Short Documentation

Farid Guliyev

The source code consists of a total of 4 source codes and 3 headers. Every code is well commented so that you can read the code and understand it. General algorithm is that, first we initialize the balls with desired positions, velocities etc. Then we initialize the OpenGL, draw the room, and finally animate the balls. Now let's describe the purpose of each of the source code.

- *main.cpp* - Main function is the heart of the source code that runs the simulation using the help of the other source codes. The user defines the ball positions, velocity, mass, radius and other variables in the init function that is located in the main source code.
- *opengl_conf.cpp* - This file responsible for configuring the OpenGL and creating the environment. The wall functions are also located here. The walls are drawn in GL_LINES mode. The default value for the WALL_LENGTH is 15.
- *utils.cpp* - This file contains the functions that I use for matrix computation. They are the same functions that I have used in other assignments as well.
- *balls_animation.cpp* - This file contains all the functions that have been used to initialize the balls, overcome the collision problems with walls and one another and animate the balls.

Here are the detailed information about the animate_balls function:

For each ball, we calculate the new position and velocity with Newtonian formulas. Then we check if there is a collision with the wall. If the sum of radius and absolute value of the position is bigger than the length of the wall, we multiply the velocity with the coefficient of the energy loss. Then we check the collision between balls. If there is a collision between the current ball and other balls that have id greater than current ball, we calculate position and velocity difference, calculate the impulse, then update the velocities of the current and other ball.

The formulas that is used to solve the ball collisions:

Formula that is used to calculate the impulse $J = \frac{2 \cdot \mathrm{dot}(\Delta \mathbf{v}, \Delta \mathbf{r})}{\|\Delta \mathbf{r}\|^2 \cdot (m_1 + m_2)}$

Formula that is used to update the velocities

$$\mathrm{new\_velocity}_1 = \mathrm{old\_velocity}_1 - \frac{J \cdot m_2 \cdot \Delta x}{\|\Delta \mathbf{r}\|^2} \cdot \hat{\mathbf{r}}$$

$$\mathrm{new\_velocity}_2 = \mathrm{old\_velocity}_2 + \frac{J \cdot m_1 \cdot \Delta x}{\|\Delta \mathbf{r}\|^2} \cdot \hat{\mathbf{r}}$$