Package ‘FieldSim’

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Title Random fields simulations

Author Alexandre Brouste <Alexandre.Brouste@univ-lemans.fr>, Sophie Lambert-Lacroix <Sophie.Lambert@imag.fr>.

Maintainer Alexandre Brouste <Alexandre.Brouste@univ-lemans.fr>

Depends R (>= 2.0.0), methods, rgl, RColorBrewer

Description This package provides routines for simulate random fields.

URL http://cran.r-project.org/src/contrib/Descriptions/FieldSim.html

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R topics documented:

constructcovf *Construct usual fractional covariance functions*

Description

The function `constructcovf` constructs the covariance function of usual fractional processes (fBm, mBm).

Usage

```
constructcovf(manifold,typeproc,H,F)
```

Arguments

`manifold`	a manifold;
`typeproc`	the type of covariance, possible choice `"fBm"` or `"mBm"`;
`H`	Hurst parameter for fBm;
`F`	Hurst function for mBm.

Author(s)

Alexandre Brouste (http://subaru.univ-lemans.fr/sciences/statist/pages_persos/Brouste/) and Sophie Lambert-Lacroix (http://ljk.imag.fr/membres/Sophie.Lambert).

References

A. Brouste, J. Istas and S. Lambert-Lacroix (2007). On Fractional Gaussian Random Fields Simulations. Journal of Statistical Software, 23(1), 1-23. URL http://www.jstatsoft.org/v23/i01/.

A. Brouste, J. Istas and S. Lambert-Lacroix (2010). On Simulation of Manifold Indexed Fractional Gaussian Fields. Journal of Statistical Software, 36(4), 1–14. URL http://www.jstatsoft.org/v36/i04/.

See Also

`fieldsim`.

Examples

```
# Load FieldSim library
library(FieldSim)

plane<-setManifold("plane")

#Two dimensional fractional Brownian motion
R<-constructcovf(plane,"fBm",H=0.6)

#Two dimensional multifractional Brownian motion
```

```
F.2<-function(x){return(1/4+1/2*x[1])}
R.2<-constructcovf(plane,"mBm",F=F.2)

#For spherical and hyperboloid examples, see fieldsim documentation.
```

---

constructgrid *Construct usual grids on some specific manifolds*

Description

The function `constructgrid` constructs usual grids on manifold.

Usage

```
constructgrid(manifold,typegrid,Ng)
```

Arguments

`manifold`	a manifold;
`typegrid`	the type of the grid, possible choice `"regular"`, `"random"` or `"visualization"`;
`Ng`	parameter of the size of the grid, see details.

Details

We list here the different implemented grids. For `manifold@name=="plane"` we have the `typegrid=="regular"` grid (with the parameter `Ng` returns a regular grid on [0,1]x[0,1] of size `Ng*Ng`), the `typegrid=="random"` grid (uniform random choice of the both coordinates on [0,1], grid of size `Ng*Ng`) and the `typegrid=="random"|typegrid==` grid, of size `(2^Ng +1)*(2^Ng +1)` composed of regular refinments.

For `manifold@name=="sphere"`, we have the following grids: there isn't exist `typegrid=="regular"` grid for a sphere, but a `typegrid=="random"` grid (uniform density sample on the sphere of size `Ng*Ng`) and a `typegrid=="visualization"` grid (sphere-visualization grid on the sphere of size `6*Ng*Ng`, union of the 6 domains centered around one of the 6 triply orthogonal poles, each domain are composed of the heights on the sphere (when they exists) corresponding to the regular mesh [-3/4,3/4]x[-3/4,3/4] of the others two cartesian coordinates).

Finally, for `manifold@name=="hyperboloid"` we have: no `typegrid=="regular"` grid on the hyperboloid, but a `typegrid=="random"` grid (uniform density sample on the sphere of size `Ng*Ng`) and a `typegrid=="visualization"` grid (hyperboloid-vizualisation grid of size `Ng*Ng`, a domain of composed of the height of the hyperboloid corresponding to the regular mesh [-3,3]x[-3,3] of the other two cartesian coordinates)

Author(s)

Alexandre Brouste (`http://subaru.univ-lemans.fr/sciences/statist/pages_persos/Brouste/`) and Sophie Lambert-Lacroix (`http://ljk.imag.fr/membres/Sophie.Lambert`).

References

A. Brouste, J. Istas and S. Lambert-Lacroix (2010). On Simulation of Manifold Indexed Fractional Gaussian Fields. Journal of Statistical Software, 36(4), 1–14. URL http://www.jstatsoft.org/v36/i04/.

See Also

fieldsim.

Examples

```
# Load FieldSim library
library(FieldSim)

#Regular (or visualization) grid on plane
plane<-setManifold("plane")
plane@atlas<-constructgrid(plane,"regular",15)
str(plane@atlas)

#Random grid on the plane
plane@atlas<-constructgrid(plane,"random",15)
str(plane@atlas)

#For more examples of use of constructgrid, see fieldsim documentation.
```

---

fieldsim — *Simulate manifold indexed Gaussian field by the fieldsim method*

Description

The function `fieldsim` yields discretization of sample path of a manifold indexed Gaussian field following the procedure described in Brouste et al. (2007, 2010).

Usage

```
fieldsim(manifold,R,Ne,nbNeighbor)
```

Arguments

`manifold`	an S4 object manifold
`R`	a covariance function of the Gaussian random field to simulate
`Ne`	a positive integer corresponding to the number of points to simulate with the accurate simulation step
`nbNeighbor`	a positive integer (between 1 and 32) corresponding to the number of neighbors to use in the second refined step of the algorithm.

