3D Physics Simulation

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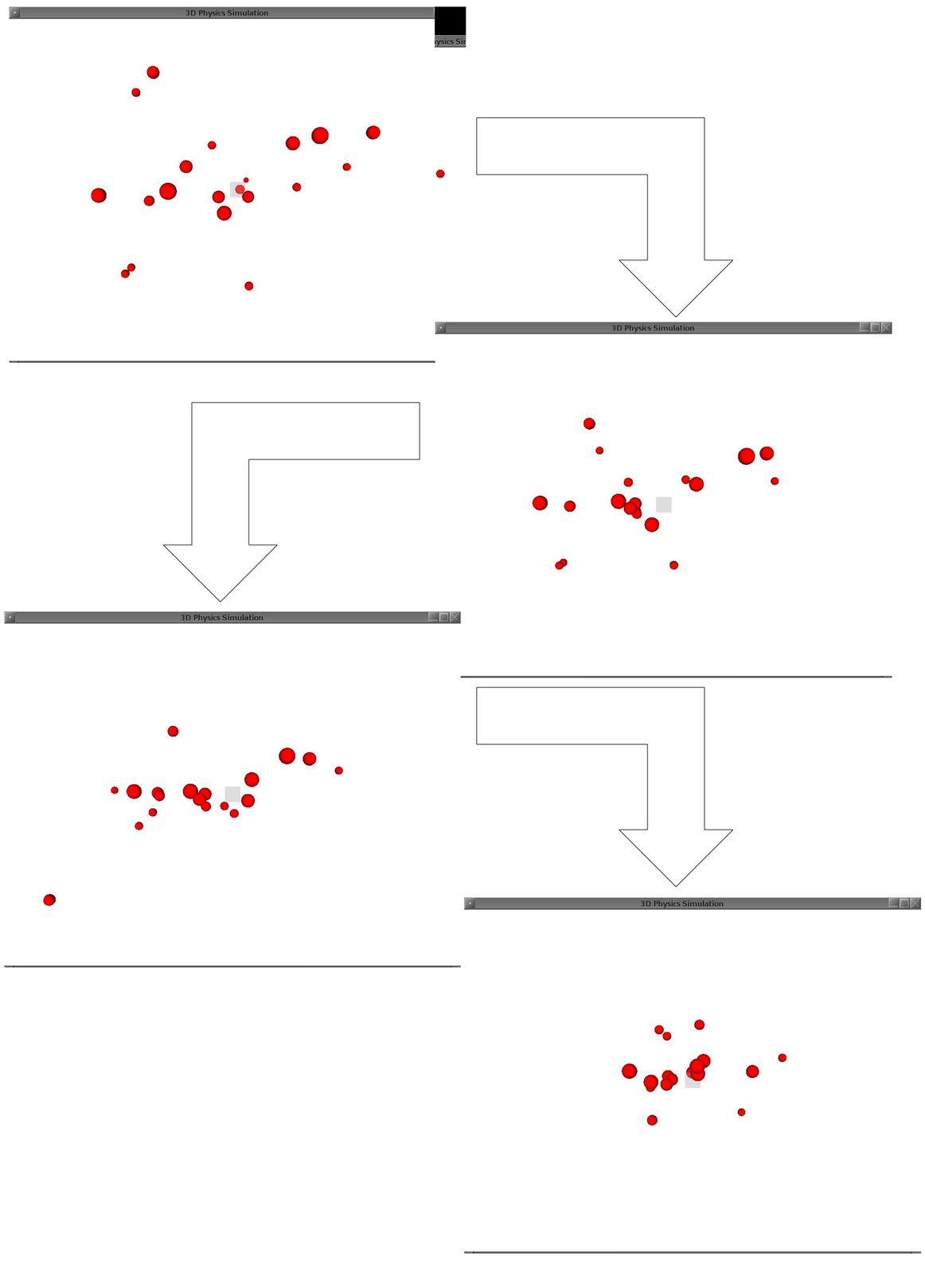

Abstract

The creation of any physics simulation is applying the laws of physics into a virtual environment on a computer. All physical laws are taken into account for the interactions between the various particles and results can be seen on screen. My simulation takes into account gravity, elastic collisions and conservation of momentum among other things. These physical rules result in a visual display via OpenGL. Various cases can be programmed in and then the particles can be observed as they interact with one another.

Method

The movement of the particles is calculated from basic physical equations. Equation (1) was used to calculate the force between each pair of objects. Acceleration was then calculated using equation (2).
Velocity and position were calculated using Euler's method (3) (4). These values were all calculated in magnitude and then applied to the particles by being multiplied by a unit vector along the path of the force. Collisions were detected by calculating the distance between two particles and then checking to see if the distance is less than the sum of the radii. New velocities were given using conservation of momentum (5).

1. $[F = G * M_1 * M_2 / r^2]$
2. $[a = F / M]$
3. $[V' = V_0 + a * \Delta t]$
4. $[P' = P_0 + V * \Delta t]$
5. $[V_x' = V_y * M_y / M_x]$

Conclusions and Future Plans

The simulation is close to being physically accurate, but in order to test any real situations it is necessary that the collision detection be perfectly accurate. This involves constantly finding the next collision to occur chronologically, calculating how long until the collision, and then moving the spheres properly before and after the collision. Once this is working accurately the simulation can be used to observe interactions involving large amounts of particles.
My physics simulation is correct for orbiting particles and I am working on a method to randomize particles such that they are all orbiting a significantly more massive central particle. Repeated testing shows that the method to randomize a system including orbiting particles works approximately 20% of the time.