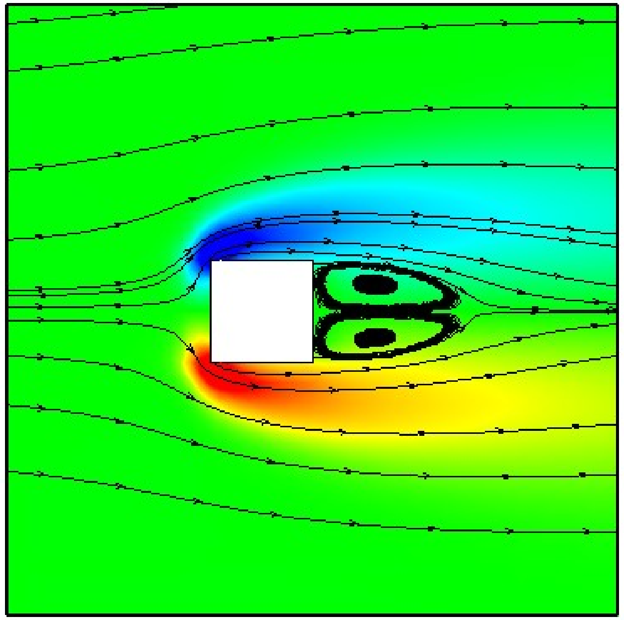
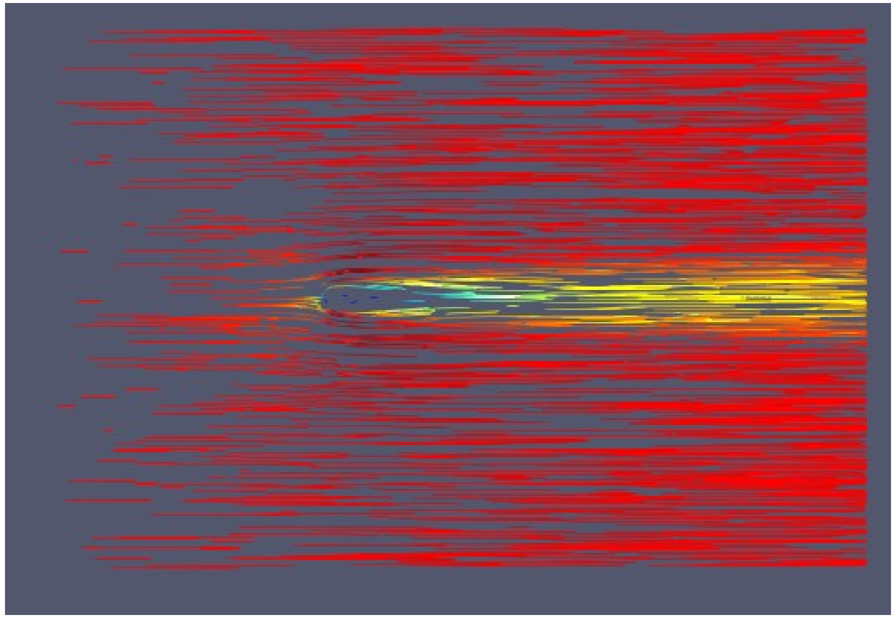




Flow over the square cylinder for Re = 25

Assignment -3
Foundations of CFD (AM5630)

