

CS453/553 Scientific Visualization

Project 3

Due 11:59 pm November 11, 2022

The purpose of the this project is to help you

- (1) be able to compute a streamline given an initial point
- (2) be able to extract vector field topology including singularities and separatrices.
- (3) experience generating a good visualization using evenly-spaced streamlines.

Detailed tasks are listed below. Please submit everything necessary to compile and run your program, and a project report that contains results and discussions. Feel free to explore and have fun!

1. Select three of your favorite images or photos.
 - a. For each image, treat it as the initial noise to the IBFV algorithm. Next, select one of the vector fields from the vector_data folder. Then, run IBFV. What does the result look like? Can you make some observations about what IBFV can do with photos as input instead of noise?
 - b. Which vector field from the vector_data folder works the best for each image?
 - c. Extract the edge field from the image using the Sobel filter. Visualize this edge field using the initial noise texture to the IBFV algorithm.
 - d. Use this edge field as the vector field and run IBFV again, this time with your favorite images as the input noise. Compare this result with that from part (b). Which vector field is better? Why do you think this happens?
2. Provide the following capabilities given a vector field:
 - a. Extract all the singularities. For each singularity, determine its type, i.e. source, sink, saddle, center, focus. Visualize this information.
 - b. Allow the user to select a point in the domain through picking and compute the streamline (both forward and backward in time) containing the point.
3. For each given vector field data from the vector_data folder,
 - a. Use your program to visualize all singularities (location and type) on top of IBFV visualization of the same field. Do the singularities that you extracted match the IBFV visualization result? If not, reason why this may occur.
 - b. Generate a streamline-based visualization by manually selecting a set of seed points. Also visualize the singularities including their types. Discuss the strengths and weakness of such an approach versus IBFV.
 - c. **(553 students only)** Enhance the visualization in (b) by first visualizing all separatrices and singularities before adding additional streamlines. Compare this technique to the one without using vector field topology.