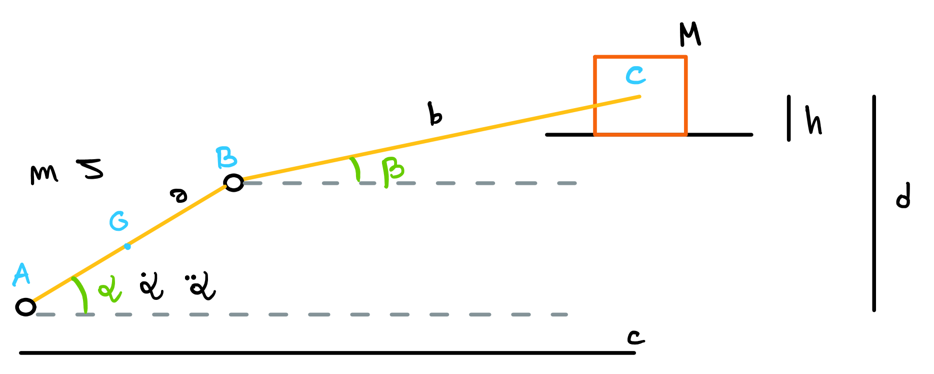
Es 5

Saturday, 1 January 2022 13:49

MANOVELLISMO ORDINARIO DEVIATO

ESERCIZIO CLASSICO E COMPLETO



$a = 0.021\,m$	$\alpha = 62$ DEG	$C_M = 1.5\,Nm$
$b = 0.053\,m$	$\beta = 6$ DEG	$J = 0.1\,Kg\,m^2$
$c = 0.063\,m$	$\dot\alpha = 12$ RAD/s	$m = 1{,}9\,Kg$
$d = 0.024\,m$	$\ddot\alpha = -2$ RAD/s^2	h $0.002\,m$

GRADI DI LIBERTA'

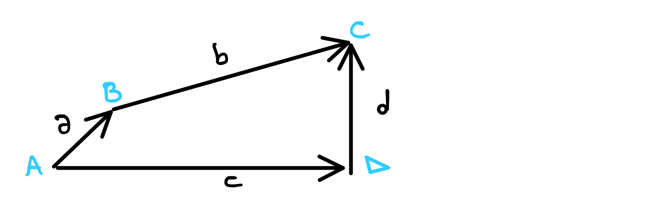
3 CORPI RIGIDI $+3 \times 3$
2 CERNIERE -2×2
1 PATTINO -2×1

1 GDL

HO UNA COORDINATA LIBERA
CONOSCENDONE UNA LE CONOSCO TUTTE

EQUAZIONE DI CHIUSURA

	$\lvert\cdot\rvert$	$\angle$
$\bar a$	COST	$\alpha(t)$
$\bar b$	COST	$\beta(\alpha)$
$\bar c$	$c(\alpha)$	COST
$\bar d$	COST	COST



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

$\bar a + \bar b = \bar c + \bar d$

$a(\cos\alpha\,\hat\imath + \sin\alpha\,\hat\jmath) + b(\cos\beta\,\hat\imath + \sin\beta\,\hat\jmath) = c\,\hat\imath + d\,\hat\jmath$

POSIZIONI

$$\begin{array}{c|l} \hat\imath & a\cos\alpha + b\cos\beta = c \\ \hat\jmath & a\sin\alpha + b\sin\beta = d \end{array}$$

VELOCITA'

$$\begin{array}{c|l} \hat\imath & -a\dot\alpha\sin\alpha - b\dot\beta\sin\beta = \dot c \\ \hat\jmath & a\dot\alpha\cos\alpha + b\dot\beta\cos\beta = 0 \end{array}$$

$\longrightarrow \quad \dot\beta = -\dfrac{a\dot\alpha\cos\alpha}{b\cos\beta}$

$\longrightarrow \quad \dot c = -a\dot\alpha\sin\alpha + \dfrac{\cancel{b}\,a\dot\alpha\cos\alpha}{\cancel{b}\cos\beta}\sin\beta$

$\quad = a\dot\alpha(\cos\alpha\tan\beta - \sin\alpha)$

JACOBIANO

$\dot\beta = -\dfrac{a\cos\alpha}{b\cos\beta}\dot\alpha = J_B\,\dot\alpha$

POICHE' $\beta = \beta(\alpha(t))$ ALLORA $\dot\beta = \dfrac{\partial\beta}{\partial\alpha}\cdot\dfrac{d\alpha}{dt}$

$\boxed{J_B = \dfrac{\partial\beta}{\partial\alpha} = \dfrac{\dot\beta}{\dot\alpha}}$

SAPENDO CHE $c = c(\alpha(t))$

$\dot c = \dfrac{\partial c}{\partial\alpha}\cdot\dfrac{d\alpha}{dt}$ $\quad \boxed{J_C = \dfrac{\dot c}{\dot\alpha}}$

PRINCIPIO DEI LAVORI VIRTUALI

LEGAMI CINEMATICI

$\delta\beta = \dfrac{\dot\beta}{\dot\alpha}\,\delta\alpha$

$\delta c = \dfrac{\dot c}{\dot\alpha}\,\delta\alpha$

RELAZIONO TUTTO AD α (COORDINATA LIBERA)

