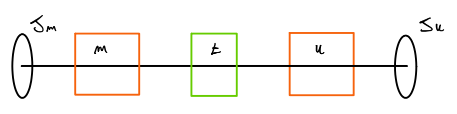
Modello MTU

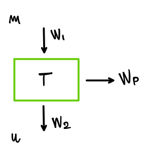
Friday, 14 January 2022 10:30

TRATTAZIONE GENERALE



CONOSCO M_m M_u J_m J_u τ η_d

POTENZA TRASMESSA



$$\boxed{W_1 = W_2 + W_p}$$

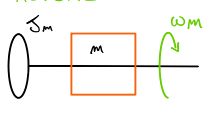
BILANCIO DI POTENZE

$$\boxed{W_m + W_u + W_d = \frac{\partial}{\partial t} E_{c,TOT}}$$

$$\underbrace{W_m - \left(\frac{\partial E_c}{\partial t}\right)_m}_{W_1} + \underbrace{W_u - \left(\frac{\partial E_c}{\partial t}\right)_u}_{W_2} + W_p = 0$$

ANALISI DEL SISTEMA

MOTORE

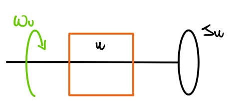


$W_m = M_m \omega_m$

$E_c = \frac{1}{2} J_m \omega_m^2$

$\frac{\partial E_c}{\partial t} = J_m \omega_m \dot{\omega}_m$

UTILIZZATORE



$W_u = M_u \omega_u$

$E_c = \frac{1}{2} J_u \omega_u^2$

$\frac{\partial E_c}{\partial t} = J_u \omega_u \dot{\omega}_u$

TRASMISSIONE

η RENDIMENTO

$W_1 + W_2 + W_p = 0 \qquad (W_2 < 0)$

$\boxed{\eta = \frac{W_2}{W_1}} \qquad \eta \in [0,1] \qquad W_1 > W_2$

$$\boxed{W_p = -W_1 + W_2 = -W_1 + W_1\eta = -W_1(1-\eta)}$$

τ RAPPORTO

$$\boxed{\tau = \frac{\omega_u}{\omega_m} = \frac{\dot{\omega}_u}{\dot{\omega}_m}} \rightarrow \begin{array}{l} \omega_u = \tau \omega_m \\ \dot{\omega}_u = \tau \dot{\omega}_m \end{array}$$

BILANCIO DI POTENZE

$M_m\omega_m + M_u\omega_u - (1-\eta)W_1 = J_m\omega_m\dot{\omega}_m + J_u\omega_u\dot{\omega}_u$

$(M_m\omega_m - J_m\omega_m\dot{\omega}_m) + M_u\tau\omega_m - J_u\tau^2\omega_m\dot{\omega}_m + (\eta-1)(M_m\omega_m - J_m\omega_m\dot{\omega}_m) = 0$

$\cancel{M_m\omega_m} - \cancel{J_m\omega_m\dot{\omega}_m} + M_u\tau\omega_m - J_u\tau^2\omega_m\dot{\omega}_m + \eta M_m\omega_m - \eta J_m\omega_m\dot{\omega}_m - \cancel{M_m\omega_m} + \cancel{J_m\omega_m\dot{\omega}_m} = 0$

$\cancel{\omega_m}(M_u\tau - J_u\tau^2\dot{\omega}_m + \eta M_m - \eta J_m\dot{\omega}_m) = 0$

$\tau M_u + \eta M_m = \tau^2 J_u\dot{\omega}_m + \eta J_m\dot{\omega}_m$

$$\boxed{\dot{\omega}_m = \frac{\tau M_u + \eta M_m}{\tau^2 J_u + \eta J_m}}$$

ALLO SPUNTO $(M_u = 0)$

LA POTENZA DEVE ESSERE ANCORA PORTATA ALL' UTILIZZATORE

$$\left|\begin{array}{l} \dot{\omega}_m = \dfrac{\cancel{\tau M_u} + \eta M_m}{\tau^2 J_u + \eta J_m} \\ \dot{\omega}_u = \dot{\omega}_m \tau \end{array}\right.$$

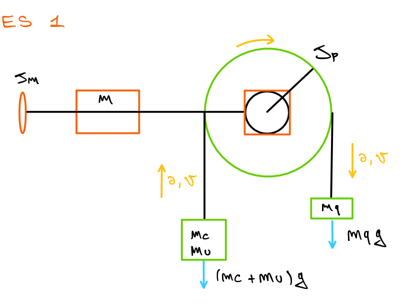
A REGIME $(\omega_m = \text{COST} \rightarrow \dot{\omega}_m = 0)$

