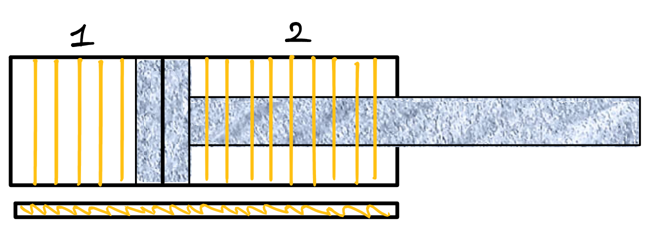
Es2

Tuesday, 25 January 2022 00:33

ATTUATORE IDRAULICO (RUSPA)

DESCRIVIAMO L' ATTUATORE COME $\vec{v}$ DI LUNGHEZZA VARIABILE

COME FUNZIONA ?

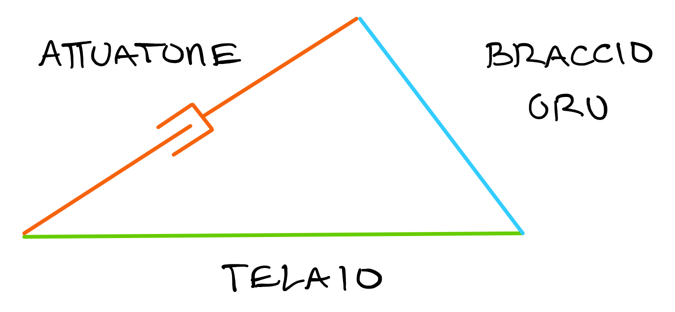


2 SERBATOI

PER EQUILIBRIO $P_1 = P_2$
SE VI E' UN GRADIENTE ∇P
IL LIQUIDO SI MUOVERA VERSO IL
SERBATOIO CON P MINORE

MODELLO FISICO

SCHEMA CINEMATICO



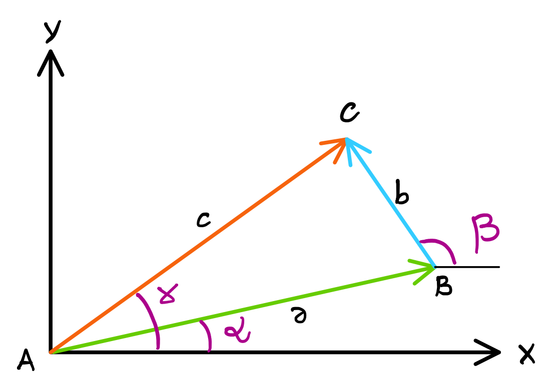
MODELLO ANALITICO

STUDIAMO LA COMPOSIZIONE DI VETTORI
ED EQUAZIONE DI CHIUSURA CINEMATICA

MANICOTTO ~ ATTUATORE

VINCOLO DI SOLA TRASLAZIONE

TELAIO COME SISTEMA ASSOLUTO



	$\lvert\cdot\rvert$	$\angle$
C-A	$c(t)$	$\gamma(t)$
B-A	a	α
C-B	b	$\beta(t)$

NOTE $a, \alpha, b, c, \dot{c}, \ddot{c}$

TROVA γ, β E LE LORO DERIVATE

POSIZIONE

$(C-A) = (B-A) + (C-B)$ CHIUSURA

$$c(\cos\gamma\,\hat{i} + \sin\gamma\,\hat{j}) = a(\cos\alpha\,\hat{i} + \sin\alpha\,\hat{j}) + b(\cos\beta\,\hat{i} + \sin\beta\,\hat{j})$$

SEPARIAMO LUNGO I VERSORI

$$\begin{cases} \hat{i} & c\cos\gamma = a\cos\alpha + b\cos\beta \\ \hat{j} & c\sin\gamma = a\sin\alpha + b\sin\beta \end{cases}$$

ELEVO AL QUADRATO E SOMMO

$$c^2 = (a\cos\alpha + b\cos\beta)^2 + (a\sin\alpha + b\sin\beta)^2$$

$$= a^2\cos^2\alpha + b^2\cos^2\beta + 2ab\cos\alpha\cos\beta + a^2\sin^2\alpha + b^2\sin^2\beta + 2ab\sin\alpha\sin\beta$$

$$\underbrace{\cos^2\alpha + \sin^2\alpha}_{=1} \qquad \underbrace{\cos^2\beta + \sin^2\beta}_{=1}$$

$$= a^2 + b^2 + 2ab(\cos\alpha\cos\beta + \sin\alpha\sin\beta)$$

USANDO LE FORMULE DI 'WERNER'

$$\sin\alpha\sin\beta = \frac{1}{2}\left[\cos(\alpha-\beta) - \cos(\alpha+\beta)\right]$$

$$\cos\alpha\cos\beta = \frac{1}{2}\left[\cos(\alpha+\beta) + \cos(\alpha-\beta)\right]$$

$$c^2 - a^2 - b^2 = ab\left[\cancel{\cos(\alpha+\beta)} + \cos(\alpha-\beta) + \cos(\alpha-\beta) - \cancel{\cos(\alpha+\beta)}\right]$$

$$c^2 - a^2 - b^2 = 2ab\cos(\alpha-\beta)$$

$$\boxed{\begin{aligned} \beta &= \alpha - \cos^{-1}\left(\frac{c^2 - a^2 - b^2}{2ab}\right) \\ \gamma &= \cos^{-1}\left(\frac{a\cos\alpha + b\cos\beta}{c}\right) \end{aligned}}$$

