

# Oblig UniK 4660 - Visualization of vector fields

In this exercise you are visualizing vector fields using two different methods - a geometric method using field lines and a texture based method using Line Integral Convolution (LIC). In exercise 1, vector fields are to be visualized using field lines. In the second exercise you are going to use LIC.

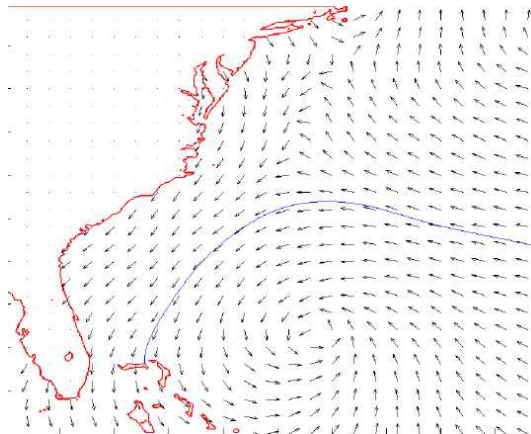
The exercises consist in implementation of both techniques, comparing the results and finally to summing up the results in a report.

## Exercise 1

In the first exercise you are going to do the following 3 tasks:

1. Write a program that reads two vector data sets stored in HDF5.
2. Make a field line integrator based on both forward Euler and on the 4'th order Runge Kutta integration method.
3. Visualize the two vector fields using field lines. Try out various seed point strategies. Seed points are start points for the field lines to be computed. The visualization result depends strongly on the selection of seed points. In addition, try out the effect of varying the lengths of the field lines. Also you are encouraged to test out various integration schemes (first order Euler or fourth order Runge Kutta).

Figure 1 shows a simple filed line for one of the data sets.



Figur 1: Isabel data visualization using field lines and arrows.

## Exercise 2

In the second exercise you are going to visualize the same two vector fields using LIC (Line Integration Convolution). The results obtained in exercise 1 will be useful. Your answer is going to cover what follows:

1. Introduction - Write a short introduction about LIC by describing the LIC algorithm. Do present the most relevant formulas.
2. Tell short about your LIC implementation.
3. Compare the results obtained by Euler and Runge Kutta integration methods.
4. Try out various lengths on the LIC filter core and compare the results. Compare the efficiency.
5. Compare the result from exercise 1 and 2, i.e compare the geometric field lines with LIC textures.
6. Write a short conclusion/summary.

## 1 Data

The two datasets to be used in the exercise is taken from weather simulations. They can be down loaded from:

<http://prosjekt.ffi.no/unik-4660/oblig/>

The first data set is generated by a forecast model at developed using the Weather Research and Forecasting model (WRF) of university of Washington, while the second data set is a simulation of a tropical hurricane done by “National Center for Atmospheric Research”.

OBS!!!!

Both datasets are stored a one-dimensional arrays, but with a significant difference. In the WRF data set (metsim) the x-index is the first index, while in the Isabel data set the y-index is the first index. You can put the data in a two dimensional array as follows:

Isabel:

```
for (int i = 0; i < dim[0]; i++)
  for (int j = 0; j < dim[1]; j++) {
    I[i][j] = dataarray[ j + (i * dim[1])];
  }
```

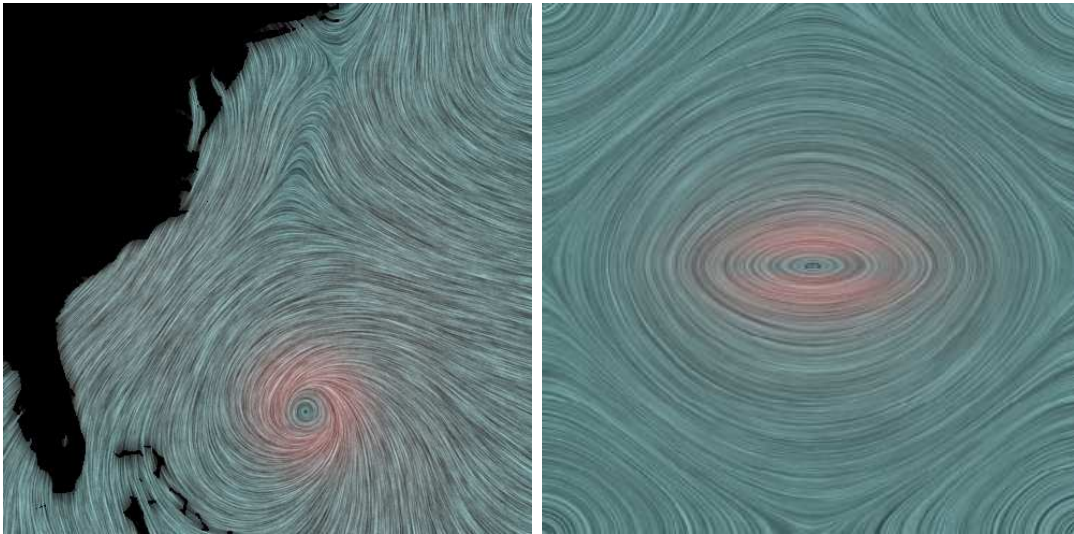


Figure 2: LIC-images of Isabel (right) and metsim (left).

```

metsim:
for (int j = 0; j < dim[1]; j++)
  for (int i = 0; i < dim[0]; i++) {
    I[i][j] = dataarray[ i + (j * dim[0])];
  }

```

In Figure 2 are shown LIC pictures of the two vector fields. These pictures can be used to check whether you have done the coding right.