

14.4: Lagrange's Planetary Equations

We now go to Equation 14.2.8 to obtain *Lagrange's Planetary Equations*, which will enable us to calculate the rates of change of the orbital elements if we know the form of the perturbing function:

$$\dot{a} = -\frac{2a^2}{GMm} \frac{\partial R}{\partial T}, \quad (14.4.1)$$

$$\dot{e} = -\frac{a(1-e^2)}{GMme} \frac{\partial R}{\partial T}, \quad (14.4.2)$$

$$\dot{i} = -\frac{1}{\sqrt{GMm^2 a(1-e^2)} \sin i} \frac{\partial R}{\partial \Omega} - \frac{1}{me} \sqrt{\frac{1-e^2}{GMa}} \frac{\partial R}{\partial \omega}, \quad (14.4.3)$$

$$\dot{\omega} = \frac{1}{me} \sqrt{\frac{1-e^2}{GMa}} \frac{\partial R}{\partial e} - \frac{1}{\sqrt{GMm^2 a(1-e^2)} \tan i} \frac{\partial R}{\partial i}, \quad (14.4.4)$$

$$\dot{\Omega} = \frac{1}{\sqrt{GMm^2(1-e^2)} \sin i} \frac{\partial R}{\partial i}, \quad (14.4.5)$$

$$\dot{T} = \frac{2a^2}{GMm} \frac{\partial R}{\partial a} + \frac{a(1-e^2)}{GMme} \frac{\partial R}{\partial e}. \quad (14.4.6)$$

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