Lezione 8 30/3/2022

mercoledì 30 marzo 2022 14:01

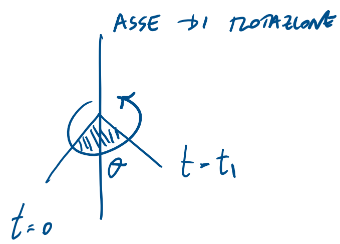
Lezione #8

30/3/2022

$$\vec{F} = M_{TOT}\,\vec{a}_{CDM}$$

$$\vec{M} = \vec{r} \times \vec{F}$$

Velocità angolare:

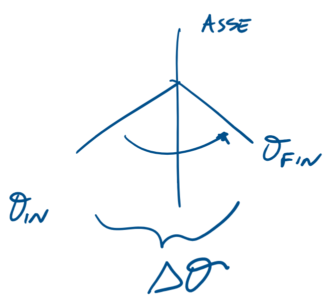


θ PERCORSO IN UN INT. DI TEMPO

$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{\theta_F - \theta_{IN}}{\Delta t}$$

$\downarrow$

Omega; velocità angolare



$$[\omega] = \frac{rad}{s}$$

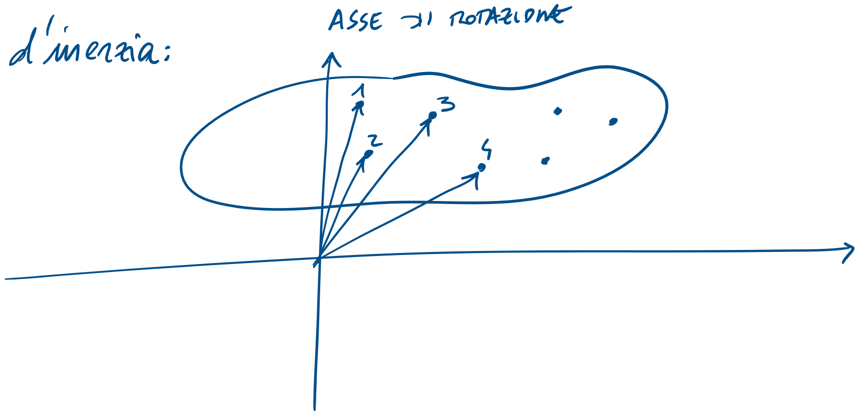
Accelerazione angolare

$$\alpha = \frac{\Delta\omega}{\Delta t} \qquad [\alpha] = rad/s^2$$

$\downarrow$

alfa

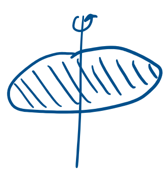
Momento d'inerzia:



$$I = m_1 r_1^2 + m_2 r_2^2 + \text{—} + m_n r_n^2$$

↳ momento di inerzia
(misura di dispersione masse rispetto all'asse di rotazione)

I piccolo rotaz. + veloce



I grande rotaz. + lenta

$$\begin{cases} \vec{F} = M_{TOT}\, \vec{a}_{CDM} & \text{I eq}^{ne} \text{ cardinale (TRASLAZ.)} \\ \vec{M} = I\, \vec{\alpha} & \text{II " " (ROTAZ.)} \end{cases}$$

$\vec{F} \leftrightarrow \vec{M}$

$\vec{M}_{TOT} \leftrightarrow \vec{I}$

$\vec{a}_{COM} \leftrightarrow \vec{\alpha}$

In generale:

$$\begin{cases} \vec{F} = \frac{d}{dt}\left(m\vec{v}_{COM}\right) = m\,\vec{a}_{COM} & \text{(SIST. A MASSA FISSA)} \\ \vec{M} = \frac{d}{dt}\left(I\vec{\omega}\right) = I\,\vec{\alpha} & \text{(quando } I \text{ è COST.)} \end{cases}$$

LE CONDIZIONI DI EQUILIBRIO SONO

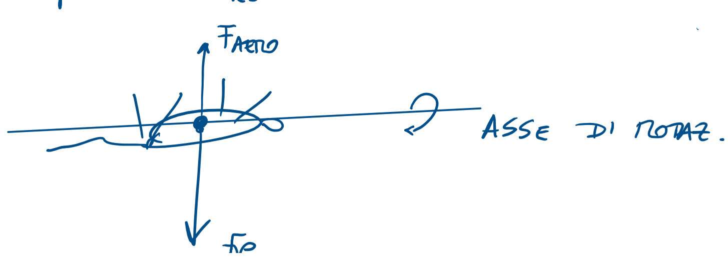
$$\begin{cases} \vec{F} = \vec{0} \\ \vec{M} = \vec{0} \end{cases}$$

