ASEN 5070:
Statistical Orbit Determination I

Homework Set #1

1. Given the following Earth orbiting spacecraft position and velocity vectors in Cartesian coordinates, solve for the Keplerian elements (a, e, i, **Ω**, ω, ν). See this handout for the details: http://ccar.colorado.edu/ASEN5070/handouts/cart2kep2002.pdf
Example code is available on the course website for debugging (see RVtoKepler.m).

$$\vec{R} = -2436.45\hat{\imath} - 2436.45\hat{\jmath} + 6891.037\hat{k} \text{ km}$$
$$\vec{V} = \dot{\vec{R}} = 5.088611\hat{\imath} - 5.088611\hat{\jmath} + 0.0\hat{k} \text{ km/s}$$

assume **μ** = 398600.5 km^3/s^2.

2. Convert the Keplerian elements from Problem 1 back to position and velocity. See this handout on the course website:
http://ccar.colorado.edu/ASEN5070/handouts/kep2cart_2002.doc
The code Kepler_to_RV.m may be used for debugging.

3. Given the gravity potential function $U = \frac{\mu}{R}$ solve for the two-body acceleration due to gravity, i.e., $\nabla U = \frac{\partial U}{\partial x}\hat{\imath} + \frac{\partial U}{\partial y}\hat{\jmath} + \frac{\partial U}{\partial z}\hat{k}$ where $R = \sqrt{x^2 + y^2 + z^2}$.

4. Develop the necessary code to integrate the equations of motion using the position and velocity from Problem 1 as the initial conditions. Compute the future position and velocity at 20-second intervals for two full orbits.

5. Plot the magnitude of the position, velocity, and acceleration as a function of time for two full orbits.

6. Compute the specific kinetic energy and specific potential energy as a function of time and plot the change in total specific energy to show that it remains constant over the two orbits. (i.e. plot dTE = TE(t) - TE(t0))

7. Problem #1, Chapter 1 of text.