

Package ‘Mobius’

September 28, 2026

Type Package

Title Mobius Transport for Directional Data

Version 1.0

Date 2026-09-18

Author Michail Tsagris [aut, cre]

Maintainer Michail Tsagris <mtsagris@uoc.gr>

Depends R (>= 4.0)

Imports Directional, grDevices, Rfast, rgl, stats

Suggests Rfast2

Description Density evaluation, random generation, and maximum likelihood estimation for the Mobius-von Mises-Fisher and isotropic scaled von Mises-Fisher distributions on the hypersphere, introduced in Garcia-Portugues and Kato (2026) <doi:10.48550/arXiv.2607.29280>. Both distributions arise from Mobius transport of a von Mises-Fisher distribution.

License GPL (>= 2)

NeedsCompilation no

Repository CRAN

Date/Publication 2026-09-28 09:10:14 UTC

Contents

Mobius-package	2
disvmf	2
dmvmf	3
isvmf.contour	5
isvmf.mle	6
mvmf.contour	7
mvmf.mle	8
risvmf	9
rmvmf	10
Index	12

 Mobius-package

Mobius Transport for Directional Data

Description

Density evaluation, random generation, and maximum likelihood estimation for the Mobius-von Mises-Fisher and isotropic scaled von Mises-Fisher distributions on the hypersphere, introduced in Garcia-Portugues and Kato (2026). Both distributions arise from Mobius transport of a von Mises-Fisher distribution.

Details

Package: Mobius
 Type: Package
 Version: 1.0
 Date: 2026-09-18

Maintainers

Michail Tsagris <mtsagris@uoc.gr>.

Author(s)

Michail Tsagris <mtsagris@uoc.gr>

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. arXiv preprint arXiv:2607.29280.

 disvmf

Density of the isotropic scaled von Mises-Fisher distribution

Description

Density of the isotropic scaled von Mises-Fisher distribution.

Usage

```
disvmf(y, mu, kappa, alpha, logden = FALSE)
```

Arguments

y	A matrix or a vector with the data expressed in Euclidean coordinates, i.e. unit vectors.
mu	The μ parameter, a unit vector.
kappa	The concentration parameter (κ).
alpha	The α parameter.
logden	If you the logarithm of the density values set this to TRUE.

Details

The density of the Mobius-von Mises-Fisher distribution is computed.

Value

A vector with the (log) density values of y.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

[dmvmf](#), [isvmf.mle](#)

Examples

```
mu <- c(0.6, 0.8, 0)
y <- risvmf(100, mu, 10, 2)
f <- disvmf(y, mu, 10, 2)
```

dmvmf

Density of the Mobius-von Mises-Fisher distribution

Description

Density of the Mobius-von Mises-Fisher distribution.

Usage

```
dmvmf(y, mu1, mu2, kappa, rho, logden = FALSE)
```

Arguments

y	A matrix or a vector with the data expressed in Euclidean coordinates, i.e. unit vectors.
mu1	The μ_1 parameter, a unit vector.
mu2	The μ_2 parameter, a unit vector.
kappa	The concentration parameter (κ).
rho	The ρ parameter.
logden	If you the logarithm of the density values set this to TRUE.

Details

The density of the Mobius-von Mises-Fisher distribution is computed.

Value

A vector with the (log) density values of y.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

[mvmf.mle](#), [disvmf](#)

Examples

```
mu1 <- c(1, 0, 0)
mu2 <- c(0.6, 0.8, 0)
y <- rmvmf(100, mu1, mu2, 5, 0.5)
f <- dmvmf(y, mu1, mu2, 5, 0.5)
```

isvmf.contour	<i>Contour plot (on the sphere) of the isotropic scaled von Mises-Fisher distribution</i>
---------------	---

Description

Contour plot (on the sphere) of the isotropic scaled von Mises-Fisher distribution.

Usage

```
isvmf.contour(mu, kappa, alpha, bgcol = "snow", dat = NULL, col = NULL,
lat = 50, long = 50)
```

Arguments

mu	The mean direction μ of the distribution.
kappa	The κ parameter of the distribution.
alpha	The α parameter of the distribution.
bgcol	The color of the surface of the sphere.
dat	If you have you want to plot supply them here. This has to be a numerical matrix with three columns, i.e. unit vectors.
col	If you supplied data then choose the color of the points. If you did not choose a color, the points will appear in red.
lat	A positive number determining the range of degrees to move left and right from the latitude center. See the example to better understand this argument.
long	A positive number determining the range of degrees to move up and down from the longitude center. See the example to better understand this argument.

Details

The goal of this function is for the user to see how the isotropic scaled von Mises-Fisher distribution looks like on the sphere.

Value

A plot containing the contours of the distribution.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also[disvmf](#)**Examples**

```
mu <- c(0.6, 0.8, 0)
isvmf.contour(mu = mu, kappa = 20, alpha = 5, lat = 20, long = 20)
```

isvmf.mle

*MLE of the isotropic scaled von Mises-Fisher distribution***Description**

MLE of the isotropic scaled von Mises-Fisher distribution.

Usage

```
isvmf.mle(y, maxit = 1000, tol = 1e-6)
```

Arguments

y	A matrix with directional data, i.e. unit vectors.
maxit	The maximum number of iterations allowed.
tol	The tolerance value at which to terminate the algorithm.

Details

The functions estimates the parameters of a fitted MLE of the isotropic scaled von Mises-Fisher distribution. The function employs a combination of the fixed points iteration algorithm and the `optim()` function.

