Physics 325 — Scientific Computing — Fall 2016 — Lab 06

September 30, 2016

Exercise 1. Earth Orbit

Use our discussions in class to write an program RK4 program that calculates the orbit of the Earth around the sun. Use the preferred units of A.U. for distance and years for time. Remember that in these units, $GM_\circ = 4\pi^2$. Use your code to create a plot of the motion of the Earth where the initial (x,y) =(1.0,0.0) and (vx,vy)=(0,2π). Explain in the code or attached document why these are reasonable starting values. (10 points)

Exercise 2. Energy for Earth Motion

Using the program from 1, make a plot of total energy per unit mass of the Earth vs. time and calculate the fractional change in energy in your calculation over a 100 year period using h=0.01 years. The total energy/mass of the earth is kinetic plus potential -

$$E = \frac{1}{2}(\dot{x}^2 + \dot{y}^2) - \frac{4\pi^2}{r}$$

(10 points)

Extra Credit. RK2 Energy

Repeat exercise 2 using the RK2 algorithm and comment on the differences. **(5 points)**