

Dynamics of the Solar System

Problem

There are many celestial objects in the universe, all obeying Newton's law of gravity. Many of those celestial bodies could be on their way to disrupt the current motions of the planets in our solar system. It is possible such disruptions could have drastic effects on the orbits of the planets in our solar system. However, the most drastic effects will result from the disruptions of Jupiter since it has the most mass compared to other planets in our solar system. The goal of project is to determine, through simulation, how the behavior of the planets, mostly their trajectories, will change if Jupiter collides with a celestial object of considerable size and mass while being governed by the gravitational law. The collision will be treated as a perfectly inelastic collision.

Approach

HW6 already contains the base for this project. The idea is to treat the sun as a fixed point in the "universe". We will use velocity Verlet to simulate the solar system. All that needs to be done is to setup the solar system using all planets in our solar system. We will acquire planet data from here: <https://solarsystem.nasa.gov/planets/>. Once that is setup, create a celestial body such that its trajectory will be to collide with Jupiter. Once it collides, we change Jupiter's velocity and observe how that affects rest of the planets in the solar system. Lastly, we will simulate all of the motions of the planets in VPython.

Objectives

1. Calculate the positions and velocities before and after disruptions of Jupiter, for a time period of 120 years(10 revolutions of Jupiter).

2. Create a simulation video to show changes to the solar system as a function of time for the cases of no disruptions of Jupiter as well as with disruptions of Jupiter.
3. Determine the changes to the orbital parameters of Earth, including the period, semimajor and semiminor axes, eccentricity, aphelion, and perihelion.
4. Motion of planets will be determined by classical gravitational interactions and inelastic collisions
5. Program will consider at least 2 difference runs where the mass of the mass and size of the celestial object are different: one whose mass is approximately a small asteroid and another object whose mass is about half of Jupiter. Other runs with difference mass and size of the celestial object maybe added, if necessary.