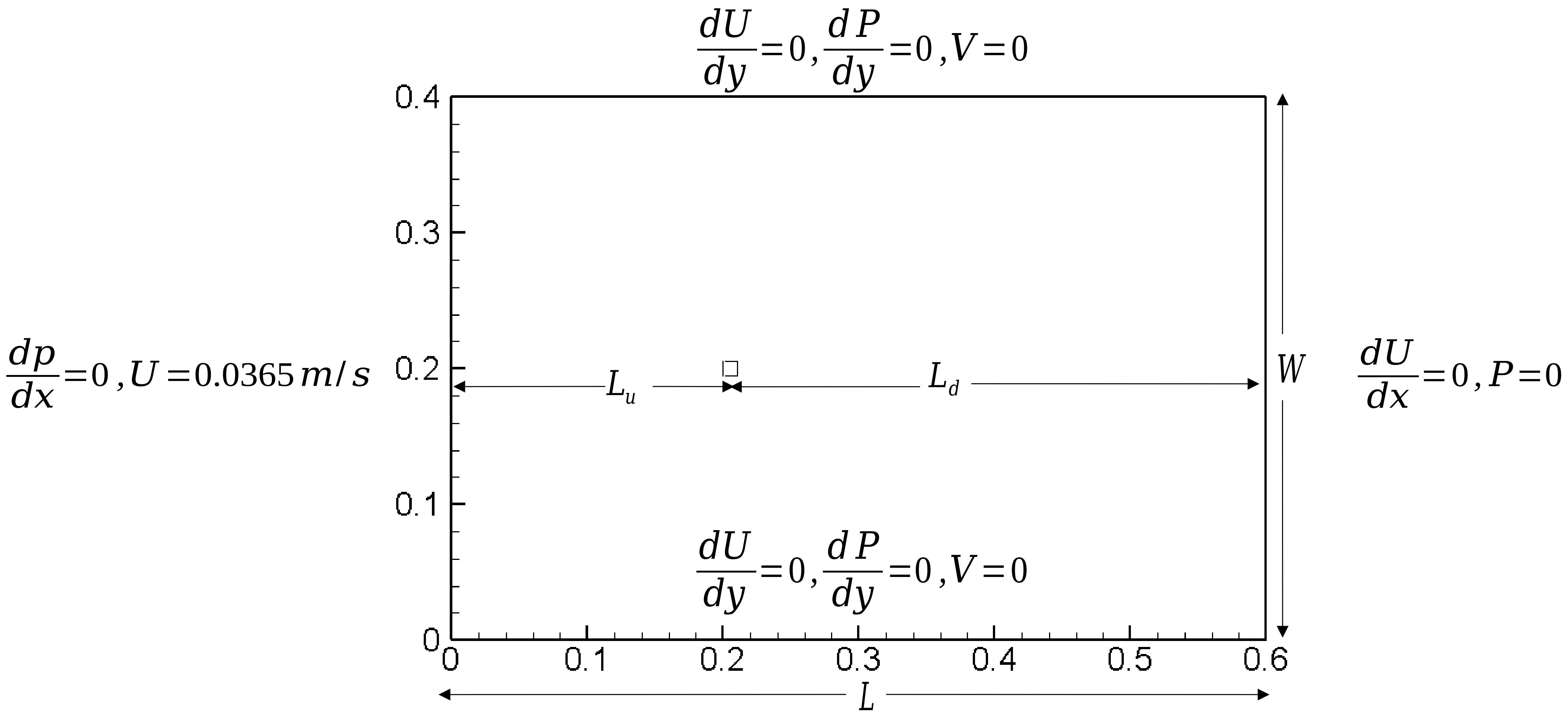
Pratik Panchal

Outline

- Methodology
  - Problem description
  - Governing equation
  - Numerical details
- Algorithm comparison
- Results and discussion

