Package 'rgeomstats'

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Title Interface to 'Geomstats'

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Description Provides an interface to the Python package 'Geomstats' authored by Miolane et al. (2020) <doi:10.48550/arXiv.2004.04667>.

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Suggests testthat (>= 3.0.0)

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URL https://github.com/LMJL-Alea/rgeomstats, https://lmjl-alea.github.io/rgeomstats/

BugReports https://github.com/LMJL-Alea/rgeomstats/issues

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Imports cli, purrr, R6, Rdpack, reticulate, rlang

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Repository CRAN

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Contents

`NFoldManifold` *Class for N-Fold Product Manifolds*

Description

Class for an n-fold product manifold M^n. It defines a manifold as the product manifold of n copies of a given base manifold M.

Super classes

`rgeomstats::PythonClass` -> `rgeomstats::Manifold` -> `NFoldManifold`

Methods

Public methods:

- `NFoldManifold$new()`
- `NFoldManifold$clone()`

Method `new()`**:** The `NFoldManifold` class constructor.

Usage:

```
NFoldManifold$new(
  base_manifold,
  n_copies,
  metric = NULL,
  default_coords_type = "intrinsic",
  py_cls = NULL
)
```

Arguments:

`base_manifold` An R6::R6Class specifying the base manifold to copy.

`n_copies` An integer value specifying the number of replication of the base manifold.

`metric` An R6::R6Class specifying the base metric to use. Defaults to `NULL` which uses the Riemannian metric.

`default_coords_type` A string specifying the coordinate type. Choices are `"intrinsic"` or `"extrinsic"`. Defaults to `"intrinsic"`.

`py_cls` A Python object of class `NFoldManifold`. Defaults to `NULL` in which case it is instantiated on the fly using the other input arguments.

Returns: A `NFoldManifold` R6::R6Class object.

Examples:

```
if (reticulate::py_module_available("geomstats")) {
  nfm <- NFoldManifold$new(
    base_manifold = SPDMatrix(n = 3),
    n_copies = 3
  )
  nfm
}
```

Method `clone()`**:** The objects of this class are cloneable with this method.

Usage:

```
NFoldManifold$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

Author(s)

Nicolas Guigui

Examples

```
## ------------------------------------------------
## Method `NFoldManifold$new`
## ------------------------------------------------

if (reticulate::py_module_available("geomstats")) {
  nfm <- NFoldManifold$new(
    base_manifold = SPDMatrix(n = 3),
    n_copies = 3
  )
  nfm
}
```

SPDMatrix *Class for the Manifold of Symmetric Positive Definite Matrices*

Description

This function generates an instance of the class for the manifold of symmetric positive definite matrices $\mathrm{SPD}(n)$.

Usage

```
SPDMatrix(n, ...)
```

Arguments

n	An integer value specifying the number of rows and columns of the matrices.
...	Extra arguments to be passed to parent class constructors. See OpenSet and Manifold classes.

Value

An object of class SPDMatrices.

Author(s)

Yann Thanwerdas

See Also

Other symmetric positive definite matrix classes: SPDMatrices

Examples

```
if (reticulate::py_module_available("geomstats")) {
  spd3 <- SPDMatrix(n = 3)
  spd3
}
```

SPDMetricAffine *Class for the Affine Metric on the Manifold of Symmetric Positive Definite Matrices*

Description

An R6::R6Class object implementing the SPDMetricAffine class. This is the class for the affine-invariant metric on the SPD manifold (Thanwerdas and Pennec 2019).

Super classes

rgeomstats::PythonClass -> rgeomstats::Connection -> rgeomstats::RiemannianMetric -> SPDMetricAffine

Public fields

n An integer value specifying the shape of the matrices: $n \times n$.

power_affine An integer value specifying the power transformation of the classical SPD metric.

Methods

Public methods:

- SPDMetricAffine$new()
- SPDMetricAffine$clone()

Method new(): The SPDMetricAffine class constructor.

Usage:

