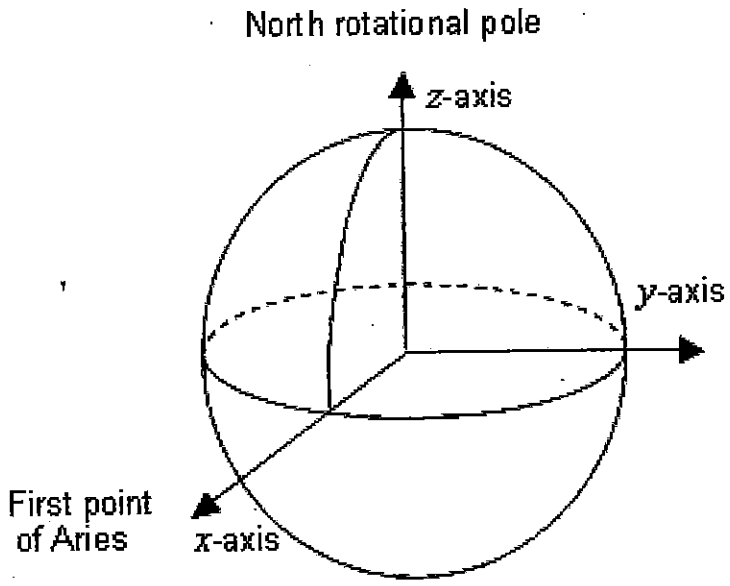
The Gibbs Problem:

Given the geocentric position vectors of a space object at three successive times $\mathbf{R}_1$,$\mathbf{R}_2$, and $\mathbf{R}_3$, determine the orbital elements:



To determine the orbital elements, **R** and **V** at any one position is required:

$$\mathbf{V} = \sqrt{\frac{\mu}{ND}}\left(\frac{\mathbf{D}\times\mathbf{r}}{r}+\mathbf{S}\right)$$

Where:

$$r_1 = (\mathbf{R}_1\cdot\mathbf{R}_1)^{1/2} \qquad r_2 = (\mathbf{R}_2\cdot\mathbf{R}_2)^{1/2} \qquad r_3 = (\mathbf{R}_3\cdot\mathbf{R}_3)^{1/2}$$

$$\mathbf{N} = r_1(\mathbf{R}_2\times\mathbf{R}_3) + r_2(\mathbf{R}_3\times\mathbf{R}_1) + r_3(\mathbf{R}_1\times\mathbf{R}_2)$$

$$\mathbf{D} = \mathbf{R}_2\times\mathbf{R}_3 + \mathbf{R}_3\times\mathbf{R}_1 + \mathbf{R}_1\times\mathbf{R}_2$$

$$\mathbf{S} = \mathbf{R}_1(r_2 - r_3) + \mathbf{R}_2(r_3 - r_1) + \mathbf{R}_3(r_1 - r_2)$$