**Orbital Simulation Report – Miles Whiticker**

**Overview**

This simulation shows the orbital positions and speed of all eight planets around the sun in a real-time, 3D environment. To assist with viewability (ease of use) certain scale modifiers have been put in place, and are as follows:

* Solar equatorial radius multiplier: 0.000005
* Planetary orbital distance multiplier: 0.000000075
* Planetary equatorial radius multiplier: 0.00001
* Planetary orbital period multiplier: 0.01

The simulation’s algorithms employ standard SI units throughout, with these scale modifiers applied after the values have been calculated for them to be output to the screen visually.

**Player Input**

Several player input commands are available to assist with perusing the simulation, and are as follows:

* Tab + Mousewheel: Scroll through viewable intersystem bodies.
* Shift + Mousewheel: Modify the rate of passage of time
* Ctrl + Mousewheel: Modify the zoom on the currently focussed intersystem body.
* Right mouse button + Mouse Move: Rotate around the currently focussed intersystem body.

**Equations**

* r is calculated to be the distance between the Star and the object.
  + r =
  + is the semi-latus rectum
  + is the object’s orbital eccentricity
  + is the angle between the object and it’s orbital perihelion.
  + The perihelion is the shortest distance possible between the Star and an orbital trajectory
* cycles between 0 and 2, at a rate determined by the product of the orbital period, orbital period multiplier and rate of passage of time multiplier.
* is determined to be the amount the orbit deviates from a circle, 0 being a perfect circle while 1 is a parabola.
* is calculated to be proportional to the semi- major and minor axes of the object’s orbit.
  + is the semi-major axis
  + is the semi-minor axis
* is an axis measured as the greatest distance between the center of the orbital ellipse and the circumference.
* is measured as the axis between the center of the orbital ellipse and the circumference perpendicular to

Note that each planet’s inclination to the solar equator is also modelled, however the calculation is trivial (but noticeable).

**Alternate Implementations**

Astrodymanics is a complex subject, and modelling ellipses is almost as much so. That said, it is not impossible to develop a model for either and that is what is presented here. Additional attention could be paid to realism however, in the area of additional lower level equations that modelled the orbits as directly proportional to the affected body’s physical properties, instead of a mix of their physical and observed properties, which was what was done. There may have been an oversimplification in order to achieve a correct result in simulated, but this astrophysicist is not willing to let go of the notion that equations that purely rely on the physical properties of the bodies of the solar system would not be possible to implement.

**Future additions**

The most obvious expansions to the simulation involve the addition of moons orbiting relevant planets. Due to the number of moons of certain planets, this would most likely have been a theoretical simulation, and not an actual presentation of the number and properties of those real moons. Other options are largely aesthetic, and include an asteroid belt, a galactic skybox, planet textures, comets and particles for visual effect.