```
SPDMetricAffine$new(n, power_affine = 1, py_cls = NULL)
```

Arguments:

n An integer value specifying the shape of the matrices: $n \times n$.

power_affine An integer value specifying the power transformation of the classical SPD metric. Defaults to 1L.

py_cls A Python object of class SPDMetricAffine. Defaults to NULL in which case it is instantiated on the fly using the other input arguments.

Returns: An object of class SPDMetricAffine.

Method clone(): The objects of this class are cloneable with this method.

Usage:

```
SPDMetricAffine$clone(deep = FALSE)
```

Arguments:

deep Whether to make a deep clone.

Author(s)

Yann Thanwerdas

References

Thanwerdas Y, Pennec X (2019). "Is affine-invariance well defined on SPD matrices? A principled continuum of metrics." In *International Conference on Geometric Science of Information*, 502–510. Springer.

`SPDMetricBuresWasserstein` *Class for the Bures-Wasserstein Metric on the Manifold of Symmetric Positive Definite Matrices*

Description

An R6::R6Class object implementing the `SPDMetricBuresWasserstein` class. This is the class for the Bures-Wasserstein metric on the SPD manifold (Bhatia et al. 2019; Malagò et al. 2018).

Super classes

`rgeomstats::PythonClass` -> `rgeomstats::Connection` -> `rgeomstats::RiemannianMetric` -> `SPDMetricBuresWasserstein`

Public fields

`n` An integer value specifying the shape of the matrices: $n \times n$.

Methods

Public methods:

- `SPDMetricBuresWasserstein$new()`
- `SPDMetricBuresWasserstein$clone()`

Method `new()`**:** The `SPDMetricBuresWasserstein` class constructor.

Usage:

```
SPDMetricBuresWasserstein$new(n, py_cls = NULL)
```

Arguments:

`n` An integer value specifying the shape of the matrices: $n \times n$.

`py_cls` A Python object of class `SPDMetricBuresWasserstein`. Defaults to `NULL` in which case it is instantiated on the fly using the other input arguments.

Returns: An object of class `SPDMetricBuresWasserstein`.

Method `clone()`**:** The objects of this class are cloneable with this method.

Usage:

```
SPDMetricBuresWasserstein$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

Author(s)

Yann Thanwerdas

References

Bhatia R, Jain T, Lim Y (2019). "On the Bures–Wasserstein distance between positive definite matrices." *Expositiones Mathematicae*, **37**(2), 165–191.

Malagò L, Montrucchio L, Pistone G (2018). "Wasserstein Riemannian geometry of Gaussian densities." *Information Geometry*, **1**(2), 137–179.

`SPDMetricEuclidean` *Class for the Euclidean Metric on the Manifold of Symmetric Positive Definite Matrices*

Description

An R6::R6Class object implementing the `SPDMetricEuclidean` class. This is the class for the Euclidean metric on the SPD manifold.

Super classes

`rgeomstats::PythonClass` -> `rgeomstats::Connection` -> `rgeomstats::RiemannianMetric` -> `SPDMetricEuclidean`

Public fields

`n` An integer value specifying the shape of the matrices: $n \times n$.

`power_euclidean` An integer value specifying the power transformation of the classical SPD metric.

Methods

Public methods:

- `SPDMetricEuclidean$new()`
- `SPDMetricEuclidean$clone()`

Method `new()`**:** The `SPDMetricEuclidean` class constructor.

Usage:

```
SPDMetricEuclidean$new(n, power_euclidean = 1, py_cls = NULL)
```

Arguments:

`n` An integer value specifying the shape of the matrices: $n \times n$.

`power_euclidean` An integer value specifying the power transformation of the classical SPD metric. Defaults to `1L`.

`py_cls` A Python object of class `SPDMetricEuclidean`. Defaults to `NULL` in which case it is instantiated on the fly using the other input arguments.