ACCELERAZIONI

$$\begin{array}{c|l} \hat\imath & -a\ddot\alpha\sin\alpha - a\dot\alpha^2\cos\alpha - b\ddot\beta\sin\beta - b\dot\beta^2\cos\beta = \boxed{\ddot c} \\ \hat\jmath & a\ddot\alpha\cos\alpha - a\dot\alpha^2\sin\alpha + b\boxed{\ddot\beta}\cos\beta - b\dot\beta^2\sin\beta = 0 \end{array}$$

RICAVO DA QUA $\ddot\beta$ E $\ddot c$

CALCOLA V_G, a_G

$|(G-A)| = \dfrac{a}{2}$

$\bar V_G = \dot\alpha\hat k \wedge (G-A) = \dot\alpha\hat k \wedge \left[\dfrac{a}{2}(\cos\alpha\,\hat\imath + \sin\alpha\,\hat\jmath)\right]$

$\quad = \dfrac{a}{2}\dot\alpha\cos\alpha\,\hat\jmath - \dfrac{a}{2}\dot\alpha\sin\alpha\,\hat\imath = -0.11\,\hat\imath + 0.06\,\hat\jmath$ $\quad \dfrac{m}{s}$

$a_G = \ddot\alpha K \wedge (G-A) - \dot\alpha^2(G-A) = -0.68\,\hat\imath - 1.34\,\hat\jmath$ $\quad \dfrac{m}{s^2}$

CALCOLA V_C, a_C

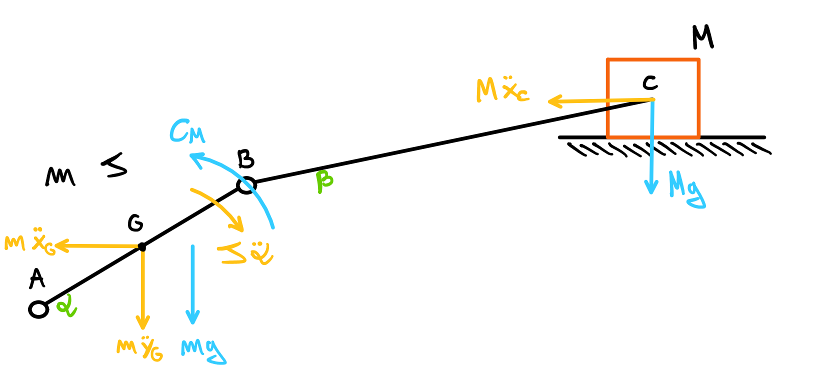
$V_C = \dot c\,\hat\imath = -0.21$ m/s

$a_C = \ddot c\,\hat\imath = -1.93$ m/s^2

CALCOLA M CON IL PLV

DINAMICA

LE REAZIONI VINCOLARI NON COMPIONO LAVORO



MOLTIPLICARE LE FORZE PER SPOSTAMENTI INFINITESIMI
TUTTI GLI SPOSTAMENTI POSITIVI PER

$C_M\delta\alpha - mg\,\delta y_G - \underbrace{\cancel{Mg\,\delta y_C}}^{\text{VINCOLO}} - m\ddot x_G\,\delta x_G - m\ddot y_G\,\delta y_G - J\ddot\alpha\,\delta\alpha - M\ddot x_C\,\delta x_C = 0$

SOSTITUISCO I LEGAMI CINEMATICI (JACOBIANI)

$\delta\beta = \dfrac{\dot\beta}{\dot\alpha}\,\delta\alpha$

$\delta x_C = \dfrac{\dot c}{\dot\alpha}\,\delta\alpha$

$\delta x_G = \dfrac{\dot x_G}{\dot\alpha}\,\delta\alpha$

ETC

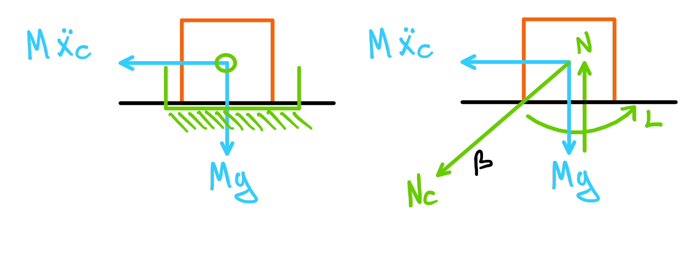
$\left[C_M - mg\left(\dfrac{\dot y_G}{\dot\alpha}\right) - m\ddot x_G\left(\dfrac{\dot x_G}{\dot\alpha}\right) - m\ddot y_G\left(\dfrac{\dot y_G}{\dot\alpha}\right) - J\ddot\alpha - M\ddot x_C\left(\dfrac{\dot c}{\dot\alpha}\right)\right]\cancel{\delta\alpha} = 0$

$\longrightarrow \quad M = \dots = 47.52\,Kg$

R VINCOLARE TRA CORSOIO E TERRA

SPACCO IL SISTEMA

SOSTITUISCO VINCOLO CON FORZE



EQUILIBRIO DINAMICO

$$\begin{array}{l|l} \sum F_x = 0 & N_C\cos\beta = M\ddot x_C \\ \sum F_y = 0 & Mg + N_C\sin\beta = N \\ \sum M_C = 0 & L = 0 \end{array}$$

$N_C = \dfrac{M\ddot x_C}{\cos\beta}$

$N = Mg + N_C\sin\beta$

$L = 0$