ZADATAK 1.3

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3.AUT 1

- $L(x) = 2\frac{\lambda}{x}$
- $F(i,x) = -\lambda\frac{i^2}{x^2}$

(1) $m\ddot{x} = mg + F \rightarrow m\ddot{x} = mg - \lambda\frac{i^2}{x^2}$

(2) $u = Ri - \frac{d}{dt}(L(x)i) = Ri - \frac{2\lambda i}{x^2}\dot{x} + \frac{2\lambda}{x}(\dot{i})$

(a) $\dot{x} = f(x,u)$

$x_1 = x, \quad x_2 = \dot{x}, \quad x_3 = i$

$\hookrightarrow x_2 = \dot{x}_1$

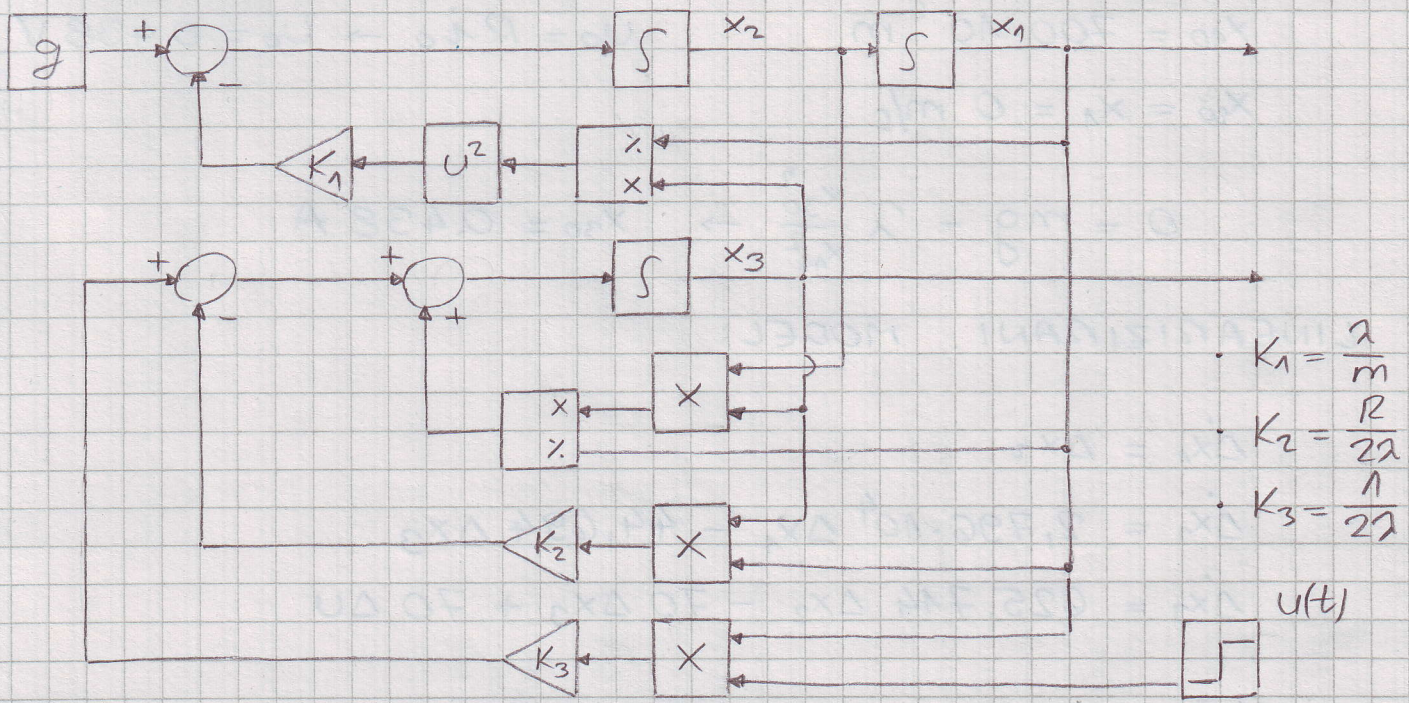
$m\dot{x}_2 = mg - \lambda\left(\frac{x_3}{x_1}\right)^2 \rightarrow \dot{x}_2 = g - \frac{\lambda}{m}\left(\frac{x_3}{x_1}\right)^2$ (1)

$u = Rx_3 - 2\lambda\frac{x_3x_2}{x_1^2} + 2\lambda\frac{1}{x_1}\cdot\dot{x}_3$

$\dot{x}_3 = 2\lambda\frac{x_2x_3}{x_1^2}\cdot\frac{1}{2\lambda}x_1 - Rx_3\cdot\frac{1}{2\lambda}x_1 + u\cdot\frac{1}{2\lambda}x_1$

$\dot{x}_3 = \frac{x_2x_3}{x_1} - \frac{R}{2\lambda}x_1x_3 + \frac{1}{2\lambda}x_1u$ (2)

$\dot{x}_1 = x_2$ (3)



- $K_1 = \frac{\lambda}{m}$
- $K_2 = \frac{R}{2\lambda}$
- $K_3 = \frac{1}{2\lambda}$