POTENZA PASSATA A VELOCITÀ COSTANTE

$\dot{\omega}_m = \frac{\tau M_u + \eta M_m}{\cancel{\tau^2 J_u + \eta J_m}} = 0 \rightarrow \tau M_u + \eta M_m = 0 \qquad (M_u = J_u \omega_u)$

$$\left|\begin{array}{l} \omega_u = -\dfrac{\eta M_m}{\tau J_u} \\ \omega_m = \dfrac{\omega_u}{\tau} \end{array}\right.$$

ES 1



MOTORE

$W_m = M_m\omega_m \qquad J_m$ NOTA

UTILIZZATORE

$W_u = M_u\omega_u = [-R(m_c + m_u)g + R m_q g]\omega_u =$
$= (m_q - m_c - m_u) g R \omega_u$

$J_u = J_p + R^2(m_q + m_c + m_u)$

ENERGIA CINETICA

$E_c = \frac{1}{2}J_m\omega_m^2 + \frac{1}{2}J_u\omega_u^2 + \frac{1}{2}(m_c + m_u)V_u^2 + \frac{1}{2}(m_q)V_u^2$

$\frac{\partial E_c}{\partial t} = J_m\omega_m\dot{\omega}_m + J_u\omega_u\dot{\omega}_u + (m_c + m_u + m_q)V_u a_u$

POTENZA DISSIPATA

$W_p = -W_1 + W_2 = -W_1(1-\eta)$

$$\left|\begin{array}{l} W_2 = W_1\eta \\ W_1 = W_m - \frac{\partial}{\partial t}E_{c,m} \end{array}\right.$$

$W_p = (\eta - 1)\cdot(M_m\omega_m - J_m\omega_m\dot{\omega}_m)$

BILANCIO DELLE POTENZE

$W_m + W_u + W_p = \frac{\partial}{\partial t} E_{c,TOT}$

$M_m\omega_m - J_m\omega_m\dot{\omega}_m + (m_q - m_c - m_u)gR\tau\omega_m - J_u\omega_u\dot{\omega}_u + (\eta-1)(M_m\omega_m - J_m\omega_m\dot{\omega}_m) = 0$

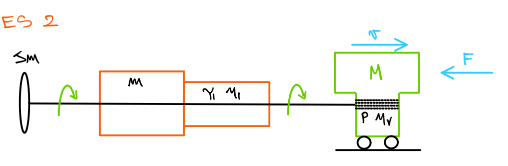
$\cancel{M_m\omega_m} - \cancel{J_m\omega_m\dot{\omega}_m} + (m_q - m_c - m_u)gR\tau\omega_m - J_u\tau^2\omega_m\dot{\omega}_m + \eta M_m\omega_m - \cancel{M_m\omega_m} - \eta J_m\omega_m\dot{\omega}_m + \cancel{J_m\omega_m\dot{\omega}_m} = 0$

$(m_q - m_c - m_u)gR\tau + \eta M_m = \dot{\omega}_m(J_u\tau^2 - J_m\eta)$

$$\boxed{\dot{\omega}_m = \frac{\eta M_m - \tau g R(m_c + m_u - m_q)}{J_u\tau^2 - J_m\eta}}$$

CON $J_u = J_p + R^2(m_q + m_c + m_u)$

ES 2



CONOSCENDO M J_m F τ η_1 η_v P

- M_m CON ω_m COSTANTE
- M_m AFFINCHÈ $a_M = 0.5\ m/s^2$

MOTORE

$W_m = M_m\omega_m$

$\left(\frac{\partial E_c}{\partial t}\right)_m = J_m\omega_m\dot{\omega}_m$

$W_1 = M_m\omega_m - J_m\omega_m\dot{\omega}_m$

UTILIZZATORE

$W_u = M_u\omega_u = -FV$

$\left(\frac{\partial E_c}{\partial t}\right)_u = MVa$

TRASMISSIONE

$\eta = \eta_1\cdot\eta_v$ RENDIMENTO TOTALE

$W_p = W_1 - W_2 = W_1(1-\eta)$

$-W_p = (\eta - 1)(M_m\omega_m - J_m\omega_m\dot{\omega}_m)$

LEGAME CINEMATICO

$T = \frac{P}{v} = \frac{2\pi}{\omega_u} \rightarrow \boxed{v = \frac{\tau_1 P}{2\pi}\omega_m}$

$a = \frac{d}{dt}v = \dot{v} = \frac{\tau_1 P}{2\pi}\dot{\omega}_m$

BILANCIO DELLE POTENZE

$\cancel{M_m\omega_m - J_m\omega_m\dot{\omega}_m} - FV - MVa + (\eta \cancel{-1})(M_m\omega_m - J_m\omega_m\dot{\omega}_m) = 0$

$-FV - MVa + \eta M_m\omega_m - \eta J_m\omega_m\dot{\omega}_m = 0$

$-F\frac{\tau_1 P}{2\pi}\cancel{\omega_m} - M\frac{\tau_1^2 P^2}{4\pi^2}\cancel{\omega_m}\dot{\omega}_m + \eta M_m\cancel{\omega_m} - \eta J_m\cancel{\omega_m}\dot{\omega}_m = 0$

$$\boxed{-\frac{F\tau_1 P}{2\pi} + \eta M_m = \left(M\left(\frac{\tau_1 P}{4\pi}\right)^2 + \eta J_m\right)\dot{\omega}_m}$$

