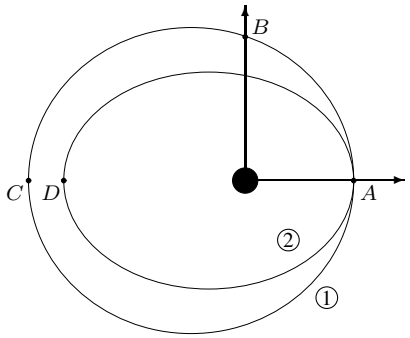
MAE3145: Simulating a Phasing Maneuver via STK

Due date: December 10, 2014

Problem 1 We discussed the following phasing maneuver in class. Consider an initial elliptic orbit ①with the periapsis A and the apoapsis C. There are chaser A and target B on the orbit. The initial true anomalies of the chaser and the target are given by $\theta_A = 0$ and $\theta_B = 90^\circ$, respectively. We designed a phasing orbit ②of the chaser such that the chaser catches the target at the point A.



$$r_A = 6800\,\text{km}, \quad r_C = 13600\,\text{km}, \quad \theta_A = 0, \quad \theta_B = 90^\circ.$$

We wish to simulate the resulting maneuver in STK according to the following steps.

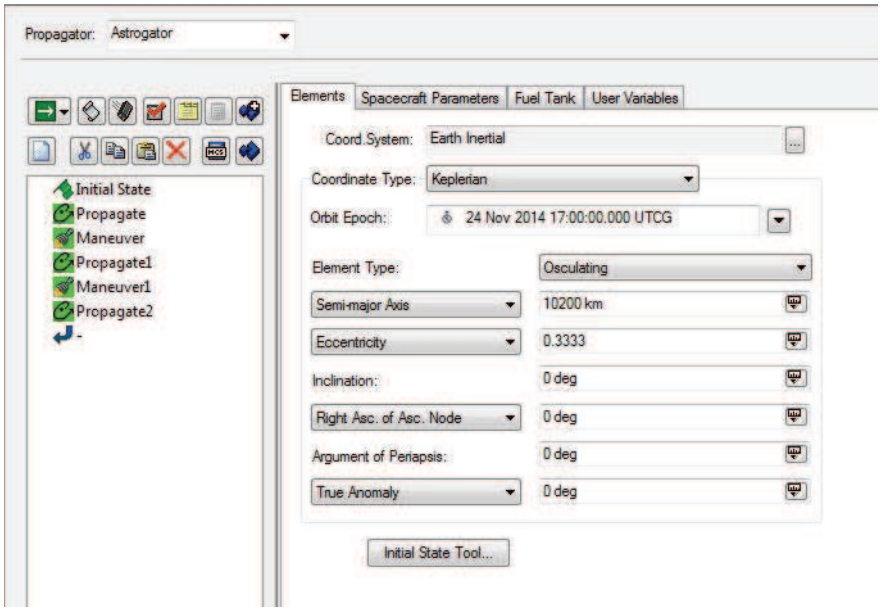
1. Create a new scenario.
2. Insert the chaser satellite to the point A of Orbit ①.

$$a_1 = \frac{1}{2}(r_A + r_C) = 10200\,\text{km}, \quad e_1 = \frac{r_C - r_A}{r_C + r_A} = 0.3333, \quad i_1 = 0, \quad \omega_1 = 0, \quad \Omega_1 = 0, \quad \theta_A = 0.$$

3. Insert the target satellite to the point B of Orbit ①.

$$a_1 = \frac{1}{2}(r_A + r_C) = 10200\,\text{km}, \quad e_1 = \frac{r_C - r_A}{r_C + r_A} = 0.3333, \quad i_1 = 0, \quad \omega_1 = 0, \quad \Omega_1 = 0, \quad \theta_B = 90^\circ.$$

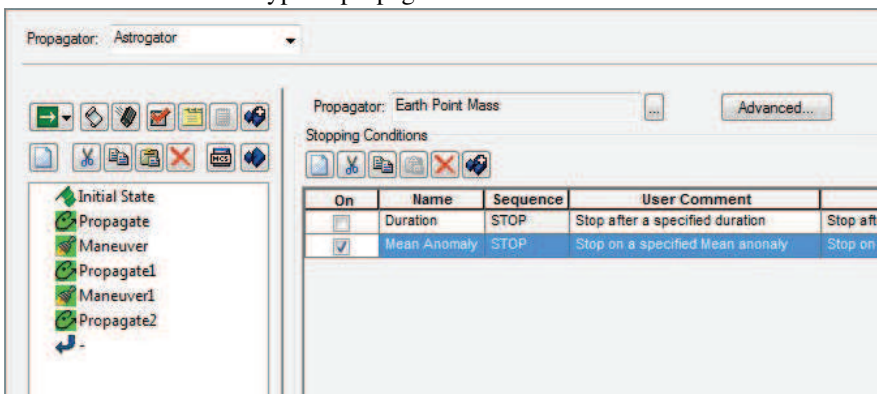
4. Take a snap shot of the resulting orbit at the 3D graphics window. **Save it as a jpg file, and upload it to Blackboard.** A sample jpg file is illustrated at the last page.
5. Double-click the chaser satellite at the left object browser, and change "Propagator" to "Astrogator" at the pull down menu. This requires that the orbital elements of the chaser should be **re-entered** at the following element tab of the initial state.



