GA_3: Orbital Motion

ME 273 | Spring Semester 2018

Mission:

Your mission, should you choose to accept it, is to provide thorough answers/solutions to each of the Exercises, including numerical values and graphs where appropriate. Also provide any code that you used to produce the results shown in your solutions to the Exercises. It is imperative that the code you include be commented in detail with your own, original content. Detailed comments are the main way to uniquely identify your individual effort.

Exercises

1 Euler vs. Euler-Cromer Methods

Recall that in class when we built the gravitational model of the moon orbiting the Earth with a spreadsheet, we employed the modified Euler method (also known as the Euler-Cromer method) to complete the model. To gain an appreciation of why it is important to use this modified algorithm, first build a computational (MATLAB or C) model of the moon's orbit around Earth using the simple, non-modified Euler method. What happens with the moon's trajectory in your model (Hint: something disastrous!)? Provide plots of the moon's trajectory to demonstrate this disastrous behavior. Can you get rid of the artificial behavior by making Δt smaller? Next, build the model (MATLAB or C) using the Euler-Cromer method. Demonstrate that your model produces the correct period of orbit. Finally, try to make an intelligent comment about why the Euler-Cromer algorithm works, and the non-modified Euler algorithm does not. Is there something you can calculate and plot that may provide insight into why the Euler algorithm fails?

2 Halley's Comet

Alter your (MATLAB or C) program to model the orbital trajectory of Halley's Comet around the Sun. Produce plots of the orbital trajectory and demonstrate that your model correctly simulates the orbital period, the aphelion, and perihelion of the comet's orbit. Don't forget to address the accuracy issue (what is a sufficiently small Δt?).