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Final Project Proposal

1 Project goal

This project uses Finite-Time Lyapunov Exponent (FTLE) as an approach to study the behaviors of a dynamic system, which could be a circuit system, a chemical reaction or even a single set of equations. However, in our project, we are going to analyze Double Gyre. We use the Shadden's method to compute FTLE and as well make a short animation.

2 Team Members and roles

Jialun Bao: analyze system equations, and write code for solving FTLE and making animation.

Jerry Qiu: animation for vector field and tracer particle.

3 Ph 235 related topics

RK4 method for solving partial differential equations and updating state.

Discrete method to compute partially derivative for PDE.

Density plot and animation on python.

Making a small video using movie maker.

Using quiver to draw vector field.

4 Final demo

First, we will show a vector field of a dynamic system with help arrows for visualization, in which two particle separated by small distance are dropped. Then they will diverge as time goes, showing the chaotic behavior of the system. Ideally, it could as many particles as possible, and we would be able to choose initial position for them as well.

Then we will move on to another aspect: the finite time lyapunov exponent field of the system. The LCS is then identified through local extrema, which shows the local attracting or local repelling.

In the end, we will show the a short video of time-variant FTLE field, which will probably be around 10s due to the intensive computation.

5 Evaluation

The evaluation will mainly based on the speed of the simulation, and the accuracy. Also the speed and accuracy of the simulation are closely related to the resolution, which we might also take some consideration– if we could get some clear graphes. In the very end, all the number and animation have to somehow show that the system is chaotic, since we choose a chaotic system at the first place.

6 Time schedule

11/6 In class presentation
11/6 Finish vector field animation (done)
11/23 One page update
11/30 Finish FTLE calculation and animation
12/4 In class update
12/11 Final presentation

12/18 Final Project deliverables