq")
`maxerror_f`	maximal tolerance on f precision
`tol`	the desired accuracy (convergence tolerance on f arg).
`ex_filter.tri`	boolean function to validate a geometry::tri as considered in excursion : 'any' or 'all'
`...`	parameters to forward to mesh_roots(...) call

Examples

```
# mesh_exsets(function(x) x, threshold=.51, sign=1, intervals=rbind(0,1),
#   maxerror_f=1E-2,tol=1E-2) # for faster testing
# mesh_exsets(function(x) x, threshold=.50000001, sign=1, intervals=rbind(0,1),
#   maxerror_f=1E-2,tol=1E-2) # for faster testing
# mesh_exsets(function(x) sum(x), threshold=.51,sign=1, intervals=cbind(rbind(0,1),rbind(0,1)),
#   maxerror_f=1E-2,tol=1E-2) # for faster testing
# mesh_exsets(sin,threshold=0,sign="sup",interval=c(pi/2,5*pi/2),
#   maxerror_f=1E-2,tol=1E-2) # for faster testing

if (identical(Sys.getenv("NOT_CRAN"), "true")) { # too long for CRAN on Windows

  e = mesh_exsets(function(x) (0.25+x[1])^2+(0.5+x[2])^2 ,
                threshold =0.25,sign=-1, intervals=matrix(c(-1,1,-1,1),nrow=2),
                maxerror_f=1E-2,tol=1E-2) # for faster testing

  plot(e$p,xlim=c(-1,1),ylim=c(-1,1));
  apply(e$tri,1,function(tri) polygon(e$p[tri,],col=rgb(.4,.4,.4,.4)))

  if (requireNamespace("rgl")) {
    e = mesh_exsets(function(x) (0.5+x[1])^2+(-0.5+x[2])^2+(0.+x[3])^2,
                  threshold = .25,sign=-1, mesh="unif",
                  intervals=matrix(c(-1,1,-1,1,-1,1),nrow=2),
                  maxerror_f=1E-2,tol=1E-2) # for faster testing

    rgl::plot3d(e$p,xlim=c(-1,1),ylim=c(-1,1),zlim=c(-1,1));
    apply(e$tri,1,function(tri)rgl::lines3d(e$p[tri,]))
  }
}
```

---

mesh_roots *Multi Dimensional Multiple Roots (Zero) Finding, sampled by a mesh*

Description

Multi Dimensional Multiple Roots (Zero) Finding, sampled by a mesh

Usage

```
mesh_roots(
  f,
  vectorized = FALSE,
  intervals,
  mesh = "seq",
  mesh.sizes = 11,
  maxerror_f = 1e-07,
  tol = .Machine$double.eps^0.25,
  ...
)
```

Arguments

`f`	Function (one or more dimensions) to find roots of
`vectorized`	is f already vectorized ? (default: no)
`intervals`	bounds to inverse in, each column contains min and max of each dimension
`mesh`	function or "unif" or "seq" (default) to preform interval partition
`mesh.sizes`	number of parts for mesh (duplicate for each dimension if using "seq")
`maxerror_f`	the maximum error on f evaluation (iterates over uniroot to converge).
`tol`	the desired accuracy (convergence tolerance on f arg).
`...`	Other args for f

Value

matrix of x, so f(x)=0

Examples

```
mesh_roots(function(x) x-.51, intervals=rbind(0,1))
mesh_roots(function(x) sum(x)-.51, intervals=cbind(rbind(0,1),rbind(0,1)))
mesh_roots(sin,intervals=c(pi/2,5*pi/2))
mesh_roots(f = function(x) sin(pi*x[1])*sin(pi*x[2]),
           intervals = matrix(c(1/2,5/2,1/2,5/2),nrow=2))

r = mesh_roots(function(x) (0.25+x[1])^2+(0.5+x[2])^2-.25,
               intervals=matrix(c(-1,1,-1,1),nrow=2))
plot(r,xlim=c(-1,1),ylim=c(-1,1))

r = mesh_roots(function(x) (0.5+x[1])^2+(-0.5+x[2])^2+(0.+x[3])^2- .25,
               mesh.sizes = 11,
               intervals=matrix(c(-1,1,-1,1,-1,1),nrow=2))
scatterplot3d::scatterplot3d(r,xlim=c(-1,1),ylim=c(-1,1),zlim=c(-1,1))

mesh_roots(function(x)exp(x)-1,intervals=c(-1,2))
mesh_roots(function(x)exp(1000*x)-1,intervals=c(-1,2))
```

