ΤΥΠΟΛΟΓΙΟ ΘΕΩΡΗΤΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

$$\vec{\mathbf{e}}_\mathbf{r} = \cos\theta\vec{\mathbf{i}} + \sin\theta\vec{\mathbf{j}}, \quad \vec{\mathbf{e}}_\theta = -\sin\theta\vec{\mathbf{i}} + \cos\theta\vec{\mathbf{j}} \quad , \quad \vec{\mathbf{i}} = \cos\theta\vec{\mathbf{e}}_\mathbf{r} - \sin\theta\vec{\mathbf{e}}_\theta, \quad \vec{\mathbf{j}} = \sin\theta\vec{\mathbf{e}}_\mathbf{r} + \cos\theta\vec{\mathbf{e}}_\theta$$

$$\dot{\vec{\mathbf{e}}}_\mathbf{r} = \dot{\theta}\vec{\mathbf{e}}_\theta, \quad \dot{\vec{\mathbf{e}}}_\theta = -\dot{\theta}\vec{\mathbf{e}}_\mathbf{r} \ , \ \vec{\upsilon} = \dot{r}\vec{e}_r + r\dot{\theta}e_\theta, \quad \vec{\gamma} = (\ddot{r} - r\dot{\theta}^2)\vec{e}_r + (2\dot{r}\dot{\theta} + r\ddot{\theta})\vec{e}_\theta, \ \vec{\gamma} = \frac{d\upsilon}{dt}\vec{\varepsilon} + \frac{\upsilon^2}{R}\vec{n}$$

$$x = r\sin\theta\cos\varphi, \quad y = r\sin\theta\sin\varphi, \quad z = r\cos\theta \qquad \vec{\upsilon} = \dot{r}\vec{e}_r + r\dot{\theta}\vec{e}_\theta + r\sin\theta\,\dot{\varphi}\vec{e}_\varphi,$$

$$grad\,V(r,\theta,\varphi) = \frac{\partial V}{\partial r}\vec{e}_r + \frac{1}{r}\frac{\partial V}{\partial\theta}\vec{e}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial\varphi}\vec{e}_\varphi$$

$$\vec{\upsilon}_a = \vec{\upsilon}_0 + \vec{\omega}\times\vec{r} + \vec{\upsilon}_\sigma, \qquad \vec{\gamma}_a = \vec{\gamma}_0 + \vec{\omega}\times(\vec{\omega}\times\vec{r}) + \dot{\vec{\omega}}\times\vec{r} + 2\vec{\omega}\times\vec{\upsilon}_\sigma + \vec{\gamma}_\sigma$$

$$\ddot{x} = 2\omega\sin\varphi\,\dot{y}, \quad \ddot{y} = -2\omega\cos\varphi\,\dot{z} - 2\omega\sin\varphi\,\dot{x}, \quad \ddot{z} = -g + 2\omega\cos\varphi\,\dot{y}, \quad \vec{\omega} = -\omega\cos\varphi\vec{i} + \omega\sin\varphi\vec{k}$$

$$\ddot{x} + \omega^2 x = 0 \Rightarrow x = A\cos\omega t + B\sin\omega t, \qquad \ddot{x} - a^2 x = 0 \Rightarrow \quad x = c_1 e^{at} + c_2 e^{-at}$$

$$m\ddot{x} + b\dot{x} + kx = F_0\cos(\omega t) \quad \Rightarrow \quad x(t) = De^{-\gamma t}\cos(\omega_1 t + \theta_0) + A\cos(\omega t - \delta)$$

