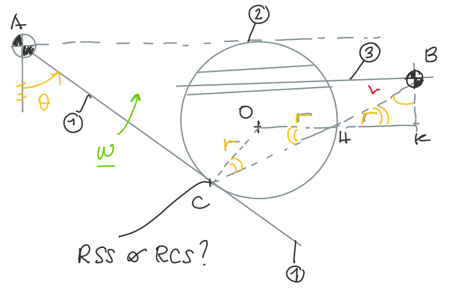
Esercit: RSS

giovedì 28 novembre 2024 18:07



Noto: $\dot{\theta} > 0$

$\theta = 60°$

Richiesto:
0) valutare il tipo di rotolam. ⇒ 1 gdl
1) $\underline{v}_{P_i}$, $i = 1, 2, 3$
2) soluz. $\underline{v}$ per via grafica
3) soluz. $\underline{v}$ → geometrica / analitica } parametr.
4) soluz $\underline{v}$ → numerica
⇓
$\dot{\theta} = \pi/2$ rad/s
$r = 0.5$ m
5) C_{V_2}
6) Impostare il problema $\underline{a}$

0) AGV: A, B ⇒ − 2 gdl

2 − 3 ⇒ − 2 gdl

C = X ⇒ RSS ⇒ −2 gdl ; RCS ⇒ −1 gdl

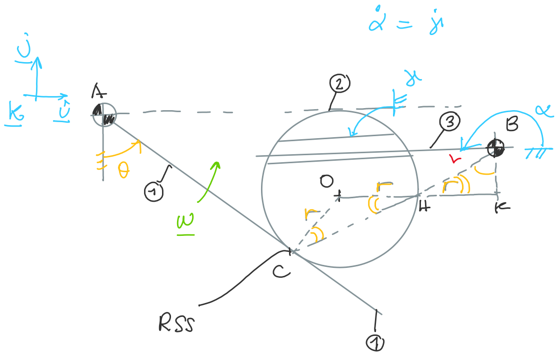
$$n° \text{gdl} = 1 = (3 \times 3) - \underset{CR}{2 \times 2} - \underset{CP}{2} - X$$

$$X = 9 - 4 - 2 - 1 = 2 \Rightarrow \text{RSS}$$

RSS come VINCOLO MOBILE

$\alpha = \pi/2 + \gamma$

$\dot{\alpha} = \dot{\gamma}$



1)

$$\underline{v}_{P①} = \cancel{\underline{v}_A} + \underline{\omega} \wedge \overrightarrow{AP}$$
$\underline{v}_A = 0$
$$= \dot{\theta}\,\underline{k} \wedge \overrightarrow{AP}$$

$$\underline{v}_{P②} = \underline{v}_C + \underline{\omega}_2 \wedge \overrightarrow{CP}$$
$$= \underline{v}_C + \dot{\gamma}\,\underline{k} \wedge \overrightarrow{CP}$$

$C \equiv C_{V12} \Rightarrow \underline{v}^{rel}_{12} = \underline{0}$

$$\underline{v}_{C①} = \underline{v}_{C②} = \dot{\theta}\underline{k} \wedge \overrightarrow{AC}$$

$$\underline{v}_{P②} = \dot{\theta}\underline{k} \wedge \overrightarrow{AC} + \dot{\gamma}\,\underline{k} \wedge \overrightarrow{CP}$$
?

$$\underline{v}_{P③} = \cancel{\underline{v}_B} + \underline{\omega}_3 \wedge \overrightarrow{BP} = \dot{\alpha}\,\underline{k} \wedge \overrightarrow{BP} \quad (*)$$
$\underline{v}_B = 0$?

} → 2 INCOGNITE $\dot{\gamma}$, $\dot{\alpha}$

TCW: $\Sigma③$

$$\underline{\omega}_2^{ass} = \cancel{\underline{\omega}^{rel}} + \underline{\omega}^{tr} = \underline{\omega}_3 \Rightarrow$$
$\underline{\omega}^{rel} = \underline{0}$, $\underline{\omega}^{tr} = \underline{\omega}_3$

