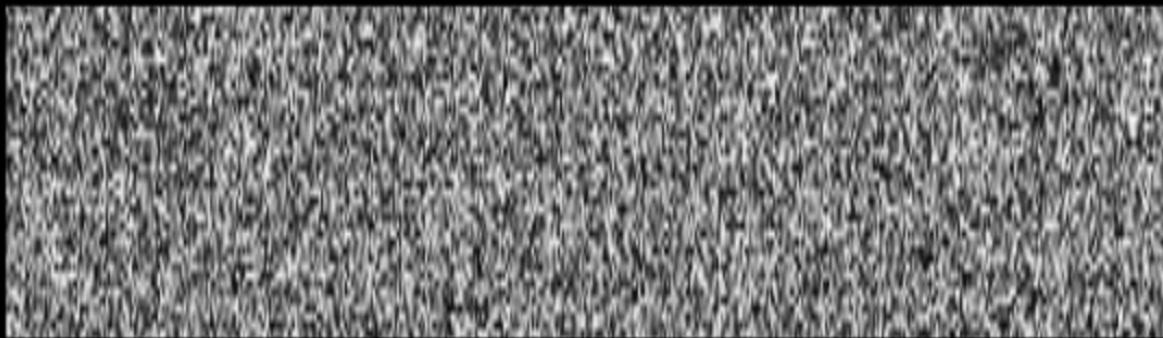


Fluid Fluid Visualization using Line Integral Convolution

By Kalin Johnson

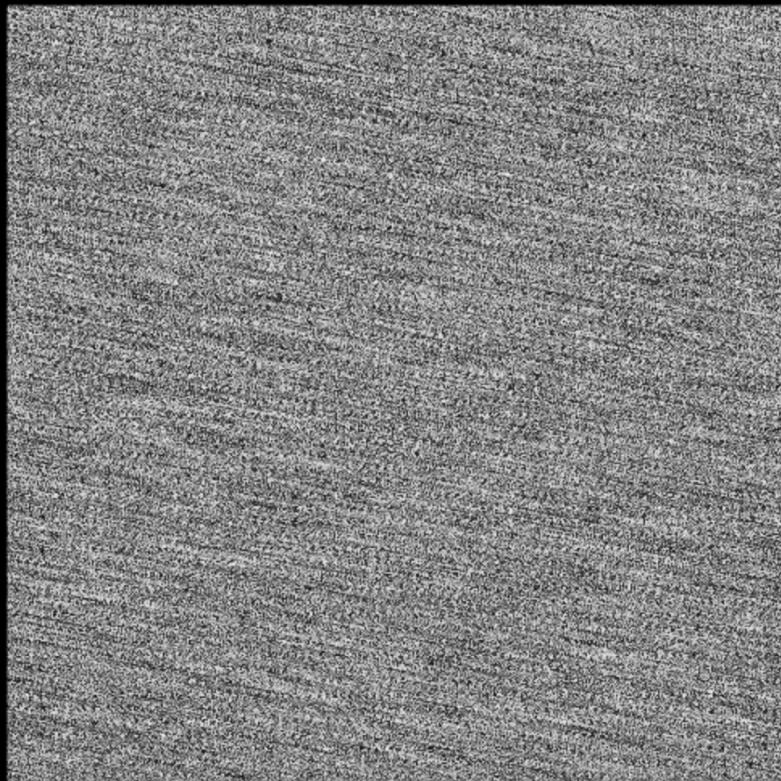
Small Base Noisy Image

Fluid Flow Visualization with Line Integral Convolution



Noisy Image Smeared in the Same Direction

Fluid Flow Visualization with Line Integral Convolution

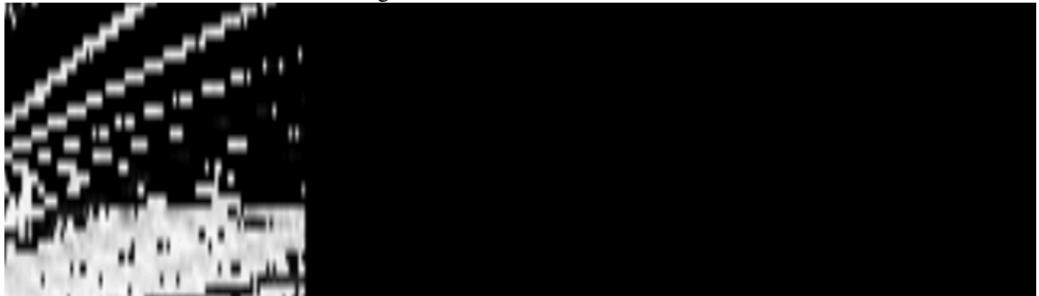


For this project I smeared a noisy image in the direction the fluid was flowing by calculating streamlines and then sampling along the streamline.

