Lezione lunedì 12 ottobre 2020

lunedì 12 ottobre 2020 10:19

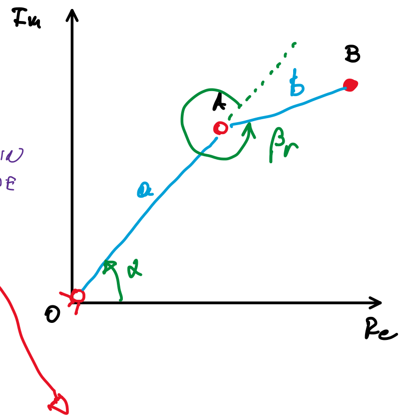
CATENE CINEMATICHE APERTE

↳ ROBOT PLANARI

↳ DEFINIZIONE DEL "WORKSPACE"

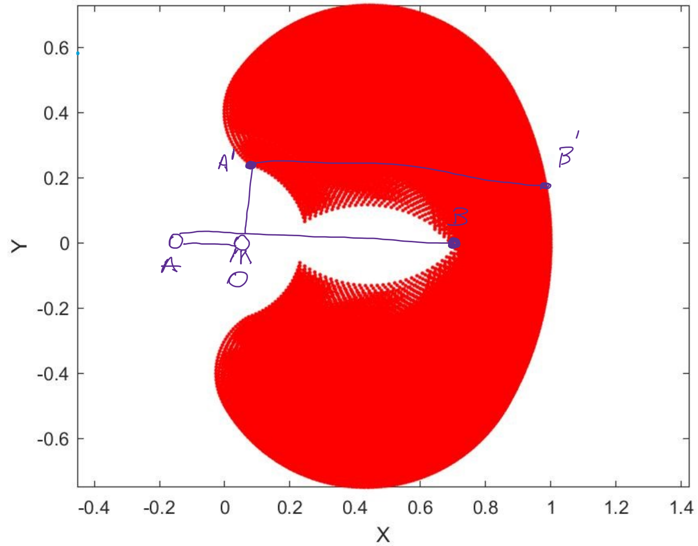
NON È DETTO IN GENERALE CHE
$0 \leq \alpha < 2\pi$
$0 \leq \beta_r < 2\pi$

"WORKSPACE" NEL PIANO: PORZIONE DI PIANO RAGGIUNGIBILE DAL MIO MANIPOLATORE VARIANDO α e β_r



PER CHI VOLESSE DIVERTIRSI A DISEGNARE WORKSPACE SEGUITE IL LINK!

Link a BeeP (installate prima il toolbox di Matlab, poi aprite lo script per vedere le istruzioni)

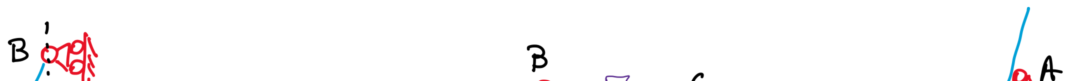


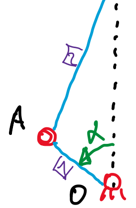
CATENE CINEMATICHE CHIUSE

↳ BASE MECCANISMI TRADIZIONALI DELLA MECCANICA

- MANOVELLISMO → MOTORI A COMBUSTIONE INTERNA / COMPRESSORE / POMPA ALTERNATIVA
- QUADRILATERO ARTICOLATO → BIOMECCANICA / TELAI / PANTOGRAFI / SOSPENSIONI AUTO (F1) / AZIONAMENTI SUP. CONTROLLO AERONAUTICHE
- GLIFO → MACCHINE UTENSILI /

TUTTI SISTEMI A 1 G.d.L.





