

Scientific Visualization (Assignment 12)

Exercise 12.1 [6 Points] Path lines, Stream lines, Streak lines

Vector fields are often visualized indirectly, by constructing their characteristic lines:

- Path line represent trajectory of a particle traveling in the time-varying vector field. I.e. if you would drop a particle at position x_0 , timestep t_0 , what path would it take over the next n timesteps?
- Stream line represents a trajectory of a particle traveling through a 'snapshot' of the field. I.e. if you would 'freeze' the vector field at a particular timestep t , and drop a particle at position x_0 , what path would it take?
- Streak line consists of positions of particles that were dropped one-by-one at the same position, over a period of mutiple timesteps. I.e. if starting with timestep t_0 a particle is dropped at position x_0 every time step $(t_0, t_1, \dots t_n)$, what would a line connecting the current position of all the particles look like?

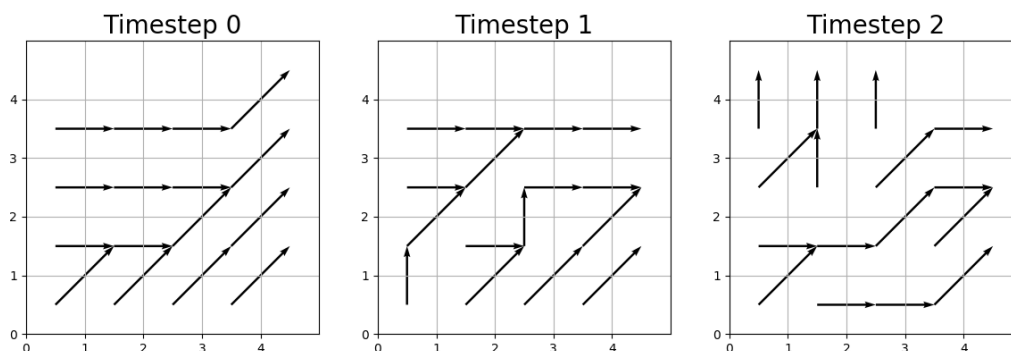


Figure 1: The vector field.

Given a vector field with 3 timesteps, for each of the two seed points $x_0 \in \{(0, 0), (1, 0)\}$ construct a path line, a stream line (for timestep 1) and a streak line. You should draw six lines in total.

You can either draw the lines by hand, or using matplotlib. For latter option, a Python file containing the vector field values is provided.

Exercise 12. 2 [6 Points] (Bonus) Vector Calculus

For the following scalar fields described by $f(x, y, t)$, calculate the gradient $\begin{pmatrix} \delta/\delta x \\ \delta/\delta y \end{pmatrix} f(x, y, t)$ and use matplotlib to plot the vector field of the gradients at $t = 1, 2$ and 3. Submit the formula of each gradient, your python code and the generated images.

1. $x^3 y^2 + x \cos t$

2. $t \sqrt{x^2 - y^2}$

3. $t \sin x^2 \cos y^2$

Submission Deadline: 12.07.2019, 23:55

please hand in your submission through the ILIAS system.