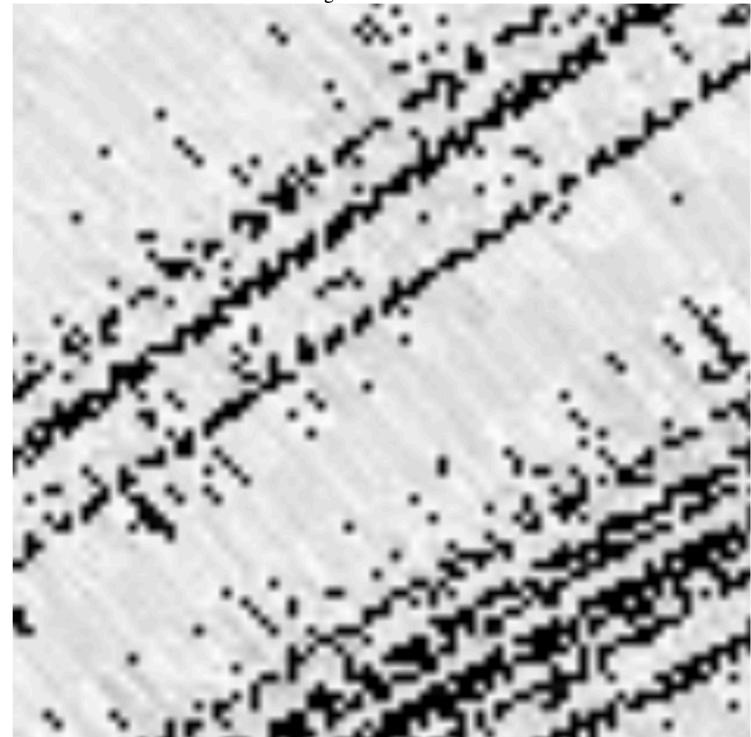
To view the other slides use the **up and down arrows** on the keyboard

Examples of Output from Intermediate Steps during Debugging

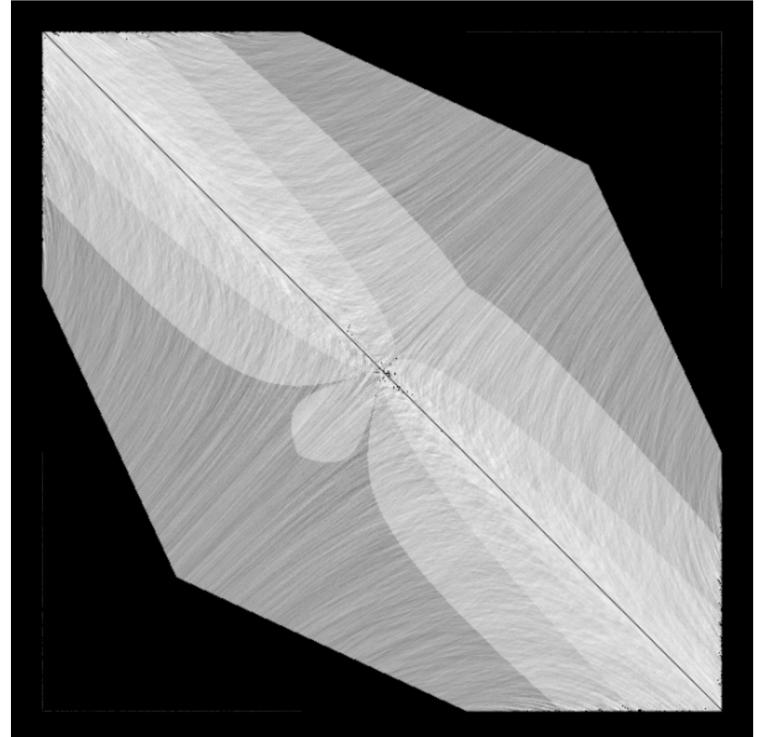
Fluid Flow Visualization with Line Integral Convolution