`min_dist` *Minimal distance between one point to many points*

Description

Minimal distance between one point to many points

Usage

```
min_dist(x, X, norm = rep(1, ncol(X)))
```

Arguments

`x`	one point
`X`	matrix of points (same number of columns than x)
`norm`	normalization vecor of distance (same number of columns than x)

Value

minimal distance

Examples

```
min_dist(runif(3),matrix(runif(30),ncol=3))
```

`plot2d_mesh` *Plot a two dimensional mesh*

Description

Plot a two dimensional mesh

Usage

```
plot2d_mesh(mesh, color = "black", ...)
```

Arguments

`mesh`	2-dimensional mesh to draw
`color`	color of the mesh
`...`	optional arguments passed to plot function

Examples

```
plot2d_mesh(mesh_exsets(f = function(x) sin(pi*x[1])*sin(pi*x[2]),
                        threshold=0,sign=1, mesh="unif",mesh.size=11,
                        intervals = matrix(c(1/2,5/2,1/2,5/2),nrow=2)))
```

plot3d_mesh *Plot a three dimensional mesh*

Description

Plot a three dimensional mesh

Usage

```
plot3d_mesh(mesh, engine3d = NULL, color = "black", ...)
```

Arguments

mesh	3-dimensional mesh to draw
engine3d	3d framework to use: 'rgl' if installed or 'scatterplot3d' (default)
color	color of the mesh
...	optional arguments passed to plot function

Examples

```
if (identical(Sys.getenv("NOT_CRAN"), "true")) { # too long for CRAN on Windows

  plot3d_mesh(mesh_exsets(function(x) (0.5+x[1])^2+(-0.5+x[2])^2+(0.+x[3])^2,
                          threshold = .25,sign=-1, mesh="unif",
                          maxerror_f=1E-2,tol=1E-2, # faster display
                          intervals=matrix(c(-1,1,-1,1,-1,1),nrow=2)),
                          engine3d='scatterplot3d')

  if (requireNamespace("rgl")) {
    plot3d_mesh(mesh_exsets(function(x) (0.5+x[1])^2+(-0.5+x[2])^2+(0.+x[3])^2,
                            threshold = .25,sign=-1, mesh="unif",
                            maxerror_f=1E-2,tol=1E-2, # faster display
                            intervals=matrix(c(-1,1,-1,1,-1,1),nrow=2)),engine3d='rgl')
  }
}
```

plot_mesh *Plot a one dimensional mesh*

Description

Plot a one dimensional mesh

Usage

```
plot_mesh(mesh, y = 0, color = "black", ...)
```

Arguments

mesh	1-dimensional mesh to draw
y	ordinate value where to draw the mesh
color	color of the mesh
...	optional arguments passed to plot function

Examples

```
plot_mesh(mesh_exsets(function(x) x, threshold=.51, sign=1, intervals=rbind(0,1)))
plot_mesh(mesh_exsets(function(x) (x-.5)^2, threshold=.1, sign=-1, intervals=rbind(0,1)))
```

---

points_in.mesh — *Extract points of mesh which belong to the mesh triangulation (may not contain all points)*

Description

Extract points of mesh which belong to the mesh triangulation (may not contain all points)

Usage

```
points_in.mesh(mesh)
```

Arguments

mesh	mesh (list(p,tri,...) from geometry)

Value

points coordinates inside the mesh triangulation

---

points_out.mesh — *Extract points of mesh which do not belong to the mesh triangulation (may not contain all points)*

Description

Extract points of mesh which do not belong to the mesh triangulation (may not contain all points)

Usage

```
points_out.mesh(mesh)
```

Arguments

mesh	(list(p,tri,...) from geometry)

Value

points coordinates outside the mesh triangulation

---

root *One Dimensional Root (Zero) Finding*

Description

Search one root with given precision (on y). Iterate over uniroot as long as necessary.

