

ASSIGNMENT-2 REPORT

Description: - Vector field visualization of wind speed using hedgehog, streamlines, streaklines, and LIC, with color mapping

Data Set Information:- The data set is a simulation of a hurricane from the [National Center for Atmospheric Research](#) in the United States.

Data Format

A summary of the data can be found below:

- **Dimensions:** 500 x 500 x 100
- **Physical Scale:** 2139km (east-west) x 2004km (north-south) x 19.8km (vertical) Note: The east-west distance of 2139km is measured at the southern latitude; the distance is only 1741km at the northern latitude due to the curvature of the earth.
- **Physical Location:** Longitude (x): 83W to 62W; Latitude (y): 23.7N to 41.7N; Height (z): 0.035km to 19.835km
- **Format:** The data is in "Brick-of-Floats" format. It consists of a volume of data values at each position in space. The three-dimensional array of data consists of planes of x-y values in ascending z order; in the data, the x values vary fastest. Assuming the data was stored as a one-dimensional array, the index into that array for the point x, y, z would be:

$$index = x + dim_x \times (y + dim_y \times z)$$

where dim_x is the number of x values (500) and dim_y is the number of y values (500).

Visualization Algorithm And Implementation: -

1. Hedgehog Visualization:- The Wind direction is findout using the angle in between the wind speed in X and Y direction. Then according the vector magnitude and the direction the vector glyphus are created. Then color mapping is given based on the magnitude of vector.

2. Streamline Visualization:- Streamlines are curves which tangent to the wind speed vector at any point in the flow. These curves shows the direction a fluid element will travel in at any point in time. The streamlines are implemented using the polylines. Start from a seed point then applied Euler's first order. For every segment find the curve which tangent to the wind speed. These segments form the polyline. The color mapping is done using the Heatmap and its based on vector magnitude.

3. LIC visualization:- This is implemented based on the algorithm proposed by Brian Cabral and Leith (Casey) Leedom in the paper "Imaging Vector Fields Using Line Integral Convolution".

-It employs a low-pass filter to convolve an input noise texture along pixel-centered symmetrically bi-directional streamlines to exploit spatial correlation in the flow direction. For each pixel of the output LIC image, the contributing or correlated pixels are first located along the bi-directionally advected streamline and then the associated noise texture values are referenced for convolution.

Insights :-

1. Hedgehog visualization is collection of arrows with magnitude and direction, So it gives the direction of wind at corresponding position. The color mapped arrows are used. So the heatmap is used to implement color mapping. The red, green and blue indicate the high, medium and low wind speed.

2. Streamlines gives the flow of wind travel at any point of time. In this color-map is implemented using Heatmap.

3. LIC is visualize the wind movement of whole dataset. Here also the color represents the wind speed at particular point.