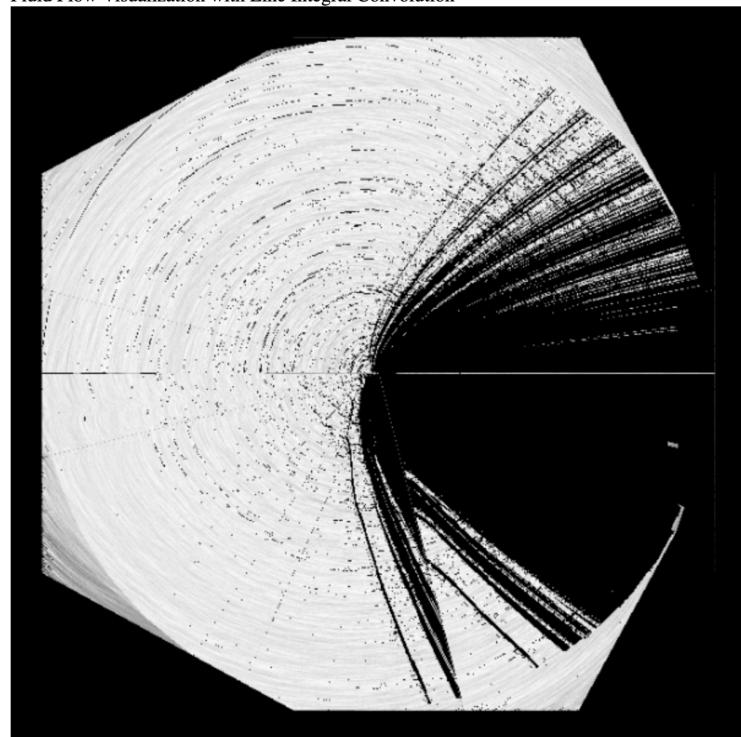
Fluid Flow Visualization with Line Integral Convolution



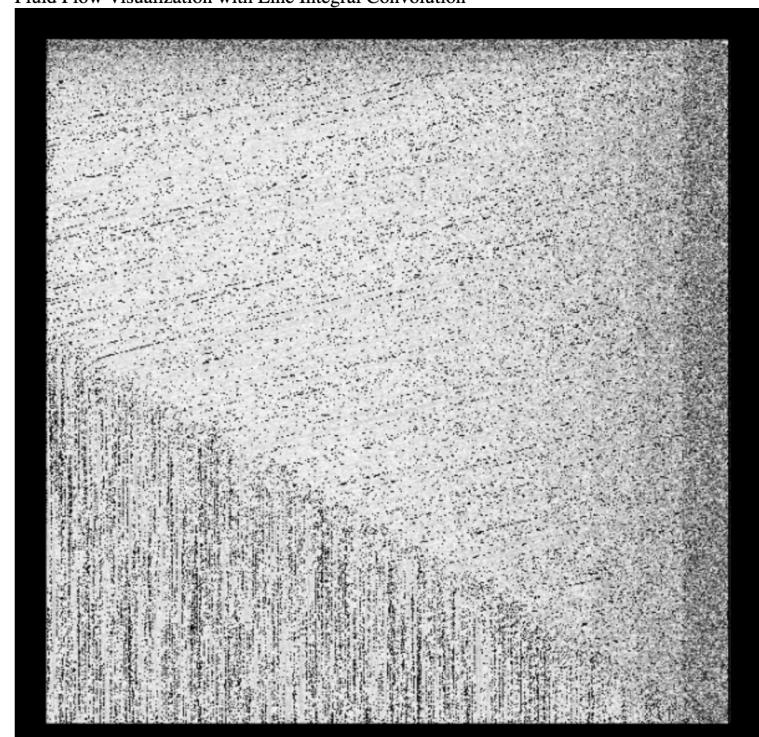
Fluid Flow Visualization with Line Integral Convolution