Usage

```
root(
  f,
  lower,
  upper,
  maxerror_f = 1e-07,
  f_lower = f(lower, ...),
  f_upper = f(upper, ...),
  tol = .Machine$double.eps^0.25,
  convexity = 0,
  ...
)
```

Arguments

f	the function for which the root is sought.
lower	the lower end point of the interval to be searched.
upper	the upper end point of the interval to be searched.
maxerror_f	the maximum error on f evaluation (iterates over uniroot to converge).
f_lower	the same as f(lower).
f_upper	the same as f(upper).
tol	the desired accuracy (convergence tolerance on f arg).
convexity	the learned convexity factor of the function, used to reduce the boundaries for uniroot.
...	additional named or unnamed arguments to be passed to f.

Author(s)

Yann Richet, IRSN

Examples

```
f=function(x) {cat("f");1-exp(x)}; f(root(f,lower=-1,upper=2))
f=function(x) {cat("f");exp(x)-1}; f(root(f,lower=-1,upper=2))

.f = function(x) 1-exp(1*x)
f=function(x) {cat("f");y=.f(x);points(x,y,pch=20,col=rgb(0,0,0,.2));y}
plot(.f,xlim=c(-1,2)); f(root(f,lower=-1,upper=2))

.f = function(x) exp(10*x)-1
f=function(x) {cat("f");y=.f(x);points(x,y,pch=20);y}
plot(.f,xlim=c(-1,2)); f(root(f,lower=-1,upper=2))

.f = function(x) exp(100*x)-1
f=function(x) {cat("f");y=.f(x);points(x,y,pch=20);y}
plot(.f,xlim=c(-1,2)); f(root(f,lower=-1,upper=2))

f=function(x) {cat("f");exp(100*x)-1}; f(root(f,lower=-1,upper=2))
```

---

roots *One Dimensional Multiple Roots (Zero) Finding*

Description

Search multiple roots of 1D function, sampled/splitted by a (1D) mesh

Usage

```
roots(
  f,
  interval,
  maxerror_f = 1e-07,
  split = "seq",
  split.size = 11,
  tol = .Machine$double.eps^0.25,
  ...
)
```

Arguments

`f`	Function to find roots
`interval`	bounds to inverse in
`maxerror_f`	the maximum error on f evaluation (iterates over uniroot to converge).
`split`	function or "unif" or "seq" (default) to preform interval partition
`split.size`	number of parts to perform uniroot inside
`tol`	the desired accuracy (convergence tolerance on f arg).
`...`	additional named or unnamed arguments to be passed to f.

Value

array of x, so f(x)=target

Examples

```
roots(sin,interval=c(pi/2,5*pi/2))
roots(sin,interval=c(pi/2,1.5*pi/2))

f=function(x)exp(x)-1;
f(roots(f,interval=c(-1,2)))

f=function(x)exp(1000*x)-1;
f(roots(f,interval=c(-1,2)))
```

---

sectionview.function *Plot a section view of a prediction model or function, including design points if available.*

Description

Plot a section view of a prediction model or function, including design points if available.

