1) Project Overview

a. Brief description of system

We created a simulation which describes the motion of planets or stars according to Newton’s Law of Gravity.

Our simulation will handle systems of arbitrary size however computation time needed for each step increases dramatically with the addition of additional bodies.

b. Statement of goals and/or hypothesis

Goals of the Simulation:

Compare computational cost to induced errors through using different integration techniques in solving the n-body problem.

Computational methods in question: Euler, RK2, RK4

Compare the reduced algorithms for calculating total force to the standard brute force method

Witness effect of different types of collision handling.

2) Model

a. Mathematical or graphical model of the system

Newton’s Law of Gravity: F= ma = -GmMr/|r^3|

Collisions: perfectly inelastic

b. Discussion of accuracy of model and explanation of inaccuracies or omissions

idealizing collisions to be perfectly inelastic conserves momentum but does not account for realistic collisions

3) Simulation

a. Description of implementation

implementation in vpython with full graphical view of orbiting bodies

Calculated position changes from Force using

Euler

RK2

RK4

b. Discussion of accuracy of the implementation (relative to model) and explanation of inaccuracies

or omissions

Error accumulation through time stepping for all computational methods

Gravitational constant set to 1. Means all masses and radius’s are scaled

4) Results

a. Description of experiments and summary of results

b. Analysis of results relative to goals and/or hypothesis