
Subject: Re: Random spherical distributions

Posted by [Kenneth P. Bowman](#) on Sat, 01 Mar 2003 20:08:18 GMT

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In article <3E613888.D4C6A30D@ukc.ac.uk>, Larry Morgan <lkm8@ukc.ac.uk> wrote:

```
> Hi,
> I have used the program below to create a random spherical
> distribution of particles but realised that when the distribution is
> viewed perpendicular to the z-axis a clear streak is seen running up
> down along the plot.
> Dave Fanning was contacted about this (see below) and we are both
> unsure as to why this might occur and therefore how to get around it.
> Does anyone have any suggestions of the cause of this pattern in a
> supposedly random distribution?
>                                     cheers
>                                     Larry
>
> Npartic=10000
>
> omega=RANDOMU(seed,Npartic,/UNIFORM,/DOUBLE) * 180.0
> rho = RANDOMU(seed1,Npartic,/UNIFORM,/DOUBLE) * 360.0
> radius = RANDOMU(seed2,Npartic,/UNIFORM,/DOUBLE)
```

For simplicity, think about the 2-D case on the sphere. If particles are randomly distributed in longitude (λ) and latitude (ϕ), particles will be denser near the pole. A rectangle of given $\Delta\lambda$ and $\Delta\phi$ is much smaller near the pole than near the equator.

To fix this, you need to distribute your particles randomly in $\sin(\phi)$ rather than ϕ (or $\cos(\text{polar angle})$ if you are a physicist). So generate random numbers between -1 and 1, and then take the arcsine to get the polar angular distribution.

The examples below use geophysical coordinates (longitude and latitude) rather than polar angle (co-latitude) in order to use the built-in mapping functions directly.

Your way

```
Npartic = 5000L
rho = 360.0D0 * RANDOMU(seed,Npartic,/UNIFORM,/DOUBLE)
omega= -90.0D0 + 180.0D0 * RANDOMU(seed,Npartic,/UNIFORM,/DOUBLE)
MAP_SET, 90, 0, -90, /LAMBERT, /ISOTROPIC
PLOTS, rho, omega, PSYM = 3
```

Uniform way

```
omega=!RADEG*ASIN(-1.0D0 +  
2.0D0*RANDOMU(seed,Npartic,/UNIFORM,/DOUBLE))  
MAP_SET, 90, 0, -90, /LAMBERT, /ISOTROPIC  
PLOTS, rho, omega, PSYM = 3
```

The other way to do this is to generate random points uniformly distributed inside a cube, then throw away the points with radii greater than your maximum value. The problem there is getting the exact number of points that you want. ;-) (You can do it by adding random points until you reach Npartic).

Ken Bowman
