Four-bar linkage analysis in natural coordinates

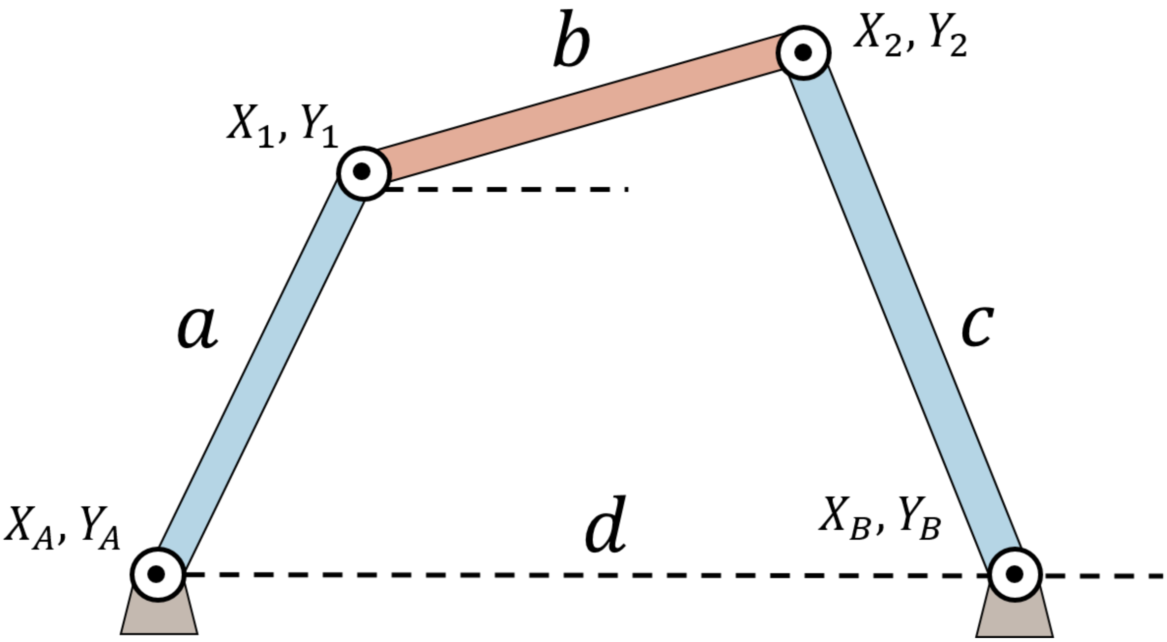

Fig.1 Four bar linkage diagram

Equations

$l = \sqrt[2]{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$l^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$

$$\phi = \begin{bmatrix} (x_1 - x_A)^2 + (y_1 - y_A)^2 - a^2 \\ (x_2 - x_1)^2 + (y_2 - y_1)^2 - b^2 \\ (x_2 - x_B)^2 + (y_2 - y_B)^2 - c^2 \\ x_1 - x_A - \mathrm{a} * \cos\left(\frac{1}{2}\alpha_{initial2}t^2 + \omega_{initial2}t + \phi_{initial2}\right) \end{bmatrix} = 0$$

$$J = \begin{bmatrix} 2(x_1 - x_A) & 2(y_1 - y_A) & 0 & 0 \\ -2(x_2 - x_1) & -2(y_2 - y_1) & 2(x_2 - x_1) & 2(y_2 - y_1) \\ 0 & 0 & 2(x_2 - x_B) & 2(y_2 - y_B) \\ 1 & 0 & 0 & 0 \end{bmatrix} = 0$$

$$\dot{\phi} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ a * \sin\left(\frac{1}{2}\alpha_{initial2}t^2 + \omega_{initial2}t + \phi_{initial2}\right)(\alpha_{initial2}t + \omega_2) \end{bmatrix}$$

$$\dot{J} = \begin{bmatrix} 2\dot{x}_1 & 2\dot{y}_1 & 0 & 0 \\ -2(\dot{x}_2 - \dot{x}_1) & -2(\dot{y}_2 - \dot{y}_1) & 2(\dot{x}_2 - \dot{x}_1) & 2(\dot{y}_2 - \dot{y}_1) \\ 0 & 0 & 2(\dot{x}_2) & 2(\dot{y}_2) \\ 1 & 0 & 0 & 0 \end{bmatrix} = 0$$

$$\ddot{\phi} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ a(\alpha_{initial2}t + \omega_2)^2 * \cos\left(\frac{1}{2}\alpha_{initial2}t^2 + \omega_{initial2}t + \phi_{initial2}\right) + \alpha_{initial2}\mathrm{a} * \sin\left(\frac{1}{2}\alpha_{initial2}t^2 + \omega_{initial2}t + \phi_{initial2}\right) \end{bmatrix}$$

$$t = \frac{-\omega_0 \pm \sqrt[2]{{\omega_0}^2 - 2\alpha_0(\theta_0 - \theta)}}{\alpha_0}$$