ENAE 791 PROBLEM SET 2, REV. 1 – SPRING, 2012

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Your spacecraft is in an Earth orbit with the following initial state: $\bar{r} = (7000,\ 0,\ 0)km$; $\bar{v} = (0,\ 8000,\ 0)m/sec$. The ballistic coefficient is 500 kg/m^3.

(1) Calculate a, e, r_{apogee}, and P (period) for the current orbit.
(2) Using Matlab, Excel, or any other computer system or tool of your choice, use the planar state equations from lecture #13 and numerically integrate the orbit for one orbital period. At the end of one period, what is the difference in position between where it should be using orbital mechanics, and where it is based on numerical integration?
(3) For a deorbit burn at perigee, calculate the orbital parameters of an entry orbit which arrives at entry interface (125 km) at a flight path angle γ= –2 degrees. What is the velocity at entry interface?
(4) Numerically integrate the trajectory of the spacecraft on an ballistic entry. Also calculate the trajectory using the analytical approximation derived in class. Plot the following charts for the numerical integration results, with the analytical approximations derived in class superimposed on charts (b) and (c):
    (a) Downrange distance from entry (X) vs. altitude (Y)
    (b) Velocity (X) vs. altitude (Y)
    (c) Deceleration (X) vs. altitude (Y)
    (d) Time (X) vs. deceleration (Y)
(5) Repeat the analysis of (4) for an L/D=0.25 (always lifting upwards), and comparing the numerical solutions against the equilibrium glide approximation. Create the same set of plots for this case.