Problem description

Geometric details of problem and boundary conditions



Methodology

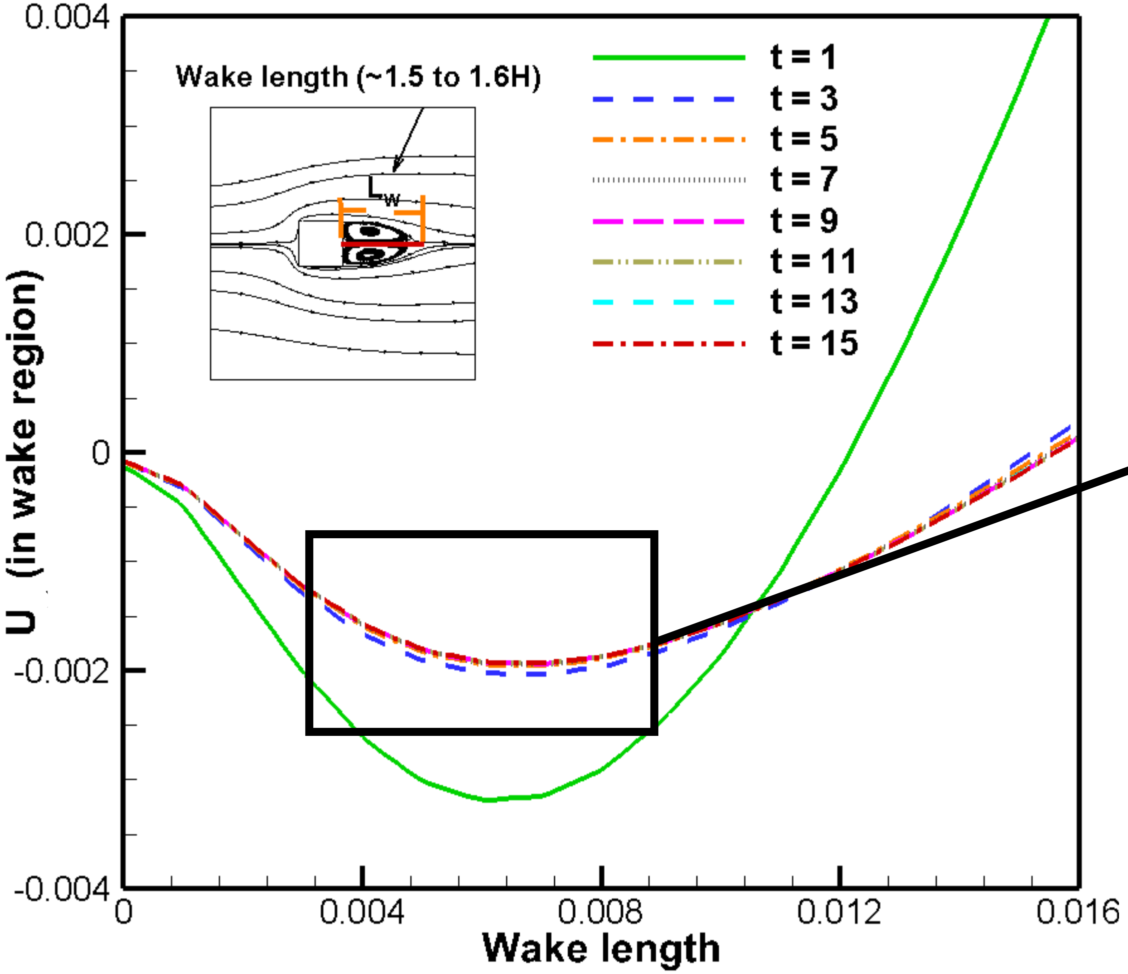
Governing equation

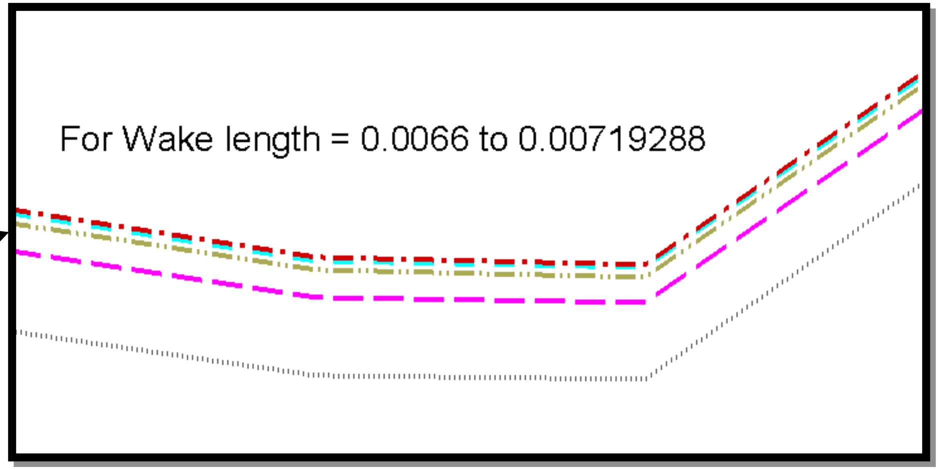
Mass conservation $$\frac{\partial u_i}{\partial x_i} = 0$$

