

2025. 11.19 Rbt (10) = 3

model

truly

$\vec{P}(x_p, y_p)$

$$\frac{d\vec{F}(A, c)}{dc} = \frac{dF}{dA} \times \frac{dA}{dc}$$

$$\frac{d}{dc} \cos A \rightarrow \frac{d}{dA} \cos A = -\sin A$$

$$\sin A \rightarrow \frac{d}{dA} \sin A = \cos A$$

Question
Watching
Time

State
Understand

Report

Express

POSITION
(m)

$$x_p = l_1 \cos \theta_1 + l_2 \cos(\theta_1 + \theta_2) \quad [\text{m}]$$

$$y_p = l_1 \sin \theta_1 + l_2 \sin(\theta_1 + \theta_2)$$

SPEED

$$\frac{dx_p}{dt} = l_1 (-\sin \theta_1 \dot{\theta}_1) - l_2 \sin(\theta_1 + \theta_2) (\dot{\theta}_1 + \dot{\theta}_2)$$

$$= \{ l_1 \sin \theta_1 - l_2 \sin(\theta_1 + \theta_2) \} \dot{\theta}_1 + \{ -l_2 \sin(\theta_1 + \theta_2) \} \dot{\theta}_2 \quad \text{ok!!}$$

$$\frac{dy_p}{dt} = l_1 \cos \theta_1 \dot{\theta}_1 + l_2 \cos(\theta_1 + \theta_2) (\dot{\theta}_1 + \dot{\theta}_2)$$

$$= \{ l_1 \cos \theta_1 + l_2 \cos(\theta_1 + \theta_2) \} \dot{\theta}_1 + \{ l_2 \cos(\theta_1 + \theta_2) \} \dot{\theta}_2 \quad \text{ok!!}$$

input

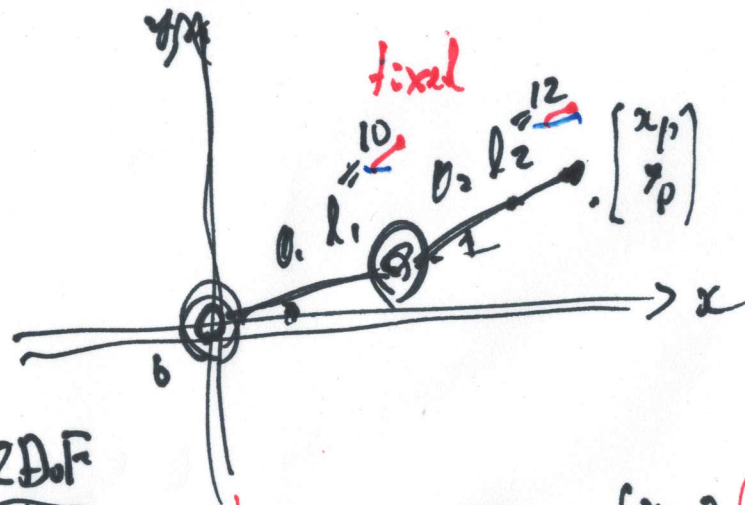
$$\begin{bmatrix} \frac{dx_p}{dt} \\ \frac{dy_p}{dt} \end{bmatrix} = \begin{bmatrix} \frac{dx_p}{dt} \\ \frac{dy_p}{dt} \end{bmatrix} \quad \begin{matrix} 2 \times 1 \\ 2 \times 1 \end{matrix}$$

Jacobian



input

$$\begin{bmatrix} \frac{d\theta_1}{dt} \\ \frac{d\theta_2}{dt} \end{bmatrix} \quad \begin{matrix} 2 \times 1 \\ 2 \times 1 \end{matrix}$$



2DOF
scalar
FK

$$\begin{bmatrix} 0, \\ 0, \end{bmatrix} \quad FK \quad \begin{bmatrix} x_p \\ y_p \end{bmatrix}$$

IK

$$\begin{bmatrix} 0, \\ 0, \end{bmatrix} \quad IK \quad \begin{bmatrix} x_p \\ y_p \end{bmatrix}$$