Ma quando $\vec{M} = \vec{0} \Rightarrow \frac{d}{dt}\left(I\vec{\omega}\right) = 0$

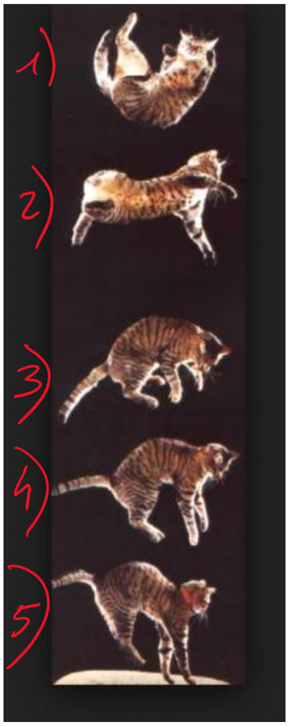
$$\Rightarrow \boxed{I\omega = \text{COST.}}$$

APPLICAZIONE RIFLESSO VERTICALE DEL GATTO:

Due forze in gioco: $\vec{F}_P + \vec{F}_{AERO} = \vec{F}^{RIS}$



$\downarrow F_p$



Rispetto all'asse di rotazione sia F_p che F_{AREO} hanno momento nullo ($\vec{r} = \vec{0}$)

$M = 0 \Rightarrow I\omega = cost.$

Il gatto "divide" il corpo a metà

prima rannicchia il corpo intorno alle zampe anteriori $\Rightarrow I \downarrow \Rightarrow \omega \nearrow$

" " sono + ruotate rispetto alle posteriori 1) + 2)

3) Allunga le zampe anteriori che rallentano $\omega \searrow$

l'opposto con le zampe posteriori

4) 5) Per rallentare la caduta

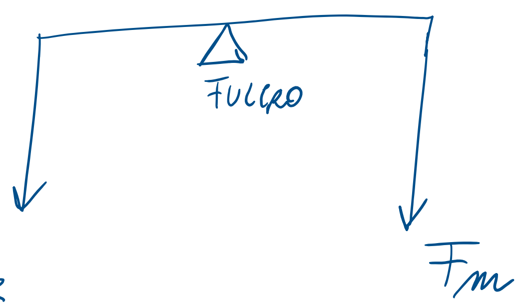
sfrutta $F_{AREO} = \frac{1}{2} \rho A C v^2$

sfrutta $F_{AREO} = \frac{1}{2} \rho A c v^2$

Paracadute $A \nearrow \quad c \nearrow$

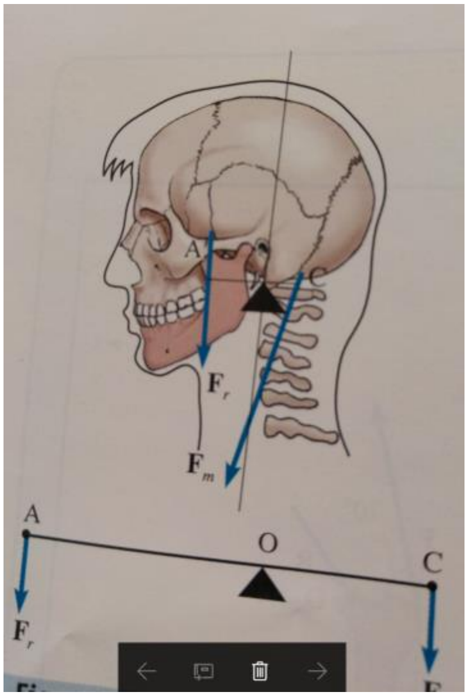
LEVE

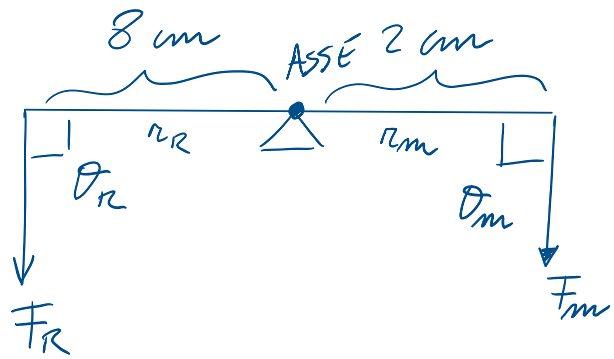
LEVA I° TIPO



Tutte le leve si basano sull'equilibrio del sistema fisico considerato:

