

Math 462, Name:
Matlab Assignment II

1) Study the following systems.

a) $\frac{dx}{dt} = -x, \frac{dy}{dt} = -y$
b) $\frac{dx}{dt} = -x, \frac{dy}{dt} = -2y$
c) $\frac{dx}{dt} = -x, \frac{dy}{dt} = y$

The next examples look at differences between the phase plot of a non-linear system and that of its linearization. Pay careful attention to the length of time you can run your model to obtain the same qualitative behavior. In each case, use the tools that you are learning in class to assist with your decisions for making the phase portraits and plot the phase portraits for the given non-linear systems and then determine its linearized system, if possible, and plot the phase portraits for this linearized system. Discuss what is the same and what is different. Assume each equation is non-dimensional, i.e., there are no dimensions to consider.

2a) (only study origin)

$$\begin{aligned} \dot{x}_1 &= -x_2 + x_1(x_1^2 + x_2^2) \\ \dot{x}_2 &= x_1 + x_2(x_1^2 + x_2^2) \end{aligned}$$

2b) (study all fixed points)

$$\begin{aligned} \dot{x}_1 &= \sin x_1 \\ \dot{x}_2 &= -\sin x_2 \end{aligned}$$

2c) (study all fixed points)

$$\begin{aligned} \dot{x}_1 &= x_1 - x_2^3 \\ \dot{x}_2 &= x_2 + x_1^3 \end{aligned}$$

1d) (study all fixed points)

$$\begin{aligned} \dot{x}_1 &= \frac{1}{2}(x_1 + x_2) + x_1^2 \\ \dot{x}_2 &= \frac{1}{2}(3x_2 - x_1) \end{aligned}$$

2e) (only study the origin)

$$\begin{aligned} \dot{x}_1 &= x_1 + 4x_2 + e^{x_1} - 1 \\ \dot{x}_2 &= -x_2 - x_2 e^{x_1} \end{aligned}$$