OK

vector
matrix

FK

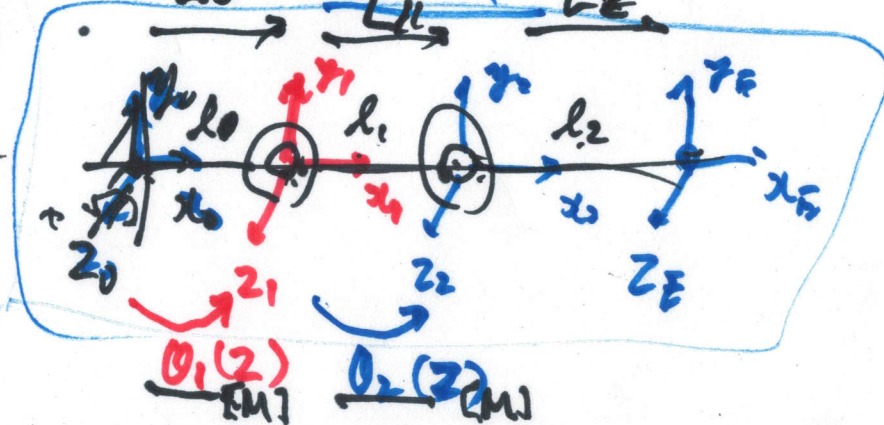
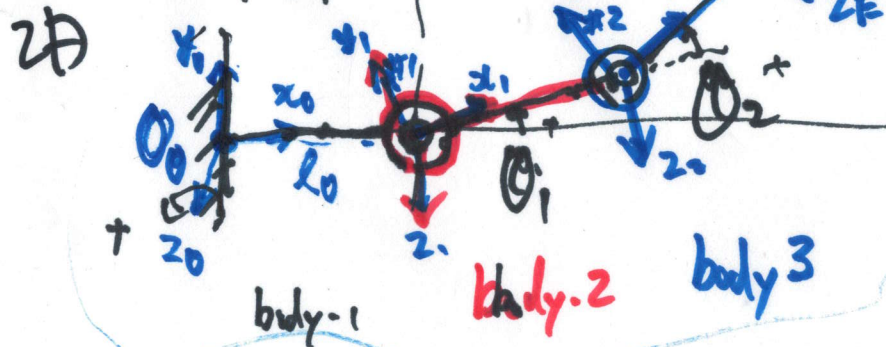


Diagram illustrating the reduction of two matrices C_1 and C_2 to L_1 and L_2 using elementary row operations.

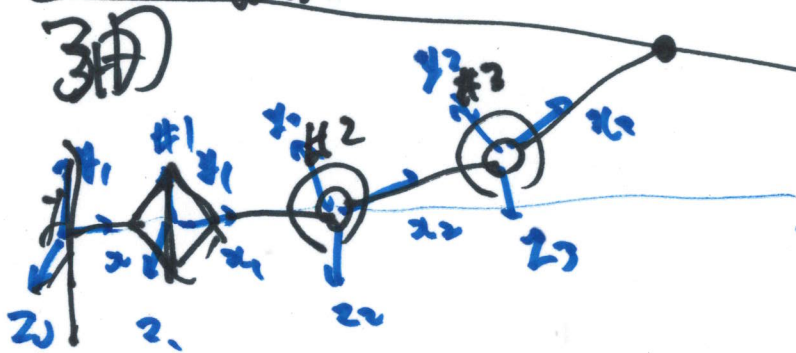
Matrix C_1 is transformed into L_1 by the operation $R_2 \rightarrow R_2 - S_1$.

Matrix C_2 is transformed into L_2 by the operation $R_2 \rightarrow R_2 - S_2$.

$$\begin{bmatrix} x_0 \\ 0 \\ 0 \end{bmatrix} \xrightarrow{C_1} \begin{bmatrix} x_1 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} - \\ - \\ 0 \end{bmatrix}_0 + \begin{bmatrix} - \\ - \\ 0 \end{bmatrix}_0 =$$

FK

articulated robot



value

simple



UIC

HK

2027

2

UIC

HK

2027



simple

value

articulated robot

FK

$$\begin{bmatrix} x_0 \\ 0 \\ 0 \end{bmatrix} \xrightarrow{C_1} \begin{bmatrix} x_1 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} - \\ - \\ 0 \end{bmatrix}_0 + \begin{bmatrix} - \\ - \\ 0 \end{bmatrix}_0 =$$

Diagram illustrating the reduction of a block diagonal matrix to row echelon form. The matrix is partitioned into blocks C_1 and C_2 .

Block C_1 (size $l_1 \times l_1$):

$$\begin{bmatrix} C_1 - S_1 & 0 \\ S_1 & C_1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Block C_2 (size $l_2 \times l_2$):

$$\begin{bmatrix} C_2 - S_2 & 0 \\ S_2 & C_2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Red arrows indicate row operations:

- For C_1 , the first row is swapped with the second row, and the second row is subtracted from the first row.
- For C_2 , the first row is swapped with the second row, and the second row is subtracted from the first row.

The resulting matrix has a staircase pattern of ones on the diagonal.

check