

# Glyph Design - The Visualization of The Hurricane Isabel

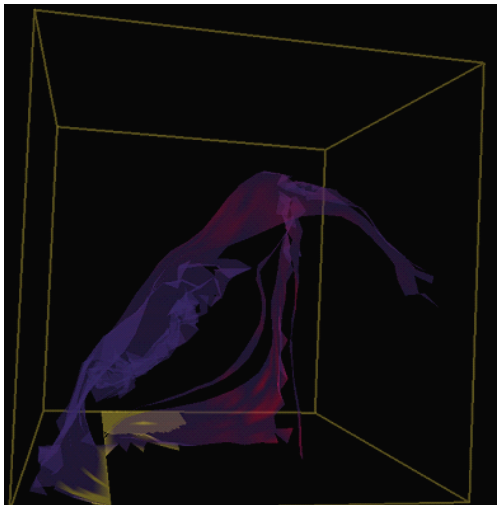
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The purpose of this project is the glyph design in the visualization of numerical data. Glyph is a visual object for the representation of a piece of data, where the attributes and the inter-relationship of the data are depicted as visual elements of the glyphs, e.g. color, shape, spatial arrangement, ...etc. Glyph is a useful means to visualize the multivariate data.

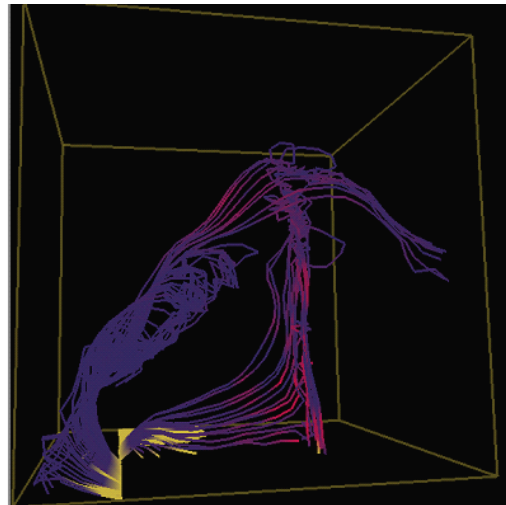
In this project, a flow visualization of the Weather Research and Forecasting (WRF) Model simulation data of Hurricane Isabel( published on <http://www.vets.ucar.edu/vg/isabeldata/readme.html>) is implemented.

Among all the other variables of the data, only the wind velocity is visualized in this project. There are two forms of visualizations of the data:

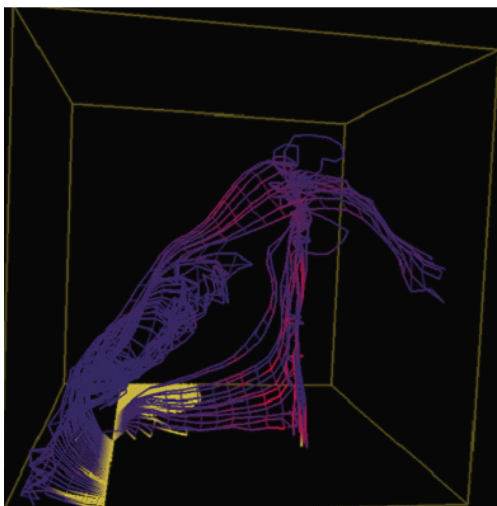
## 1. **Streamsurface:**



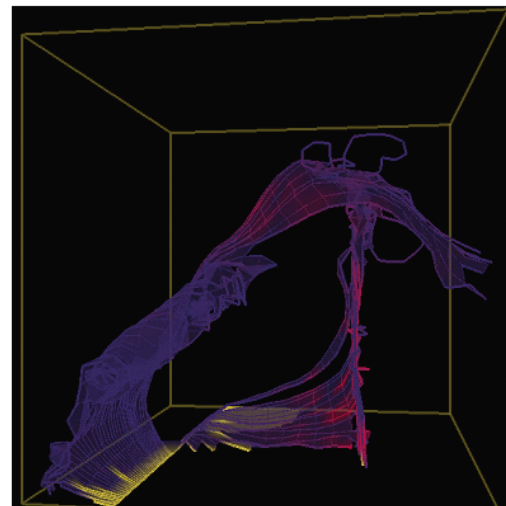
(a)



