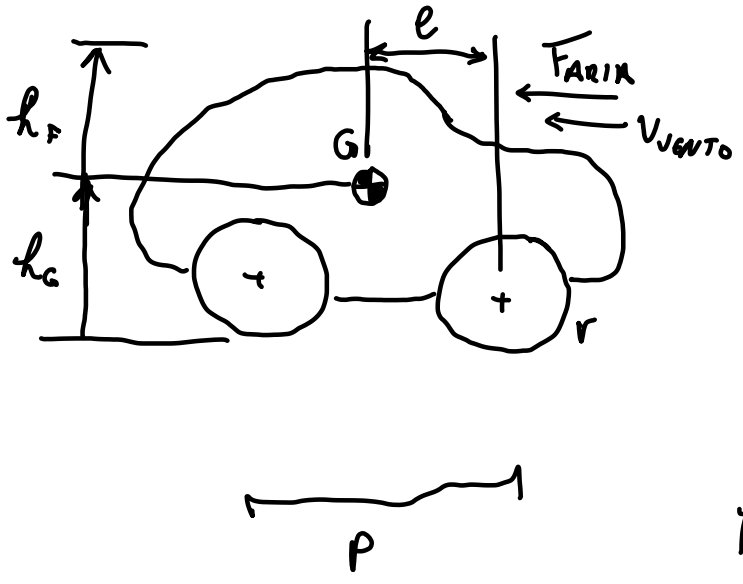
Esercitazione 20 -

Modello autovettura con valori vicino alla realtà



$m_a = 1000\,kg$

$m_c = 240\,kg$ $\quad M = 1240\,kg$

$p = 2.4\,m$ $\quad l = 0.8\,m$

$h_G = 0.6\,m$ $\quad \rho = 1{,}25\,\frac{kg}{m^3}$

$$F_{air} = \frac{1}{2}\rho_{aria}\left(V_{AUTO} - V_{VENTO}\right)^2 S C_r$$

$S = 1{,}7\,m^2$ — Sezione Frontale

$C_r = 0{,}41$

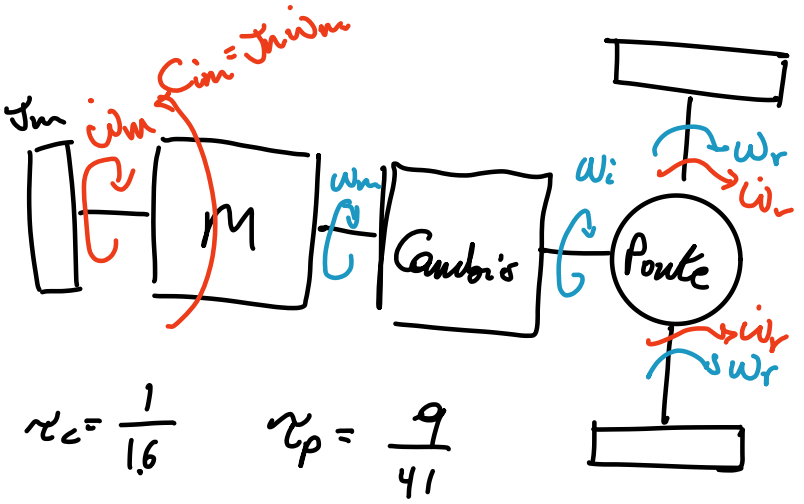
$h_F = 0.8\,m$

$r = 0.28\,m$

$f_v = 0.013$

$J_r = 1\,kg\,m^2$

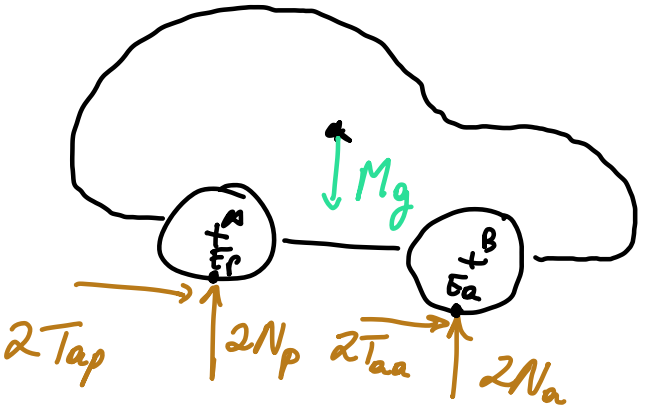
$J_m = 0{,}1\,kg\,m^2$



$\tau_c = \frac{1}{1.6}$ $\quad \tau_p = \frac{9}{41}$

$\eta_{dc} = 0{,}94$ $\quad \eta_{dp} = 0{,}95$

2) Reazioni quando macchina è ferma



