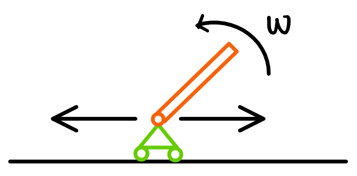
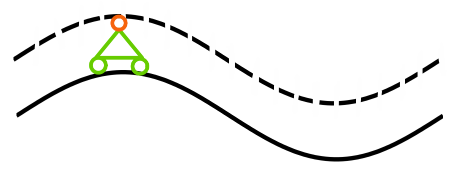
Es1

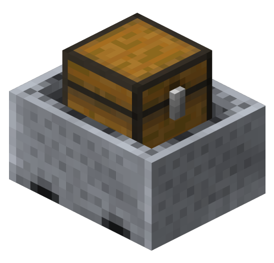
Tuesday, 25 January 2022 00:30

CINEMATICA DEL CORPO RIGIDO

VINCOLO DI CARRELLO

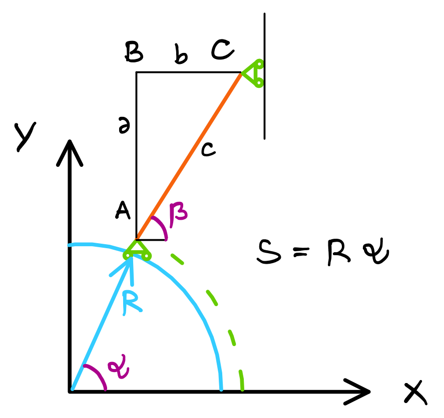






IL CARRELLO BLOCCA LA y MA LASCIA IL CORPO RIGIDO LIBERO DI RUOTARE E TRASLARE

IL TRENO DELLE MONTAGNE RUSSE NON PUO' STACCARSI DAL BINARIO (UNI VS BILATERO)



$S = R\varphi$

CARRELLO SU BINARIO CIRCOLARE
ASSUMIAMO CARRELLO PUNTIFORME

$a, b, c, R, \varphi, \dot\varphi, \ddot\varphi, \beta$

v_A, a_A ?

IL PUNTO A IDENTIFICA IL CARRELLO
IL CARRELLO E' UN VETTORE CHE RUOTA
(SCORRE SU CIRCONFERENZA)

$\boxed{\begin{aligned} x_A &= R\cos\varphi \\ y_A &= R\sin\varphi \end{aligned}}$ $(A-O) = R(\cos\varphi\,\hat\imath + \sin\varphi\,\hat\jmath) = R\hat{n}$

$\boxed{\begin{aligned} v_{Ax} &= -R\dot\varphi\sin\varphi \\ v_{Ay} &= +R\dot\varphi\cos\varphi \end{aligned}}$ $v_A = \dfrac{dR\hat n}{dt} = R\dfrac{d\hat n}{dt} = R\dot\varphi(-\sin\varphi\,\hat\imath + \cos\varphi\,\hat\jmath) = \dot s\,\hat t$

$\boxed{\begin{aligned} a_{Ax} &= -R\dot\varphi\left(\sin\varphi + \frac{R\dot\varphi}{\rho}\cos\varphi\right) \\ a_{Ay} &= +R\dot\varphi\left(\cos\varphi - \frac{R\varphi}{\rho}\sin\varphi\right) \end{aligned}}$

$a_A = \dfrac{d\dot s\hat t}{dt} = \ddot s\,\hat t + \dfrac{\dot s^2}{\rho}\hat m = \ddot x_A\,\hat\imath + \ddot y_A\,\hat\jmath$

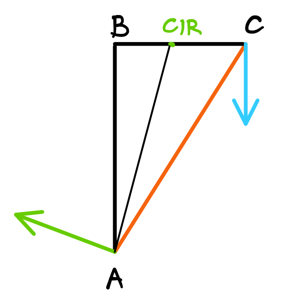
$= R\ddot\varphi(-\sin\varphi\,\hat\imath + \cos\varphi\,\hat\jmath) + \dfrac{R^2\dot\varphi^2}{\rho}(-\cos\varphi\,\hat\imath - \sin\varphi\,\hat\jmath)$