$$\begin{cases} \vec{F}^{RIS} = \vec{0} \\ \vec{M}^{(RIS)} = \vec{0} \end{cases}$$





$\theta_R = \theta_m = 90°$

$F_R = 80\,N$

$r_R = 8\,cm$

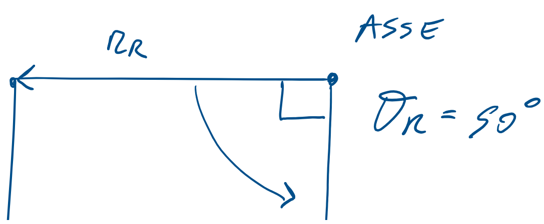
$r_m = 2\,cm$

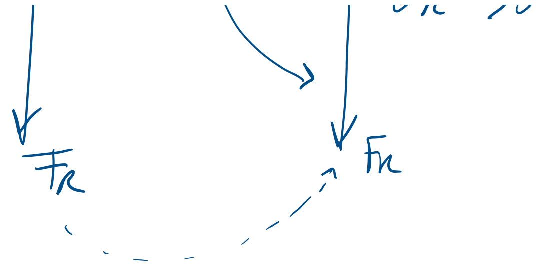
All'equilibrio:

$$\vec{M}^{ris} = \vec{0} = \vec{M}_R + \vec{M}_m = \vec{0}$$

Calcolare quanto $F_m = ?$

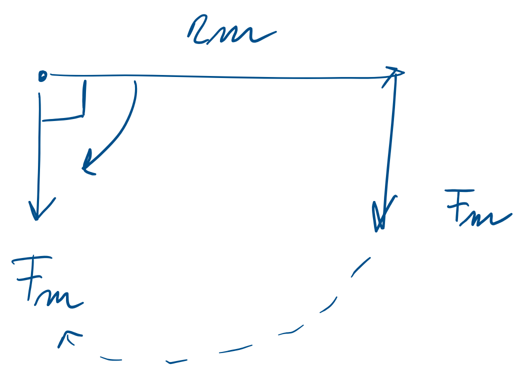
$\vec{M}_R$:





$$M_R = r_R F_R$$

$\vec{M}_m$:



$$M_m = - r_m F_m$$

$\theta_m = 90°$

$$M^{ris} = r_R F_R - r_m F_m = 0$$

?

