GaussBetti

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TOPOLOGICALFUNC

topologicalFunc . **GaussianFiltration** (*GaussianRandomField*, *type='lower'*) Generates Filtration for the Gaussian Random Field.

Parameters

- **GaussianRandomField** (*array*) numpy 2-D array. The Gaussian Random Field generated from the class using Gen_GRF method.
- **type** (*string*) Takes ipnut either 'lower' or 'upper' for lower or upper filtration.
- nsize (integer) Size of the Gaussian Random Fields grid.

Returns Filtration Diagram

Return type Dionysus object

topologicalFunc.**GenerateBettiP**(*Filtraion*, *thresholds_start*, *thresholds_stop*, *type='lower'*)

Generates the Betti numbers from the Filtration diagram.

Parameters

- **Filtration** (*Dionysus object*) Output of GaussianFiltration.
- **thresholds_start** (*float*) start value for generating superlevels of the Gaussian Random field .
- **thresholds_stop** (*float*) stop value for generating superlevels of the Gaussian Random field.

Returns Multidimensaion array containing Betti numbers for different dimensions

Return type Numpy array

topologicalFunc.GenerateGenus(Betti_array)

Generates the Genus curve for gaussian random field using Betti arrays.

Parameters array (Betti) – Betti array from GenerateBettiP.

Returns 1-D array containing Genus curve for the Gaussian random field.

Return type Numpy array

CHAPTER

TWO

UTILITIES

utilities.KLdivergence(x, y1, y2)

Calculates the KL divergence for 2 different Gaussian Random Field.

Parameters

- **x** (array) -
- y1 (array) Gausian Random Field of null hypothesis as a 1-D array
- y2 (array) Gaussian Random Field of test hypothesis as a 1-D array

Returns KL divergence

Return type float

utilities.SaveROC(PFA, PD, nsize, num_iter, H0, H1, Betti, type)

Saves the PFA and PD array with the labels provided through parameters.

Parameters

- **PFA** (array) numpy vector. The PFA array generated during ROC gen.
- PD (array) numpy vector. THe PD array generated during ROC gen.
- **nsize** (*integer*) Size of the Gaussian Random Fields grid.
- num_iter (integer) Number of iteration for which ROC gen is run.
- **H0** (*integer*) Power spectral index of Null Hypothesis.
- **H1** (*integer*) Power spectral index of Test Hypothesis.
- **type** (*string*) type of the ROC curve generated

Returns None

Return type None

utilities.likelihoodratio(correlation0, correlation1, X0, X1)

Calculates the likelihood ratio for the False alarm and detection.

Parameters

- **correlation0** (*array*) Correlation matrix for the Gaussian Random Field for null hypothesis.
- **correlation1** (*array*) Correlation matrix for the Gaussian Random Field for test hypothesis.
- **X0** (array) Gausian Random Field of null hypothesis as a 1-D array
- **X1** (array) Gaussian Random Field of test hypothesis as a 1-D array

Returns likelihood ratio

Return type float

utilities.plotROC(PFA, PD, nsize, num_iter, H0, H1, Betti, type)

Plots the PFA and PD ROC graph with the labels provided through parameters.

Parameters

- **PFA** (array) numpy vector. The PFA array generated during ROC gen.
- PD (array) numpy vector. THe PD array generated during ROC gen.
- nsize (integer) Size of the Gaussian Random Fields grid.
- num_iter (integer) Number of iteration for which ROC gen is run.
- **H0** (*integer*) Power spectral index of Null Hypothesis.
- **H1** (*integer*) Power spectral index of Test Hypothesis.
- **type** (*string*) type of the ROC curve generated

Returns None

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Return type None

THREE

GAUSSCLASS

class gaussClass.GaussianRandomField(Nsize, n)

The class for making Gaussian random field with specified spectral index and size of grid.

Nzise

size of the grid.

Type int

n

Spectral index of the power law used to generate the Gaussian Random Field.

Type int

k_ind

Grid in the fourier space.

Type array

PowerSpectrum

The power spectrum grid made using the spectral index used to make the Gaussian Random Field.

Type array

corr_s

Correlation matrix in the fourier space.

Type array

corr f

Correlation matrix in the spatial space.

Type array

Gen_GRF(type='grid')

GenerateBettiP

Generates the Gaussian Random field with the specified paramters.

Parameters type(str) – Takes either 'grid' or 'array' in string format

Returns: Numpy array: Gaussian Random field

PowerSpectrum_grid_generator()

Generates the powerspectrum grid.

fourier_space_ind()

Generates the fourier space grid.

gen_correlation()

Generates the correlation matrices in fourier and spatial spcae.

CHAPTER

FOUR

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