Predict the Transfer Orbit Parameters (Continued)

2.4 For any ellipse,

$$r = P/(1 + e \cos \theta)$$

$$\rho = a(1-e^2) = \frac{2r_a\, r_p}{r_a + r_p}$$

$$2a = r_a + r_p$$

$$e = \frac{r_a - r_p}{r_a + r_p}$$

$$\tau = 2\pi \sqrt{\frac{a^3}{\mu}}$$

Equating the radii at the point of intersection,

$$r = \frac{P_t}{1+e_t \cos \theta_t} = \frac{P_f}{1+e_f \cos \theta_f} = \frac{P_f}{1+e_f \cos(\theta_t - \Psi)}$$

$$P_f\,(1+e_t \cos \theta_t) = P_t\,[1+e_f \cos(\theta_t - \Psi)]$$

$$P_f\, e_t \cos \theta_t = P_t\,[1+e_f\,(\cos \theta_t \cos \Psi + \sin \theta_t \sin \Psi)] - P_f$$

$$\cos \theta_t\,[\,P_f\, e_t - P_t\, e_f \cos \Psi] - \sin \theta_t\,[\,P_t\, e_f \sin \Psi] = P_t - P_f$$

$$A \cos \theta_t - B \sin \theta_t - C = 0$$

$$A \cos \theta_t - C = B \sqrt{1-\cos^2 \theta_t}$$