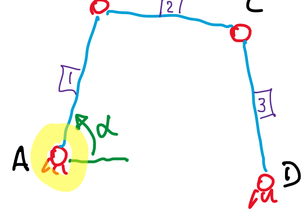
MANOVELLISMO

$2\ CR \times 3\ GDL = 6\ GDL$

$2\ CERN \times 2\ GDV = -4\ GDV$

$1\ CARR. \times 1\ GDV = -1\ GDV$

$1\ GDL$

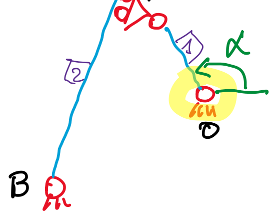


QUADRILATERO ARTICOLATO

$3\ CR \times 3\ GDL = 9\ GDL$

$4\ CERN \times 2\ GDV = -8\ GDV$

$1\ GDL$



GLIFO

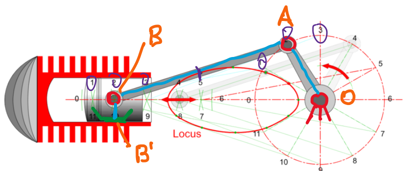
$2\ CR \times 3\ GDL = 6\ GDL$

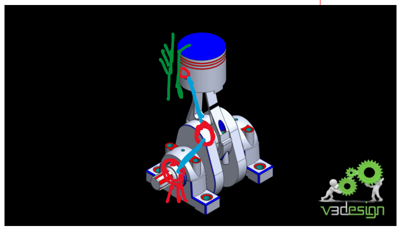
$2\ CERN \times 2\ GDV = -4\ GDV$

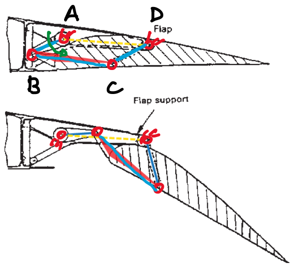
$1\ CARR. \times 1\ GDV = -1\ GDV$

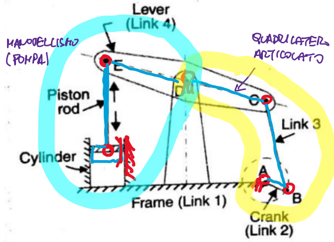
$1\ GDL$

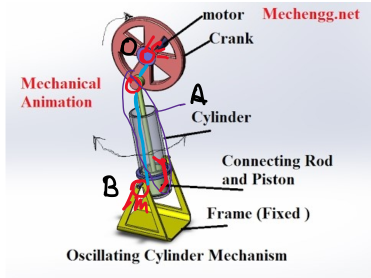
[1] COLLEGATO AD UN MOTORE

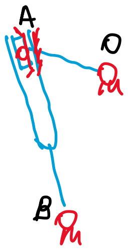


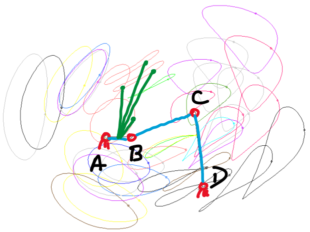


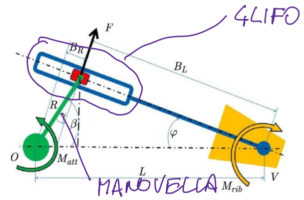


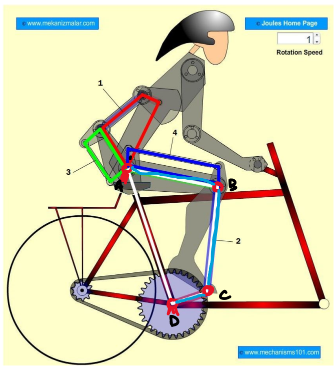


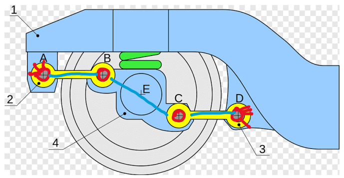


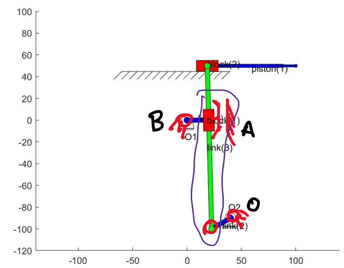












PER CHI VOLESSE UN SEMPLICE SIMULATORE DI SISTEMI ARTICOLATI IN AMBIENTE MATLAB

[Link al simulatore sistemi articolati (leggete il Readme.docx ed eseguite gli script suggeriti dopo aver estratto lo zip in una directory)]

OVELLISMO

MOTORE A.C.I / POMPA / COMPRESSORE

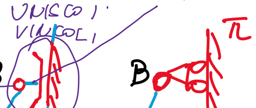
ALTERNATIVI

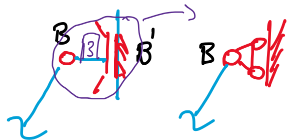
PISTONE / C

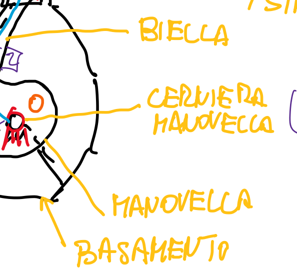
CERNIERA PIEDE DI B

UNISCO I VINCOLI

STANTUFFO



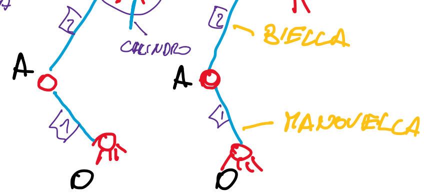




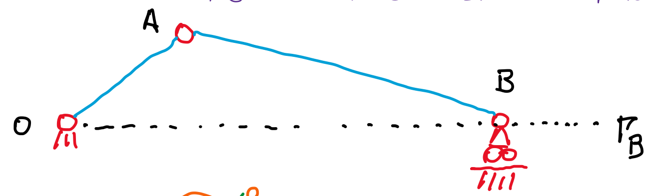
(TRACCIA NEL PIANO DELL'ALBERO A GOMITI)