Usage

```
## S3 method for class '`function`'
sectionview(
  fun,
  vectorized = FALSE,
  dim = NULL,
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_surf = "blue",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'matrix'
sectionview(
```

```
  X,
  y,
  sdy = NULL,
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_points = "red",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  bg_blend = 5,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'km'
sectionview(
  km_model,
  type = "UK",
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  bg_blend = 5,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'Kriging'
sectionview(
  Kriging_model,
  center = NULL,
  axis = NULL,
  npoints = 100,
```

```
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  bg_blend = 5,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'NuggetKriging'
sectionview(
  NuggetKriging_model,
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  bg_blend = 5,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'NoiseKriging'
sectionview(
  NoiseKriging_model,
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  bg_blend = 5,
  mfrow = NULL,
```

```
  xlab = NULL,
  ylab = NULL,
  xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'glm'
sectionview(
  glm_model,
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.5, 0.8, 0.9, 0.95, 0.99),
  conf_blend = NULL,
  bg_blend = 5,
  mfrow = NULL,
  xlab = NULL,
  ylab = NULL,
  xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)

## S3 method for class 'list'
sectionview(
  modelFit_model,
  center = NULL,
  axis = NULL,
  npoints = 100,
  col_points = "red",
  col_surf = "blue",
  bg_blend = 5,
  mfrow = NULL,
  xlab = NULL,
  ylab = NULL,
  xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  ...
)
```

```
sectionview(...)
```

Arguments

fun	a function or 'predict()'-like function that returns a simple numeric or mean and standard error: list(mean=...,se=...).
vectorized	is fun vectorized?
dim	input variables dimension of the model or function.
center	optional coordinates (as a list or data frame) of the center of the section view if the model's dimension is > 2.
axis	optional matrix of 2-axis combinations to plot, one by row. The value `NULL` leads to all possible combinations i.e. `choose(D, 2)`.
npoints	an optional number of points to discretize plot of response surface and uncertainties.
col_surf	color for the surface.
conf_lev	an optional list of confidence interval values to display.
conf_blend	an optional factor of alpha (color channel) blending used to plot confidence intervals.
mfrow	an optional list to force `par(mfrow = ...)` call. The default value `NULL` is automatically set for compact view.
Xlab	an optional list of string to overload names for X.
ylab	an optional string to overload name for y.
Xlim	an optional list to force x range for all plots. The default value `NULL` is automatically set to include all design points.
ylim	an optional list to force y range for all plots.
title	an optional overload of main title.
add	to print graphics on an existing window.
...	arguments of the `sectionview.km`, `sectionview.glm`, `sectionview.Kriging` or `sectionview.function` function
X	the matrix of input design.
y	the array of output values.
sdy	optional array of output standard error.
col_points	color of points.
bg_blend	an optional factor of alpha (color channel) blending used to plot design points outside from this section.
km_model	an object of class `"km"`.
type	the kriging type to use for model prediction.
Kriging_model	an object of class `"Kriging"`.
NuggetKriging_model	an object of class `"Kriging"`.

NoiseKriging_model
: an object of class "Kriging".

glm_model
: an object of class "glm".

modelFit_model
: an object returned by DiceEval::modelFit.

Details

If available, experimental points are plotted with fading colors. Points that fall in the specified section (if any) have the color specified col_points while points far away from the center have shaded versions of the same color. The amount of fading is determined using the Euclidean distance between the plotted point and center.

Author(s)

Yann Richet, IRSN

See Also

sectionview.function for a section plot, and sectionview3d.function for a 2D section plot. Vectorize.function to wrap as vectorized a non-vectorized function.

sectionview.matrix for a section plot, and sectionview3d.matrix for a 2D section plot.

sectionview.km for a section plot, and sectionview3d.km for a 2D section plot.

sectionview.Kriging for a section plot, and sectionview3d.Kriging for a 2D section plot.

sectionview.NuggetKriging for a section plot, and sectionview3d.NuggetKriging for a 2D section plot.

sectionview.NoiseKriging for a section plot, and sectionview3d.NoiseKriging for a 2D section plot.

sectionview.glm for a section plot, and sectionview3d.glm for a 2D section plot.

sectionview.glm for a section plot, and sectionview3d.glm for a 2D section plot.