$$\sum F_V^{AUTO} = 0$$

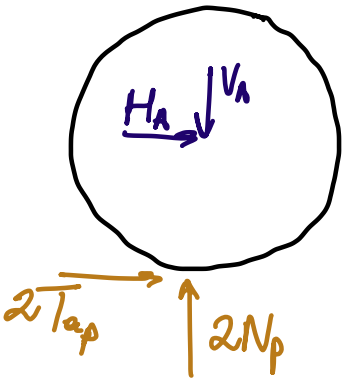
$$\sum M_{Ea}^{AUTO} = 0 \quad 2N_p \cdot p - Mg\,l = 0$$

$$2N_p = \frac{Mg\,l}{p} = \frac{1240 \cdot 9{,}81 \cdot 0{,}8}{2{,}4}$$

$$= 4054{,}80\,N$$

$$\sum M_{Ep}^{AUTO} = 0 \quad 2N_a p - Mg(p-l) = 0$$

$$2N_a = \frac{Mg(p-l)}{p} = 8109{,}6\,N$$



$$\sum M_A^{RUOTA\ POS} \Rightarrow T_{Ap} = 0$$

Determinare a_{AUTO} quando $C_m = 120\,Nm$,

$V_{VENTO} = 5\,m/s$ e $\omega_m = 3000\,rpm =$

$V_{AUTO} =$

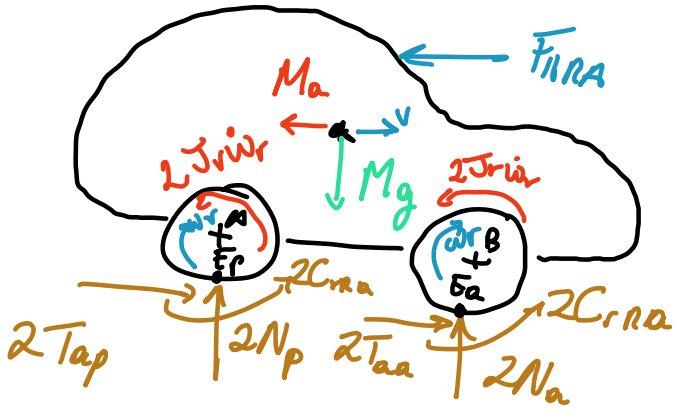
$$\frac{\omega_i}{\omega_m} = \tau_c \qquad \frac{\omega_r}{\omega_i} = \tau_p$$

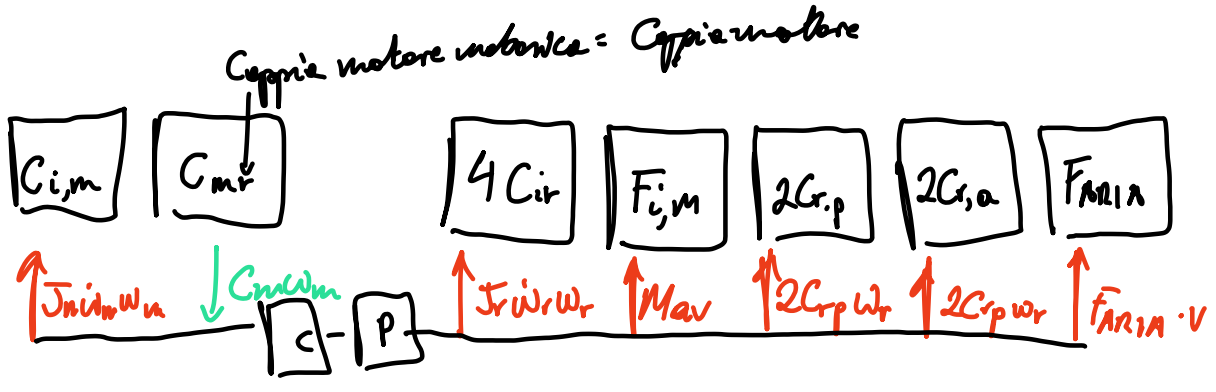
$$\frac{\omega_i}{\omega_m} \cdot \frac{\omega_r}{\omega_i} = \tau_c \tau_p$$

