Physics 325 — Scientific Computing — Fall 2016 — Lab 09

October 21, 2016

Exercise 1. RNG Testing

Test the Python numpy.random.rand using the moments and correlation tests described in class. For the moment test, calculate the moments up to k=10 for at least 1000 random numbers and plot the moment values. Do the same for the correlation test where the average of products of random values is calculated as a function of k, the separation between points, and you plot for 10 separations from 1 to 10. Discuss in comments whether or not these tests indicate that the rand() function is performing adequately. **(10 points)**

Exercise 2. Random Walk

Either by writing new code, or by updating the code given in class, write a 2D random walk program that uses the better approach described in class to calculate steps. Use a step size of 1.0 As a reminder, the idea is to randomly choose an orientation angle that ranges from $0 < \theta < 2\pi$ and then changes the x and y positions in a step according to -

$$\Delta x = cos(\theta)$$

$$\Delta y = sin(\theta)$$

Plot for at least 10 walkers, and make a second plot that calculates and plots a histogram of the rms distance traveled for 100 walkers for nsteps=100. Comment on whether or not the histogram is peaked near the expected average rms distance traveled. **(10 points)**

Extra Credit. Random Walk

Repeat Exercise 2, but instead of having the step size a constant equal to 1, pick the size of each step using a normal distribution of mean 1.0 and standard deviation 0.2. Make a plot similar to the second in Exercise 2, and comment on any apparent change in the distribution of rms distances. **Note:** you will have to explore numpy.random.normal() and you may want to test for negative step sizes. (5 points)