Examples

```
x1 <- rnorm(15)
x2 <- rnorm(15)

y <- x1 + x2 + rnorm(15)

model <- lm(y ~ x1 + x2)

sectionview(function(x) sum(x),
                     dim=2, center=c(0,0), Xlim=cbind(range(x1),range(x2)), col='black')

sectionview(function(x) {
                      x = as.data.frame(x)
                      colnames(x) <- names(model$coefficients[-1])
                      p = predict.lm(model, newdata=x, se.fit=TRUE)
                      list(mean=p$fit, se=p$se.fit)
                    }, vectorized=TRUE,
```

```
                    dim=2, center=c(0,0), Xlim=cbind(range(x1),range(x2)), add=TRUE)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

sectionview(X,y, center=c(.5,.5))

if (requireNamespace("DiceKriging")) { library(DiceKriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- km(design = X, response = y, covtype="matern3_2")

sectionview(model, center=c(.5,.5))

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- Kriging(X = X, y = y, kernel="matern3_2")

sectionview(model, center=c(.5,.5))

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin) + 5*rnorm(15)

model <- NuggetKriging(X = X, y = y, kernel="matern3_2")

sectionview(model, center=c(.5,.5))

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin) + 5*rnorm(15)

model <- NoiseKriging(X = X, y = y, kernel="matern3_2", noise=rep(5^2,15))

sectionview(model, center=c(.5,.5))

}

x1 <- rnorm(15)
x2 <- rnorm(15)
```

```
y <- x1 + x2^2 + rnorm(15)
model <- glm(y ~ x1 + I(x2^2))

sectionview(model, center=c(.5,.5))

if (requireNamespace("DiceEval")) { library(DiceEval)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- modelFit(X, y, type = "StepLinear")

sectionview(model, center=c(.5,.5))

}

## A 2D example - Branin-Hoo function
sectionview(branin, center= c(.5,.5), col='black')

## Not run:
## a 16-points factorial design, and the corresponding response
d <- 2; n <- 16
design.fact <- expand.grid(seq(0, 1, length = 4), seq(0, 1, length = 4))
design.fact <- data.frame(design.fact); names(design.fact) <- c("x1", "x2")
y <- branin(design.fact); names(y) <- "y"

if (requireNamespace("DiceKriging")) { library(DiceKriging)
## model: km
model <- DiceKriging::km(design = design.fact, response = y)
sectionview(model, center= c(.5,.5))
sectionview(branin, center= c(.5,.5), col='red', add=TRUE)
}

if (requireNamespace("rlibkriging")) { library(rlibkriging)
## model: Kriging
model <- Kriging(X = as.matrix(design.fact), y = as.matrix(y), kernel="matern3_2")
sectionview(model, center= c(.5,.5))
sectionview(branin, center= c(.5,.5), col='red', add=TRUE)
}

## model: glm
model <- glm(y ~ 1+ x1 + x2 + I(x1^2) + I(x2^2) + x1*x2, data=cbind(y,design.fact))
sectionview(model, center= c(.5,.5))
sectionview(branin, center= c(.5,.5), col='red', add=TRUE)

if (requireNamespace("DiceEval")) { library(DiceEval)
## model: StepLinear
model <- modelFit(design.fact, y, type = "StepLinear")
sectionview(model, center= c(.5,.5))
sectionview(branin, center= c(.5,.5), col='red', add=TRUE)
}
```

```
## End(Not run)
```

---

sectionview3d.function

Plot a contour view of a prediction model or function, including design points if available.

Description

Plot a contour view of a prediction model or function, including design points if available.

Usage

```
## S3 method for class '`function`'
sectionview3d(
  fun,
  vectorized = FALSE,
  dim = NULL,
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_surf = "blue",
  conf_lev = c(0.95),
  conf_blend = NULL,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

## S3 method for class 'matrix'
sectionview3d(
  X,
  y,
  sdy = NULL,
  center = NULL,
  axis = NULL,
  col_points = "red",
  conf_lev = c(0.95),
  conf_blend = NULL,
  bg_blend = 1,
```

```
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

## S3 method for class 'km'
sectionview3d(
  km_model,
  type = "UK",
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.95),
  conf_blend = NULL,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

## S3 method for class 'Kriging'
sectionview3d(
  Kriging_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.95),
  conf_blend = NULL,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
```

```
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

## S3 method for class 'NuggetKriging'
sectionview3d(
  NuggetKriging_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.95),
  conf_blend = NULL,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

## S3 method for class 'NoiseKriging'
sectionview3d(
  NoiseKriging_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.95),
  conf_blend = NULL,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
```

```
  engine3d = NULL,
  ...
)

## S3 method for class 'glm'
sectionview3d(
  glm_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_points = "red",
  col_surf = "blue",
  conf_lev = c(0.95),
  conf_blend = NULL,
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

## S3 method for class 'list'
sectionview3d(
  modelFit_model,
  center = NULL,
  axis = NULL,
  npoints = 20,
  col_points = "red",
  col_surf = "blue",
  bg_blend = 1,
  mfrow = NULL,
  Xlab = NULL,
  ylab = NULL,
  Xlim = NULL,
  ylim = NULL,
  title = NULL,
  add = FALSE,
  engine3d = NULL,
  ...
)

sectionview3d(...)
```

