TTK4225 System theory, Autumn 2023

Assignment 7

The expected output is a .pdf written in LaTeX or a Python notebook exported to .pdf, even if photos of your handwritten notes or drawings will work. Every person shall hand in her/his assignment, independently of whether it has been done together with others. When dealing with mathematical derivations, unless otherwise stated, explain how you got your answer (tips: use programming aids like Python, Matlab, Maple, or compendia like Rottmann's to check if you have obtained the right answer).

Question 1

Characterize and draw qualitatively the free evolution of the system

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 2 & 5 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

from a generic initial condition in $\mathbb{R}^2$. All the derivations should be done by hand. For every quantity you use in the derivations, provide its mathematical definition, its geometrical description, plus comment what is the purpose and meaning from control perspectives.

Question 2

Describe why in your opinion at this point of the course you cannot do the same characterization of the system above when considering

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

from a generic initial condition in $\mathbb{R}^2$, but only from a specific subset (which one, by the way?). What can you though say about the stability properties of the origin?