Astro Engr 423 – Homework

Name:

Due: Lesson 9

You may receive help from any person; however, you are required to turn in your own homework. This assignment must be documented in accordance with the policies explained in the DFAS Policy Letter and course handbook. Show all work – just writing the answer is not sufficient. If you use Matlab or some other software, provide a copy of your code. Submit your homework with this coversheet and per the homework format guidance in the course handbook.

Documentation:

Exercise 1 (40 pts)

For a target satellite at GEO (a=42,164 km) and a chase satellite with the following relative position and velocity vectors:

$$\overrightarrow{\boldsymbol{\rho_0}}|_{\boldsymbol{R}} = \begin{bmatrix} x_0 \\ y_0 \\ z_0 \end{bmatrix} = \begin{bmatrix} 2 \\ 6 \\ 1 \end{bmatrix} km \ \ and \ \ {}^{\boldsymbol{R}\cdot}\overrightarrow{\boldsymbol{\rho_0}}|_{\boldsymbol{R}} = \begin{bmatrix} \dot{x}_0 \\ \dot{y}_0 \\ \dot{z}_0 \end{bmatrix} = \begin{bmatrix} 0.0729 \\ -0.2188 \\ 0 \end{bmatrix} m/sec$$

a) (10 pts) Calculate the RMOEs and the drift rate of the NMC ($\dot{y}_c$) . How far does the y_c drift in one period? *Caution: Note the units given for relative position and velocity*

b) (10 pts) Make a sketch of the motion in the x-y plane. Include the following in your sketch:
   - The current chase satellite position
   - The center of the instantaneous NMC at t=0 (denoted with a +) and the direction of NMC drift (denoted with an arrow).
   - Depiction of the instantaneous NMC at t=0 (denoted by a dashed-line ellipse)
   - The trajectory of the chase satellite over one period of the target satellite's orbit (denoted with a solid line)
   - Be sure to make your sketch on graph paper to ensure the scale of your sketch is relatively accurate.

c) (10 pts) Make a sketch of the motion in the x-z plane. Show the current position of the chase satellite and the trajectory over one target satellite orbital period. Be sure to make your sketch on graph paper to ensure the scale of your sketch is relatively accurate.

d) (10 pts) Make a sketch of the z-motion vs time (as a percentage of target orbital period). Show the current chase satellite position and the trajectory over one target satellite orbital period. Be sure to make your sketch on graph paper to ensure the scale of your sketch is relatively accurate.

e) Bonus (5 pts): use your hcw.m function to calculate and plot the trajectories in Matlab. You can use these to check your prior work!

Exercise 2 (20 pts)

You're working as an orbital analyst for the Space Force's new orbital servicing program. You need to place the servicing vehicle (chase) into a drifting NMC around a target vehicle in GEO (r=42,164 km) with the following characteristics:

- Initial position should be 5 km in front of the target and 1 km to the left. The chase should begin at the "front" of the instantaneous NMC.
- The NMC should drift towards the target at a rate of 0.1 km per period
- The maximum radial separation between the chase and the target should be ~2 km
- The maximum out-of-plane (z) separation should be 1 km

a) (10 pts) Determine the RMOEs at epoch (t=0) for this desired NMT.
b) (10 pts) Calculate the initial position and velocity in the RIC frame required for this desired NMT.

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