Momentum conservation $$\frac{\partial u_i}{\partial t} + u_j \frac{\partial u_i}{\partial x_j} = -\frac{1}{\rho}\frac{\partial p}{\partial x_i} + \nu \frac{\partial^2 u_i}{\partial x_j \partial x_j}$$

First unsteady simulation is performed using PISO algorithm (pisofoam).
Then after based solution check the steady state !

Unsteady analysis (using pisofoam (PISO algorithm))



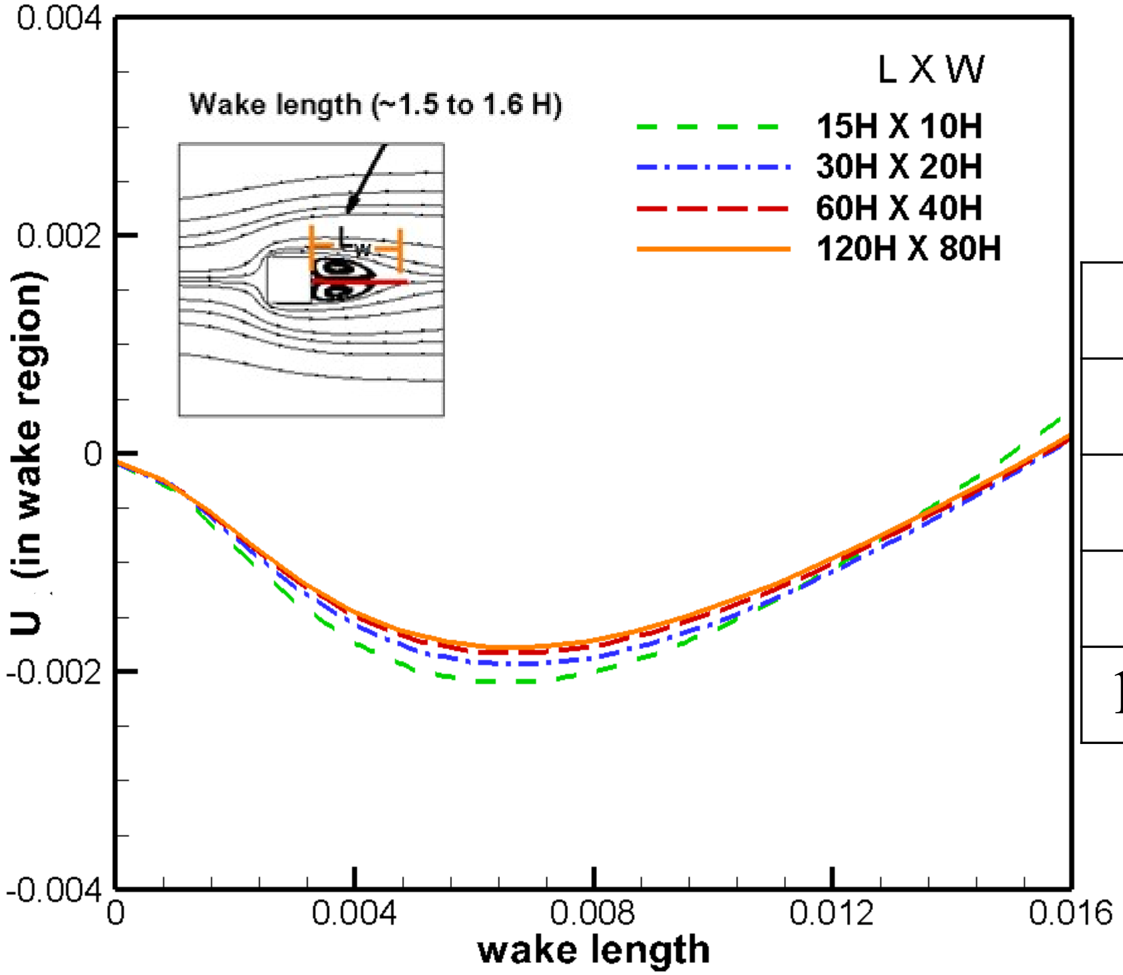


Converged to steady solution after 15 sec.

Therefore, Further analysis performed using simplefoam (SIMPLE algorithm)

