

Virtual Physics

16.12.2014

Exercise 10: Stability Analysis

Task 1: (from Exam WS 2011/2012)

Given is the following system in ODE-form

$$dx/dt = y/4$$

$$dy/dt = -x^2 - x - y$$

There are two equilibrium points where the system remains in steady-state. These are

$$x=0, y = 0;$$

and

$$x = -1, y=0;$$

Linearize the system around these two equilibrium points and state for each equilibrium point if it is stable, marginally stable or unstable. Make an eigenvalue analysis for this purpose.

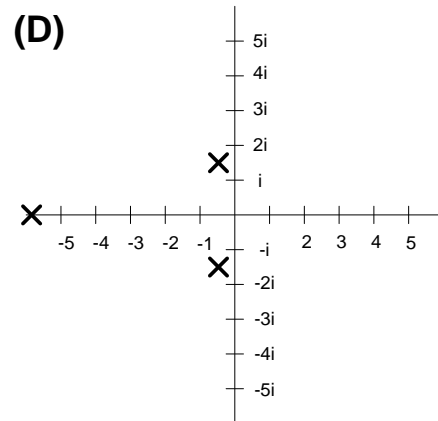
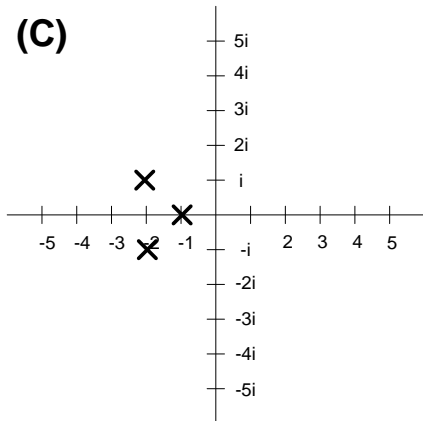
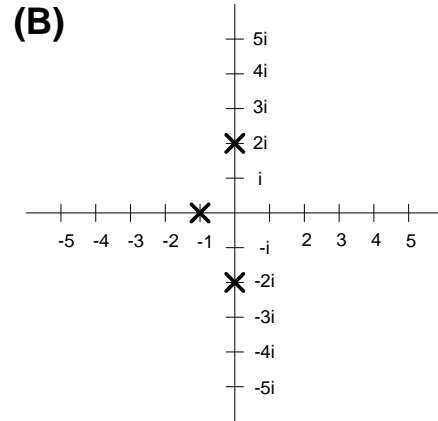
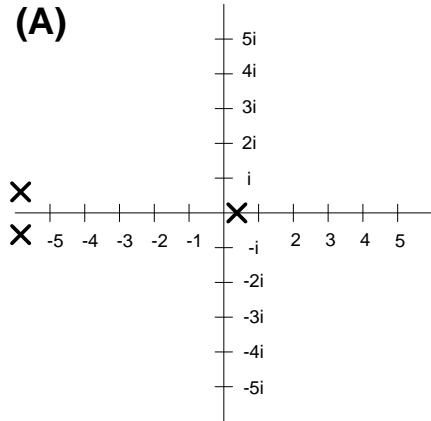
Hint: For the linearization find a matrix A such that

$$\begin{pmatrix} dx/dt \\ dy/dt \end{pmatrix} = \begin{pmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

is a local approximation of the system

Task 2: (reduced version from Exam WS 2010/2011)

The eigenvalues of four linear systems ($dx/dt = Ax$) are depicted.



Mark what is true (12 points):

	A	B	C	D
The system is stable				
The system is unstable				
The system is marginally stable				