AER E 351 - Homework 3

1.) Earth satellite

Orbital elements @ t_0

Find $\bar{r}_0$ & $\bar{v}_0$ at t_0 in a geocentric non-rotating frame

a.) $a = 1.7 R_{Earth}$

$e = 0.4$

$i = 20°$

$\Omega = 30°$

$\omega = 10°$

$f_0 = 60°$

$\theta = \omega + f$

$r_0 = \frac{a(1-e^2)}{1+e\cos f} = 7{,}590$ km

$\bar{r}_0 = r_0(\cos\Omega\cos\theta - \sin\Omega\sin\theta\cos i)\hat{I} + r_0(\sin\Omega\cos\theta + \cos\Omega\sin\theta\cos i)\hat{J} + r_0\sin\theta\sin i\hat{k}$

see MATLAB

ans

$\bar{r}_0 = \begin{bmatrix} -1{,}103\,\hat{I} \\ 7{,}102\,\hat{J} \\ 2{,}439\,\hat{k} \end{bmatrix}$ km $\quad \bar{v}_0 = \begin{bmatrix} -8.069\,\hat{I} \\ 0.6241\,\hat{J} \\ 1.665\,\hat{k} \end{bmatrix}$ km/s

b.) $a = 2R_{Earth}$

$e = 0$

$i = 10°$

$\Omega = 30°$

$\theta_0 = 20°$

$\theta = \omega + f$

$r_0 = \frac{a(1-0^2)}{1+0\cdot\cos f} = a$

$\bar{r}_0 = \begin{bmatrix} 8{,}233\,\hat{I} \\ 9{,}714\,\hat{J} \\ 757.6\,\hat{K} \end{bmatrix}$ km

$\bar{v}_0 = \begin{bmatrix} -4.242\,\hat{I} \\ 3.524\,\hat{J} \\ 0.9121\,\hat{K} \end{bmatrix}$ km/s

$v_0 = \sqrt{\mu(2/r - 1/a)}$

$\gamma = \cos^{-1}\left(\frac{h}{rv}\right)$