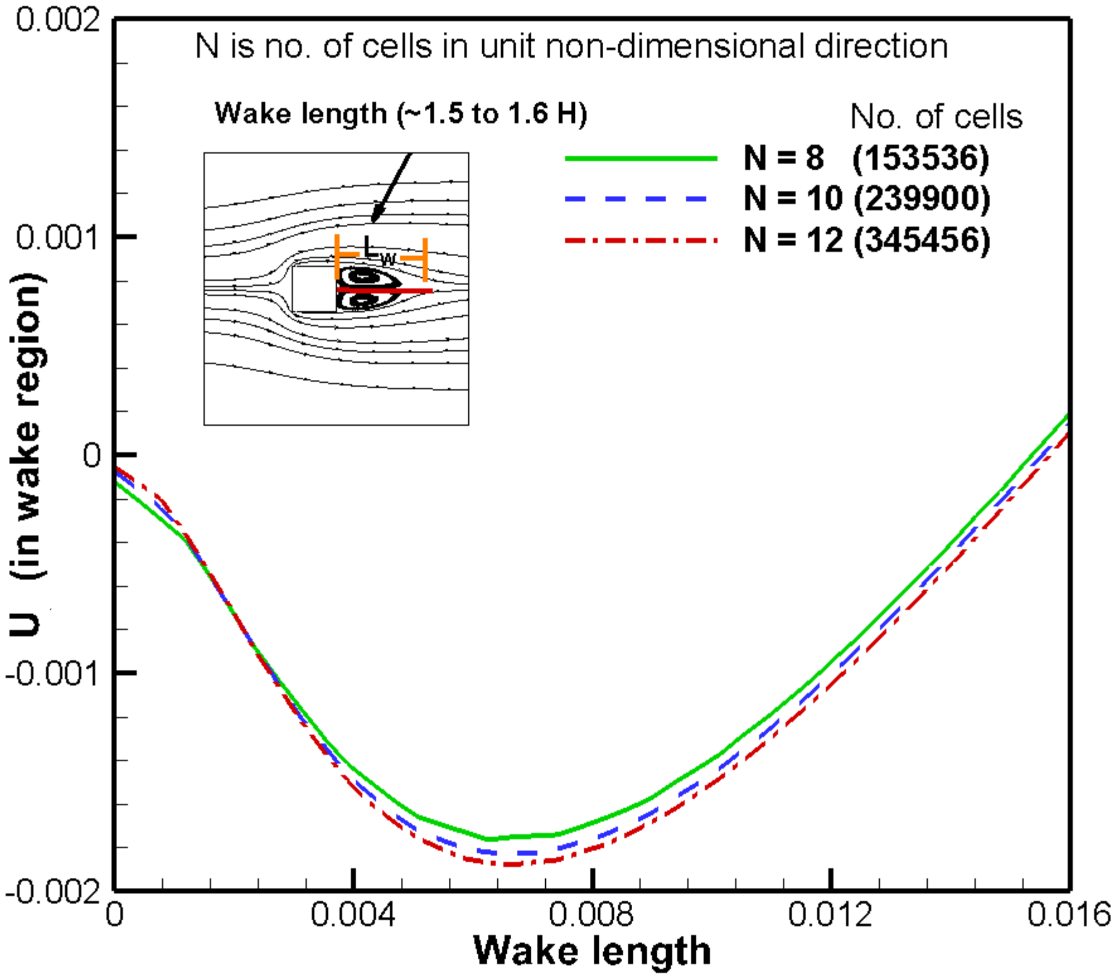
Numerical details

Domain independence study



L X W	L_u	L_d	W
15H X 10H	6.5H	8.5H	10H
