

# Package ‘BSSoverSpace’

May 6, 2026

**Type** Package

**Title** Blind Source Separation for Multivariate Spatial Data using Eigen Analysis

**Version** 0.1.0

**Maintainer** Sixing Hao <s.hao3@lse.ac.uk>

**Description** Provides functions for blind source separation over multivariate spatial data, and useful statistics for evaluating performance of estimation on mixing matrix. 'BSSoverSpace' is based on an eigen analysis of a positive definite matrix defined in terms of multiple normalized spatial local covariance matrices, and thus can handle moderately high-dimensional random fields. This package is an implementation of the method described in Zhang, Hao and Yao (2022)<[doi:10.48550/arXiv.2201.02023](https://doi.org/10.48550/arXiv.2201.02023)>.

**License** GPL-3

**Encoding** UTF-8

**Imports** SpatialBSS, expm, rSPDE

**RoxygenNote** 7.2.1

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**NeedsCompilation** no

**Author** Sixing Hao [aut, cre]

**Repository** CRAN

**Date/Publication** 2022-11-10 18:50:05 UTC

## Contents

BSSS . . . . .	2
d_score . . . . .	3
gen_matern_gaussian_rf . . . . .	3
<b>Index</b>	<b>5</b>

**Description**

BSSS estimates the mixing matrix of blind source separation model for multivariate spatial data.

**Usage**

```
BSSS(x, coord, kernel_type, kernel_parameter, kernel_list = NULL)
```

**Arguments**

x	A numeric matrix of dimension $c(n, p)$ , where the $p$ columns correspond to the entries of the random field and the $n$ rows are the observations.
coord	A numeric matrix of dimension $c(n, 2)$ where each row represents the coordinates of a point in the spatial domain. Only needed if the argument <code>kernel_list</code> is <code>NULL</code> .
kernel_type	A string indicating which kernel function to use. Either 'ring', 'ball' or 'gauss'.
kernel_parameter	A numeric vector that gives the parameters for the kernel function. At least length of one for 'ball' and 'gauss' or two for 'ring' kernel.
kernel_list	List of spatial kernel matrices with dimension $c(n, n)$ . Can be computed by the function <a href="#">spatial_kernel_matrix</a> .

**Details**

BSSS estimates the mixing matrix by combining the information of all local covariance matrices together and conduct eigenanalysis.

**Value**

BSSS returns a list, including the estimation of maxing matrix, the estimated latent field, and eigenvalues of matrix  $W$  for validating the estimation. Larger gaps among first few eigenvalues of matrix  $W$  strengthens the validity of estimation. See Zhang, Hao and Yao (2022) <arXiv:2201.02023> for details.

**Examples**

```
sample_size <- 500
coords <- runif(sample_size * 2) * 50
dim(coords) <- c(sample_size, 2)
dim <- 5 # specify the dimensionality of random variable
nu <- runif(dim, 0, 6) # parameter for matern covariance function
kappa <- runif(dim, 0, 2) # parameter for matern covariance function
zs <- gen_matern_gaussian_rf(coords=coords, dim=dim, nu=nu, kappa=kappa)
```

```

mix_mat <- diag(dim) # create a diagonal matrix as the mixing matrix
xs <- t(mix_mat %**% t(zs))
example <- BSSS(xs, coords, 'ring', c(0,0.5,0.5,1,1,8))
d_score(example$mix_mat_est, mix_mat)

```

---

d\_score

*d score*


---

### Description

d score measures the similarity of two square matrix with same dimension. d\_score equals 0 if the estimator is a column permutation of true value.

### Usage

```
d_score(estimator, true_value)
```

### Arguments

estimator      A square matrix, usually an estimator of the true\_value matrix.  
true\_value      A square matrix, which the estimator is compared to.

### Value

A numeric value in [0,1].

### Examples

```
d_score(diag(3), diag(3))
```

---

gen\_matern\_gaussian\_rf

*Generating Gaussian random fields with Matern covariance function*


---

### Description

Generate Gaussian random fields with Matern covariance function

### Usage

```
gen_matern_gaussian_rf(coords, dim, nu, kappa)
```

**Arguments**

coords	coordinate of target random field to be generated
dim	dimension of target random field to be generated
nu	parameter of matern covariance function
kappa	parameter of matern covariance function

**Value**

A data matrix with number of rows equal to 'coords', and number of columns equal to 'dim'.

# Index

BSSS, [2](#)

d\_score, [3](#)

gen\_matern\_gaussian\_rf, [3](#)

spatial\_kernel\_matrix, [2](#)