6. Describe the phasing maneuver of the chaser as follows:

   - Propagate until periapsis before maneuver
   - First impulse $\Delta v_A = -0.2485\,\mathrm{km/s}$ to transfer the chaser to Orbit ②
     (Choose "AntiVelocity" to enter a negative velocity change.)
   - Propagate until periapsis of Orbit ②
   - Second impulse $\Delta v_A = +0.2485\,\mathrm{km/s}$ to transfer the chaser to Orbit ①
   - Propagate until periapsis of Orbit ①

   Choose "Earth Point Mass" for the type of propagator.



7. Simulate the resulting maneuver at the 3D graphics window, and make it sure that the chaser catches the target.

8. Take a snap shot of the resulting orbit at the 3D graphics window. **Save it as a jpg file, and upload it to Blackboard.** A sample jpg file is illustrated at the next page.

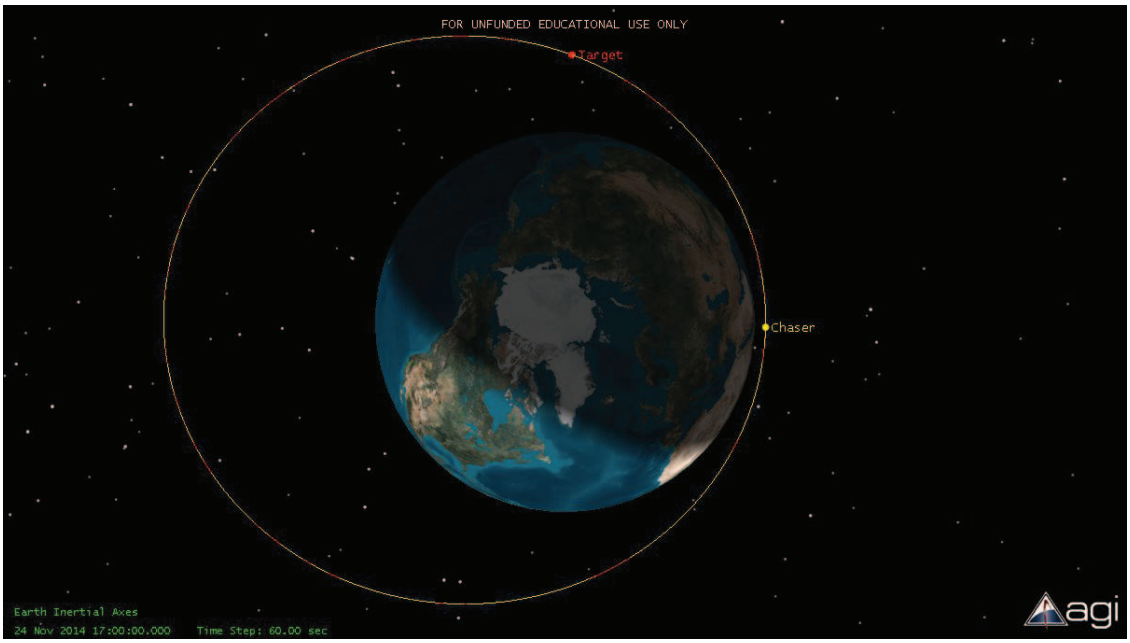


Figure 1: Step 4

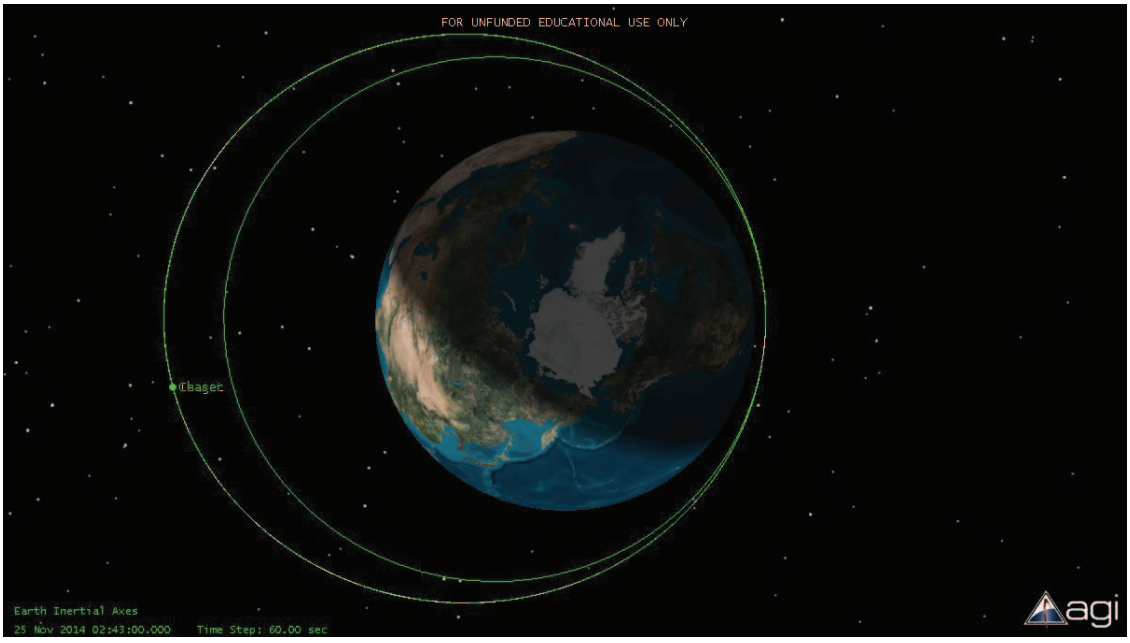


Figure 2: Step 8