30H X 20H	10.5H	19.5H	20H
60H X 40H	20.5H	39.5H	40H
120H X 80H	40.5H	79.5H	80H

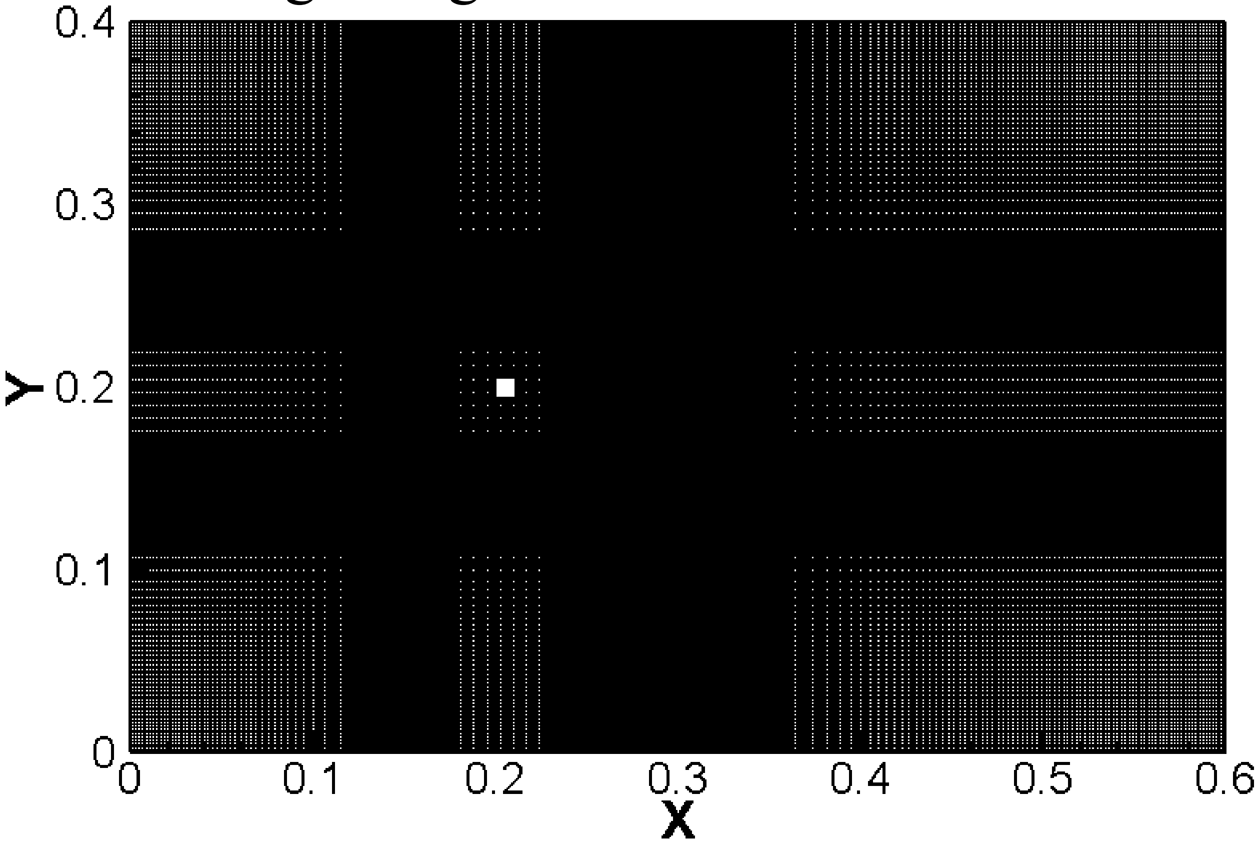