$\underline{\omega}_2 = \underline{\omega}_3$

$\dot{\alpha} = \dot{\gamma}$

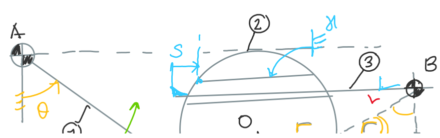
$\ddot{\alpha} = \ddot{\gamma}$

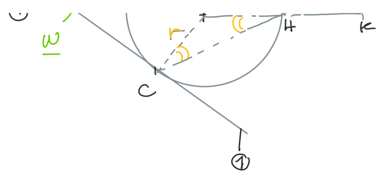
} → 1 INCOGNITA $\dot{\gamma} = \dot{\alpha}$

$$\boxed{\underline{v}_{C②} = \underline{v}_{C②}}$$

$\underline{v}_{C①}$ FFC — TCV $\Sigma③$

Eq^{ne} CHIUSURA





$$\Sigma_{③} \quad v_{C②}^{ass} = v_C^{rel} + v_C^{tr} = \dot s\,\underline{i} + \dot\gamma\,\underline{k} \wedge \vec{BC}$$

v_C^{rel}: $\dot s\,\underline{i}$

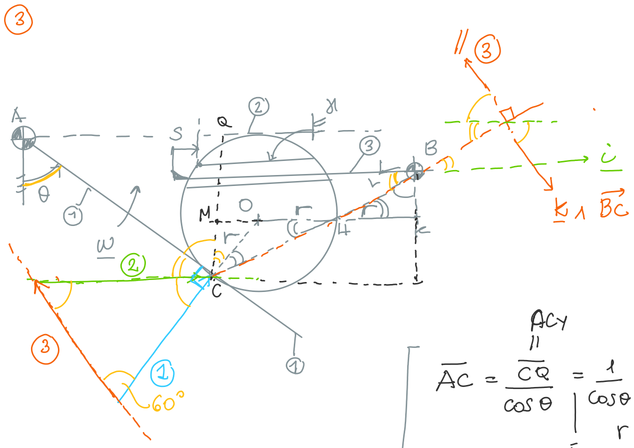
v_C^{tr}: $v_{C\in③} = \dot\gamma\,\underline{k} \wedge \vec{BC}$ (*)

$$\boxed{\dot\theta\,\underline{k} \wedge \vec{AC} = \dot s\,\underline{i} + \dot\gamma\,\underline{k} \wedge \vec{BC}}$$

① noto ? ② ? ③

SOLUZ. GRAFICA

$$\begin{cases} \dot s > 0 \\ \dot\gamma < 0 \end{cases}$$



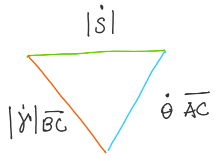
$$\overline{AC} = \frac{\overset{AC_y}{\overline{CQ}}}{\cos\theta} = \frac{1}{\cos\theta}(r + r\sin\theta) = \frac{r(1+\sin 60)}{\cos 60} = (\sqrt{3}+2)\,r$$

$$\overline{BC_y} = r + r\sin 30$$

$$BC = \frac{BC_y}{\sin 30} = \frac{r(1+\sin 30)}{\sin 30} = \frac{5}{\sqrt{3}}\,r$$

SOLUZ. GEOMETRICA

△ delle v è EQUILATERO:



$$\dot s = |\dot\gamma|\,\overline{BC} = \dot\theta\,\overline{AC}$$

$$\begin{cases} \dot s = \dot\theta\,\overline{AC} = \dot\theta(\sqrt{3}+2)\,r \\ |\dot\gamma| = \dfrac{\dot\theta\,\overline{AC}}{\overline{BC}} = \dot\theta\,\dfrac{(\sqrt{3}+2)\cancel{r}\sqrt{3}}{5\,\cancel{r}} = \dot\theta\,\dfrac{(\sqrt{3}+2)\sqrt{3}}{5} \end{cases}$$

$$\dot s = \dot\theta(\sqrt{3}+2)\,r = 2{,}93 \text{ m/s} \Rightarrow \dot s\,\underline{i} = +2{,}93\,\underline{i} \text{ m/s}$$

$$\dot\gamma = -\dot\theta\,\frac{(\sqrt{3}+2)\sqrt{3}}{5} = -2{,}03 \text{ rad/s}$$

SOLUZ. ANALITICA

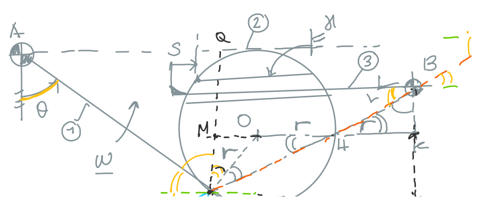
$$\dot\theta\,\underline{k} \wedge \vec{AC} = \dot s\,\underline{i} + \dot\gamma\,\underline{k} \wedge \vec{BC}$$

