Homework #3

For all questions use default values given in RelativeMotionDemo.m, except when specified.

Please ensure all plots are clearly labeled and titled, and that your data is clearly differentiated with the corresponding legends. Also, please clearly comment and turn in your Matlab (or Python/C etc.) code.

1. 1. Using the code provided by the course and the relative motion slides, numerically integrate the nonlinear equations of relative motion (NERM) and linear equations of relative motions (LERM) for eccentricities: e = [0 0.2 0.4 0.6 0.8] with commensurate initial conditions and plot the results. Comment on what you observe.

2. Using NERM as the "truth", compute the following error metric

$$\epsilon = \|\boldsymbol{x}_{NERM} - \boldsymbol{x}_{LERM}\| \,/\, \|\boldsymbol{x}_{NERM}\|$$

   and plot as a function of (plot e vs ϵ, number of orbits vs ϵ, etc.):

   a. Eccentricity (between 0.0 and 0.9)

   b. Number of orbits (vary between 1 and 100 orbits)

   c. Baseline length (between 10^1 m and 10^4 m) (assume equal separation in x, y, and z)

   d. Initial $\dot{x}$ and $\dot{z}$ (between 0.0 m/s and 10 m/s) (keep the commensurability conditions intact)

   e. Which of these parameters has the greatest effect on the relative error metric? (NOTE: $\boldsymbol{x}_{NERM}$ and $\boldsymbol{x}_{LERM}$ denote the entire state vector, so this error metric takes into account position and velocity errors.)

3. Find an analytical solution to the Hill-Clohessy-Wiltshire equations as they appear below. Start by writing the full solution procedure (steps):

$$\ddot{x} = 3n^2x + 2n\dot{y}$$

$$\ddot{y} = -2n\dot{x}$$

$$\ddot{z} = -n^2z$$