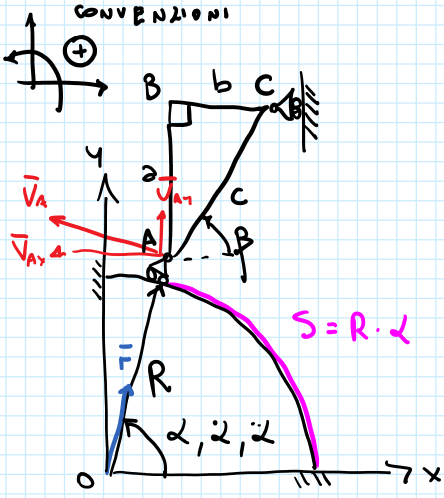



**DATI**

$a = 4\,m$
$b = 1\,m$
$c = 4{,}1\,m$
$R = 6\,m$
$\alpha = 1{,}4\,rad$
$\dot{\alpha} = 3\,rad/s$
$\ddot{\alpha} = 1\,rad/s^2$
$\beta = 1{,}3\,rad$

**CALCOLARE**

1) $\bar{V}_A$ e $\bar{a}_A$ ?
2) $\bar{V}_C$ e $\bar{a}_C$ ?
3) Posizione del C.I.R. ? e $\bar{V}_B$ ?

**POSIZIONE DI A**

$$(A-O) = R\bar{r} = R\underbrace{(\cos\alpha\,\bar{i} + \sin\alpha\,\bar{j})}_{\bar{r}}$$
$$= \underbrace{R\cos\alpha}_{x_A}\,\bar{i} + \underbrace{R\sin\alpha}_{y_A}\,\bar{j}$$
$$= x_A\,\bar{i} + y_A\,\bar{j}$$

**VELOCITÀ DI A**

$$\frac{d(A-O)}{dt} = \frac{d R\bar{r}}{dt} = R \cdot \frac{d\bar{r}}{dt}$$

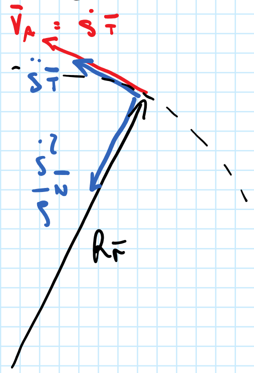
Ricordando che $\frac{d\cos\alpha}{dt} = \frac{d\cos\alpha}{d\alpha} \cdot \frac{d\alpha}{dt}$ con $\alpha = \alpha(t)$

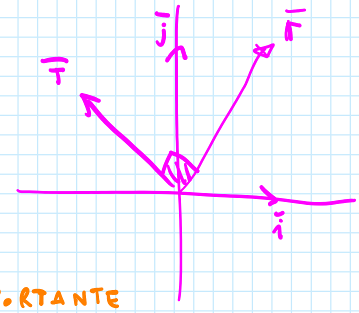
$$\frac{d\bar{r}}{dt} = -\sin\alpha\,\dot{\alpha}\,\bar{i} + \cos\alpha\,\dot{\alpha}\,\bar{j}$$

$$= R \cdot (-\sin\alpha\,\dot{\alpha}\,\bar{i} + \cos\alpha\,\dot{\alpha}\,\bar{j})$$
$$= \underbrace{R\dot{\alpha}}_{\dot{s}}\,\underbrace{(-\sin\alpha\,\bar{i} + \cos\alpha\,\bar{j})}_{\bar{t}}$$

MODULO DELLA $\bar{V}_A$ — VERSORE DELLA $\bar{V}_A$

$$= \underbrace{-R\dot{\alpha}\sin\alpha}_{\dot{x}_A}\,\bar{i} + \underbrace{R\dot{\alpha}\cos\alpha}_{\dot{y}_A}\,\bar{j}$$




IMPORTANTE

$\dot{x}_A = -17{,}7\ \frac{m}{s}$
$\dot{y}_A = 3{,}1\ \frac{m}{s}$

**ACC. DI A**

$$\bar{a}_A = \frac{d\bar{V}_A}{dt} = \frac{d(\dot{s}\bar{t})}{dt} = \underbrace{\ddot{s}\,\bar{t}}_{TANG.} + \underbrace{\frac{\dot{s}^2}{\rho}\,\bar{N}}_{NORM.}$$