όπου $\gamma = \dfrac{b}{2m}, \quad \omega_1 = \sqrt{\dfrac{k}{m} - \gamma^2}, \quad A = \dfrac{F_0}{\sqrt{b^2\omega^2 + (k - m\omega^2)^2}}, \ \tan\delta = \dfrac{b\omega}{k - m\omega^2}$

$$V'(r) = V(r) + \frac{L^2}{2mr^2} \ , \quad m\ddot{r} = F(r) + \frac{L^2}{mr^3}, \quad \upsilon_o^2 = -\frac{r_0 F(r_0)}{m}, \quad \frac{F'(r_0)}{F(r_0)} + \frac{3}{r_0} > 0$$

$$\frac{d^2(1/r)}{d\theta^2} + \frac{1}{r} = -\frac{mr^2}{L^2}F(r), \qquad \frac{dr}{d\theta} = \pm\frac{\sqrt{2m}}{L}r^2\left(E - V'(r)\right)^{1/2} \qquad r = \frac{a\,|1 - e^2\,|}{1 + e\cos(\theta - \theta_0)},$$

$$e = \sqrt{1 + \frac{2EL^2}{mk^2}}, \quad a = -\frac{k}{2E}, \quad \upsilon^2 = \frac{k}{m}\left(\frac{2}{r} - \frac{1}{a}\right), \quad T^2 = \frac{4\pi^2}{GM}a^3, \quad \hat{a} = \arccos\left(\frac{1}{e}\right)$$

$$\mu\ddot{\vec{r}} = \vec{F}_{12} + \mu\left(\frac{\vec{F}_2}{m_2} - \frac{\vec{F}_1}{m_1}\right), \quad \mu = \frac{m_1 m_2}{m}, \quad \vec{r}_1 = -\frac{m_2\vec{r}}{m}, \quad \vec{r}_2 = \frac{m_1\vec{r}}{m}, \quad m = m_1 + m_2,$$

$$\vec{L} = \vec{R}_K \times m\vec{\upsilon}_K + \vec{r}\times\mu\vec{\upsilon}\ , \quad T = \frac{1}{2}m\upsilon_K^2 + \frac{1}{2}\mu\upsilon^2$$

$$\delta\mathbf{r}_i = \sum_{j=1}^{n}\frac{\partial\mathbf{r}_i}{\partial q_j}\delta q_j, \quad Q_j = \sum_{i=1}^{N}\mathbf{F}_i\frac{\partial\mathbf{r}_i}{\partial q_j}, \quad W = \sum_{j=1}^{n}Q_j\delta q_j\ , \ U(q_i,\dot{q}_i,t) = \Phi(q_i,t) + \sum_{k=1}^{n}A_k(q_i,t)\dot{q}_k\ ,$$

$$\vec{\upsilon} = \vec{\upsilon}_O + \vec{\omega}\times\vec{r}, \quad T = \frac{1}{2}m\upsilon_O^2 + \vec{\upsilon}_O(\vec{\omega}\times m\vec{r}_K) + \frac{1}{2}J\omega^2, \quad J' = J + m\delta^2$$

$$\vec{L} = m\vec{r}_k\times\vec{\upsilon}_o + \mathbf{J}\vec{\omega}, \qquad T = \frac{1}{2}m\upsilon_k^2 + \frac{1}{2}\vec{L}\cdot\vec{\omega}$$

$$\dot{\vec{e}}_i = \vec{\omega}\times\vec{e}_i\ (i = 1,2,3), \quad \frac{d_a\vec{A}}{dt} = \frac{d_\sigma\vec{A}}{dt} + \vec{\omega}\times\vec{A}$$

$$\vec{A} = A_1\vec{i} + A_2\vec{j} + A_3\vec{k}, \quad \nabla\times\vec{A} = \left(\frac{\partial A_3}{\partial y} - \frac{\partial A_2}{\partial z}\right)\vec{i} + \left(\frac{\partial A_1}{\partial z} - \frac{\partial A_3}{\partial x}\right)\vec{j} + \left(\frac{\partial A_2}{\partial x} - \frac{\partial A_1}{\partial y}\right)\vec{k}$$

$$\vec{A}\times(\vec{B}\times\vec{C}) = (\vec{A}\cdot\vec{C})\vec{B} - (\vec{A}\cdot\vec{B})\vec{C}, \qquad \vec{i}\times\vec{j} = \vec{k}, \quad \vec{k}\times\vec{i} = \vec{j}, \quad \vec{j}\times\vec{k} = \vec{i}$$

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