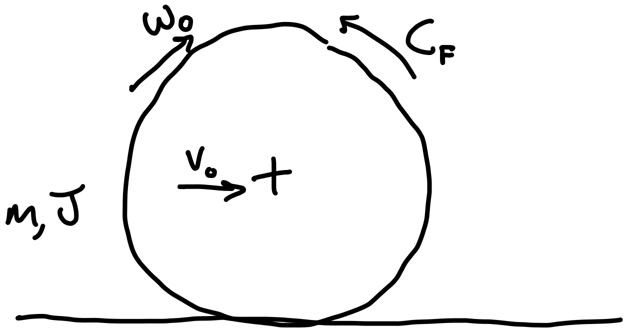
Esercitazione 17 -



Dati:

$C_f = 10\,Nm$ $r = 0{,}3$

$\omega_0 = 20\,\frac{rad}{s}$ $f_a = 0{,}2$

$m = 20\,kg$

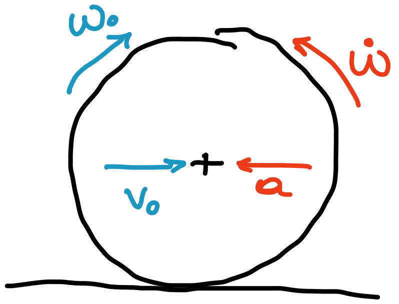
$f_v = 0{,}05$

$J = 0{,}8\,kg/m^2$

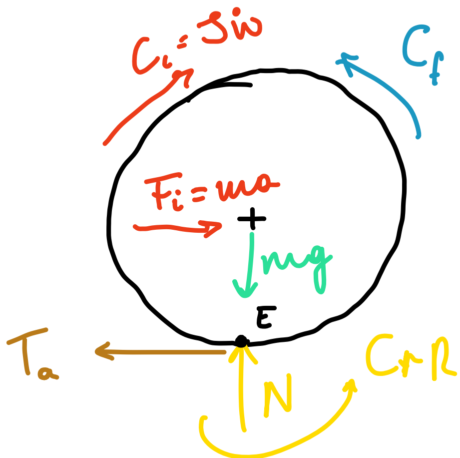
$f_d = 0{,}05$

$\omega_0 = 20\,\frac{rad}{s}$

Schema Cinematico



Schema Dinamico



Incognite:

N, T_a, $a(\dot{\omega})$

1) $\sum F_V = 0$ $\quad N = mg$

2) $\sum M_E = 0$ $\quad C_r R + C_f - mar - J\dot{\omega} = 0$

$$m r^2 \dot{\omega} + J\dot{\omega} = C_f + C_{rR}$$

$$C_{rR} = f_v r N = f_v r m g$$

$$\dot{\omega} = \frac{C_f + f_v r m g}{m r^2 + J} = 4,98 \ \frac{rad}{s^2}$$

$$a = \dot{\omega} r = 1,49 \ \frac{m}{s^2}$$

$$\sum F_H = 0 \qquad T_a = ma = 20 \cdot 1,49 = 29,8 \ N$$

$$T_{a,lim} = f_a \cdot N = f_a \cdot m \cdot g = 39,24 \ N$$

$$v_c(t) = v_0 - at \qquad t_{ar} \Rightarrow v_c = 0 \rightarrow v_0 - a t_{ar} = 0$$

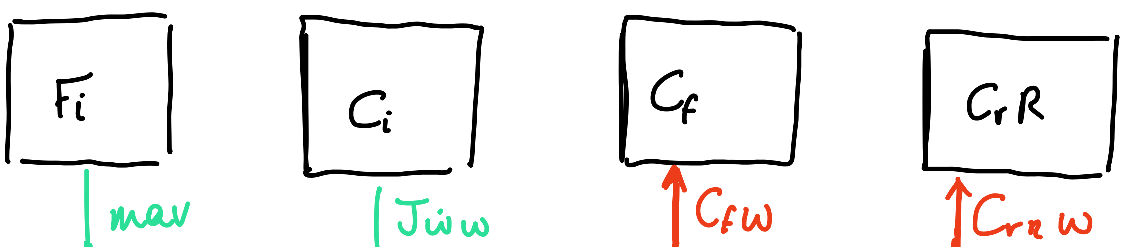
$$t_{ar} = \frac{v_0}{a} = \frac{\omega_0 r}{a} = 4,02 \ s$$