Grid independence study



Final Mesh information

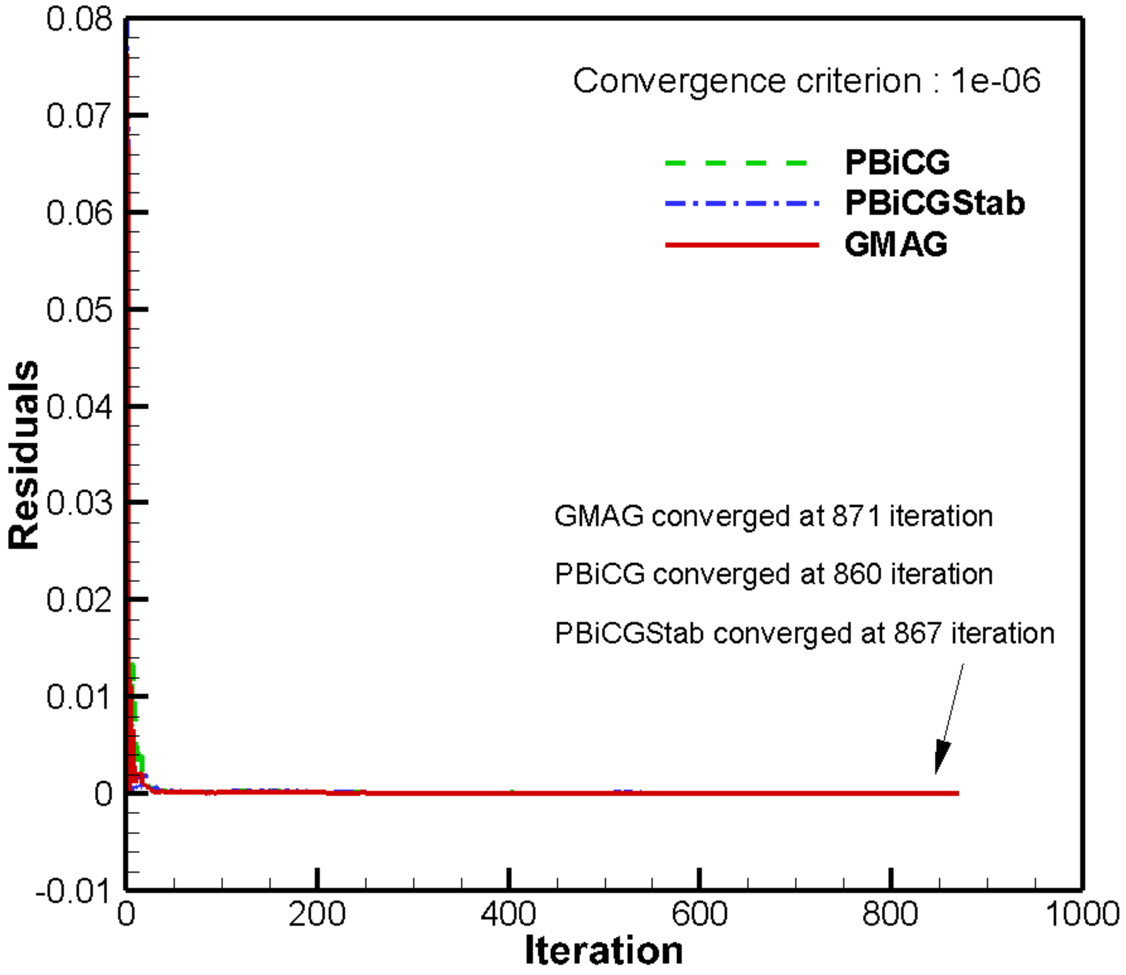
N = 10 – 239900 cells

