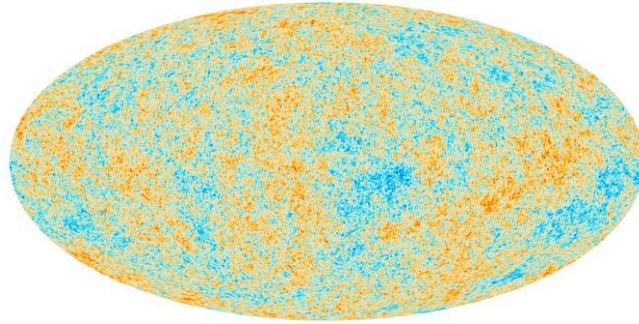


A Collection of R Packages for Spherical Data Analytics



1. **SpherWave:** An R Package for Analyzing Scattered Spherical Data by Spherical Wavelets

<http://dasan.sejong.ac.kr/~dhkim/main/research/pub/SpherWaveR.pdf>

A list of main functions :

- Multiscale SBF representation
- Multiresolution analysis
- Spherical wavelet estimators

2. **Package ‘CircNNTSR’:** An R Package for the statistical analysis of circular data using nonnegative trigonometric sums (NNTS) models; The package includes functions for calculation of densities and distributions, for the estimation of parameters, for plotting and more.

<https://cran.r-project.org/web/packages/CircNNTSR/index.html>

- Mnntsrandominitial: generates a random point on the surface of the $\text{prod}(M+1)$ -dimensional unit hypersphere

3. **Package ‘sphereplot’:** Various low level and high level routines for generate spherical plots. Includes celestial sphere style 3D grid and routines for overlaying additional points and text. Requires rgl.

<https://cran.r-project.org/web/packages/sphereplot/index.html>

- car2sph: Transforms 3D cartesian coordinates to spherical coordinates
- pointsphere: Random sphere pointing
- rgl.sphcirc: Great circle generator
- rgl.sphgrid: Create a spherical plotting grid
- rgl.sphMW: Plot Galactic plane + Galactic centre
- rgl.sphpoints: Add points to spherical plots
- rgl.sphsun: Plot ecliptic + Sun
- rgl.sphtext: Add text to spherical plot
- sph2car: Transforms 3D spherical coordinates to cartesian coordinates

4. **Package ‘VecStatGraphs3D’:** This package performs a 3D statistical analysis, both numerical and graphical, of a set of vectors. Since a vector has three

components (a module and two angles) vectorial analysis is performed in two stages: modules are analyzed by means of linear statistics and orientations are analyzed by spherical statistics. Tests and spherical statistic parameters are accompanied by a graphs as: density maps, distribution modules and angles. The tests, spherical statistic parameters and graphs allow us detecting another distribution properties (i.e. anisotropy) and outliers.

<https://www.rdocumentation.org/packages/VecStatGraphs3D/versions/1.6>

5. CRAN packages in R for astronomy

<https://asaip.psu.edu/forums/software-forum/459833927>

- 5.1. **Package ‘cosmoFns’**: Package encapsulates standard expressions for distances, times, luminosities, and other quantities useful in observational cosmology, including molecular line observations.
- 5.2. **Package ‘CRAC’**: n R functions for cosmological research. The main functions are similar to the python library, cosmology
- 5.3. **Package ‘FITSio’**: Utilities to read and write files in the FITS (Flexible Image Transport System) format, a standard format in astronomy (see e.g. for more information). Present low-level routines allow: reading, parsing, and modifying FITS headers; reading FITS images (multi-dimensional arrays); reading FITS binary and ASCII tables; and writing FITS images (multi-dimensional arrays). Higher-level functions allow: reading files composed of one or more headers and a single (perhaps multidimensional) image or single table; reading tables into data frames; generating vectors for image array axes; scaling and writing images as 16-bit integers. Known incompletenesses are reading random group extensions, as well as bit, complex, and array descriptor data types in binary tables.
- 5.4. **Package ‘SPADAR’**: Provides easy to use functions to create all-sky grid plots of widely used astronomical coordinate systems (equatorial, ecliptic, galactic) and scatter plots of data on any of these systems including on-the-fly system conversion. It supports any type of spherical projection to the plane defined by the 'mapproj' package.
 - createAllSkyGridChart: create all-sky charts with gridlines of one or more astronomical coordinate systems. The function can create gridlines for the equatorial, ecliptic or galactic coordinate systems. Any spherical projection supported by the mapproj package is supported (but only the Aitoff, Mollweide and Mercator projections routinely are tested)
 - createAllSkyScatterPlotChart: A function to create all-sky scatter plots with superposed gridlines of one or more astronomical coordinate systems

6. Package ‘sm’: Smoothing methods for nonparametric regression and density estimation

<https://cran.r-project.org/web/packages/sm/index.html>

- sm.sphere: Nonparametric density estimation for spherical data.

