ECE 6390 Homework 2: Look Angles and Link Budgets

Due Date: 3 September 2009 (Thursday)

1. **Numerical Analysis of Orbits:** Derive the system of 4 discrete difference equations that we used to calculate orbits for two-body problems. (5 points)

2. **Geosynchronous vs. Geostationary:** We learned in class that to be *geostationary*, a satellite must have a circular, equatorial orbit in addition to being geosynchronous. An example of this type of orbit is used by XM satellite radio, where two satellites (named "Rock" and "Roll") sit stationary in the sky above North America, providing broadcast digital radio to paying customers. Their competitor Sirius, however, uses 4 satellites (and one extra, for back-up) in a common geosynchronous *Tundra* orbit, which sits at an inclination of 63.4° with an apogee of 46,983 km (measured from the center of the earth). At apogee, each Sirius satellite is aligned at -96.00° longitude.

   For this problem, you must plot the path in the sky taken by a Sirius satellite in an eccentric, geosynchronous Tundra orbit, as seen by an earth station on two locations. Plot the look angles on a rectangular plot, with azimuth on the x-axis and elevation on the y-axis. The plot should show the progression of look angles to the satellite through exactly 1 sidereal day. You may re-use your code from the previous homework assignment to track the satellite subpoint across the earth. Just remember, the earth station is rotating in the same direction as the satellite orbit.

   Make sky plots of the satellite path as viewed from (a) Miami, FL and (b) Seattle, WA. In each case, how much time does the satellite spend above the horizon in each city? (20 points)