

# Package: Mobius (via r-universe)

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**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** <https://cran.r-universe.dev>

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|                |                                              |
|----------------|----------------------------------------------|
| Mobius-package | <i>Mobius Transport for Directional Data</i> |
|----------------|----------------------------------------------|

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**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.

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|        |                                                                      |
|--------|----------------------------------------------------------------------|
| disvmf | <i>Density of the isotropic scaled von Mises-Fisher distribution</i> |
|--------|----------------------------------------------------------------------|

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**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 $\mu$ parameter, a unit vector.                                                       |
| kappa  | The concentration parameter ( $\kappa$ ).                                                 |
| alpha  | The $\alpha$ 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)
```

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|       |                                                            |
|-------|------------------------------------------------------------|
| dmvmf | <i>Density of the Mobius-von Mises-Fisher distribution</i> |
|-------|------------------------------------------------------------|

---

### 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 $\mu_1$ parameter, a unit vector.                                                     |
| mu2    | The $\mu_2$ parameter, a unit vector.                                                     |
| kappa  | The concentration parameter ( $\kappa$ ).                                                 |
| rho    | The $\rho$ 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 $\mu$ of the distribution.                                                                                                           |
| kappa | The $\kappa$ parameter of the distribution.                                                                                                             |
| alpha | The $\alpha$ 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 $\mu$ vector.                   |
| kappa  | The $\kappa$ 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 $\mu_1$ vector of the distribution.                                                                                                                 |
| mu2   | The $\mu_2$ vector of the distribution.                                                                                                                 |
| kappa | The $\kappa$ parameter of the distribution.                                                                                                             |
| rho   | The $\rho$ 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  $\mu_1$ , and the red box is the  $\mu_2$ .

**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 $\mu_1$ vector.                 |
| mu2    | The $\mu_2$ vector.                 |
| kappa  | The $\kappa$ parameter.             |
| rho    | The $\rho$ parameter.               |
| loglik | The maximum log-likelihood value.   |
| iters  | The number of iterations performed. |

In the case of the mvmf1.mle() one  $\mu$  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 $\mu$ parameter, a unit vector.       |
| kappa | The concentration parameter ( $\kappa$ ). |
| alpha | The $\alpha$ 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 $\mu_1$ parameter, a unit vector.     |
| mu2   | The $\mu_2$ parameter, a unit vector.     |
| kappa | The concentration parameter ( $\kappa$ ). |
| rho   | The $\rho$ 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)
```

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