This function creates a density estimate from data which can be viewed as lying on the surface of a sphere. Directional data form a principal example. The data are displayed in spherical form and a density estimate may be superimposed. The angle of view may be altered. An interactive panel is available to control some features of the estimate and the display. Only modest amounts of data may be used. The limit will depend on the memory available.

7. **Package ‘Directional’**: Circular-linear regression, spherical-spherical regression, discriminant analysis, ANOVA for circular and (hyper-)spherical data, tests for equality of concentration parameters, fitting distributions, random values generation, contour plots and many more are included in this package.

<https://cran.r-project.org/web/packages/Directional/index.html>

A list of functions:

- Analysis of variance for (hyper-)spherical data;
- von Mises-Fisher kernel density estimation for (hyper-)spherical data;
- Test for equality of concentration parameters for spherical data;
- Spherical and hyperspherical median;
- Spherical-spherical correlation;
- Spherical-spherical regression;
- Summary statistics for circular data;

8. **Package ‘SphericalCubature’**: Numerical integration over spheres and balls in n-dimensions; multivariate polar/spherical coordinates.

<https://cran.r-project.org/web/packages/SphericalCubature/index.html>

A list of functions:

- `adaptIntegrateSpherePolar`: Adaptive integration over sphere or ball in n-dimensions;
- `adaptIntegrateSphereTri`: Adaptive integration over spherical triangles;
- `integrateSpherePolynomial`: Integration of polynomials over sphere or ball;
- `integrateSphereStroud11`: Integrate a function over the sphere in n-dimensions;
- `rect2polar`: n-dimensional polar coordinate transformations;
- `sphereArea`: Calculates the (n-1) dimensional surface area of a sphere and the n dimensional volume of a ball in n-space;

9. **Package ‘gensphere’**: Define and compute with generalized spherical distributions - multivariate probability laws that are specified by a star shaped contour (directional behavior) and a radial component.

<https://cran.r-project.org/web/packages/gensphere/index.html>

10. **Package ‘geoR’**: Analysis of Geostatistical Data

<https://cran.r-project.org/web/packages/geoR/index.html>

11. **Package ‘geometry’**: Mesh Generation and Surface Tessellation

<https://cran.r-project.org/web/packages/geometry/index.html>

- 12. Package ‘geosphere’:** This package implements functions that compute various aspects of distance, direction, area, etc. for geographic (geodetic) coordinates. Some of the functions are based on an ellipsoid (spheroid) model of the world, other functions use a (simpler, but less accurate) spherical model. Functions using an ellipsoid can be recognized by having arguments to specify the ellipsoid’s radius and flattening (a and f). By setting the value for f to zero, the ellipsoid becomes a sphere.

<https://cran.r-project.org/web/packages/geosphere/index.html>

- 13. Package ‘sphereplot’:** Various functions for creating spherical coordinate system plots via extensions to rgl;

<https://cran.r-project.org/web/packages/sphereplot/index.html>

A list of functions:

- car2sph
- pointsphere
- rgl.sphcirc
- rgl.sphgrid
- rgl.sphMW
- rgl.sphpoints
- rgl.sphsun
- rgl.sphtext
- sph2car

- 14. Package ‘sphere’:** Functions for handling 3D data and ellipsoids (2d/3d): Spherical coordinate transformations, rotation representations, random sampling, ellipsoid fitting, various plotting, etc.

<https://github.com/asgr/sphereplot/>

- 15. Package ‘s2’:** This package aims at providing bindings for the C++ library s2 for geometry on the sphere. The C++ library was originally developed by Google under the Apache license. At the moment very few things are exposed and the main concern is to make the C++ code compile with the R toolchain on the three major platforms and have the package accepted on CRAN. Once this proof of concept has been achieved more of the underlying features will be made available to the user.

<https://cran.r-project.org/web/packages/s2/index.html>

- 16. Package ‘circular’:** Circular Statistics, from “Topics in circular Statistics” (2001) S. Rao Jammalamadaka and A. SenGupta, World Scientific.

<https://cran.r-project.org/web/packages/circular/index.html>

Some Packages in Matlab

1. Fast Wavelets on the Sphere

https://astro-informatics.github.io/s2let/matlab_doc.html

2. A Matlab Package for Spherical Needlets

<https://github.com/minjay/NeedMat/tree/master/MEALPix>