Introduction to Flight Simulation (List 2)

Due: 19 october 2010

In this list, we will simulate planets and asteroids. Download the files `vector.h` and `planets.cpp` and the `Makefile` from the homepage of the course. In the main program, the sun is set in the origin with zero speed. Its mass equals $1.9891.10^{30}$kg. The mass of the earth equals $5.9736.10^{24}$ kg. Its initial distance is set at $152098232km$ from the sun, and its initial speed is set at 29.78 km/s.

1. The gravitational force between two objects with masses m_1, m_2, and distance r is given by the following formula:

   $$F = G\frac{m_1 m_2}{r^2}.$$

   In this formula, G is a constant, the *gravity constant*. The formula defines only the strength of the gravitational force, not its direction. The direction is defined as follows: Both of the masses feel the force F. The first mass m_1 feels the force in the direction of m_2. The second mass m_2 feels the force in the direction of m_1.

   Complete the function `computegravity( )` that adds the gravity force between two objects to the total forces working on the objects.

2. Comlete function method `integrate( double h )` of `struct object` . At this moment, I do not know how to integrate with a good convergence order. Just write a primitive algorithm.

3. Complete the program, so that it can simulate the orbit of the earth around the sun. The time to complete one orbit should be approximately one year.

4. Add the moon to the system. The mass, speed and distance between the moon and the earth can be found at Wikipedia.

5. Look up at Wikipedia what is a *horseshoe orbit*. Add an asteroid to the solar system, that is in a horse shoe orbit. Take a weight of 1000kg for the asteroid.

6. Look up at Wikipedia what are the *Lagrangian points*. Since it appears that the points L_4 and L_5 are stable, it must be possible to put an asteroid in these points. Add an asteroid to the solar system that stays close to either L_4 or L_5.