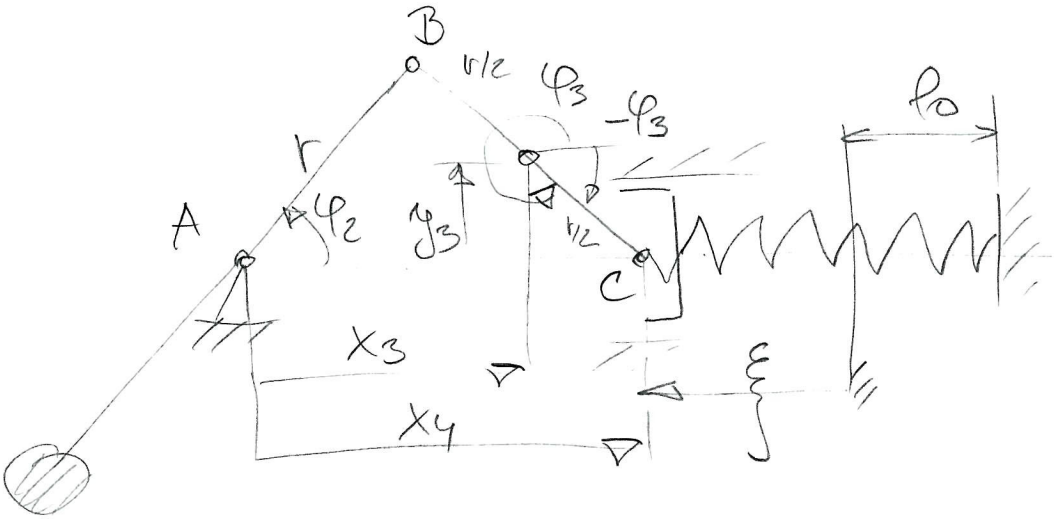
LR smíšené kapitoly

$$\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot{s}_j}\right) - \frac{\partial E_k}{\partial s_j} = Q_j + \sum_{\xi=1}^{\text{počet vazeb. r.}} \lambda_\xi \frac{\partial f_\xi}{\partial s_j} \qquad j = 1, 2, \ldots, \text{počet}$$

Volba souřadnic

$$s = [\varphi_2, x_3, y_3, \varphi_3, x_4]$$



$$E_k = \frac{1}{2} I_{2A} \dot{\varphi}_2^2 + \frac{1}{2} m_3 (\dot{x}_3^2 + \dot{y}_3^2) + \frac{1}{2} I_{3S3} \dot{\varphi}_3^2 + \frac{1}{2} m_4 \dot{x}_4^2$$

$$\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot{s}_j}\right) \frac{\partial E_k}{\partial s_j} = \begin{bmatrix} I_{2A} & & & & \\ & m_3 & & & \\ & & m_3 & & \\ & & & I_{3S3} & \\ & & & & m_4 \end{bmatrix} \begin{bmatrix} \ddot{\varphi}_2 \\ \ddot{x}_3 \\ \ddot{y}_3 \\ \ddot{\varphi}_3 \\ \ddot{x}_4 \end{bmatrix}$$

Zobecnění síly

$$Q_1 \delta s_1 + Q_2 \delta s_2 + Q_3 \delta s_3 + Q_4 \delta_4 + Q_5 \delta s_5 =$$

$$= \theta_2 \delta \varphi_2 - G_3 \delta y_3 - k(2r - x_4)(-\delta x_4)$$

$\xi = 2r - x_4$, $F_p = k \cdot \xi$ $\Rightarrow Q \delta x_4 = -k \cdot \xi \cdot \delta \xi$

$\delta \xi = -\delta x_4$ $\quad Q \delta x_4 = -k(2r - x_4) \cdot (-\delta x_4)$

$$\rightarrow Q = [\theta_2, 0, -G_3, 0, k(2r - x_4)]^T$$

Vazbové podmínky

soustředěné - počet = počet n.r.

$5 - 1 = 4$ n.r.

rotace v B

$$r \cos\varphi_2 + \frac{r}{2}\cos\varphi_3 - x_3 = 0 \quad |f_1|$$

$$r \sin\varphi_2 + \frac{r}{2}\sin\varphi_3 - y_3 = 0 \quad |f_2|$$

rotace v C

$$x_3 + \frac{r}{2}\cos\varphi_3 - x_4 = 0 \quad |f_3|$$

$$y_3 + \frac{r}{2}\sin\varphi_3 = 0 \quad |f_4|$$

Jacobiho matice

$$\underline{\Phi} = \frac{\partial f_k}{\partial s_j}$$

	$\partial\varphi_2$	∂x_3	∂y_3	$\partial\varphi_3$	∂x_4
f_1	$-r\sin\varphi_2$	-1	0	$-\frac{r}{2}\sin\varphi_3$	0
f_2	$r\cos\varphi_2$	0	-1	$\frac{r}{2}\cos\varphi_3$	0
f_3	0	1	0	$-\frac{r}{2}\sin\varphi_3$	-1
f_4	0	0	1	$\frac{r}{2}\cos\varphi_3$	0

PR

$$\underline{\underline{M}}\,\underline{\ddot{s}} + \underline{\underline{\Phi}}^T(-\underline{\lambda}) = \underline{Q}$$