$$\frac{\omega_r}{\omega_m} = \tau_c \tau_p \qquad V = r\omega_r = r\tau_c\tau_p\omega_m = 0{,}28 \cdot \frac{1}{1.6} \cdot \frac{9}{41} \cdot 3000 \cdot \frac{2\pi}{60} = 12.06 \ \frac{m}{s}$$

Non meno perché vogliamo la velocità relativa, ha estratto il meno e mentre il modulo è basta

$$F_{ARIA} = \frac{1}{2}\rho_{ARIA}\left(V_{AUTO} + V_{VENTO}\right)^2 S C_r = 126{,}78\,N$$





$$(C_m\omega_m - J_m\dot{\omega}_m\omega_m)\eta_{dc}\eta_{dp} - 4J_r\dot{\omega}_r\omega_r - M_{av} - 2C_{rR,p}\omega_r - 2C_{rR,a}\omega_r - F_{ARIA}V \simeq 0$$

$$a = \omega_m r \tau_p \tau_c$$

$$\omega_m = \frac{a}{r\tau_p\tau_c} \qquad \omega_r = \frac{a}{r} \qquad \omega_m = \frac{v}{r\tau_p\tau_c} \qquad \omega_r = \frac{v}{r}$$

$$C_m \frac{v}{r\tau_p\tau_c}\eta_{dc}\eta_{dp} - J_m \frac{av}{(r\tau_p\tau_c)^2}\eta_{dc}\eta_{dp} - 4J_r \frac{av}{r^2} - M_a v - \underbrace{(2N_p \cdot u + 2N_a u)\frac{v}{r}}_{\text{attrito volvente}} - F_{ARIA}\cdot v = 0$$

$$\hookrightarrow (2N_p + 2N_a)\frac{u}{r} = Mg\frac{f_v r}{r} = Mg f_v$$

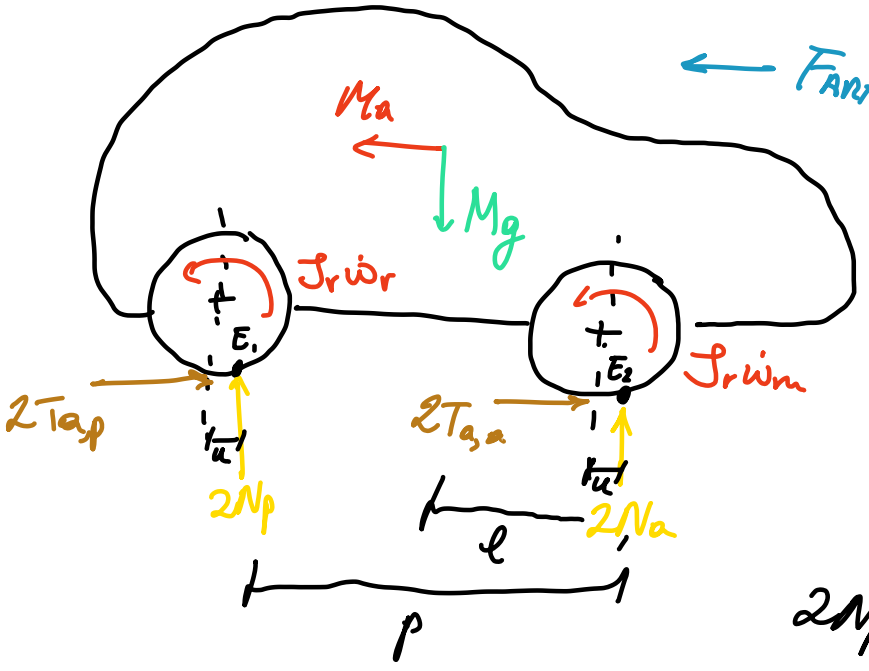
$$\sum F_v^{AUTO} = 0 \rightarrow Mg = 2N_p + 2N_a$$