$\ddot{s} = R\ddot{\alpha}$
$\bar{t} = -\sin\alpha\,\bar{i} + \cos\alpha\,\bar{j}$
$\dot{s} = R\dot{\alpha}$

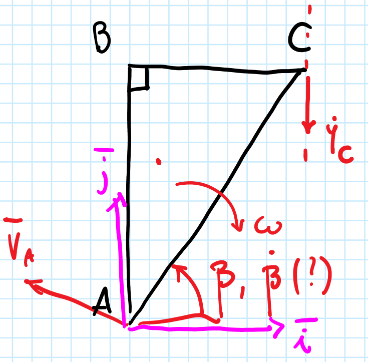
$\rho = R$

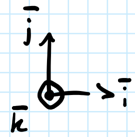
$\bar n = -\bar r = -\cos\alpha\,\bar i - \sin\alpha\,\bar j$

$$\bar a_c = R\ddot\alpha\left(-\sin\alpha\,\bar i + \cos\alpha\,\bar j\right) + \frac{R^{\cancel{2}}\dot\alpha^2}{\cancel{R}}\left(-\cos\alpha\,\bar i - \sin\alpha\,\bar j\right)$$

$$= -R\ddot\alpha\sin\alpha\,\bar i + R\ddot\alpha\cos\alpha\,\bar j - R\dot\alpha^2\cos\alpha\,\bar i - R\dot\alpha^2\sin\alpha\,\bar j$$

$$= (\underbrace{-R\ddot\alpha\sin\alpha - R\dot\alpha^2\cos\alpha}_{\ddot x_A})\,\bar i + (\underbrace{R\ddot\alpha\cos\alpha - R\dot\alpha^2\sin\alpha}_{\ddot y_A})\,\bar j$$




VELOCITÀ DI C

TH. DI RIVALS PER LE VELOCITÀ

$$\bar V_c = \bar V_A + \bar\omega \wedge (C-A)$$

$$\bar V_c = \bar V_{TR} + \bar V_{REL}$$

$\bar V_{TR}$ ↓ TRASCINAMENTO DELLA TERNA RELATIVA

$\bar V_{REL}$ ↳ ROTAZIONE DI C RISPETTO AD A NELLA TERNA RELATIVA

MOTO TRASCINAMENTO TRASLATORIO → $\bar V_c = \bar V_A$

MOTO RELATIVO ($C$ vs $A$) ROTATORIO → $\bar V_c = \bar\omega \wedge (C-A)$

NOI ABBIAMO UN ATTO DI MOTO ROTOTRASLATORIO

$$\bar V_c = \bar V_A + \bar\omega \wedge (C-A)$$

$$\bar V_A = \dot x_A\,\bar i + \dot y_A\,\bar j$$

$$\bar\omega = \dot\beta\,\bar k$$

$$(C-A) = c\,(\cos\beta\,\bar i + \sin\beta\,\bar j)$$

SOSTITUISCO

$$\dot y_C\,\bar j = \dot x_A\,\bar i + \dot y_A\,\bar j + \dot\beta\,\bar k \wedge c\left(\cos\beta\,\bar i + \sin\beta\,\bar j\right)$$

$\dot x_C = 0$

$$= \dot x_A\,\bar i + \dot y_A\,\bar j + \dot\beta c\cos\beta\,\bar j - \dot\beta c\sin\beta\,\bar i$$

$$\begin{array}{l} \bar i \\ \bar j \end{array}\left\{\begin{array}{ll} 0 = \dot x_A - \dot\beta c\sin\beta & \Rightarrow \quad \dot\beta = \dfrac{\dot x_A}{c\sin\beta} \Rightarrow \text{TROVO } \dot\beta \\ \dot y_C = \dot y_A + \dot\beta\,c\cos\beta & \Rightarrow \quad \text{TROVO } \dot y_C \end{array}\right.$$