CASO 1 $\omega_m = \text{COST} \rightarrow \dot{\omega}_m = 0$ REGIME

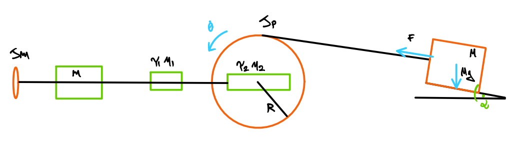
$M_m = +\frac{F\tau_1 P}{2\pi\eta}$

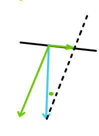
CASO 2 $a_m = 0.5$

$a = \frac{\tau_1 P}{2\pi}\dot{\omega}_m = 0 \rightarrow \dot{\omega}_m = \frac{2\pi a}{\tau P}$

$M_m = \frac{\left(M\left(\frac{\tau_1 P}{4\pi}\right)^2 + \eta J_m\right)\dot{\omega}_m + \frac{F\tau_1 P}{2\pi}}{\eta}$

ES 3





CONOSCIAMO

$M, J_p, \tau_1, \tau_2, \eta_1, \eta_2, R, \alpha$

TROVA M_m PER SOLLEVARE M A $V = \text{COST}$

MOTORE

$W_m = M_m\omega_m$

$\left(\frac{\partial E_c}{\partial t}\right)_m = \frac{\partial}{\partial t}\cdot\frac{J_m\omega_m^2}{2} = J_m\omega_m\dot{\omega}_m$

$W_1 = W_m - \frac{\partial E_{c_m}}{\partial t} = \omega_m(M_m - J_m\dot{\omega}_m)$

TRASMISSIONE

$\eta = \eta_1\cdot\eta_2 \rightarrow -W_p = W_1 - W_2 = (1-\eta)W_1$

$\tau = \tau_1\cdot\tau_2 \rightarrow \omega_p = \tau_1\tau_2\omega_m = \tau\omega_m$

$V = \omega_p R \qquad a = \dot{\omega}_p R$

UTILIZZATORE

$\left(\frac{\partial E_c}{\partial t}\right)_u = \frac{\partial}{\partial t}\left(\frac{J_p\omega_p^2}{2} + \frac{mV^2}{2}\right) = J_p\omega_p\dot{\omega}_p + mVa$

$= J_p\tau^2\omega_m\dot{\omega}_m + m\tau^2R^2\omega_m\dot{\omega}_m$

$= \omega_m\dot{\omega}_m(J_p\tau^2 + m\tau^2R^2)$

$W_u = -F\cdot V = -mg\sin\alpha\cdot V = -mgR\omega_p\sin\alpha$

$= -mgR\tau\omega_m\sin\alpha$

BILANCIO DI POTENZE

$W_m + W_u + W_p = \frac{\partial}{\partial t}E_{c,TOT}$

$\underbrace{\cancel{M_m\omega_m - J_m\omega_m\dot{\omega}_m}}_{W_1} \underbrace{- mgR\tau\cancel{\omega_m}\sin\alpha - (J_p\tau^2 + m\tau^2R^2)\cancel{\omega_m}\dot{\omega}_m}_{W_2} + \underbrace{(\eta\cancel{-1})(M_m\cancel{\omega_m} - J_m\cancel{\omega_m}\dot{\omega}_m)}_{W_p} = 0$

$-mgR\tau\sin\alpha - J_p\tau^2\dot{\omega}_m - m\tau^2R^2\dot{\omega}_m + \eta M_m - \eta J_m\dot{\omega}_m = 0$

$$\boxed{-mgR\tau\sin\alpha + \eta M_m = \dot{\omega}_m(J_p\tau^2 + mR^2\tau^2 + \eta J_m)}$$

SE $a = R\dot{\omega}_p = R\tau_1\tau_2\dot{\omega}_m = 0 \rightarrow \dot{\omega}_m = 0$

$M_m = \frac{mgR\tau\sin\alpha}{\eta} = \frac{mgR\tau_1\tau_2\sin\alpha}{\eta_1\eta_2}$

SE $a = 2\ m/s^2 \rightarrow \dot{\omega}_m = \frac{a}{R\tau} = 16\ RAD/s^2$ E $M_m = 2M_m$

$-\frac{mgR\tau\sin\alpha + \eta M_m}{\dot{\omega}_m} = J_p\tau^2 + mR^2\tau^2 + \eta J_m$

$J_m = \frac{1}{\eta}\left(-\frac{mgR\tau\sin\alpha + \eta M_m}{\dot{\omega}_m} - J_p\tau^2 - mR^2\tau^2\right)$