Formelblad spelfysik

Grunder

Tröghetsmoment

$$I = \int r^2 dm$$

Sfär $I = 0.4mr^2$

Ihålig sfär $I = \frac{2}{3}mr^2$

Disk $I = 0.5mr^2$

Newt. Lag $F = ma,\ \tau = I\alpha$

Reynolds tal $R_e = \frac{\rho L v}{\mu}$

Luftmotstånd $\bar{F}$=-0.5$C_D \rho A v^2 e_v$

Magnuskraft (sfäriska objekt)

$$\bar{F} = 0.5\rho A r(\bar{v} x \bar{w})$$

Utgångshastighet pilar

$$v = \sqrt{\frac{Fxe}{m_p + cm_b}}$$

Kollision en dimension

$$u_i = \frac{m_i - em_j}{m_i + m_j} v_i + \frac{(1+e)m_j}{m_i + m_j} v_j$$

Kollision (rullvillkor ej uppnått)

$$\bar{u_i} = \bar{v_i} + \left(u_{i\rho} - v_{i\rho}\right)\left(e_\rho + \mu e_n\right)$$

$$\bar{w} = \frac{mr\mu\left(u_\rho - v_\rho\right)}{I}(e_r x e_n)$$

Kollision (rullvillkor uppnått)

$$u_n = \left(\frac{mr^2}{mr^2 + I}\right)v_n, \qquad w = \frac{u_n}{r}$$

Golf

$$e_n = \begin{pmatrix} sin\alpha \\ -cos\alpha \end{pmatrix} \qquad e_\rho = \begin{pmatrix} cos\alpha \\ sin\alpha \end{pmatrix}$$

$$\bar{u} = \frac{(1+e)m_c v cos\alpha}{m_c + m_b} e_\rho + \frac{2m_c v sin\alpha}{7(m_c + m_b)} e_n$$

$$\bar{w} = -\frac{2m_c v sin\alpha}{7r(m_c + m_b)} e_y$$

$$C_D(two\ piece) \approx \begin{cases} 0.53 - 0.0051v & v < 65 \\ 0.21 & v > 65 \end{cases}$$

$$C_D(three\ piece) \approx \begin{cases} 0.73 - 0.0084v & v < 60 \\ 0.22 & v > 60 \end{cases}$$

$$C_M \approx 0.05\left(\sqrt{1 + 0.31\frac{w}{v}} - 1\right)$$

Glidtid $T = \frac{2(v_0 - rw_0)}{7\mu g}$

Fotboll

$$C_D \approx \begin{cases} 0.47 & Re < 10^5 \\ 1.18 - \frac{Re}{140\,000} & 10^5 < Re < 135\,000 \\ 0.22 & Re > 135000 \end{cases}$$

$$C_M \approx 0.385 \cdot \sqrt[4]{\frac{rw}{v}}$$

Basket $C_D \approx 0.5$ $C_M \approx \frac{rw}{v}$

Bilar

$$\tau_w = g_k G \tau_e \qquad w_w = \frac{w_e}{g_k G}$$

$$P_e = \tau_e w_e \quad F = \frac{\tau_w}{r} \quad v = w_w r$$

Bromskoefficient $\mu_b = \frac{\tau_b}{f}$

Svängradie $r = \frac{l}{sin\delta}$

Båtar

Lyftkraft $F_L = \rho_{omg} V_u g$

Slip ratio

$v_b - v_w = (1 - s_r)\bar{P}n \quad v_b = (1 - s_a)\bar{P}n$

Motorkraft $F_T = \frac{n_p P_e}{n_H v_b (1 - w_f)}$

Flygplan

Motorkraft propeller $F_T = \frac{n_p P_e}{Jnd}$

Motorkraft jetmotor

$$F_T = \dot{m}_a(v_e - v_0) + \dot{m}_f v_e + A(P_e - P_0)$$

Empirisk atmosfärsmodell

$$T = (T_0 - T_R)e^{-\frac{h}{800}} + T_R - 0.0065h$$

$$P = (P_0 - P_R)e^{-\frac{h}{400}} + P_R\left(1 - \frac{h}{44330}\right)^{5.25}$$

$$T_R = 288.15\ K, \qquad P_R = 101325\ pa$$

$$\rho = 0.00348\frac{P}{T}$$

Förlustfaktor $\emptyset = \frac{\rho - 0.12\rho_0}{\rho_0(1 - 0.12)}$

Svängradie $r = \frac{v^2}{g tan(\varphi)}$

Raketer

Motorkraft $F_T = \dot{m} v_e$

Raketekvationen $v = v_0 + v_e ln\left(\frac{m_0}{m_f}\right)$

Specifik impuls $I_e = \frac{v_e}{g}$

Flykthastighet v= $\sqrt{\frac{2GM}{r}}$

Hastighet i bunden bana

$$v = \sqrt{GM\left(\frac{2}{r} - \frac{1}{a}\right)}$$

Ellips

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 = 1, \quad c = \sqrt{a^2 - b^2}$$

Övrigt

Kraftfaktorn

$$f = \alpha\left(1.8288\left(\frac{\Delta x}{D} - 0.45\right)(\theta^2 + 2000) + 12192\right)$$

Penetreringsenergi

$$E = \frac{10.22\Delta x A f^2}{cos^2\theta}$$

1-D värmeledning

$$T_t = KT_{xx}, \qquad K = -\frac{\kappa}{c\rho}$$

Övertryck

$$P = \frac{8.08 \cdot 10^7 \alpha}{\sqrt{\beta\gamma\delta}}$$

$$\alpha = 1 + \left(\frac{z}{4.5}\right)^2, \quad \beta = 1 + \left(\frac{z}{0.048}\right)^2$$

$$\gamma = 1 + \left(\frac{z}{0.32}\right)^2, \quad \delta = 1 + \left(\frac{z}{1.35}\right)^2$$