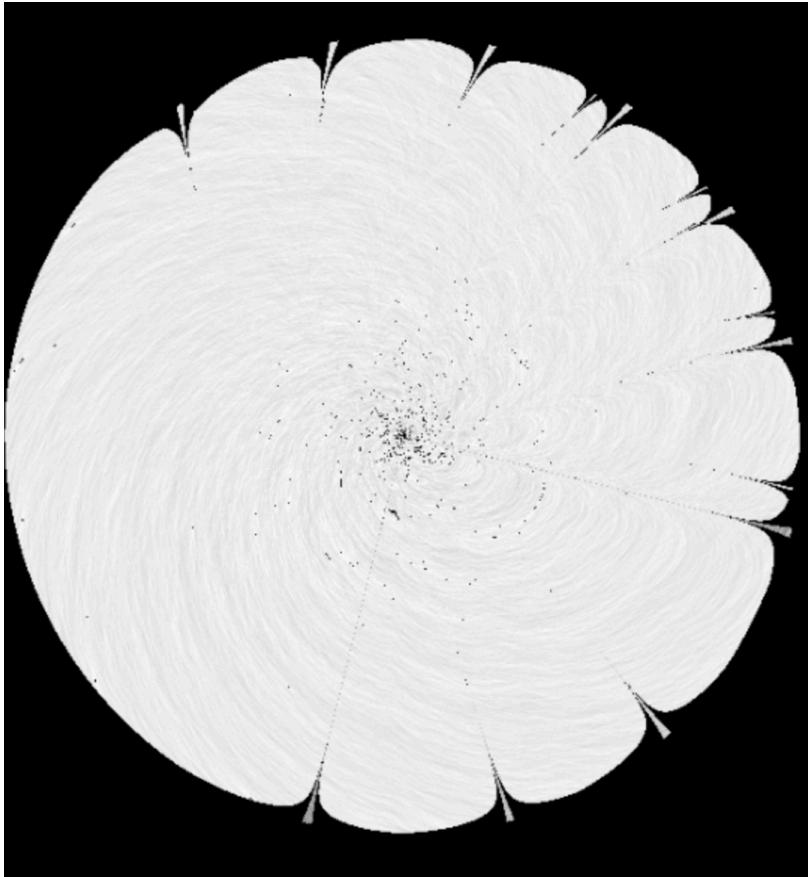
Fluid Flow Visualization with Line Integral Convolution



Fluid Flow Visualization with Line Integral Convolution



Spiral Fluid Flow: Completed Image



Definitions:

Streamline = Direction a fluid flow is moving

Mathematical Methods

Runge Kutta was used to find the streamline originating at each pixel.

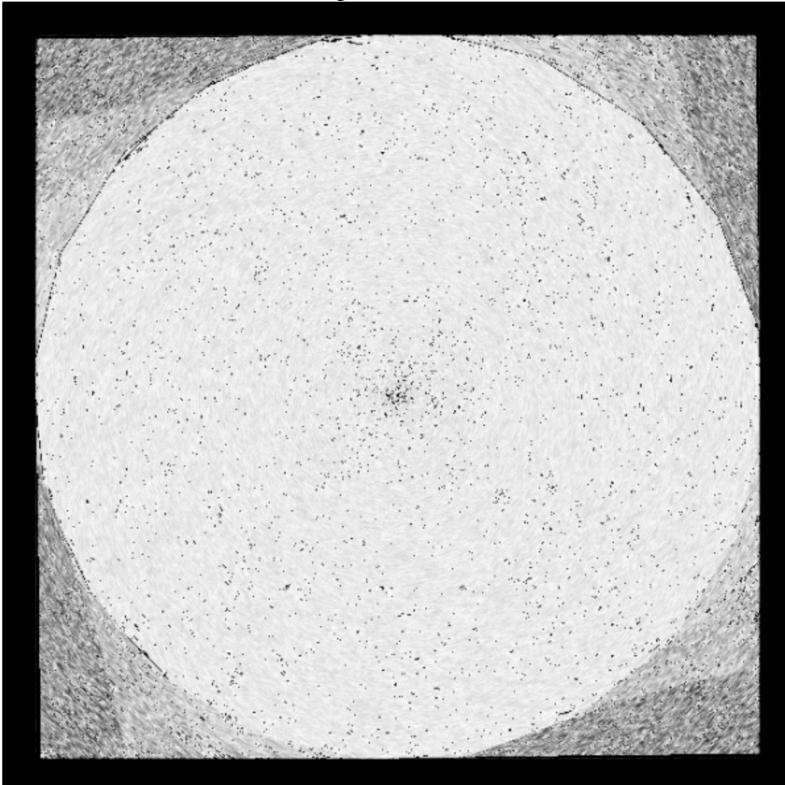
$$k_1 = h \mathbf{f}(\mathbf{x}) \quad k_3 = h \mathbf{f}(\mathbf{x} + \frac{1}{2} \mathbf{k}_2)$$