Spazio percorso:

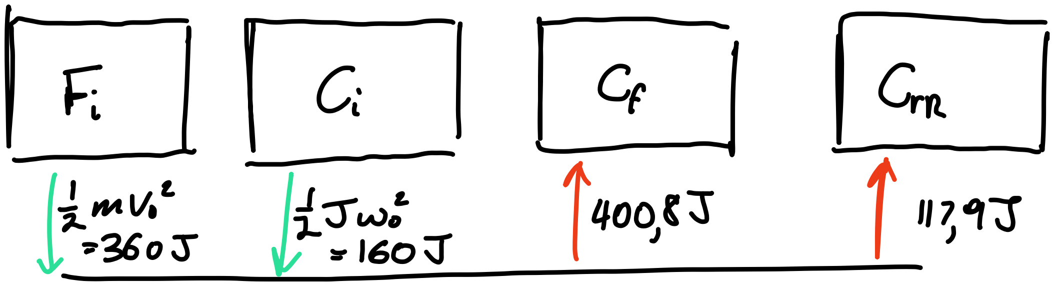
$$s(t) = v_0 t - \frac{1}{2} a t^2$$

$$s(t_{ar}) = v_0 t_{ar} - \frac{1}{2} a t_{ar}^2 = v_0 \frac{v_0}{a} - \frac{1}{2} a \frac{v_0^2}{a^2} = \frac{1}{2} \frac{v_0^2}{a} =$$

$$= \frac{1}{2} \frac{(\omega_0 r)^2}{a} = 9,28 \ m$$



↳ Diagramma del flusso di potenza



↳ Diagramma del flusso di energia

→ La energia dispersa nel transitorio dell'arresto è tutta quella cinetica

Energia dissipata dalla coppia frenante

$$E_{dcf} = \int_0^{t_{ar}} C_f \omega \, dt = C_f \int^{t_{ar}} \omega_0 - \dot{\omega} t \, dt = 0$$

$$= C_f \left[\omega_0 t - \frac{1}{2} \dot{\omega} t^2 \right]_0^{t_{ar}} = C_f \left[\omega_0 t_{ar} - \frac{1}{2} \dot{\omega} t_{ar}^2 \right]$$

$$= C_f \left[\omega_0 \frac{\omega_0}{\dot{\omega}} - \frac{1}{2} \dot{\omega} \frac{\omega_0^2}{\dot{\omega}^2} \right] = C_f \frac{\omega_0^2}{2\dot{\omega}} =$$

$$E_{dcf} = \int_0^{t_{ar}} C_{rn} \omega(t) \, dt = C_{rn} \int_0^{t_{ar}} \omega \, dt = C_{rn} \frac{\omega_0^2}{2\dot{\omega}} = f_v \cdot r m g \frac{20^2}{2 \cdot 4,99} =$$

$$= 117,9\,J$$

Se aumentiamo C_f allora diminuisce la energia dissipata da C_{rn}, e vice versa

Condizioni di limite con C_{fLIM} e T_{aLIM}

Voglio sapere la coppia che si porta a T_{aLIM}

Incognite $N, C_{fLIM}, a(\dot{\omega})$

1) $\sum F_V = 0 \qquad N = mg$

2) $\sum M_E = 0 \qquad C_{rR} + C_{fLIM} - mar - J\dot{\omega} = 0$

3) $\sum F_H = 0 \qquad T_{aLIM} = ma \qquad a = \frac{f_a mg}{m} = f_a g = 1{,}96\ m/s^2$

$$\dot{\omega} = \frac{a}{r} = 6{,}54\ \frac{rad}{s^2}$$

$$C_{fLIM} = mr^2\dot{\omega} + J\dot{\omega} - C_{rR}R = 14{,}06\ Nm$$

$$\omega(t) = \omega_0 - \dot{\omega}t \qquad t_{ar} = \frac{\omega_0}{\dot{\omega}} = 3{,}06\,s$$