MOTI DEI C.R. [1]: ROTATORIO

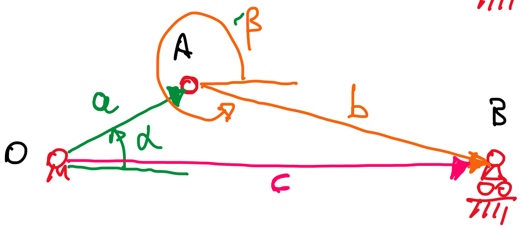
[2]: ROTOTRASLATORIO



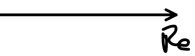
(ROTAZIONE DI 90° DEL MECCANISMO PER RAGIONI PRATICHE



(SE Γ_B PASSA PER O ⇒ MANOVELLISMO CENTRATO)



$\vec{c}$ è orizzontale → $c e^{i0} = c$



DATI DEL PROBLEMA

$a, b, \alpha(t)$

...IONE $(A-O) + (B-A) = (B-O)$

$\vec{a} + \vec{b} = \vec{c}$ EQUAZIONE DI CHIUSURA

...ARE $a e^{i\alpha} + b e^{i\beta} = c$ ⊛

↳ $a(\cos\alpha + i\sin\alpha) + b(\cos\beta + i\sin\beta) = c$

...ZIONE
...E Re E Im

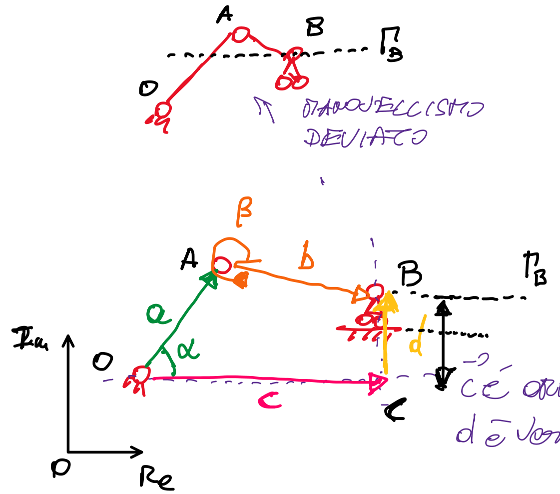
$$\begin{cases} \text{I} \quad a\cos\alpha + b\cos\boxed{\beta} = \boxed{c} \\ \text{II} \quad a\sin\alpha + b\sin\boxed{\beta} = 0 \end{cases}$$

DETERMINO β e c

← SISTEMA DI EQ. TRASCENDENTI

DALLA II $\quad \beta(t) = \arcsin\left(-\dfrac{a\sin\alpha}{b}\right) \qquad \sin\beta = -\dfrac{a\sin\alpha}{b} \qquad \cos\beta = \sqrt{1-\sin^2\beta}$

SOSTITUISCO β NELLA I $\quad c(t) = a\cos\alpha + b\sqrt{1-\left(\dfrac{a\sin\alpha}{b}\right)^2} \quad \alpha(t)$



$\vec{c}$ è orizzontale $c e^{i0} = c$

d è verticale $d e^{i\pi/2} = id$

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

$a e^{i\alpha} + b e^{i\beta} = c + id$

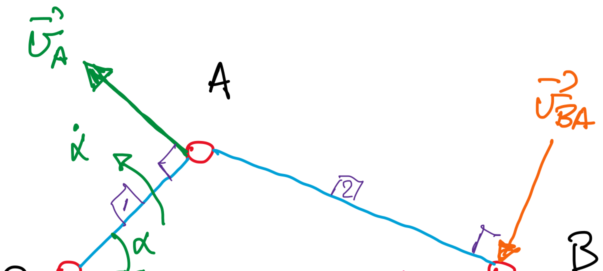
DATI DEL PROBLEMA

$a, b, d, \alpha(t)$

$a(\cos\alpha + i\sin\alpha) + b(\cos\beta + i\sin\beta) = c + id$

$$\begin{cases} a\cos\alpha + b\cos\boxed{\beta} = \boxed{c} \\ a\sin\alpha + b\sin\boxed{\beta} = d \end{cases} \qquad \sin\beta = \frac{d - a\sin\alpha}{b}$$