$\bar\omega = \dot\beta\,\bar k = -4{,}4\,\bar k \qquad -4{,}4\ \text{rad/s}$

$\dot y_{c}\,\bar j = -1{,}3\ \frac{m}{s}$


ACC. DI C 2 OPZIONI

1) DERIVO LE EQ. IN VELOCITÀ

$$\begin{array}{l} \bar i \\ \bar j \end{array}\left\{\begin{array}{ll} 0 = \ddot x_A - \ddot\beta\,c\sin\beta - c\dot\beta^2\cos\beta & \longrightarrow \quad \ddot\beta = \dots \\ \ddot y_C = \ddot y_A + \ddot\beta\,c\cos\beta - c\dot\beta^2\sin\beta & \longrightarrow \quad \ddot y_C = \dots \end{array}\right.$$

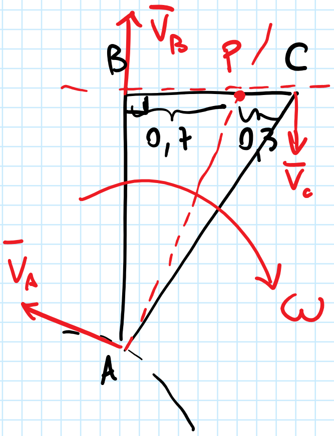
$\bar{j} \mid \ddot{y}_c = \ddot{y}_A + \ddot{\beta}\, c\cos\beta - c\dot{\beta}^2\sin\beta \longrightarrow \ddot{y}_c = \dots$

2) TH. RIVALS PER LE ACC.

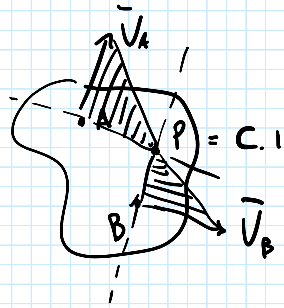
$$\underset{\downarrow \atop = \ddot{y}_c \bar{j}}{\bar{a}_c} = \bar{a}_A + \underset{\downarrow \atop \ddot{\beta}\bar{k}}{\dot{\bar{\omega}}} \wedge (C-A) - \underbrace{\omega^2\cdot(C-A)}_{\bar{\omega}\wedge(\bar{\omega}\wedge(C-A))} \quad (\text{X CASA})$$

$$\bar{\omega}\wedge(\bar{\omega}\wedge(C-A)) \Rightarrow \bar{\omega} = \dot{\beta}\bar{k}$$

POSIZIONE DEL C.I.R. (PUNTO P)




TH. DI CHALES




→ UN PTO IN CUI $V = 0$

In questo caso $\bar{V}_P = 0$

$$\bar{V}_C = \underset{=0}{\cancel{\bar{V}_P}} + \bar{\omega}\wedge(C-P)$$

$$= \bar{\omega}\wedge(C-P) \text{ quindi}$$

$$\dot{y}_c\bar{j} = \dot{\beta}\bar{k}\wedge|\overline{PC}|\bar{i}$$

$$= \dot{\beta}\cdot|\overline{PC}|\bar{j} \quad \text{Ho tutto lungo } \bar{j} \text{ quindi}$$

$$|\overline{PC}| = \frac{|\dot{y}_c|}{|\dot{\beta}|} = 0{,}3 \quad ; \quad |\overline{BP}| = 1 - 0{,}3 = 0{,}7\,m$$

VELOCITÀ DI B

$$\bar{V}_B = \underset{=0}{\cancel{\bar{V}_P}} + \bar{\omega}\wedge(B-P) = \bar{\omega}\wedge(B-P) = \dot{\beta}\bar{k}\wedge\overline{BP}\,\bar{i} = \underline{\dot{y}_B\bar{j}} =$$

$\dot{\beta}\bar{k} = -4{,}4\,\bar{k}$

$(B-P) = -0{,}7\,\bar{i}$

IMPORTANTE

$$\bar{V}_B = -4{,}4\bar{k}\wedge -0{,}7\bar{i} = +3{,}1\,\bar{j}$$