Value

The function returns the vector of the values of the process on the manifold atlas

Author(s)

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References

A. Brouste, J. Istas and S. Lambert-Lacroix (2007). On Fractional Gaussian Random Fields Simulations. Journal of Statistical Software, 23(1), 1-23. URL http://www.jstatsoft.org/v23/i01/.

A. Brouste, J. Istas and S. Lambert-Lacroix (2010). On Simulation of Manifold Indexed Fractional Gaussian Fields. Journal of Statistical Software, 36(4), 1–14. URL http://www.jstatsoft.org/v36/i04/.

See Also

quadvar,manifold-class

Examples

```
# Load FieldSim library
library(FieldSim)

# Sphere indexed fractional Brownian field

sphere<-setManifold("sphere")
R.S.1 <- constructcovf(sphere, "fBm", H = 0.4)

S.u <- constructgrid(sphere, "random", 10)
S.g <- constructgrid(sphere, "visualization", 12)
simulationgrid<-cbind(S.u,S.g)
sphere@atlas <- simulationgrid

resS <- fieldsim(sphere, R.S.1, Ne = 80, nbNeighbor = 15)

sphere@atlas<-S.g
res<-resS[(dim(S.u)[2]+1):length(resS)]
visualize(sphere,resS)
```

---

manifold-class *Manifold class*

Description

The `manifold` class is a class of the **FieldSim** package.

Slots

`name`: is the name of the manifold (a character string).

`atlas`: is the mesh (a matrix).

`distance`: is the distance set on the manifold (a function).

`origin`: is the origin fixed on the manifold (a matrix)

Author(s)

Alexandre Brouste

`quadvar` *Estimate the Hurst parameter of a plane indexed fractional Brownian field by the quadratic variations method*

Description

The function `quadvar` yields the estimation of the Hurst parameter of a fractional Brownian field by the quadratic variations method in the plane case.

Usage

```
quadvar(manifold,res)
```

Arguments

`manifold`	a S4 object manifold.
`res`	sample path of the field on the manifold atlas

Details

The Hurst parameter of the fractal Brownian field is estimated by the procedure described in Istas and Lang (1997).

Value

`H`	a real in $]0,1[$ that represents the estimate of the Hurst parameter of the fractional Brownian field.

Author(s)

Alexandre Brouste (http://subaru.univ-lemans.fr/sciences/statist/pages_persos/Brouste/) and Sophie Lambert-Lacroix (http://ljk.imag.fr/membres/Sophie.Lambert).

References

J. Istas and G. Lang (1997). Quadratic variations and estimation of the local Holder index of a Gaussian process. Annales Institut Henri Poincare, 33, 407-436.

See Also

fieldsim.

Examples

```
# load FieldSim library
library(FieldSim)

plane<-setManifold("plane")
R<-constructcovf(plane,"fBm", H=0.4)
res<-fieldsim(plane,R,Ne=80,nbNeighbor=15)

quadvar(plane,res)
```

---

setManifold — *Set a S4 manifold object*

Description

The function sets an object of class manifold.

Usage

```
setManifold(name,atlas,distance,origin)
```

Arguments

name	name of the manifold (type character);
atlas	atlas of the manifold (type matrix);
distance	distance on the manifold (type function);
origin	origin of the manifold (type matrix).

Value

An object of class manifold with the 4 slots name, atlas, distance and origin.

Author(s)

Alexandre Brouste (http://subaru.univ-lemans.fr/sciences/statist/pages_persos/Brouste/) and Sophie Lambert-Lacroix (http://ljk.imag.fr/membres/Sophie.Lambert).

References

A. Brouste, J. Istas and S. Lambert-Lacroix (2010). On Simulation of Manifold Indexed Fractional Gaussian Fields. Journal of Statistical Software, 36(4), 1–14. URL http://www.jstatsoft.org/v36/i04/.

See Also

constructgrid, constructcovf, fieldsim, visualize

Examples

```
# Load FieldSim library
library(FieldSim)

# Example 1: User manifold
name1<-"plane1"
mesh<-seq(from=0,to=1,length=16)
atlas1<-rbind(rep(mesh,each=16),rep(mesh,16))
d1<-function(xi,xj){return(sqrt(t(xi-xj)%*%(xi-xj)))}
origin1<-rbind(0,0)
manifold1<-setManifold(name=name1, atlas=atlas1, distance=d1, origin=origin1)
str(manifold1)

#Example 2: The "plane" manifold
plane<-setManifold("plane")
str(plane)

#Example 3: The "sphere" manifold
sphere<-setManifold("sphere")
str(sphere)

#Example 4: The "hyperboloid" manifold
hyper<-setManifold("hyperboloid")
str(hyper)
```

---

visualize — *Visualize some of specific manifold indexed fractional Gaussian process*

Description

The function plots some of usual manifold indexed fractional Gaussian processes.

Usage

```
visualize(manifold,res,typeplot="default")
```

Arguments

manifold	a manifold;
res	simulation heights of the process on the atlas of the manifold (type vector);
typeplot	the type of the plot, possible choice "default", "cloud" or "sun";;

Author(s)

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References

A. Brouste, J. Istas and S. Lambert-Lacroix (2010). On Simulation of Manifold Indexed Fractional Gaussian Fields. Journal of Statistical Software, 36(4), 1–14. URL http://www.jstatsoft.org/v36/i04/.

See Also

setManifold, fieldsim

Examples

```
# Load FieldSim library
library(FieldSim)

#Example 1
plane<-setManifold("plane")
R<-constructcovf(plane,"fBm",H=0.6)
res<-fieldsim(plane,R,50)

visualize(plane,res)

#Example 2: The "cloud" plotting
visualize(plane,res,"cloud")

#Example 3: The "sun" plotting
visualize(plane,res,"sun")
```

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