Orbital Project

gorczyckityler

November 2024

1 First step

The goal is to simply define a radius and velocity of the moon and observe the motion given these two parameters. We also need to define unit vector of radius for the moon to show in (x,y) or (x,y,z) where the moon is initially pointing. From initial conditions, Define a function which solves for a the semi-major axis, and define a function which solves for eccentricity. Once we have these parameters, we can solve for distance and velocity from earth at time $t_1, ...t_n$. We now have an issue where we need to discern whether the moon will exhibit an elliptic, parabolic, or hyperbolic orbit. An elliptic orbit is in which the moon normally occurs, but if we define initial conditions and unit vector such that the moon will break out of orbit, we will need to define the escape velocity threshold from initial conditions and the unit vector. This means we will have if statements from initial conditions upon which we solve for certain orbital parameters and determine in which one of the three orbits will the moon follow.

Will simulate a static earth where moon orbits elliptically, I will have some equation relating change in radius over change in time. We are given that Kepler's equation relates the mean anomaly $M(t)$, which is the fraction of the orbit's period that has elapsed, to the eccentric anomaly $E(t)$, which in turn can be used to find the true anomaly $\theta(t)$ which defines the moon's position. Eccentricity is a measure of degree in which the orbit differs from a perfect circular orbit. The most important equation so far is the Vis-Viva equation:

$$v(t) = \sqrt{\mu\left(\frac{2}{r(t)} - \frac{1}{a}\right)}$$

I first give an inital radius and velocity of the moon as

$$V_i = 1023.056 m/s$$

$$r_i = 3844000 m$$

then using vis-viva equation we re-write to solve for semi-major axis, which is half the length of the longest diameter of the ellipse, denoted a

$$a = \left(-\frac{v_i^2}{GM_E} + \frac{2}{r_i} \right)^{-1}$$

$$a = 388059385.1m$$

We now need to solve for eccentricity. Orbital energy is now considered as

$$\epsilon = \frac{v^2}{2} - \frac{\mu}{r} = -\frac{\mu}{2a}$$

2 Code

Need a cmake.txt file in folder to run VTK visualizer