Arguments

fun	a function or 'predict()'-like function that returns a simple numeric or mean and standard error: list(mean=...,se=...).
vectorized	is fun vectorized?
dim	input variables dimension of the model or function.
center	optional coordinates (as a list or data frame) of the center of the section view if the model's dimension is > 2.
axis	optional matrix of 2-axis combinations to plot, one by row. The value NULL leads to all possible combinations i.e. choose(D, 2).
npoints	an optional number of points to discretize plot of response surface and uncertainties.
col_surf	color for the surface.
conf_lev	an optional list of confidence interval values to display.
conf_blend	an optional factor of alpha (color channel) blending used to plot confidence intervals.
mfrow	an optional list to force par(mfrow = ...) call. The default value NULL is automatically set for compact view.
Xlab	an optional list of string to overload names for X.
ylab	an optional string to overload name for y.
Xlim	an optional list to force x range for all plots. The default value NULL is automatically set to include all design points (and their 1-99 percentiles).
ylim	an optional list to force y range for all plots. The default value NULL is automatically set to include all design points (and their 1-99 percentiles).
title	an optional overload of main title.
add	to print graphics on an existing window.
engine3d	3D view package to use. "rgl" if available, otherwise "scatterplot3d" by default.
...	arguments of the sectionview3d.km, sectionview3d.glm, sectionview3d.Kriging or sectionview3d.function function
X	the matrix of input design.
y	the array of output values.
sdy	optional array of output standard error.
col_points	color of points.
bg_blend	an optional factor of alpha (color channel) blending used to plot design points outside from this section.
km_model	an object of class "km".
type	the kriging type to use for model prediction.
Kriging_model	an object of class "Kriging".
NuggetKriging_model	an object of class "Kriging".
NoiseKriging_model	an object of class "Kriging".
glm_model	an object of class "glm".
modelFit_model	an object returned by DiceEval::modelFit.

Details

If available, experimental points are plotted with fading colors. Points that fall in the specified section (if any) have the color specified `col_points` while points far away from the center have shaded versions of the same color. The amount of fading is determined using the Euclidean distance between the plotted point and `center`.

Author(s)

Yann Richet, IRSN

See Also

`sectionview.function` for a section plot, and `sectionview3d.function` for a 2D section plot. `Vectorize.function` to wrap as vectorized a non-vectorized function.

`sectionview.matrix` for a section plot, and `sectionview3d.matrix` for a 2D section plot.

`sectionview.km` for a section plot, and `sectionview3d.km` for a 2D section plot.

`sectionview.Kriging` for a section plot, and `sectionview3d.Kriging` for a 2D section plot.

`sectionview.NuggetKriging` for a section plot, and `sectionview3d.NuggetKriging` for a 2D section plot.

`sectionview.NoiseKriging` for a section plot, and `sectionview3d.NoiseKriging` for a 2D section plot.

`sectionview.glm` for a section plot, and `sectionview3d.glm` for a 2D section plot.

`sectionview.glm` for a section plot, and `sectionview3d.glm` for a 2D section plot.

