CS 519: Scientific Visualization Fall 2016
In-class Worksheet 4

LIC

Line Integral Convolution Algorithm

For each pixel p compute T(p), a color for the pixel

$$T(p) = \frac{\int_{-L}^{L} N(S(p,s))k(s)ds}{\int_{-L}^{L} k(s)ds}$$

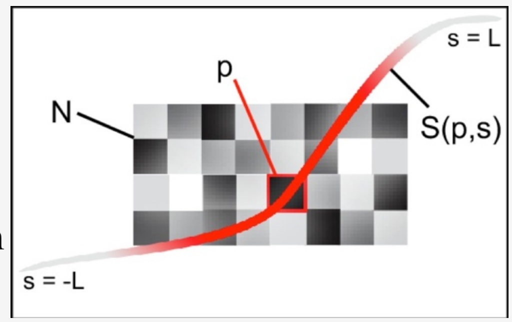
$k(s) = e^{-s^2}$

N : noise texture

$S(p,s)$: streamline of seed point P

$k(s)$: weighting or blurring function

L : width of blurring function



1. LIC Computed by Hand

Suppose we have the noise function below

1.0	0.25	0.75	0.0	0.25
0.0	0.5	0.75	0.5	0.0
0.75	1.0	0.5	0.0	0.75
0.25	0.75	0.25	0.5	0.0
1.0	0.0	1.0	0.25	1.0

The vector field is **v**(x,y) = <x, 0>. Compute the color for pixel (2,2).

- Normalize the vector **v** so as to take a unit step each time
- Use a time step of h=1
- Use L=2
- Use a weight function of $k(s) = \frac{1}{1+|s|}$

$$\frac{\left(\frac{3}{4}\times\frac{1}{3}\right) + \left(1\times\frac{1}{2}\right) + \left(\frac{1}{2}\times 1\right) + \left(0\times\frac{1}{2}\right) + \left(\frac{3}{4}\times\frac{1}{3}\right)}{\left(\frac{1}{3}+\frac{1}{2}+1+\frac{1}{2}+\frac{1}{3}\right)} = \frac{\frac{3}{2}}{\frac{16}{6}} = \frac{9}{16}$$

2. **Other LIC Considerations**

   What happens if the vector field in question 1 is **v**(x,y) = <x,x>? Don't recompute your answer…just suggest which pixels in the noise texture get sampled…

   Pixels (1,1),(1,1),(2,2),(3,3), (3,3) since we are stepping diagonally from the center of pixel (2,2) with step-size of 1.

3. **Stream Objects**

   In the image shows an unsteady 2D flow field (one that evolves over time). If the purple line indicates the seed position, what kind of line is the red line? What kind of line are the black lines?

   Red is a streakline

   Black are pathlines.