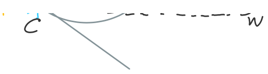
$$\begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \dot\theta \\ AC_x & AC_y & 0 \end{vmatrix} = \begin{bmatrix} \dot s \\ 0 \\ 0 \end{bmatrix} + \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \dot\gamma \\ BC_x & BC_y & 0 \end{vmatrix}$$

$$AC_y = -(r\sin\theta + r) = -\left(\frac{\sqrt{3}}{2}+1\right) r$$

$$AC_x = \frac{AC_y}{tg\,30} = \left(\frac{\sqrt{3}}{2}+1\right)\sqrt{3}\,r$$

$$BC_x = -(r + r + r\sin 30) = -\frac{5}{2}\,r$$





$BC_y = + \frac{BC_x}{tg\,60} = -\frac{5}{6}\sqrt{3}\, r$

$$\begin{cases} x: & \dot\theta\left(\frac{\sqrt3}{2}+1\right) r = \dot s + \dot\gamma\, \frac{5}{6}\sqrt3\, r \\ y: & \dot\theta\left(\frac{\sqrt3}{2}+1\right)\sqrt3\, r = -\frac{5}{2}\, r\,\dot\gamma \end{cases}$$

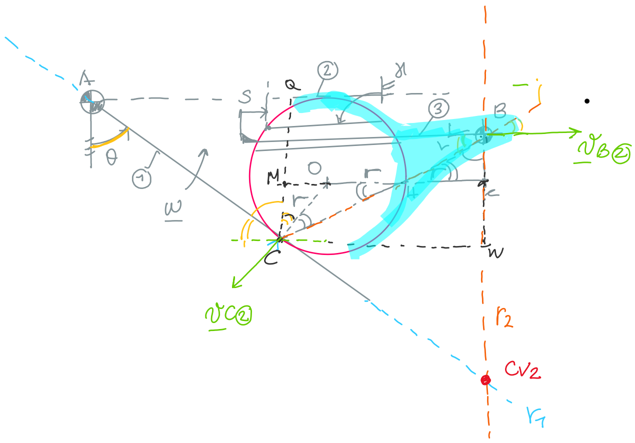
$$\begin{cases} \dot\gamma = -\frac{\sqrt3}{5}(\sqrt3+2)\,\dot\theta \\ \dot s = (\sqrt3+2)\, r\dot\theta \end{cases}$$

$\boxed{CV_2}$

$\underline{v}_{C②} = \dot\theta\, \underline{K} \wedge \vec{AC}$ $\quad r_1$

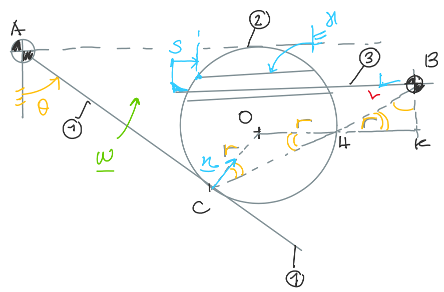
$\Sigma_③ \quad \underline{v}_{B②}^{ass} = \underline{v}_B^{rel} + \underline{v}_B^{tr} \quad r_2$

$= \dot s\, \underline{i} + \underline{\phi}$, $\quad \underline{v}_B^{tr} = \underline{v}_{B③}$



PROBLEMA ACCELERAZIONI

$\underline{a}_{P①} = \dot{\underline\omega} \wedge \vec{AP} - \omega^2 \vec{AP} = \ddot\theta\, \underline{K}\wedge\vec{AP} - \dot\theta^2\,\vec{AP}$



$\underline{a}_{P②} = \underline{a}_C + \ddot\gamma\, \underline{K} \wedge \vec{CP} - \dot\gamma^2\, \vec{CP} \qquad \ddot\gamma\,?$

?