Examples

```
x1 <- rnorm(15)
x2 <- rnorm(15)

y <- x1 + x2 + rnorm(15)
DiceView:::open3d(); DiceView:::plot3d(x1,x2,y)

model <- lm(y ~ x1 + x2)

sectionview3d(function(x) sum(x),
                     dim=2, Xlim=cbind(range(x1),range(x2)), add=TRUE, col='black')

sectionview3d(function(x) {
                      x = as.data.frame(x)
                      colnames(x) <- names(model$coefficients[-1])
                      p = predict.lm(model, newdata=x, se.fit=TRUE)
                      list(mean=p$fit, se=p$se.fit)
                   }, vectorized=TRUE, dim=2, Xlim=cbind(range(x1),range(x2)), add=TRUE)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

sectionview3d(X, y)
```

```
if (requireNamespace("DiceKriging")) { library(DiceKriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- km(design = X, response = y, covtype="matern3_2")

sectionview3d(model)

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- Kriging(X = X, y = y, kernel="matern3_2")

sectionview3d(model)

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin) + 5*rnorm(15)

model <- NuggetKriging(X = X, y = y, kernel="matern3_2")

sectionview3d(model)

}

if (requireNamespace("rlibkriging")) { library(rlibkriging)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin) + 5*rnorm(15)

model <- NoiseKriging(X = X, y = y, kernel="matern3_2", noise=rep(5^2,15))

sectionview3d(model)

}

x1 <- rnorm(15)
x2 <- rnorm(15)

y <- x1 + x2^2 + rnorm(15)
model <- glm(y ~ x1 + I(x2^2))

sectionview3d(model)
```

```
if (requireNamespace("DiceEval")) { library(DiceEval)

X = matrix(runif(15*2),ncol=2)
y = apply(X,1,branin)

model <- modelFit(X, y, type = "StepLinear")

sectionview3d(model)

}

## A 2D example - Branin-Hoo function
sectionview3d(branin, dim=2, col='black')

## Not run:
## a 16-points factorial design, and the corresponding response
d <- 2; n <- 16
design.fact <- expand.grid(seq(0, 1, length = 4), seq(0, 1, length = 4))
design.fact <- data.frame(design.fact); names(design.fact) <- c("x1", "x2")
y <- branin(design.fact); names(y) <- "y"

if (requireNamespace("DiceKriging")) { library(DiceKriging)
## model: km
model <- DiceKriging::km(design = design.fact, response = y)
sectionview3d(model)
sectionview3d(branin, dim=2, col='red', add=TRUE)
}

if (requireNamespace("rlibkriging")) { library(rlibkriging)
## model: Kriging
model <- rlibkriging::Kriging(X = as.matrix(design.fact), y = as.matrix(y), kernel="matern3_2")
sectionview3d(model)
sectionview3d(branin, dim=2, col='red', add=TRUE)
}

## model: glm
model <- glm(y ~ 1+ x1 + x2 + I(x1^2) + I(x2^2) + x1*x2, data=cbind(y,design.fact))
sectionview3d(model)
sectionview3d(branin, dim=2, col='red', add=TRUE)

if (requireNamespace("DiceEval")) { library(DiceEval)
## model: StepLinear
model <- modelFit(design.fact, y, type = "StepLinear")
sectionview3d(model)
sectionview3d(branin, dim=2, col='red', add=TRUE)
}

## End(Not run)
```

`Vectorize.function` *Vectorize a multidimensional Function*

Description

Vectorize a d-dimensional (input) function, in the same way that base::Vectorize for 1-dimensional functions.

Usage

```
Vectorize.function(fun, dim, ...)
```

Arguments

`fun`	'dim'-dimensional function to Vectorize
`dim`	dimension of input arguments of fun
`...`	optional args to pass to 'Apply.function()', including .combine, .lapply, or optional args passed to 'fun'.

Value

a vectorized function (to be called on matrix argument, on each row)

Examples

```
f = function(x)x[1]+1; f(1:10); F = Vectorize.function(f,1);
F(1:10); #F = Vectorize(f); F(1:10);

f2 = function(x)x[1]+x[2]; f2(1:10); F2 = Vectorize.function(f2,2);
F2(cbind(1:10,11:20));
```

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