

# Package ‘FieldSim’

January 2, 2012

**Version** 3.1.3

**Date** 2010-08-01

**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.

**License** GPL (>= 2)

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

**Repository** CRAN

**Date/Publication** 2010-07-30 13:49:13

## R topics documented:

constructcovf . . . . .	2
constructgrid . . . . .	3
fieldsim . . . . .	4
manifold-class . . . . .	5
quadvar . . . . .	6
setManifold . . . . .	7
visualize . . . . .	8

<b>Index</b>	<b>10</b>
--------------	-----------

---

constructcovf	<i>Construct usual fractional covariance functions</i>
---------------	--

---

### Description

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

### Usage

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

### Arguments

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

### Author(s)

Alexandre Brouste ([http://subaru.univ-lemans.fr/sciences/statist/pages\\_persos/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

<code>manifold</code>	a manifold;
<code>typegrid</code>	the type of the grid, possible choice "regular", "random" or "visualization";
<code>Ng</code>	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  $[0,1] \times [0,1]$  of size  $Ng \times Ng$ ), the `typegrid=="random"` grid (uniform random choice of the both coordinates on  $[0,1]$ , grid of size  $Ng \times Ng$ ) and the `typegrid=="random" | typegrid=="grid`, of size  $(2^{Ng} + 1) \times (2^{Ng} + 1)$  composed of regular refinements.

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  $Ng \times Ng$ ) and a `typegrid=="visualization"` grid (sphere-visualization grid on the sphere of size  $6 \times Ng \times Ng$ , 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  $[-3/4, 3/4] \times [-3/4, 3/4]$  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  $Ng \times Ng$ ) and a `typegrid=="visualization"` grid (hyperboloid-vizualisation grid of size  $Ng \times Ng$ , a domain of composed of the height of the hyperboloid corresponding to the regular mesh  $[-3,3] \times [-3,3]$  of the other two cartesian coordinates)

## Author(s)

Alexandre Brouste ([http://subaru.univ-lemans.fr/sciences/statist/pages\\_persos/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

<code>manifold</code>	an S4 object manifold
<code>R</code>	a covariance function of the Gaussian random field to simulate
<code>Ne</code>	a positive integer corresponding to the number of points to simulate with the accurate simulation step
<code>nbNeighbor</code>	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)**

Alexandre Brouste ([http://subaru.univ-lemans.fr/sciences/statist/pages\\_persos/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**

[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	<i>Estimate the Hurst parameter of a plane indexed fractional Brownian field by the quadratic variations method</i>
---------	---

---

**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\\_persons/Brouste/](http://subaru.univ-lemans.fr/sciences/statist/pages_persons/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	<i>Set a S4 manifold object</i>
-------------	---------------------------------

---

**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\\_persons/Brouste/](http://subaru.univ-lemans.fr/sciences/statist/pages_persons/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)**

Alexandre Brouste ([http://subaru.univ-lemans.fr/sciences/statist/pages\\_persos/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**

[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")
```

# Index

## \*Topic **classes**

manifold-class, [5](#)

constructcovf, [2](#), [8](#)

constructgrid, [3](#), [8](#)

fieldsim, [2](#), [4](#), [4](#), [7–9](#)

initialize, manifold-method  
(manifold-class), [5](#)

manifold-class, [5](#)

manifold-class, [5](#)

quadvar, [5](#), [6](#)

setManifold, [7](#), [9](#)

visualize, [8](#), [8](#)