$$k_2 = h \mathbf{f}(\mathbf{x} + \frac{1}{2} \mathbf{k}_1) \quad k_4 = h \mathbf{f}(\mathbf{x} + \mathbf{k}_3)$$

$$\hat{\phi}^h \mathbf{x} = \mathbf{x} + \frac{\mathbf{k}_1}{6} + \frac{\mathbf{k}_2}{3} + \frac{\mathbf{k}_3}{3} + \frac{\mathbf{k}_4}{6} + O(h^5)$$

Circular Fluid Flow: Completed Image

Fluid Flow Visualization with Line Integral Convolution

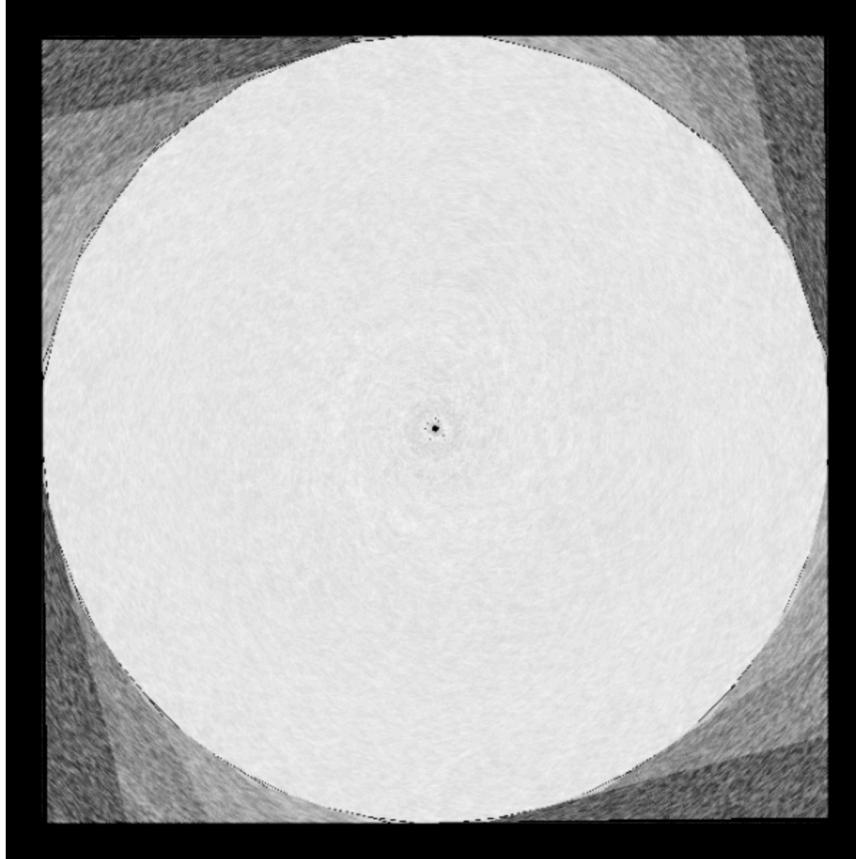


Line Integral Convolution

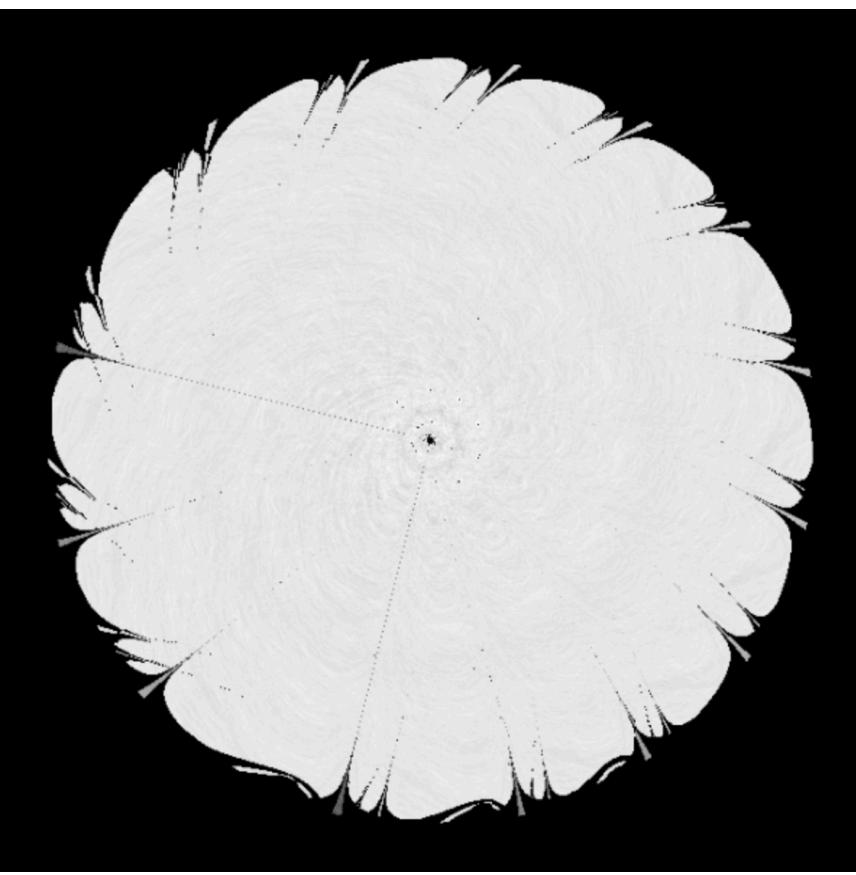
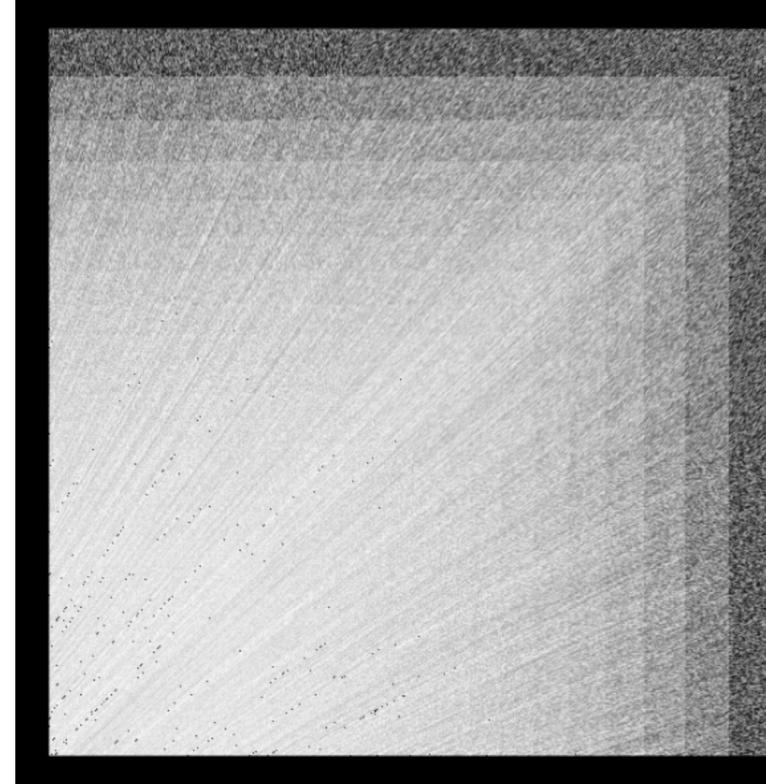
- A streamline is broken up into straight line segments
- Each of those segments can different sizes
- This technique involves sampling and averaging the value of each pixel along that line segment
- The process results in an image that is smeared along the streamlines for each point

More Final Images

Fluid Flow Visualization with Line Integral Convolution



Fluid Flow Visualization with Line Integral Convolution



The Velocity Vector Field I was Attempting to Visualize

