MAE3145: Systems Took Kit (STK)

November 12, 2014

1. Spy on DC from a Molniya Satellite

Goal Generate ground track for a satellite on a Molniya orbit, and determine how long/often it can observe DC.

Create a New Scenario

- Run STK
- Click Create a New Scenario
- At the STK: New Scenario Wizard, type WatchDC for Name
* At the STK: New Scenario Wizard, set Analysis Period from 1 Jan 2014 to 31 Jan 2014
- Click Ok, then the Insert STK Object window appears

Model Spacecraft

- Choose Satellite and Orbit Wizard
- Click Insert, then the Orbit Wizard window appears
- Choose Orbit Designer at the Type menu, and type SpySat at Satellite Name
- Choose Orbital Elements as follows:

$$a = 26610.21\,\text{km}, \quad e = 0.7, \quad i = 63.4^\circ, \quad \omega = 270^\circ, \quad \Omega = 230^\circ\,(\text{RAAN}), \quad \theta = 0^\circ$$

- Click Okay and close the Insert STK Object window
- Click Start at the tool bars and watch 2D Graphics Window and 3D Graphics Window
- At the 3D Graphics Window, drag to rotate the focal point, or drag while clicking the right button to zoom in/out.

Model Washington, DC

- In the menu, click Insert and New, then the Insert STK Objects window appears
- Choose Place and Select From City Database
- Click Insert, then the Insert From City Database window appears
- Type Washington at City Name, and click Search
- Select Washington DC and click Insert
- Close the Insert STK Objects window
- Find Washington from the 2D Graphics Window and the 3D Graphics Window

Analyze Observation Time

- In the menu, click Analysis and Access, then the Access window appears
- Check that the item for Access For is your SpySat
- Choose Washington from Associated Objects and click Compute
- Click Close
- Watch the 2D Graphics Window and the 3D Graphics Window

Create an Access Report

- In the menu, click Analysis and Access, then the Access window appears
- Click Access.. at the Reports group, then the report window appears
- Click the icon for Global Access Units, then the Units: Access window appears
- Select Hours and click Ok
- Click the icon for Save As, and type the file name and save it
- Upload your txt report to Black Board

2. Hohmann Transfer

Goal A satellite is on a circular orbit with the orbital radius of $r_P = 7000\,\mathrm{km}$. We wish to design an impulsive maneuver such that the orbital radius is increased to $r_A = 9000\,\mathrm{km}$. The required velocity changes are computed as follows:

$$\Delta v_P = \sqrt{\frac{2\mu}{r_A + r_P}\frac{r_A}{r_P}} - \sqrt{\frac{\mu}{r_P}} = 0.4577\,\mathrm{km/s},$$
$$\Delta v_A = \sqrt{\frac{\mu}{r_A}} - \sqrt{\frac{2\mu}{r_A + r_P}\frac{r_P}{r_A}} = 0.4298\,\mathrm{km/s}.$$

The window for the previous example should be closed. Otherwise, there is an error for license.

First Impulse

- Download Hohmann.zip from Black Board, and extract it to a folder.

  (Note: You SHOULD EXTRACT all of the files to your folder! Double-clicking the scenario file from the zip folder prevents loading predefined satellite.)
- Open Hohmann.sc
- Double-click GWU_Sat, then the Basic Orbit window appears
- Click the icon for Insert Segment, then the Segment Section window appears
- Select Maneuver and click Ok
- Type 0.4577 at Delta V Magnitude and click Apply
- Click the icon for Insert Segment, then the Segment Section window appears
- Select Propagate and click Ok
- Uncheck Duration
- Click Insert and choose Apoapsis
- Click the icon for Run Entire Mission Control Sequence
- Watch the 2D Graphics Window and the 3D Graphics Window

Second Impulse

- Double-click GWU_Sat, then the Basic Orbit window appears
- Click the icon for Insert Segment, then the Segment Section window appears
- Select Maneuver and click Ok
- Type 0.4298 at Delta V Magnitude and click Apply

- Click the icon for Insert Segment, then the Segment Section window appears
- Select Propagate and click Ok
- Click the icon for Run Entire Mission Control Sequence
- Watch the 2D Graphics Window and the 3D Graphics Window
- Click the icon for Snap Frame at the 3D Graphics Window, and type the file name and save it as jpg
- Upload your jpg file to Black Board