

Nonlinear Dynamics and Chaos – Group Work

Professor:

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Group Work Day 7

Consider the system:

$$\dot{x} = rx + \frac{x^3}{1+x^2}$$

Your goal is to completely analyze the system. Please do the following:

1. Solve for the fixed points. Be prepared to discuss how you found your fixed points. Decide on the possible cases for r . How did you figure this out? Based just on fixed points, do you have predictions for the type of bifurcation this is?
2. Draw Flow diagrams ($\dot{x}$ vs x) for each distinct case for r . Say in words what is happening to the fixed points. Stable? Unstable? Moving toward or away? Based on this additional information, do you have predictions for the type of bifurcation?
3. Draw the bifurcation diagram (x^* vs. r), remember to include stability information. Be prepared to explain how you got the graph that you did. From looking at the Bifurcation Diagram, say what is happening in the system for a variety of initial x values and choices for r . What type of bifurcation?
4. Use the Taylor series about $x = 0$ to confirm both your bifurcation point and the type of bifurcation.

When we get back together to present to the class I will assign each group to present one part of the problem.