(b)

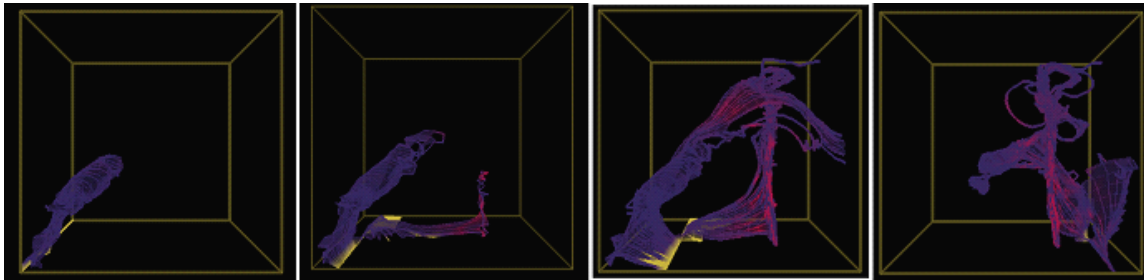


(c)

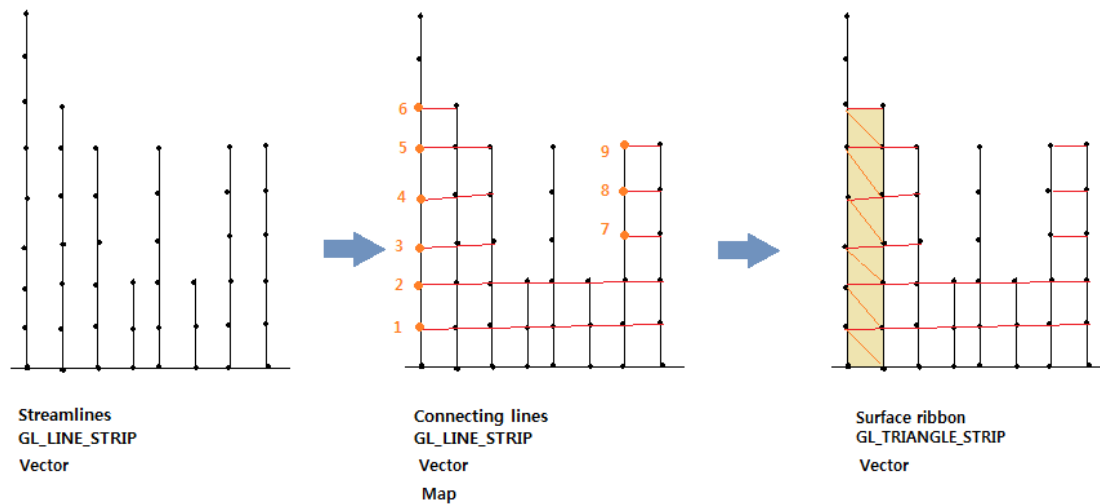


(d)

The appearance of the streamsurface can be displayed either as (a) a surface, or (b) a set of streamlines, or (c) a wireframe view, or (d) a combination of these. The color depicts the speed of the wind, red for the strong speed, and purple for the weak speed. The yellow color depicts the missing data from the data set.



The seed points are placed in a line parallel to the z axis. As this line slides along the x axis, the streamsurface evolves accordingly.