$\ddot s = R\ddot\varphi \quad , \quad \dot s = R\dot\varphi$

$\hat t = (-\sin\varphi\,\hat\imath + \cos\varphi\,\hat\jmath)$

$\hat m = -\hat n = (-\cos\varphi\,\hat\imath - \sin\varphi\,\hat\jmath)$

v_C, a_C ?



TEOREMA DI RIVALS

$v_C = v_A + w \times (C-A)$

v TRASCINAMENTO — BLOCCO TERNA, MUOVO CORPO RIGIDO
v RELATIVA — BLOCCO CORPO, MUOVO TERNA

VINCOLO DI CARRELLO IN A, C
LA DIREZIONE IN C E' SOLO VERTICALE

$\bar v_C = \dot y_C\,\hat\jmath$ INCOGNITA

$\bar v_A = \dot x_A\,\hat\imath + \dot y_A\,\hat\imath$

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

$(C-A) = c(\cos\beta\,\hat\imath + \sin\beta\,\hat\jmath)$

RIVALS $\rightarrow$ $\dot x_C\,\hat\imath = \dot x_A\,\hat\imath + \dot y_A\,\hat\jmath + \dot\beta\,\hat k \times c(\cos\beta\,\hat\imath + \sin\beta\,\hat\jmath)$

$\dot x_C\,\hat\imath = \dot x_A\,\hat\imath + \dot y_A\,\hat\jmath + \dot\beta c\cos\beta\,\hat\jmath - \dot\beta c\sin\beta\,\hat\imath$

$\hat\imath \times \hat\jmath = \hat k \qquad \hat k \times \hat\imath = \hat\jmath \qquad \hat k \times \hat\jmath = -\hat\imath$

$\hat\imath \cdot \hat\imath = 1 \qquad \hat\jmath \cdot \hat\jmath = 1 \qquad \hat\imath \cdot \hat\jmath = 0$

SUDDIVIDO TUTTO PER i, j

$\begin{array}{l|l} i & 0 = \dot x_A - \dot\beta c\sin\beta \\ j & \dot y_C = \dot y_A + \dot\beta c\cos\beta \end{array} \longrightarrow \begin{array}{l} \dot\beta = \dfrac{\dot x_A}{c\sin\beta} \\ \dot y_C = \dot y_A + \dot x_A\cot\beta \end{array}$

PER RICAVARE a_C ABBIAMO 2 METODI

1) DERIVO LE EQUAZIONI IN VELOCITA'

$\left|\begin{aligned} 0 &= \ddot x_A - \ddot\beta c\sin\beta - \dot\beta^2 c\cos\beta \\ \ddot y_C &= \ddot y_A + \ddot\beta c\cos\beta - \dot\beta^2 c\sin\beta \end{aligned}\right.$ RISOLVO PER $\ddot\beta$ E $\ddot y_C$

2) TEOREMA DI RIVALS PER LE ACCELERAZIONI

$\bar a_C = a_A + \dot{\bar\omega} \times (C-A) - \omega^2(C-A)$

CIR ? CENTRO DI ISTANTANEA ROTAZIONE

$v_C = v_{CIR} + w \times (C - CIR)$

$\dot y_C\,\hat\jmath = \dot\beta\hat k \times |CP|\,\hat\imath = \dot\beta|CP|\hat\jmath \quad \rightarrow \quad |CP| = \dfrac{\dot y_C}{\dot\beta}$

DISTANZA DEL CIR RISPETTO A C

v_B ?

$v_C = w \times (B - CIR) = \dot\beta\,|CP - BC| = \dot\beta\,|BP|$