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Comet and Gravity Soccer

Physics Honors

Period 2

Comet and Gravity Soccer

The true idea behind the project was to develop a simple gravity-simulation engine. I think I accomplished that. With few modifications I could turn this into any type of gravity simulation one could imagine.

The phenomenon, gravity, is a principle that was first mathematically understood by Newton. He understood that two objects were pulled towards each other in an inverse with a force proportion to the square of their distance apart. It is from this concept that I derived my algorithm for simulating gravity in planetary bodies. This algorithm also uses Euler's method (over time rather than distance) to approximated the velocity of an object, and thusly the position of that object in space when interacting with another body.

This is the general approach of the engine: every 25 milliseconds, the objects are moved in accordance with a straight line path at their current velocities. The acceleration on each body is calculated, and then factored into the total forces acting on the bodies during that period. From the net force, the acceleration is taken and the velocities are updated. This method provides for a fairly accurate Euler approximation of the trajectory of both objects.

In the simulation "Comet", I have only applied the engine to a single moving body in an environment of other fixed bodies. From this simulation, one can study the movement of a satellite in orbit around one or more planets, or the orbit of a planet around a single star, or even a binary or trinary star system. In these examples, the acceleration of the smaller body acting on the larger one is so small that it is negligible.

In the simulation “Gravity Soccer”, I have opted to apply the engine to every body (given that both “space” and “numpad-0” keys are pressed) on the field. From this simulation, one could view the interaction of planetary bodies where the mass of both bodies is a real factor, and not negligible.

The toughest part in making this simulation was in “Gravity Soccer”. I could not figure out how to realistically deal with collisions in the simulation, so I went with a much simpler approach. When two bodies in that simulation come together, instead of having them accelerate without bound, I turn off their effects on each other. This way, the bodies don’t receive massive acceleration as they come to a distance of 0 units apart, which ruins the Euler approximation of the trajectories. It is a bit unrealistic. However, it makes for a more fun game.