Spaceborne Imaging Systems – Homework 2

assigned Thur 19 Feb 2009, due Tuesday March 3

see additional comments at end

1. find support data for QuickBird (DigitalGlobe) image in dg_meta.zip in ftp.ecn.purdue.edu\bethel.
2. in the file dg.eph locate ephemeris points numbered: 400, 450, 500.
3. Using algorithms discussed in class convert each ECF state vector to ECI reference frame, then convert the ECI state vectors to kepler elements
4. compare a (& computed altitude), i, e to published values
5. Between #400 → #450, and #450 → #500 compute $\dot{\Omega}$, $\dot{\omega}$, $\dot{i}$, $\dot{a}$, $\dot{e}$, $\dot{M}$. which ones seem significant ?

[note: you are free to look at solution to similar problem from 2008 and use any code provided: qb_eci_ecf.m, precession.m, nutation.m, iau1980n.txt, jd.m, kep2stv.m, stkp6.m]

6. using above developed software tools, plot the subsequent orbit path for 1 day @ 1 minute intervals using the following algorithm:

   (a) take the kepler elements for eph. point #400 as the base point.

(b) advance the time by <u>1 minute</u>

$M = n(t - t_p)$ $\quad t_p$ = time @ perigee

(c) using the "new" Kepler elements, convert to state vector in ECI reference frame

(d) with the new time, approximate new R by $R = \Pi_{constant}\,\Theta_{approx}\,N_{constant}\,P_{constant}$

where,

$$\Theta_{approx} = R_3(GAST')$$

$$GAST' = GAST_0 + \left(\frac{\#\,min}{1440}\right)\cdot 2\pi \cdot \frac{366.25}{365.25}$$

(Solar minutes to sidereal angle!)

(e) using new R convert X_{ECI} to X_{ECF} (position only)

(f) scale X_{ECF} to surface of earth

(g) convert XYZ_{ECF} to geographic ϕ, λ, h, save in a trajectory array ϕ_i, λ_i

(h) plot base map and trajectory points (matlab) by:

- load coast
- plot(long, lat, 'b-') (decimal degrees)

This is just raw ϕ, λ a "platte carre" projection

- plot a trajectory data point (decimal degrees)

plot(λ_i, ϕ_i, 'r.')

if (ϕ_i < 70 deg) and (on descending path)

$$\phi_i < \phi_{i-1}$$

descending path = daytime
ascending path = night time

- Careful about units m, km, radians, degrees time seconds, arc seconds, ...
- can use use code from 2008 but you are encouraged to write your own — (you learn more!)
- path should start @ West Lafayette IN !

1. During the course of one day, the satellite will make ~14 orbits, so each time that (t-tp) exceeds Tau, the period, then you need to update tp = tp + Tau, so that M stays in the range 0 -> 2*pi