2.4 Predict the Transfer Orbit Parameters (Continued)

$$\frac{1}{r_{af}} + \frac{1}{r_{pf}} + \frac{r_{af} - r_{pf}}{r_{af}\, r_{pf}} \cos(\theta_t - \Psi)$$

$$= \frac{1}{r_{pt}} + \frac{1}{r_{at}} + \frac{r_{at} - r_{pt}}{r_{at}\, r_{pt}} \cos\theta_t$$

$$\frac{r_{af}}{r_{pf}} + 1 + \frac{r_{af} - r_{pf}}{r_{pf}} \cos(\theta_t - \Psi)$$

$$= \frac{r_{af}}{r_{pt}} + \frac{r_{af}}{r_{at}} + \frac{r_{af}(r_{at} - r_{pt})}{r_{at}\, r_{pt}} \cos\theta_t$$

$$\left(\frac{r_{af}}{r_{pf}} + 1\right) + \left(\frac{r_{af}}{r_{pf}} - 1\right)\cos(\theta_t - \Psi) =$$

$$\frac{r_{af}}{r_{at}} \left[\left(\frac{r_{at}}{r_{pt}} + 1\right) + \left(\frac{r_{at}}{r_{pt}} - 1\right)\cos\theta_t\right]$$

Also,

$$\frac{2 r_{at}\, r_{pt}}{r_{at} + r_{pt}} = r\left[1 + \frac{r_{at} - r_{pt}}{r_{at} + r_{pt}} \cos\theta_t\right]$$

$$\frac{2 r_{at}\, r_{pt}}{r} = r_{at} + r_{pt} + (r_{at} - r_{pt}) \cos\theta_t$$