Package ‘BSSoverSpace’

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Type Package
Title Blind Source Separation for Multivariate Spatial Data using Eigen Analysis
Version 0.1.0
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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)<arXiv:2201.02023>.
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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 kernel_list is
            NULL.
kernelt_type   A string indicating which kernel function to use. Either 'ring', 'ball' or 'gauss'.
kernelparameter 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.
kernellist List of spatial kernel matrices with dimension c(n,n). Can be computed by the
            function spatial_kernel_matrix.

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 mixing 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

```r
sample_size <- 500
cords <- 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

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’.
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