$$\boxed{F_m = \frac{r_R}{r_m} F_R}$$

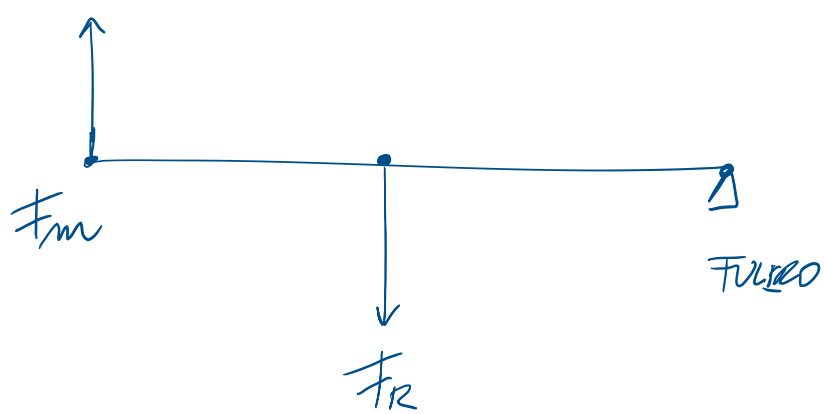
$$F_m = \frac{0{,}08}{0{,}02} F_R$$

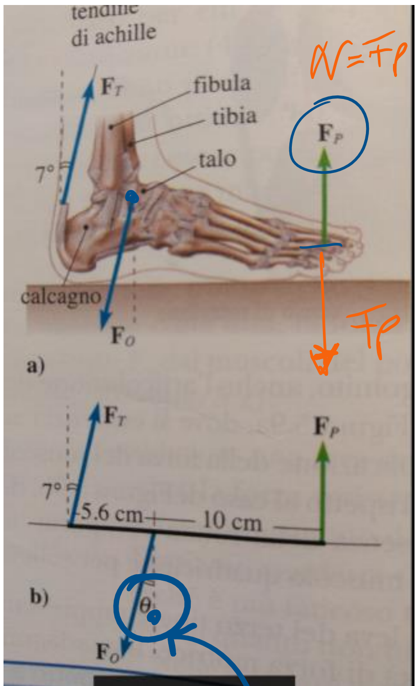
$$\boxed{F_m = 4\, F_R}$$

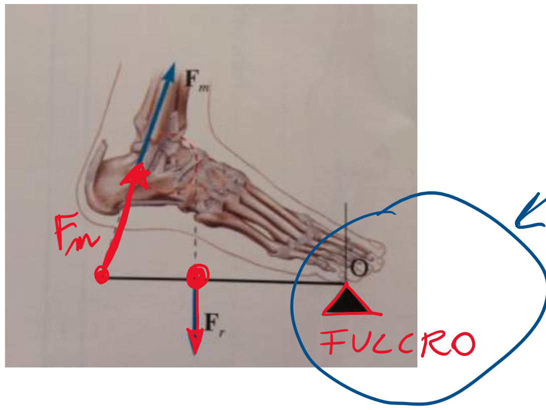
I muscoli splenici esercitano una forza motrice pari a 4 volte la F_p del cranio!!!

$$F_m = 4 \cdot 80 = 320\,N \checkmark$$

LEVA II TIPO:







F_T : Tensione nel Tendine di Achille

$\theta_T = 7°$

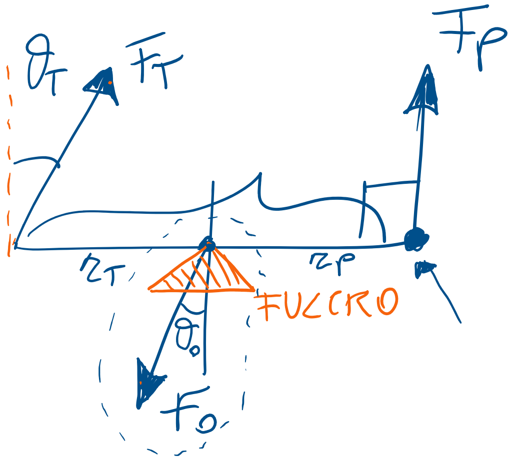
F_O : F. esercitata dalle ossa (Tibia e Fibula)

F_P : F. peso (reazione del suolo)

θ_O ?

$r_T = 5,6\ cm = 0,056\ m$

$r_P = 10\ cm = 0,1\ m$



$\theta_T = 7°$

θ_P : 90°

F_P : considerata nota

$r_P = 0,1\ m$

$r_T = 0,056\ m$

$\theta_T = 7°$

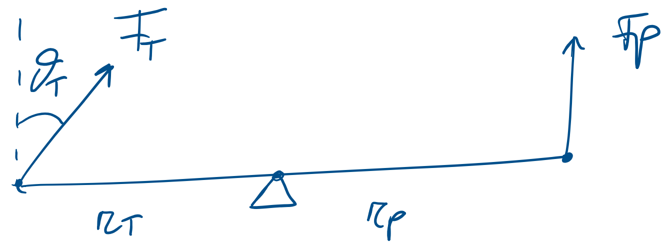
F_T ? come f^{ne} di F_P

F_O ; θ_O incognite

Se scelgo l'asse di rotazione al

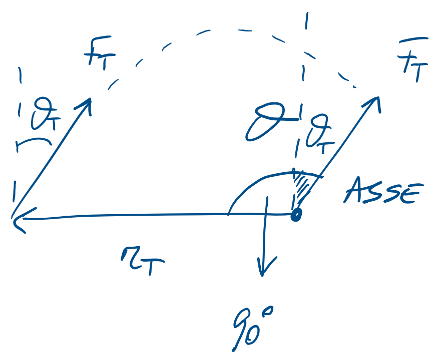
azione ar $\lfloor F_0 ; \theta_0$ incognite

$$\vec{M}^{(ris)} = \vec{0} \qquad \vec{M}_T + \vec{M}_{F_p} + \cancel{\vec{M}_0} = 0$$