VELOCITA'

SISTEMA ASSOLUTO

$$\begin{cases} \hat{i} & c\cos\gamma = a\cos\alpha + b\cos\beta \\ \hat{j} & c\sin\gamma = a\sin\alpha + b\sin\beta \end{cases}$$

DERIVO IL SISTEMA

$$\begin{cases} \hat{i} & \dot{c}\cos\gamma - c\dot{\gamma}\sin\gamma = -b\dot{\beta}\sin\beta \\ \hat{j} & \dot{c}\sin\gamma + c\dot{\gamma}\cos\gamma = +b\dot{\beta}\cos\beta \end{cases}$$

$$\begin{cases} \hat{i} & -c\dot{\gamma}\sin\gamma + b\dot{\beta}\sin\beta = \dot{c}\cos\gamma \\ \hat{j} & +c\dot{\gamma}\cos\gamma - b\dot{\beta}\cos\beta = -\dot{c}\sin\gamma \end{cases}$$

RISCRIVO IN FORMA MATRICIALE

$$\begin{bmatrix} -c\sin\gamma & +b\sin\beta \\ +c\cos\gamma & -b\cos\beta \end{bmatrix} \cdot \begin{bmatrix} \dot{\gamma} \\ \dot{\beta} \end{bmatrix} = \begin{bmatrix} -\dot{c}\cos\gamma \\ -\dot{c}\sin\gamma \end{bmatrix} \longrightarrow \text{TROVO } \dot{\gamma}, \dot{\beta}$$

ACCELERAZIONI

$$\begin{cases} \hat{i} & \dot{c}\cos\gamma - c\dot{\gamma}\sin\gamma = -b\dot{\beta}\sin\beta \\ \hat{j} & \dot{c}\sin\gamma + c\dot{\gamma}\cos\gamma = +b\dot{\beta}\cos\beta \end{cases}$$

DERIVO UNA SECONDA VOLTA IL SISTEMA
E RISCRIVO COME MATRICE

$$\begin{vmatrix} -c\sin\gamma & b\sin\beta \\ +\cos\gamma & b\cos\beta \end{vmatrix} \cdot \begin{vmatrix} \ddot{\gamma} \\ \ddot{\beta} \end{vmatrix} + \begin{vmatrix} -\dot{c}\sin\gamma - c\cos\gamma\dot{\gamma} & b\cos\beta\dot{\beta} \\ \dot{c}\cos\gamma - c\sin\gamma\dot{\gamma} & -b\sin\beta\dot{\beta} \end{vmatrix} \cdot \begin{vmatrix} \dot{\gamma} \\ \dot{\beta} \end{vmatrix} = \begin{vmatrix} -\ddot{c}\cos\gamma + \dot{c}\sin\gamma\dot{\gamma} \\ -\ddot{c}\sin\gamma - \dot{c}\cos\gamma\dot{\gamma} \end{vmatrix}$$

$\longrightarrow$ TROVO $\ddot{\gamma}, \ddot{\beta}$

VELOCITA' CON IL TH. DEI MOTI RELATIVI

$$\hat{i}' = (\cos\gamma\,\hat{i} + \sin\gamma\,\hat{j})$$

$$\hat{j}' = (-\sin\gamma\,\hat{i} + \cos\gamma\,\hat{j})$$

METTONO A CONFRONTO 2 SISTEMI DI RIFERIMENTO
FACILE DA SOSTITUIRE

$$v_C = \cancel{v_B} + \omega_{CB} \times b\,(C-B)$$

$$v_C = \dot{\beta}\hat{k} \times b(\cos\beta\,\hat{i} + \sin\beta\,\hat{j})$$

$$v_C = \dot{\beta}b(-\sin\beta\,\hat{i} + \cos\beta\,\hat{j})$$

TRASCINAMENTO

$$v_{TR} = \overset{=0}{\cancel{v_A}} + \dot{\gamma} \times c(\cos\gamma\,\hat{i} + \sin\gamma\,\hat{j}) = \dot{\gamma}c(-\sin\gamma\,\hat{i} + \cos\gamma\,\hat{j})$$

RELATIVA (ALLUNGAMENTO PISTONE)

$$v_{REL} = \dot{c}\,\hat{i}' = \dot{c}(\cos\gamma\,\hat{i} + \sin\gamma\,\hat{j})$$

TEOREMA DEI MOTI RELATIVI

$$v_C = v_{TR} + v_{REL}$$

$$b\dot{\beta}(-\sin\beta\,\hat{i} + \cos\beta\,\hat{j}) = c\dot{\gamma}(-\sin\gamma\,\hat{i} + \cos\gamma\,\hat{j}) + \dot{c}(\cos\gamma\,\hat{i} + \sin\gamma\,\hat{j})$$

$$\begin{cases} \hat{i} & c\dot{\gamma}\sin\gamma - b\dot{\beta}\sin\beta = \dot{c}\cos\gamma \\ \hat{j} & -c\dot{\gamma}\cos\gamma + b\dot{\beta}\cos\beta = \dot{c}\sin\gamma \end{cases}$$