Value

A list including:

mu	The μ vector.
kappa	The κ parameter.
alpha	The <i>alpha</i> parameter.
loglik	The maximum log-likelihood value.
iters	The number of iterations performed.

Author(s)

Michail Tsagris and Zehao Yu.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

[risvmf](#), [mvmf.mle](#),

Examples

```
mu <- c(0.6, 0.8, 0)
y <- risvmf(1000, mu, 5, 0.5)
isvmf.mle(y)
```

mvmf.contour	<i>Contour plot (on the sphere) of the Mobius-von Mises-Fisher distribution</i>
--------------	---

Description

Contour plot (on the sphere) of the Mobius-von Mises-Fisher distribution.

Usage

```
mvmf.contour(mu1, mu2, kappa, rho, bgcol = "snow", dat = NULL, col = NULL,
lat = 50, long = 50)
```

Arguments

mu1	The μ_1 vector of the distribution.
mu2	The μ_2 vector of the distribution.
kappa	The κ parameter of the distribution.
rho	The ρ parameter of the distribution.
bgcol	The color of the surface of the sphere.
dat	If you have you want to plot supply them here. This has to be a numerical matrix with three columns, i.e. unit vectors.
col	If you supplied data then choose the color of the points. If you did not choose a color, the points will appear in red.
lat	A positive number determining the range of degrees to move left and right from the latitude center. See the example to better understand this argument.
long	A positive number determining the range of degrees to move up and down from the longitude center. See the example to better understand this argument.

Details

The goal of this function is for the user to see how the isotropic scaled von Mises-Fisher distribution looks like on the sphere.

Value

A plot containing the contours of the distribution. The green box is the μ_1 , and the red box is the μ_2 .

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

[dmvmf](#)

Examples

```
mu1 <- c(1, 0, 0)
mu2 <- c(0.6, 0.8, 0)
mvmf.contour(mu1 = mu1, mu2 = mu2, kappa = 10, rho = 0.5, lat = 20, long = 20)
```

mvmf.mle

MLE of the Mobius-von Mises-Fisher distribution

Description

MLE of the Mobius-von Mises-Fisher distribution.

Usage

```
mvmf.mle(y, maxit = 1000, tol = 1e-6)
mvmf1.mle(y, maxit = 1000, tol = 1e-6)
```

Arguments

y	A matrix with directional data, i.e. unit vectors.
maxit	The maximum number of iterations allowed.
tol	The tolerance value at which to terminate the algorithm.

Details

The functions estimates the parameters of a fitted Mobius-von Mises-Fisher distribution. The function employs a combination of the fixed points iteration algorithm and the `optim()` function. The `mvmfml.mle()` function assumes that $\mu_1 = \mu_2$.

Value

A list including:

mu1	The μ_1 vector.
mu2	The μ_2 vector.
kappa	The κ parameter.
rho	The ρ parameter.
loglik	The maximum log-likelihood value.
iters	The number of iterations performed.

In the case of the mvmf1.mle() one μ is returned.

Author(s)

Michail Tsagris and Zehao Yu.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

`rmvmf`, `isvmf.mle`

Examples

```
mu1 <- c(1, 0, 0)
mu2 <- c(0.6, 0.8, 0)
y <- rmvmf(1000, mu1, mu2, 5, 0.5)
mvmf.mle(y)
```

risvmf

Simulation of random values from the isotropic scaled von Mises-Fisher distribution

Description

Simulation of random values from the isotropic scaled von Mises-Fisher distribution.

Usage

```
risvmf(n, mu, kappa, alpha)
```

Arguments

n	The sample size.
mu	The μ parameter, a unit vector.
kappa	The concentration parameter (κ).
alpha	The α parameter.

Details

The isotropic scaled vMF distribution uses a straightforward algorithm to generate random vectors.

Value

A matrix with the simulated data.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

[isvmf.mle](#), [rmvmf](#)

Examples

```
mu <- c(0.6, 0.8, 0)
y <- risvmf(100, mu, 10, 2)
```

rmvmf

Simulation of random values from the Mobius-von Mises-Fisher distribution

Description

Simulation of random values from the Mobius-von Mises-Fisher distribution.

Usage

```
rmvmf(n, mu1, mu2, kappa, rho)
```

Arguments

n	The sample size.
mu1	The μ_1 parameter, a unit vector.
mu2	The μ_2 parameter, a unit vector.
kappa	The concentration parameter (κ).
rho	The ρ parameter.

Details

The Mobius-vMF distribution uses a straight algorithm to generate random vectors.

Value

A matrix with the simulated data.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Garcia-Portugues E. and Kato S. (2026). Mobius transport on spheres. <https://arxiv.org/pdf/2607.29280>

See Also

[mvmf.mle](#), [risvmf](#)

Examples

```
mu1 <- c(1, 0, 0)
mu2 <- c(0.6, 0.8, 0)
y <- rmvmf(100, mu1, mu2, 5, 0.5)
```

Index

disvmf, [2](#), [4](#), [6](#)

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

isvmf.contour, [5](#)

isvmf.mle, [3](#), [6](#), [9](#), [10](#)

Mobius-package, [2](#)

mvmf.contour, [7](#)

mvmf.mle, [4](#), [7](#), [8](#), [11](#)

mvmf1.mle (mvmf.mle), [8](#)

risvmf, [7](#), [9](#), [11](#)

rmvmf, [9](#), [10](#), [10](#)