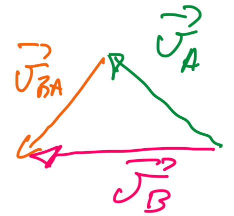
...OCITA'



$i\dot\alpha a e^{i\alpha} + i\dot\beta b e^{i\beta} = \dot{c}$ ⊕

CHIUSURA

$$\vec{v}_A + \vec{v}_{BA} = \vec{v}_B$$



$$i\dot{\alpha}a(\cos\alpha + i\sin\alpha) + i\dot{\beta}b(\cos\beta + i\sin\beta) = \dot{c}$$

$$\begin{cases} \mathrm{I} & -\dot{\alpha}a\sin\alpha + -\boxed{\dot{\beta}}b\sin\beta = \boxed{\dot{c}} \\ \mathrm{II} & \dot{\alpha}a\cos\alpha + \boxed{\dot{\beta}}b\cos\beta = 0 \end{cases}$$

DETERMINARE $\dot{\beta}$ E $\dot{c}$

← SISTEMA ALGEBRICO

$$\dot{\beta}(t) = -\dot{\alpha}\frac{a\cos\alpha}{b\cos\beta}$$

$$\dot{c}(t) = -\dot{\alpha}a(\sin\alpha - \cos\alpha\tan\beta) \boxtimes$$

ACCELERAZIONE

C

...RIVO

$$i\ddot{\alpha}ae^{i\alpha} - \dot{\alpha}^2ae^{i\alpha} + i\ddot{\beta}be^{i\beta} - \dot{\beta}^2be^{i\beta} = \ddot{c}$$

$$\vec{a}_{A_t} + \vec{a}_{A_n} + \vec{a}_{BA_t} + \vec{a}_{BA_n} = \vec{a}_B$$

$$\begin{cases} -\ddot{\alpha}a\sin\alpha - \dot{\alpha}^2a\cos\alpha - \boxed{\ddot{\beta}}b\sin\beta - \dot{\beta}^2b\cos\beta = \boxed{\ddot{c}} \\ \ddot{\alpha}a\cos\alpha - \dot{\alpha}^2a\sin\alpha + \boxed{\ddot{\beta}}b\cos\beta - \dot{\beta}^2b\sin\beta = 0 \end{cases}$$

DETERMINARE $\ddot{\beta}$ E $\ddot{c}$

← SISTEMA ALGEBRICO

JACOBIANO

PUO' ESSERE UTILE ESPRIMERE LA VELOCITÁ DI UN PUNTO IN FUNZIONE DELLA COORDINATA LIBERA: AD ESEMPIO $\vec{v}_B = \dot{c}$ COME FUNZIONE DI $\alpha(t)$

$$\dot{c} = \Lambda(\alpha)\dot{\alpha}$$

JACOBIANO

"COME IL MECCANISMO TRASFORMA LA VELOCITÁ (ANGOLARE) $\dot{\alpha}$ NELLA VELOCITÁ DI B"

$$\dot{c}(t) = -\dot{\alpha}\,a\left[\sin\alpha - \cos\alpha\tan\left(\arcsin\left(\frac{-a\sin\alpha}{b}\right)\right)\right] = \Lambda(\alpha)\dot{\alpha}$$

↓

CALCOLO ACCELERAZIONE $\frac{d}{dt}\dot{c}(t)$

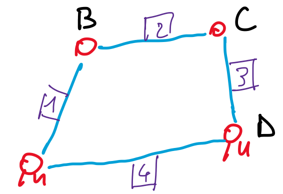
$$\ddot{c} = \frac{d}{dt}\Lambda(\alpha)\dot{\alpha} = \ddot{\alpha}\Lambda(\alpha) + \frac{\partial\Lambda(\alpha)}{\partial\alpha}\dot{\alpha}^2$$

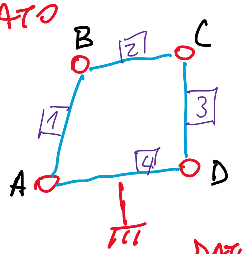
$$\ldots = \frac{d}{dt}\Lambda(\alpha)\,\dot\alpha = \ddot\alpha\,\Lambda(\alpha) + \frac{\partial \ldots}{\partial \alpha}\,\dot\alpha$$

$$\frac{d}{dt}\Lambda(\alpha)\cdot\dot\alpha$$

$$\frac{\partial\Lambda(\alpha)}{\partial t}\cdot\frac{d\alpha}{dt}\cdot\dot\alpha = \frac{\partial\Lambda(\alpha)}{\partial t}\cdot\dot\alpha^2$$

