

N-Body Orbits Project Abstract

I want to create a hypothetical system of interacting gravitational bodies and map each body's trajectory over a reasonable amount of time. I will rely on my understanding of kinematics to complete this simulation. Each body will be initialized with its own mass, position, and initial 3D velocity vector, so realistically N will be less than or equal to 10, but perhaps automated initial conditions could be created or imported for a simulation with more than 10 bodies orbiting all at once. I expect my model will exhibit orbits similar to ellipses or rose curves. I will definitely do a run that simulates our own solar system. I want to be able to understand which combinations of initial conditions form rose curves, ellipses, circles, etc.

My program will have several main functions, and will implement either RK-4 or the Verlet method to compute accelerations->velocities->positions. One of the main functions will be

```
def gen_plots(N, initial_conditions):  
    fig1 = plt.figure()  
    ax1 = fig1.add_subplot(1,1,1, projection='3d')  
    for i in range(len(N)):  
        ax1.plot(N[i]['x'], N[i]['y'], N[i]['z'],  
                color = pseudorandom_RGB_code)  
    ax1.legend()  
    plt.savefig(fig1)  
    plt.show
```

I will also ensure that energy is conserved by investigating patterns in phase space for two to three bodies, as well as conducting tests for convergence as the time step is reduced. For the paper that is to result from this project, I plan on having around 10 figures. I will use many of these figures in my final presentation to the class, and if I am feeling ambitious I want to try to make a 3D gif of an interesting (maybe chaotic) orbital system as well.