

# Lab Assignment Questions

**March 6, 2025**

1. Simulate and plot the streamlines of a two-dimensional uniform flow with velocity components  $u = 1, v = 0$ . What does the pattern of streamlines indicate?
2. Simulate the pathline of a particle in a uniform flow with velocity components  $u = 1, v = 0$ . Trace the particle's trajectory starting from  $(0, 0)$ .
3. Numerically compute and plot the streamlines for a vortex flow with velocity components  $u = -y, v = x$ . Analyze the streamline patterns.
4. Generate streamlines for a flow moving past a flat plate, represented by  $u = y, v = 0$ . Observe and interpret the streamlines.
5. Track the trajectory of a particle in a rotational velocity field  $u = -y, v = x$ . Assume the particle starts at  $(x_0, y_0) = (1, 0)$ . Plot the pathline.
6. Simulate the flow caused by a point source at the origin using the potential function  $\phi = \ln(r)$ . Plot the corresponding streamlines.
7. Create a numerical simulation to examine particle pathlines in a time-dependent velocity field  $u = t, v = y$ . Observe how the pathlines evolve.
8. Write a simulation to calculate and visualize vorticity in the velocity field  $u = x, v = -y$ . Confirm if the flow is irrotational.
9. Simulate the combined flow due to a source at  $(-1, 0)$  and a sink at  $(1, 0)$ . Plot the streamlines and velocity field.
10. Develop a simulation to visualize the evolution of streamlines for an unsteady velocity field  $u = x \cos(t), v = y \sin(t)$  over time. Observe changes in flow patterns.