QUADRILATERO ARTICOLATO

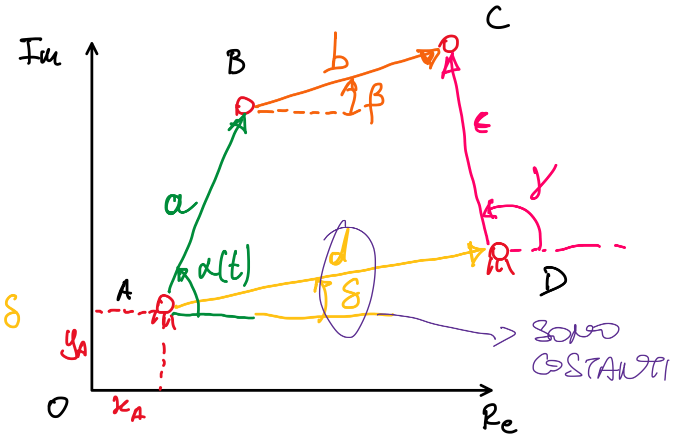




DATI DEL PROBLEMA

a, b, c, d, δ

$\alpha(t)$



ZIONE

$$(B-A)+(C-B)=(D-A)+(C-D)$$ EQUAZIONE DI CHIUSURA

$$a e^{i\alpha} + b e^{i\beta} = d e^{i\delta} + c e^{i\gamma} \quad (*)$$

$$a(\cos\alpha + i\sin\alpha) + b(\cos\beta + i\sin\beta) = d(\cos\delta + i\sin\delta) + c(\cos\gamma + i\sin\gamma)$$

$$a\cos\alpha + b\cos\boxed{\beta} = d\cos\delta + c\cos\boxed{\gamma}$$ → DETERMINARE β e γ

$$a\sin\alpha + b\sin\boxed{\beta} = d\sin\delta + c\sin\boxed{\gamma}$$ ↳ EQUAZIONI TRASCENDENTI

CITA'

ETA

ORA

$$i\dot\alpha a e^{i\alpha} + i\boxed{\dot\beta} b e^{i\beta} = i\boxed{\dot\gamma} c e^{i\gamma} \quad (*)$$

↳ 2 EQ SCALARI → DETERMINARE $\dot\beta$ E $\dot\gamma$

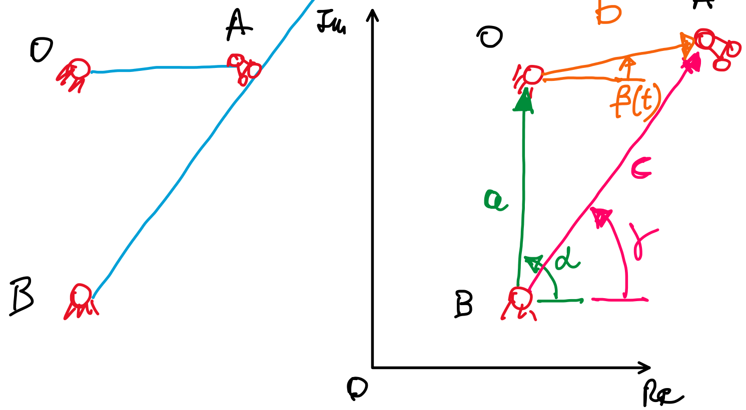
LERAZIONE

VATA

$$i\ddot\alpha a e^{i\alpha} - \dot\alpha^2 a e^{i\alpha} + i\boxed{\ddot\beta} b e^{i\beta} - \dot\beta^2 b e^{i\beta} = i\boxed{\ddot\gamma} c e^{i\gamma} - \dot\gamma^2 c e^{i\gamma}$$

↳ 2 EQ SCALARI → DETERMINARE $\ddot\beta$ E $\ddot\gamma$

LEO



DATI DEL PROBLEMA

$a, \alpha, b, \beta(t)$

POSIZIONE

$$(O-B)+(A-O)=(A-B)$$

$$a e^{i\alpha} + b e^{i\beta} = c e^{i\gamma}$$ EQ DI CHIUSURA

$$\begin{cases} a\cos\alpha + b\cos\beta = \boxed{c}\cos\boxed{\gamma} \\ a\sin\alpha + b\sin\beta = \boxed{c}\sin\boxed{\gamma} \end{cases}$$

→ DETERMINARE c E γ

EQ TRASCENDENTI

VELOCITA'

ACCELERAZIONE