$\underline{a}_{C②} \neq \underline{a}_{C1}$

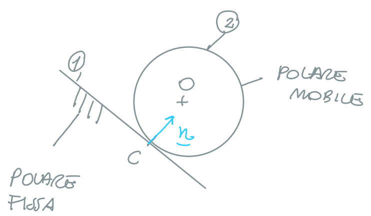
$\underline{a}_C^{rel} \neq \underline{0}$

$\boxed{\underline{a}_{\alpha} = -D\,\omega^2\, \underline{n}}$

$\Sigma_① \quad \underline{a}_{C②}^{ass} = \underline{a}_C^{rel} + \underline{a}_C^{tr} + \underline{a}_C^{cor} = 2\underline{\omega}^{tr}\wedge \cancel{\underline{v}_C^{rel}}^{\,0}$

$\underline{a}_C^{tr} = \underline{a}_{C①}$

$\underline{a}_C^{rel} = -D\,\omega_{rel}^2\, \underline{n}$



$\underline\omega_{rel} = \underline\omega_{21} = \underline\omega_2 - \underline\omega_1$

$R_f = \infty$

$R_m = \vec{C_v O_m}\cdot \underline{n} = \vec{CO}\cdot\underline{n} = r$

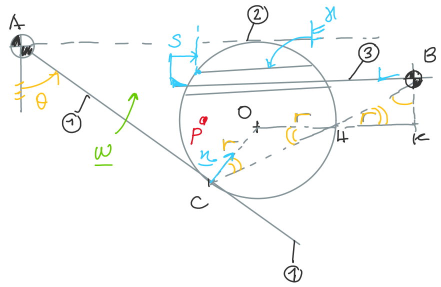
$\frac{1}{D} = \frac{1}{\cancel{R_f}} - \frac{1}{R_m} \Rightarrow D = -r$

$\underline{a}_C^{rel} = r\,(\omega_2-\omega_1)^2\, \underline{n} = r\,(\dot\theta - \dot\gamma)^2\,\underline{n}$

$\underline{a}_{P②} = \underline{a}_C^{rel} + \underline{a}_C^{tr} + \ddot\gamma\, \underline{K}\wedge\vec{CP} - \dot\gamma^2\,\vec{CP} \qquad (1)$

$= r\,(\dot\theta-\dot\gamma)^2 + \ddot\theta\,\underline{K}\wedge\vec{AC} - \dot\theta^2\,\vec{AC} + \ddot\gamma\, \underline{K}\wedge\vec{CP} - \dot\gamma^2\,\vec{CP}$

$$\underline{a}_{P③} = \underbrace{\cancel{\underline{a}_B}}_{0} + \ddot{\gamma}\,\underline{k} \wedge \overrightarrow{BP} - \dot{\gamma}^2\,\overrightarrow{BP}$$



$$\underbrace{\underline{a}_{P②}}_{\substack{(1)\\ \text{TCA } \Sigma①}} = \underbrace{\underline{a}_{P③}}_{\text{TCA } \Sigma③}$$

⇓

più comodo C

$$\boxed{\underbrace{\underline{a}_{C②}}_{\substack{(1)\\ \text{TCA } \Sigma①}} = \underbrace{\underline{a}_{C②}}_{\text{TCA } \Sigma③}}$$

$$\Sigma③ \quad \overset{ass}{\underline{a}_{C②}} = \underbrace{\overset{rel}{\underline{a}_C}}_{\ddot{s}\,\underline{i}} + \underbrace{\overset{tr}{\underline{a}_C}}_{\underline{a}_{C③}} + \overset{cor}{\underline{a}_C}$$

$$\overset{cor}{\underline{a}_C} = 2\,\underline{\omega}^{tr} \wedge \underline{v}^{rel} = 2\,\dot{\gamma}\,\underline{k} \wedge \dot{s}\,\underline{i}$$

$$= \ddot{s}\,\underline{i} + \ddot{\gamma}\,\underline{k} \wedge \overrightarrow{BC} - \dot{\gamma}^2\,\overrightarrow{BC} + 2\,\dot{\gamma}\,\underline{k} \wedge \dot{s}\,\underline{i}$$

$$\Big\| \quad r(\dot{\theta} - \dot{\gamma})^2 + \ddot{\theta}\,\underline{k} \wedge \overrightarrow{AC} - \dot{\theta}^2\,\overrightarrow{AC} = \underset{?}{\ddot{s}\,\underline{i}} + \underset{?}{\ddot{\gamma}\,\underline{k}} \wedge \overrightarrow{BC} - \dot{\gamma}^2\,\overrightarrow{BC} + 2\,\dot{\gamma}\,\underline{k} \wedge \dot{s}\,\underline{i} \quad \Big\|$$