Time to Repeat a Ground Track - Numerical Integration Solution

This ***Numerit*** program (`repeat2`) estimates the time required for an Earth satellite to repeat its ground track. The satellite's orbit is propagated using numerical integration and the user can select a closure tolerance. The form of the orbital equations of motion can be changed by the user to include other perturbations and higher-order gravity.

The numerical method used in this program calculates the difference between the east longitude of the ascending node at any time *t* given by

$$l(t) = \tan^{-1}\left(r_{y_{ecf}}, r_{x_{ecf}}\right) \tag{1}$$

and the east longitude of the ascending node crossing at the initial time t_0. Whenever this difference is less than the closure tolerance specified by the user, the software stops and displays the results of the calculations.

The Earth-centered-fixed (ECF) components of the position vector are given by

$$\begin{aligned} r_{x_{ecf}} &= r_{x_{eci}}\cos q + r_{y_{eci}}\sin q \\ r_{y_{ecf}} &= r_{y_{eci}}\cos q - r_{x_{eci}}\sin q \end{aligned} \tag{2}$$

where $q = w_e(t - t_0)$ is the right ascension of the satellite relative to the initial crossing. In these equations $r_{x_{eci}}$ and $r_{y_{eci}}$ are the inertial components of the satellite's position vector.

The following is a typical draft output created with this software. It illustrates the results for the "hardwired" default program input.

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program repeat2

< time to repeat ground track - integrated solution >

perigee altitude            1621.86  kilometers
apogee altitude             1621.86  kilometers

semimajor axis              8000  kilometers
eccentricity                0
inclination                 28.5  degrees
argument of perigee         0  degrees

Keplerian period            118.68468  minutes

nodal period                118.38671  minutes

time to repeat              0.98655594  days

number of orbits to repeat  12
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