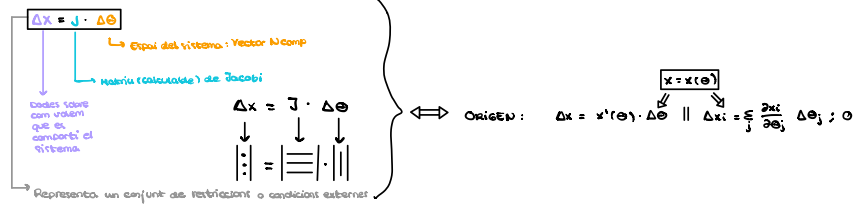


Problema matemàtic:



Solució algorítmica:

$$\Delta \theta = J^T (J \cdot J^T)^{-1} \cdot \Delta x$$

Notes:

- $J \cdot J^T$ : A (n x n)
- $\Delta x$ : Dades o condicions externes
- $B = A^{-1}$

Exercici:  $(\theta_1, \theta_2, \theta_3)$

3 graus de llibertat

$x = x(\theta)$

En  $t=0 \Rightarrow \theta_1 = \theta_2 = \theta_3 = 1$ .

Volem controlar 2 variables externes  $x_1$  i  $x_2$  on  $\dots \rightarrow x_1 = \theta_1 + \theta_2 + \theta_3$

Trobar  $\Delta \theta_j$  tal que:  $\rightarrow \Delta x_1 = 2 \cdot 10^{-2} \quad \Delta x_2 = 0$   $\rightarrow x_2 = \theta_1^2 + \theta_3$

En  $t=0 \rightarrow x_1 = 3 ; x_2 = 1$

En el nostre cas

$$\Delta x = \begin{bmatrix} \Delta x_1 \\ \Delta x_2 \end{bmatrix} = \begin{bmatrix} \frac{\partial x_1}{\partial \theta_1} & \frac{\partial x_1}{\partial \theta_2} & \frac{\partial x_1}{\partial \theta_3} \\ \frac{\partial x_2}{\partial \theta_1} & \frac{\partial x_2}{\partial \theta_2} & \frac{\partial x_2}{\partial \theta_3} \end{bmatrix} \begin{bmatrix} \Delta \theta_1 \\ \Delta \theta_2 \\ \Delta \theta_3 \end{bmatrix}$$

Notes:

- $\Delta x_1 = \theta_1 + \theta_2 + \theta_3$
- $\Delta x_2 = 1\theta_1 + \theta_3$

$$\Delta \theta = J^T (J \cdot J^T)^{-1} \cdot \Delta x$$

$$\Delta \theta = \begin{pmatrix} 2 & 0 \\ 1 & 2 \\ 1 & 1 \end{pmatrix} \cdot \text{inv} \left( \begin{pmatrix} 11 & 1 \\ 0 & 2 \end{pmatrix} \right) \begin{pmatrix} 2 \cdot 10^{-2} \\ 0 \end{pmatrix} = \begin{pmatrix} 5 \\ -1 \\ 2 \end{pmatrix}$$

Notes:

- $\Delta \theta_1 = 5/600 = 0.00833$
- $\Delta \theta_2 = -1/600 = -0.001667$
- $\Delta \theta_3 = 2/600 = 0.00333$

Final values:

- $\theta_1' = 1.00833$
- $\theta_2' = 0.99833$
- $\theta_3' = 1.00333$
- $x_1' = 3.01000$
- $x_2' = 0.999999$

Solució infinita (oo)

$$\Delta \theta = Q \cdot \Delta \theta$$

$\hookrightarrow$  diagonal matrix  $\begin{bmatrix} q_1 & 0 & 0 & \dots & 0 \\ 0 & q_2 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & q_n \end{bmatrix}$

$$\left\{ \begin{array}{l} \theta_1 = q_1 \cdot \Delta \theta_1 \\ \theta_2 = q_2 \cdot \Delta \theta_2 \\ \vdots \\ \theta_n = q_n \cdot \Delta \theta_n \end{array} \right.$$

$$\Delta \theta_{prop} = Q^T \cdot \mathcal{J}^T \cdot (\mathcal{J} \cdot Q^T \cdot \mathcal{J}^T)^{-1} \cdot \Delta x$$

$$\Delta x = (\mathcal{J} \cdot Q^T \cdot \mathcal{J}^T) (\mathcal{J} \cdot Q^T \cdot \mathcal{J}^T)^{-1} \cdot \Delta x \quad \rightsquigarrow \text{les } q_i \text{ permetten restringir sistemes.}$$