ROMTEKNOLOGI

Kapittel 2 Annex

Transformasjon av baneparametre

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Transformation from (I) til (II)

$$i = \arccos\left(\frac{Y\cdot\dot{Z} - Z\cdot\dot{Y}}{\sqrt{(X^2+Y^2+Z^2)\cdot(\dot{X}^2+\dot{Y}^2+\dot{Z}^2)}}\right)$$

$$\Omega = arc\tan\frac{Y\cdot\dot{Z} - Z\cdot\dot{Y}}{\dot{X}\cdot Z - Z\cdot\dot{X}}$$

$$x = X\cdot\cos\Omega - Y\cdot\sin\Omega$$

$$\dot{x} = \dot{X}\cdot\cos\Omega + \dot{Y}\cdot\sin\Omega$$

$$y = -X\cdot\sin\Omega\cdot\cos i + Y\cdot\cos\Omega\cdot\cos i + Z\cdot\sin i$$

$$\dot{y} = -\dot{X}\cdot\sin\Omega\cdot\cos i + \dot{Y}\cdot\cos\Omega\cdot\cos i + \dot{Z}\cdot\sin i$$

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Transformation from (II) to (I)

$$X = x \cdot \cos\Omega - y \cdot \sin\Omega \cdot \cos i$$

$$Y = x \cdot \sin\Omega + y \cdot \cos\Omega \cdot \sin i$$

$$Z = y \cdot \sin i$$

$$\dot{X} = \dot{x} \cdot \cos\Omega - \dot{y} \cdot \sin\Omega \cdot \cos i$$

$$\dot{Y} = \dot{x} \cdot \sin\Omega + \dot{y} \cdot \cos\Omega \cdot \sin i$$

$$\dot{Z} = \dot{y} \cdot \sin i$$

Transformation from (II) to (III)

$$r = \sqrt{x^2 + y^2}$$

$$v = \sqrt{\dot{x}^2 + \dot{y}^2}$$

$$a = \frac{r \cdot \mu}{2 \cdot \mu - r \cdot v^2}$$

$$\varepsilon = \sqrt{1 - \frac{(x \cdot \dot{y} - y \cdot \dot{x})^2}{\mu \cdot a}}$$

$$\nu = arc\cos \frac{a \cdot (1 - \varepsilon^2) - r}{\varepsilon \cdot r}$$

$$\omega = \nu - a\tan(\frac{y}{x})$$

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Transformation from (III) to (II)

$$r = \frac{(1-\varepsilon^2)\cdot a}{1+\varepsilon\cdot\cos\nu}$$

$$v = \sqrt{\mu\cdot(\frac{2}{r}-\frac{1}{a})}$$

$$\alpha = arc\sin(\frac{\sqrt{(1-\varepsilon^2)\cdot\mu\cdot a}}{r\cdot v}$$

$$x = r\cdot\cos(\omega+\nu) \qquad y = r\cdot\sin(\omega+\nu)$$

$$\dot{x} = v\cdot\cos(\omega+\nu+\alpha) \qquad \dot{y} = v\cdot\sin(\omega+\nu+\alpha)$$

Time as a function of true anomaly

$$t = t_p + \sqrt{\frac{a^3}{\mu}} \cdot \left\{ 2 \cdot arc\tan\left(\sqrt{\frac{1-\varepsilon}{1+\varepsilon}} \cdot \tan\frac{\nu}{2}\right) - \varepsilon \cdot \sqrt{1-\varepsilon^2} \cdot \frac{\sin\nu}{1+\varepsilon\cos\nu} \right\}$$

$$t = t_p + \sqrt{\frac{a^3}{\mu}} \cdot \left\{ \arccos\left(\frac{e+\cos\nu}{1+e\cos\nu}\right) - \varepsilon \cdot \sqrt{1-\varepsilon^2} \cdot \frac{\sin\nu}{1+\varepsilon\cos\nu} \right\}$$

t_p = time at perigeum **ν = true anomaly (function of time)**