

Report 3

题目

在球坐标系下，产生上半球面上均匀分布的随机坐标点，给出其直接抽样方法。

算法及公式

鉴于前两次作业已经写过生成随机数函数了，本实验中采用python自带随机数库。

The image shows a handwritten derivation on a grid background, likely from a tablet. The text is in Chinese and includes mathematical formulas for sampling points on a hemisphere. The derivation starts with the differential area element ds in spherical coordinates, then finds the probability density function $P(\theta, \varphi)$. It then integrates this to find the cumulative distribution function, which is used to generate random numbers ξ and η . Finally, the coordinates x , y , and z are expressed in terms of ξ and η .

15:57 Sat Oct 7

截面 $\frac{ds}{d\theta d\varphi} = \sin\theta$

$P(\theta, \varphi) = \frac{\sin\theta}{2\pi}$

ξ, η 是两个 $[0, 1]$ 的随机数

$\int_0^\theta \int_0^\varphi P(\theta, \varphi) d\theta d\varphi = \frac{\varphi(1-\cos\theta)}{2\pi} = \xi \cdot \eta$

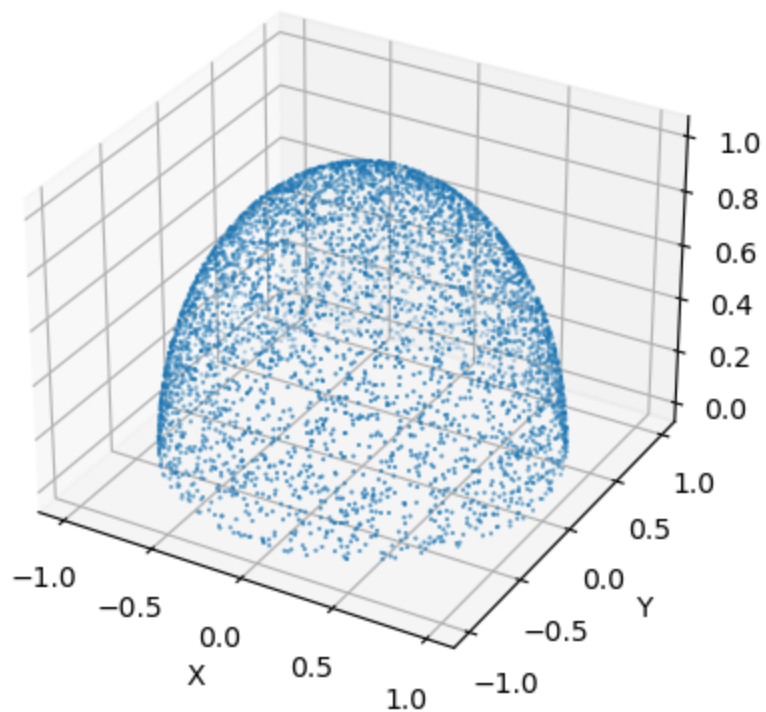
$\varphi = 2\pi\xi$ $\cos\theta = 1-\eta$ $\sin\theta = \sqrt{1-\eta^2}$

$x = \sin\theta \cos\varphi = \sqrt{1-\eta^2} \cos(2\pi\xi)$

$y = \sin\theta \sin\varphi = \sqrt{1-\eta^2} \sin(2\pi\xi)$

$z = \cos\theta = 1-\eta$

结果及讨论



由散点图来看，球面上分布很均匀

总结

本实验采用直接抽样法，在球面上生成了均匀的随机点。