

T4 Homework

1. (1 point) Please find the equilibrium points of the nonlinear models written below for:

a) $\bar{u} = 1$

$$\dot{x}_1(t) = -x_2(t) + 5u(t)$$

$$\dot{x}_2(t) = x_1^2(t) - x_1(t) - 6$$

b) $\bar{u} = -2$

$$\dot{x}_1(t) = x_1^2(t) - 3x_1(t) - 4$$

$$\dot{x}_2(t) = x_2(t) + 2u(t)$$

2. (1.5 points) Please find the nonlinear static characteristic of the following nonlinear model:

$$\dot{x}_1(t) = x_1(t) - 2x_2(t) + 4u^4(t)$$

$$\dot{x}_2(t) = 3x_1(t) - 5x_2(t)$$

$$y(t) = \cos(3x_1(t))$$

and linearize the characteristic at the equilibrium point \bar{u} .

3. (1.5 points) Dynamic process (pendulum) can be described as the following state-space nonlinear model:

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

$$\dot{x}_2(t) = \frac{1}{J}(-mgl\sin(x_1(t)) + u(t) - bx_2(t))$$

$$y(t) = x_2(t)$$

where: b , g , J , l and m are constants.

Please write down the source of nonlinearity of this model and linearize it.

Finding formula for equilibrium points is not needed in this exercise.

Hint: Think carefully what needs linearization and what does not need it.

The answer is simpler than it seems.

Max. of 4.0 points can be obtained from this homework. **Remember to clearly explain your whole process of finding the answer to the above tasks and not write down just the final answers.** Please upload all answers and signed declaration (declaration_EDYCO.pdf downloaded from MsTeams) in **one .pdf file (must be below 3mb size)** to "Reports" module on Studia website. **Homeworks without signed declaration or in wrong file format will not be checked.** The deadline is until 20.11.2020, 23.59.