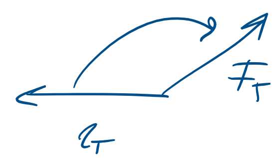
$$F_T = ?$$

M_T

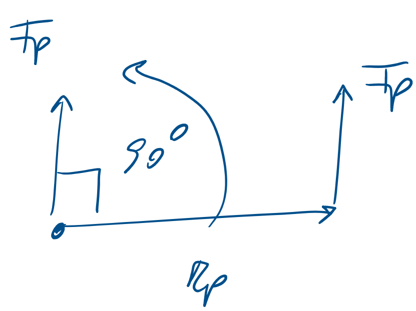


$$\theta = 90° + 7° = \left(\frac{\pi}{2} + \theta_T\right)$$

$$M_T = - r_T F_T \sin\left(\frac{\pi}{2} + \theta_T\right)$$



M_p



$$M_p = + r_p F_p$$

$$M^{(RIS)} = - r_T F_T \sin\left(\frac{\pi}{2} + \vartheta_T\right) + r_p F_p = 0$$

$$(90° + 7°)$$

$$\boxed{F_T = \frac{r_p}{r_T} \frac{F_p}{\sin\left(\frac{\pi}{2} + \vartheta_T\right)}}$$

$$F_T = \frac{0,1}{(0,56 \cdot 0,9925)} F_p$$

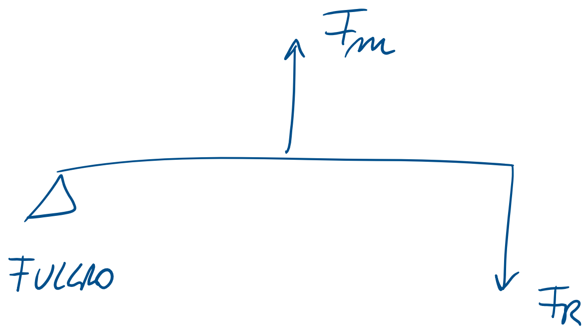
$$\boxed{F_T \simeq 1,8 \, F_p}$$

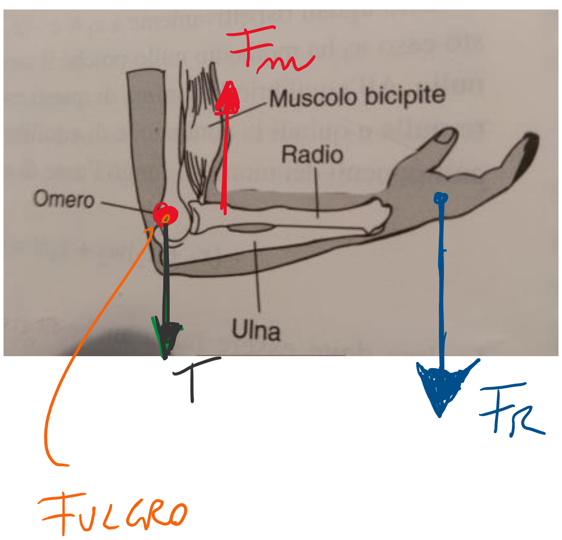
Per ogni singolo passo la tensione nel tendine d'Achille è pari al doppio della F_p!!!