Returns: An object of class `SPDMetricEuclidean`.

Method `clone()`**:** The objects of this class are cloneable with this method.

Usage:

```
SPDMetricEuclidean$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

Author(s)

Yann Thanwerdas

`SPDMetricLogEuclidean` *Class for the log-Euclidean Metric on the Manifold of Symmetric Positive Definite Matrices*

Description

An R6::R6Class object implementing the `SPDMetricLogEuclidean` class. This is the class for the log-Euclidean metric on the SPD manifold.

Super classes

`rgeomstats::PythonClass` -> `rgeomstats::Connection` -> `rgeomstats::RiemannianMetric` -> `SPDMetricLogEuclidean`

Public fields

`n` An integer value specifying the shape of the matrices: $n \times n$.

Methods

Public methods:

- `SPDMetricLogEuclidean$new()`
- `SPDMetricLogEuclidean$clone()`

Method `new()`**:** The `SPDMetricLogEuclidean` class constructor.

Usage:

```
SPDMetricLogEuclidean$new(n, py_cls = NULL)
```

Arguments:

`n` An integer value specifying the shape of the matrices: $n \times n$.

`py_cls` A Python object of class `SPDMetricLogEuclidean`. Defaults to `NULL` in which case it is instantiated on the fly using the other input arguments.

Returns: An object of class SPDMetricLogEuclidean.

Examples:

```
if (reticulate::py_module_available("geomstats")) {
  mt <- SPDMetricLogEuclidean$new(n = 3)
  mt
}
```

Method `clone()`**:** The objects of this class are cloneable with this method.

Usage:

```
SPDMetricLogEuclidean$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

Author(s)

Yann Thanwerdas

Examples

```
## ------------------------------------------------
## Method `SPDMetricLogEuclidean$new`
## ------------------------------------------------

if (reticulate::py_module_available("geomstats")) {
  mt <- SPDMetricLogEuclidean$new(n = 3)
  mt
}
```

`SpecialOrthogonal` *Class for the Special Orthogonal Group*

Description

This function generates an instance of the class for the special orthogonal group $\mathrm{SO}(n)$.

Usage

```
SpecialOrthogonal(n, point_type = "matrix", epsilon = 0, ..., py_cls = NULL)
```

Arguments

`n`	An integer value representing the shape of the `n x n` matrices.
`point_type`	A character string specifying how elements of the group should be represented. Choices are either `"vector"` or `"matrix"`. Defaults to `"matrix"`.
`epsilon`	A numeric value specifying the precision to use for calculations involving potential division by 0 in rotations. Defaults to `0.0`.

...	Extra arguments to be passed to parent class constructors. See LieGroup, MatrixLieAlgebra, LevelSet and Manifold classes.
py_cls	A Python object of class SpecialOrthogonal. Defaults to NULL in which case it is instantiated on the fly using the other input arguments.

Value

An object of class SpecialOrthogonal which is an instance of one of three different R6::R6Class depending on the values of the input arguments. Specifically:

- if n == 2 and point_type == "vector", then the user wants to instantiate the space of 2D rotations in vector representations and thus the output is an instance of the SpecialOrthogonal2Vectors class;
- if n == 3 and point_type == "vector", then the user wants to instantiate the space of 3D rotations in vector representations and thus the output is an instance of the SpecialOrthogonal3Vectors class;
- in all other cases, either the user is dealing with rotations in matrix representation or with rotations in dimension greater than 3 and thus the output is an instance of the SpecialOrthogonalMatrices class.

Author(s)

Nicolas Guigui and Nina Miolane

See Also

Other special orthogonal classes: SpecialOrthogonal2Vectors, SpecialOrthogonal3Vectors, SpecialOrthogonalMatrices

Examples

```
if (reticulate::py_module_available("geomstats")) {
  so3 <- SpecialOrthogonal(n = 3)
  so3
}
```

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