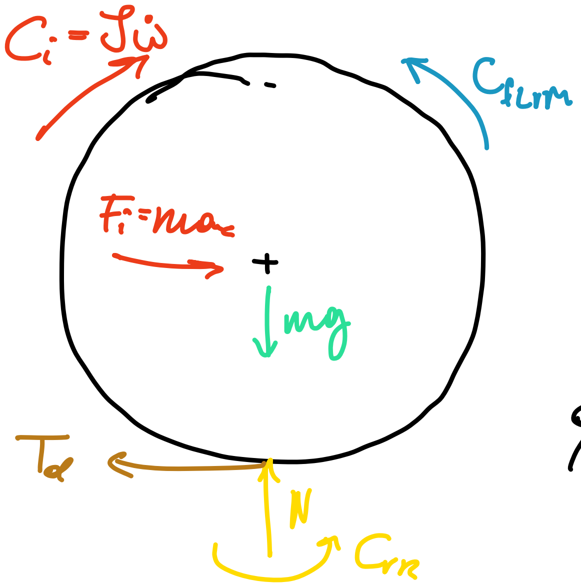
$$E_{dCf} = \int_0^{t_{ar}} C_{fLIM}\,\omega\,dt = C_{fLIM}\frac{\omega_0^2}{2\dot{\omega}} = 430\,J$$

$$E_{dCrR} = C_{rR}\cdot\frac{\omega_0^2}{2\dot{\omega}} = f_v rmg\cdot\frac{20^2}{2\cdot 6{,}54} = 90\,J$$

$\Big\}$ 520J ✓

Caso in mancanza di aderenza:

↳ non più statico e dinamico



Ci sono 2 moti ora, quindi ci sono tempi arresto, quello di rotazione e quello alla traslazione

Incognite $a_c, \dot{\omega}, N, T_d$ $\qquad T_d = f_d N$

1) $\sum_i F_V = 0 \rightarrow N = mg$

2) $\sum_i F_H = 0 \qquad T_d = m a_c \qquad T_d = f_d N = f_d \cancel{m} g = \cancel{m} a_c$

$$a_c = f_d g = 0{,}49 \frac{m}{s^2}$$

$$v_c(t) = v_0 - a_c t \qquad t_{arc} = \frac{v_0}{a_c} = \frac{\omega_0 r}{a_c} = 12{,}24\,s$$

$$s_c(t) = v_0 t - \frac{1}{2} a_c t^2$$

$$s_c(t_{arc}) = v_0 t_{arc} - \frac{1}{2} a_c t_{arc}^2 = \frac{v_0^2}{2a_c} = \frac{(\omega_0 r)^2}{2 \cdot a_c} = 36.73\,m$$