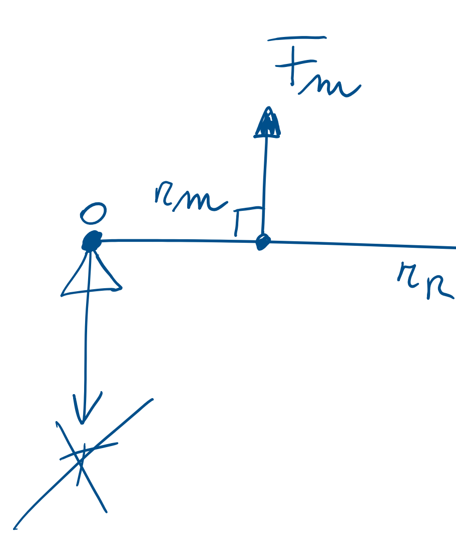
LEVA III TIPO

T

LEVA III tipo





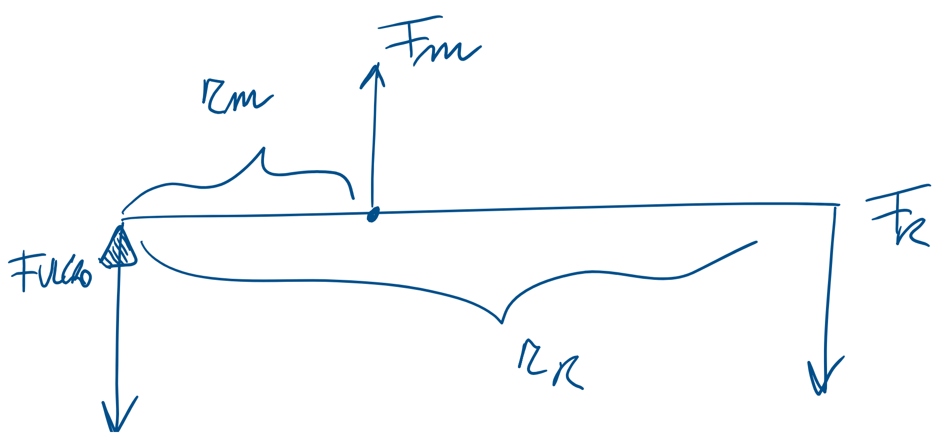


$$\begin{cases} r_m = 0{,}05\,m \\ r_R = 0{,}15\,m \\ F_R = 12\,N \end{cases}$$

F_m ? sforzo nei bicipiti

T ? tensione → omero

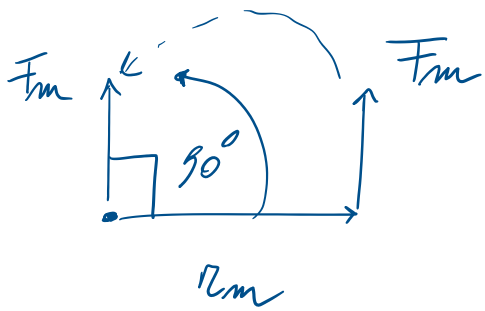
$$\begin{cases} \vec{F}^{(e)} = \vec{0} \\ \vec{M}^{(e)} = \vec{0} \end{cases}$$



$L \; \vec{M}^{(e)} = \vec{0}$ $\quad \downarrow \quad +$ $\quad r_R \quad \downarrow$

$\vec{M} = \vec{0} \qquad \vec{M}_m + \vec{M}_R = \vec{0}$

M_m:

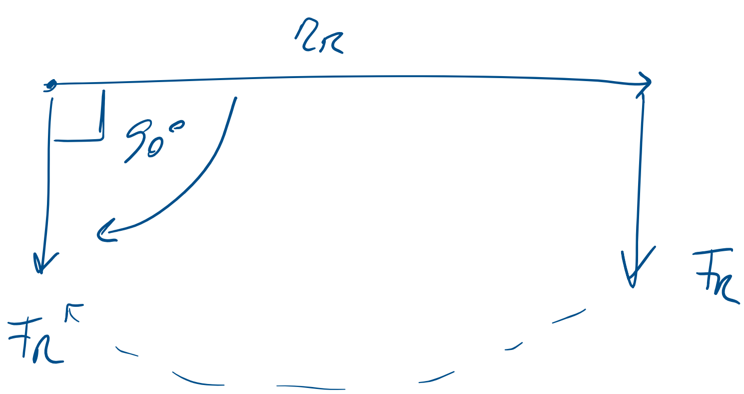


senso antiorario

$M_m > 0$

$$M_m = r_m F_m$$

M_R:



senso orario

$M_R < 0$

$$M_R = - r_R F_R$$

$$M^{ris} = r_m F_m - r_R F_R = 0$$

$$F_m = \frac{r_r}{r_m} F_r$$

$$\boxed{F_m = 3 F_r}$$

Su [illegible] si esercita una forza pari al triplo del peso alzare