

16.522 Space Propulsion Homework #2

Handed: 2/12/04
Due: 2/19/04

Problem 1

Using a method patterned after Edelbaum's suboptimal theory for plane change with climb, optimize a low-thrust maneuver consisting of a change in the longitude of the Ascending Node (Ω) from Ω_1 to

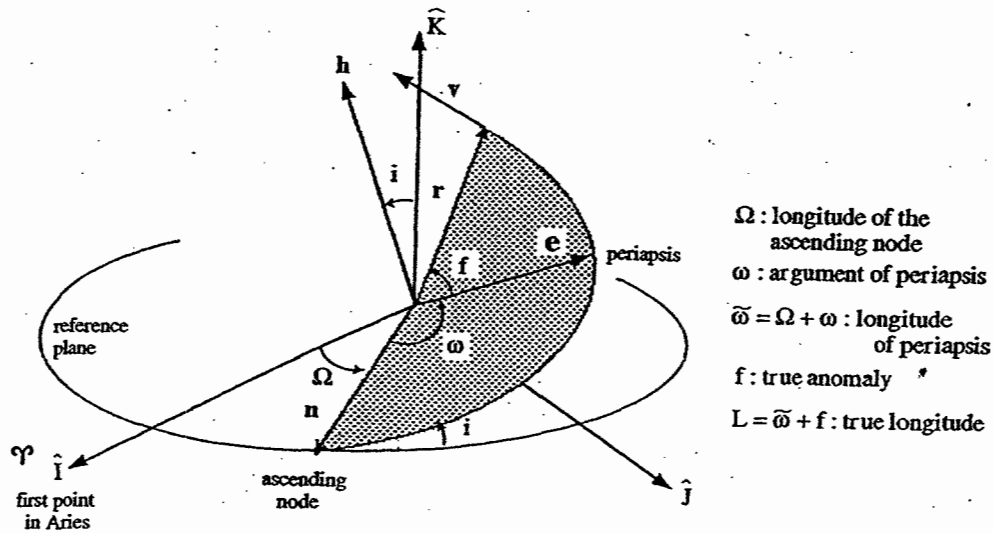


Fig. 3.3 The Angle Orbital Elements

Ω_2 with a simultaneous ascent from a radius R_1 to a radius R_2 . Assume the orbit remains circular, and the inclination i remains constant (arbitrary).

Derive formulae for the out-of-plane thrust angle magnitude α (in particular its initial and final values) and for the required ΔV .

Note: The rate of change $\dot{\Omega}$ is given by

$$\frac{d\Omega}{dt} = \frac{R \sin \vartheta}{h \sin i} a_N \quad ; \quad a_N = \frac{F}{M} \sin \alpha$$

and ϑ is the "True anomaly" (location within the orbit), measured from the ascending node ($\omega + f$ in the figure).