$$Ma + \frac{4J_r a}{r^2} + \frac{J_m \eta_{dc}\eta_{dp}}{(r\tau_d\tau_c)^2} a = \frac{\eta_{dc}\eta_{dp} C_m}{r\tau_p\tau_c} - Mg f_v - F_{ARIA}$$

$$a = \frac{\frac{\eta_{dc}\eta_{dp} C_m}{r\tau_p\tau_c} - Mg f_v - F_{ARIA}}{M + J_r/r^2 + \frac{J_m \eta_{dc}\eta_{dp}}{(r\tau_d\tau_c)^2}} = 1{,}85\ m/s^2$$

Indipendente dalla posizione del peso

Calcolo reazioni vincolari:



$$\Sigma M^{AUTO}_{E1} = 0$$

$$2N_p \cdot p - 4J_r\dot{\omega}_r - M_g(l+u) - F_{ARIA}\,h_F - M_a h_G = 0$$

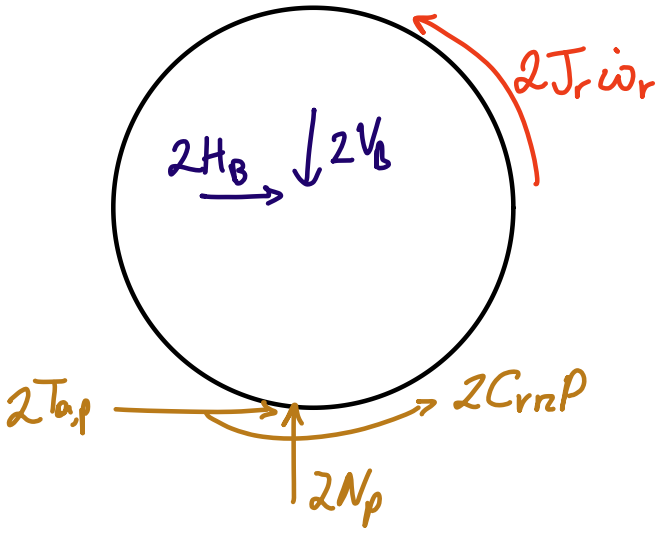
$$2N_p = \frac{4J_r\dot{\omega}_r + M_g(l+u) + F_{ARIA}\,h_F + M_a h_G}{p} = 4924{,}27\,N$$

$$\Sigma M^{AUTO}_{E2} = 0 \quad 2N_a \cdot p + 4J_r\dot{\omega}_r + M_a h_G + F_{ARIA}\,h_F - M_g(p-l-u) = 0$$

$$2N_a = \frac{M_g(p-l-u) - 4J_r\dot{\omega}_r - M_a h_G - F_{ARIA}\,h_F}{p} = 7240{,}13\,N$$

→ Più grande di quella di poppa.

↳ In fase di accelerazione aumenta il carico posteriore, invece in decelerazione aumenta il carico anteriore.



$$\Sigma M^{ASSE,POS}_B = 2J_r\dot{\omega}_r + 2C_{rrp} + 2T_{a,p}\,r = 0$$

$$2T_{ap} = \frac{-2J_r\dot{\omega}_r - 2C_{rrp}}{r} = -111\,N$$

Deve avere verso opposto

$F_{i,M} = Ma = 2294 N$

$F_{ANT} = 1299{,}1\ N$

$2\,T_{a,p} = 111 N$

La ruota posteriore è indipendente perché non la stiamo girando direttamente, invece quella anteriore sì quindi dobbiamo tenere a conto tutti i contributi

↳ → questa anteriore è più importante per l'avanzamento poiché le forze sulla ruota sulla ruota anteriore.

→ Riduce la potenza utile