B5.0 CHANGING THE ECCENTRICITY OF AN INITIALLY ECCENTRIC ORBIT

Initial Orbital Elements a, e1 (Orbit 1)

Final Orbital Elements a, e2 (Orbit 2)

Eccentricity is increased by an initial burn at perigee followed by a burn at apogee.

The same formulations for velocities are used as in the calculation for semi-major axis correction, except

$$\Delta V_{ee} = V_{PT} - V_{P1} + V_{AT} - V_{A2}$$

because the second burn slows the velocity to increase eccentricity

$$\Delta V_{ee} = \sqrt{\frac{2\mu}{a(1-e_1)+a(1+e_2)} \cdot \frac{a(1+e_2)}{a(1-e_1)}} - \sqrt{\frac{\mu}{a} \cdot \frac{(1+e_1)}{(1-e_1)}}$$

$$+ \sqrt{\frac{2\mu}{a(1-e_1)+a(1+e_2)} \cdot \frac{a(1-e_1)}{a(1+e_2)}} - \sqrt{\frac{\mu}{a}\,\frac{(1-e_2)}{(1+e_2)}}$$

Letting

$$e_2 = e + \Delta e$$
$$e_1 = e$$

$$\frac{1}{\sqrt{1+\frac{\Delta e}{2}}} \doteq 1 - \frac{\Delta e}{4}$$

$$\sqrt{1+\frac{\Delta e}{1+e}} \doteq 1 + \frac{\Delta e}{2(1+e)}$$

$$\frac{1}{\sqrt{1+\frac{\Delta e}{1+e}}} \doteq 1 - \frac{\Delta e}{2(1+e)}$$

$$\sqrt{1-\frac{\Delta e}{1-e}} \doteq 1 + \left(\frac{-\Delta e}{2(1-e)}\right)$$