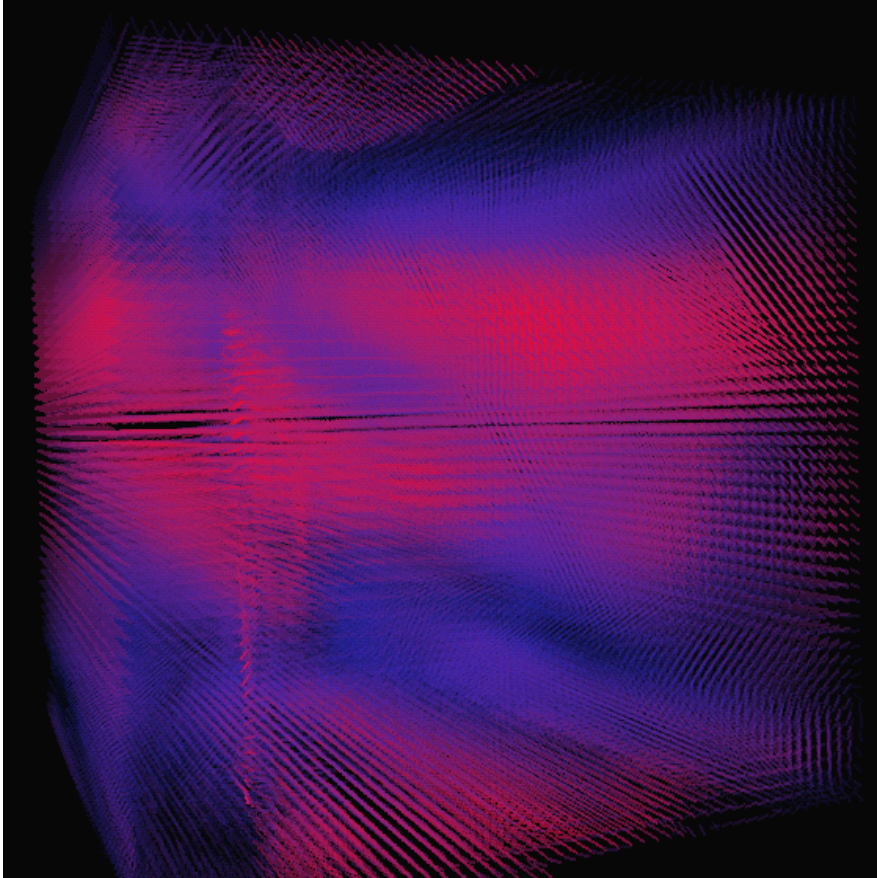
The streamsurface is generated in the following way: 1) After a set of seed points are determined, streamlines are generated from these seed points, using runga kutta 4<sup>th</sup> order integration. If the velocity at a seed point is going downward, the integration is done in the reverse direction. The streamlines are stored in a vector, and are drawn as line strips. 2) The connecting lines are generated by connecting the points of the same levels of every two neighboring streamlines. A map is used to store the indices of each connecting line, because multiple connecting lines may exist for one level. The connecting lines are stored in a vector, and are drawn as line strips. 3) Using the same set of points as the connecting lines, a surface ribbon can be generated by drawing the points as triangle strips.

Convergence of the streamlines are treated by setting a threshold of integration steps.

Divergence of the streamlines are treated by comparing the vertical distance (difference in the y components) of two neighboring points. If the distance is greater than the threshold, then the two points are not connected and no surface is generated between the streamlines starting from these two points.

## 2. The Velocity Field

The velocity field is visualized by means of a set of direction lines. The lines are generated in the geometry shader, with the direction denoting the wind direction at the corresponding location, and the color denoting the speed of the wind, red for the strong speed, and purple for the weak speed.



### User Documentation:

The hurricane data is loaded automatically by the start of the program.

User interactions:

- Home: Switch between the streamsurface view and the velocity field view.
- Left: Move the seed points of the streamsurface forward along the x axis.
- Right: Move the seed points of the streamsurface backward along the x axis.
- Up: Move forward along the z axis.
- Down: Move backward along the z axis.
- Page up: Rotate clockwise
- Page down: Rotate counterclockwise
- F1: Switch on/off the connecting lines
- F2: Switch on/off the streamlines
- F3: Switch on/off the streamsurface