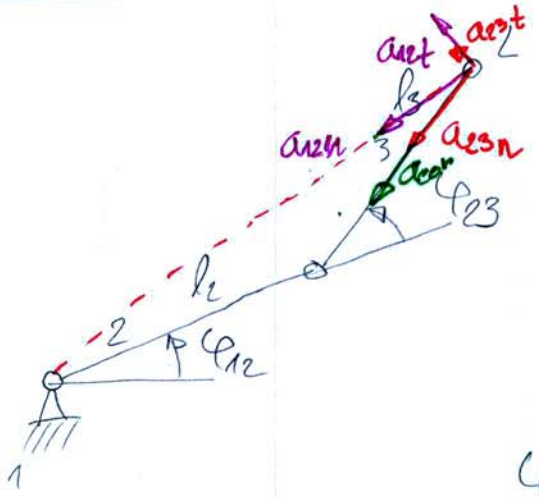

$$\underline{a_{13}} = \underline{a_{12}} + \underline{a_{23}} + \underline{a_{cor}}$$

$t \quad +u \qquad t \quad +u$

$2\omega_{12} \times \underline{v}_{23}$

$(v_{23} = l_3 \cdot \dot{\varphi}_{23})$

$$x_L = l_2 \cdot \cos\varphi_{12} + l_3 \cos(\varphi_{12} + \varphi_{23}) \qquad (\varphi_{13})$$

$$y_L = l_2 \sin\varphi_{12} + l_3 \sin(\varphi_{12} + \varphi_{23}) \qquad (\varphi_{13})$$

$$\dot{x}_L = v_{Lx} = -l_2 \sin\varphi_{12} \cdot \dot{\varphi}_{12} - l_3 \sin\varphi_{13} \dot{\varphi}_{13}$$

$$\dot{y}_L = v_{Ly} = l_2 \cos\varphi_{12} \dot{\varphi}_{12} + l_3 \cos\varphi_{13} \cdot \dot{\varphi}_{13}$$

$$\ddot{x}_L = a_{Lx} = -l_2 \cos\varphi_{12} \dot{\varphi}_{12}^2 - l_2 \sin\varphi_{12} \cdot \ddot{\varphi}_{12} - l_3 \cos\varphi_{13} \cdot \dot{\varphi}_{13}^2 - l_3 \sin\varphi_{13} \cdot \ddot{\varphi}_{13}$$

$$\varphi_{13} = \varphi_{12} + \varphi_{23} \qquad \dot{\varphi}_{13} = \dot{\varphi}_{12} + \dot{\varphi}_{23}$$

$$\dot{\varphi}_{13}^2 = \dot{\varphi}_{12}^2 + 2\dot{\varphi}_{12}\dot{\varphi}_{23} + \dot{\varphi}_{23}^2$$

$$\ddot{x}_L = \underbrace{-l_2 \cos\varphi_{12} \cdot \dot{\varphi}_{12}^2}_{\sim} \underbrace{- l_2 \sin\varphi_{12} \cdot \ddot{\varphi}_{12}}_{-} - \underbrace{l_3 \cos\varphi_{13} \cdot (\dot{\varphi}_{12}^2 + 2\dot{\varphi}_{12}\dot{\varphi}_{23} + \dot{\varphi}_{23}^2)}_{\sim\sim\sim\sim\sim\sim} - \underbrace{l_3 \sin\varphi_{13} (\ddot{\varphi}_{12} + \ddot{\varphi}_{23})}_{= \quad =}$$

$$\underline{\quad} \quad \ddot{\varphi}_{12} (-l_2 \sin\varphi_{12} - l_3 \sin\varphi_{13})$$

$$\sim\sim\sim \quad \dot{\varphi}_{12}^2 (-l_2 \cos\varphi_{12} - l_3 \cos\varphi_{13})$$

$$- - - \quad \dot{\varphi}_{23}^2 (-l_3 \cos\varphi_{13})$$

$$= \quad \ddot{\varphi}_{23} (-l_3 \sin\varphi_{13})$$

$$= = = = \quad 2\dot{\varphi}_{12}\dot{\varphi}_{23} (-l_3 \cos\varphi_{13})$$