(c) $x_0 = 700 \cdot 10^{-6}\ m$

$\lambda = 5 \cdot 10^{-6}\ Nm^2A^{-2}$

$R = 1\Omega$

$m = 92\ kg$

$g = 9{,}81\ ms^{-2}$

(1) $\Delta\dot{x}_1 = \Delta x_2$

(2) $\Delta\dot{x}_2 = -\frac{\lambda}{m} x_{30}^2 \cdot (-2) \frac{1}{x_{10}^3} \Delta x_1 - \frac{\lambda}{m} \frac{1}{x_{10}^2} \cdot 2 x_{30} \Delta x_3$

$\Delta\dot{x}_2 = \frac{2\lambda}{m} \frac{x_{30}^2}{x_{10}^3} \Delta x_1 - \frac{2\lambda}{m} \frac{x_{30}}{x_{10}^2} \Delta x_3$

(3) $\Delta\dot{x}_3 = \frac{x_{30}}{x_{10}} \Delta x_2 + \frac{x_{20}}{x_{10}} \Delta x_3 - \frac{x_{20} x_{30}}{x_{10}^2} \Delta x_1 - \frac{R}{2\lambda} x_{30} \Delta x_1$

$- \frac{R}{2\lambda} x_{10} \Delta x_3 + \frac{1}{2\lambda} x_{10} \Delta U + \frac{1}{2\lambda} U_0 \Delta x_1$

$\Delta\dot{x}_3 = \left(- \frac{x_{20} x_{30}}{x_{10}^2} - \frac{R}{2\lambda} x_{30} + \frac{1}{2\lambda} U_0 \right) \Delta x_1 + \frac{x_{30}}{x_{10}} \Delta x_2$

$+ \left(\frac{x_{20}}{x_{10}} - \frac{R}{2\lambda} x_{10} \right) \Delta x_3 + \frac{1}{2\lambda} x_{10} \Delta U$

STACIONARNJE STANJE:

$x_{10} = 700 \cdot 10^{-6}\ m$ $\qquad U_0 = R i_0 \rightarrow U_0 = 0.438\ V$

$x_{20} = \dot{x}_1 = 0\ m/s$

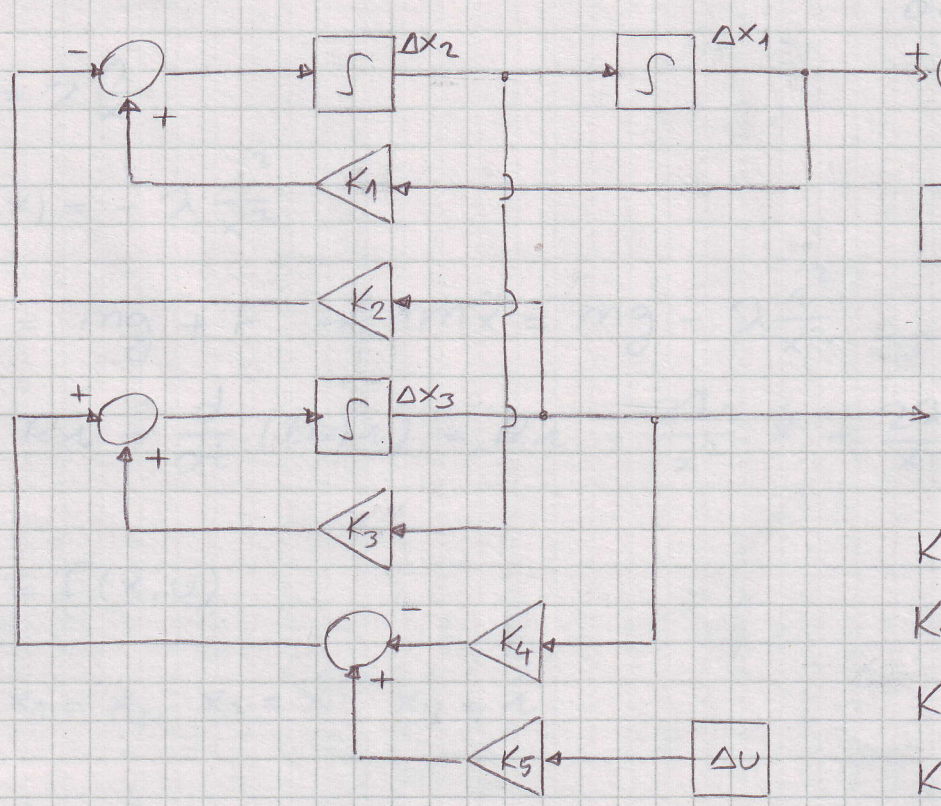
$0 = mg - \lambda \frac{x_{30}^2}{x_{10}^2} \rightarrow \quad x_{30} = 0.438\ A$

LINEARIZIRANI MODEL:

$\Delta\dot{x}_1 = \Delta x_2$

$\Delta\dot{x}_2 = 2{,}796 \cdot 10^4 \Delta x_1 - 44{,}694 \Delta x_3$

$\Delta\dot{x}_3 = 625{,}714 \Delta x_2 - 70 \Delta x_3 + 70 \Delta U$



$K_1 = 2{,}796 \cdot 10^4$

$K_2 = 44{,}694$

$K_3 = 625{,}714$

$K_4 = K_5 = 70$