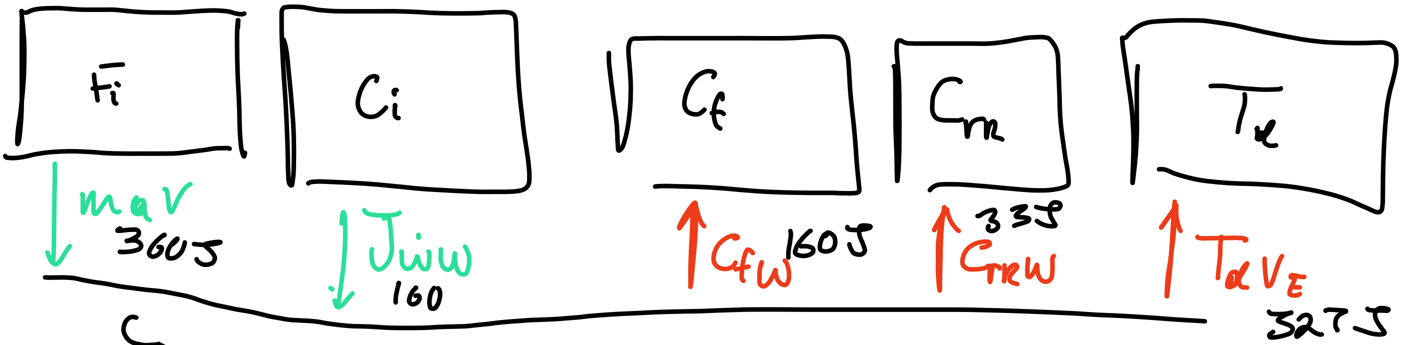
$$\sum_i M_E = 0$$

$$C_{fLIM} + C_{rR} - m a_c r - J\dot{\omega} = 0$$

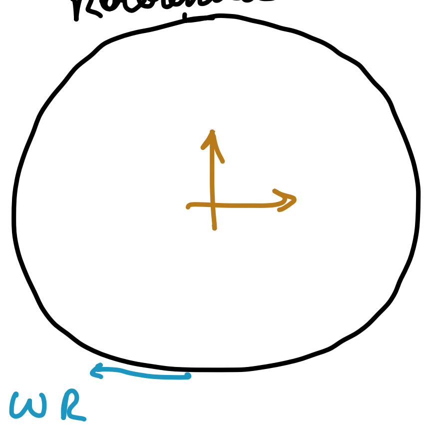
$$\dot{\omega} = \frac{C_{fLIM} + C_{rR} - m a_c r}{J} = 17{,}58 \frac{rad}{s^2}$$

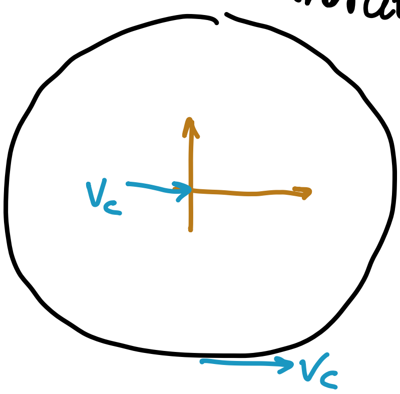
$$\omega(t_{arr}) = \omega_0 - \dot{\omega} t_{arr} = 0$$

$$t_{arr} = \frac{\omega_0}{\dot{\omega}} = 1{,}13\,s$$



non abbiamo cambiato quindi uguale V_E





$$V_G^{ASS} = V_c - \omega r$$

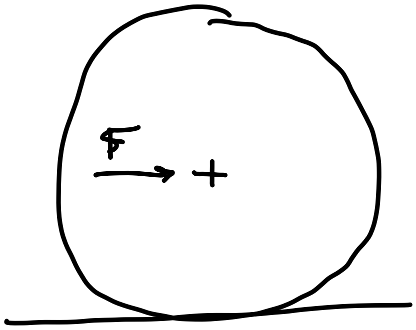
ω decresce molto più rapidamente di v_c (visti i tempi di arresto) quindi $V_E^{ASS} = (+)$

$\rightarrow V_E$

Con aderenza $V_E^{ASS} = 0$

Senza aderenza $V^{ASS} \geq 0 \quad V_c > \omega r$

Esercizi suggeriti:



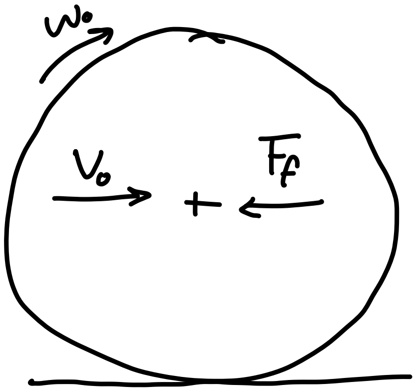
$F = 50$

$m = 20$ kg
$J = 0{,}8$ kgm^2
$r = 0{,}3$
$f_a = 0{,}2$
$f_v = 0{,}05$
$f_d = 0{,}05$

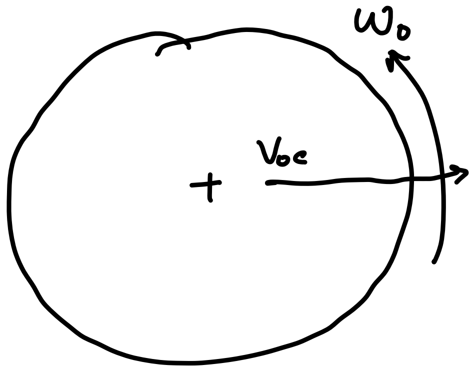
a
a_{lim} (ω_{lim})

a $\dot{\omega}$

In mancanza di aderenza



$V_0 = 10 \frac{m}{s}$



$m = 5$ kg
$J = 0{,}2$ kgm^2
$r = 0{,}2$
$f_a = 0{,}2$ $f_d = 0{,}4$
$f_v = 0{,}05$

$V_{0c} = 10 \frac{m}{s}$

Condizioni:

$\omega_0 = 20 \frac{rad}{s}$ 2) $\omega_0 = 100 \frac{rad}{s}$