Mesh grading factor in X and Y direction = 3



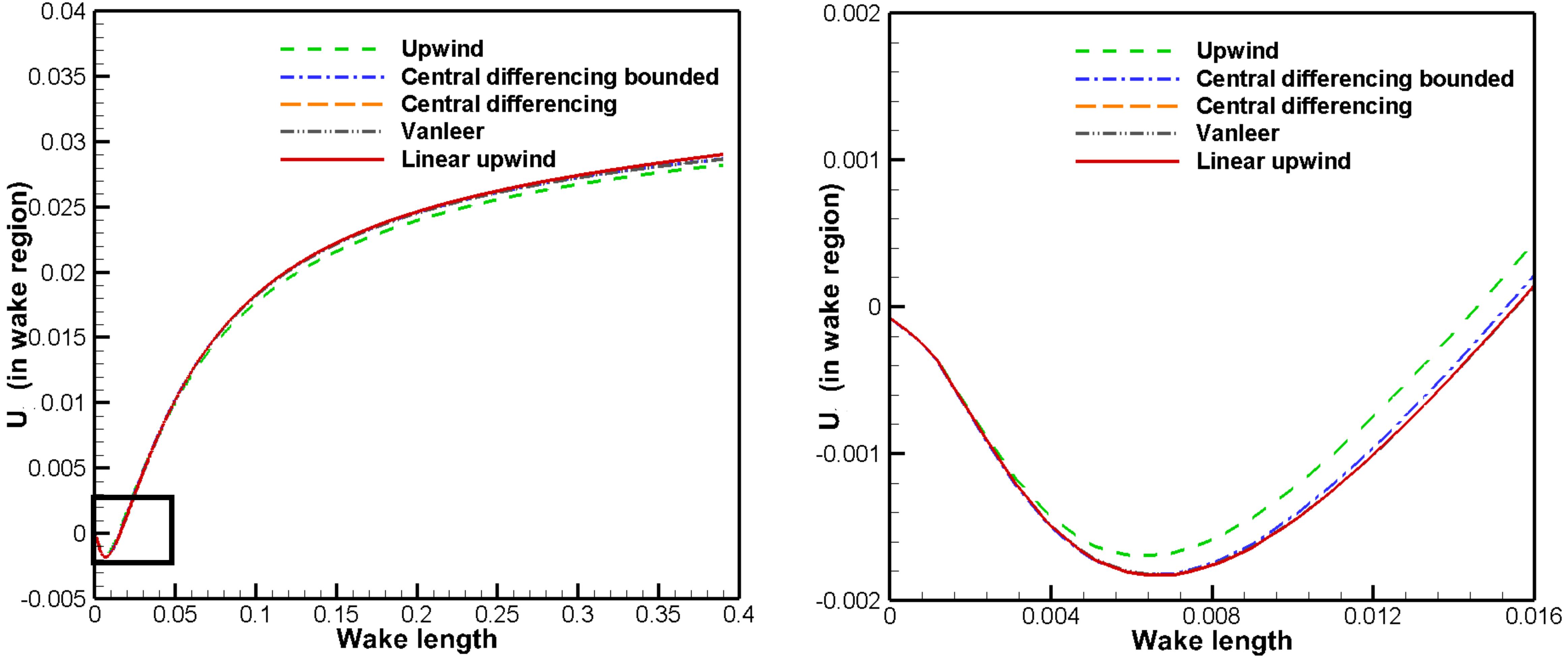
Algorithm comparison

Comparison of iterative solver

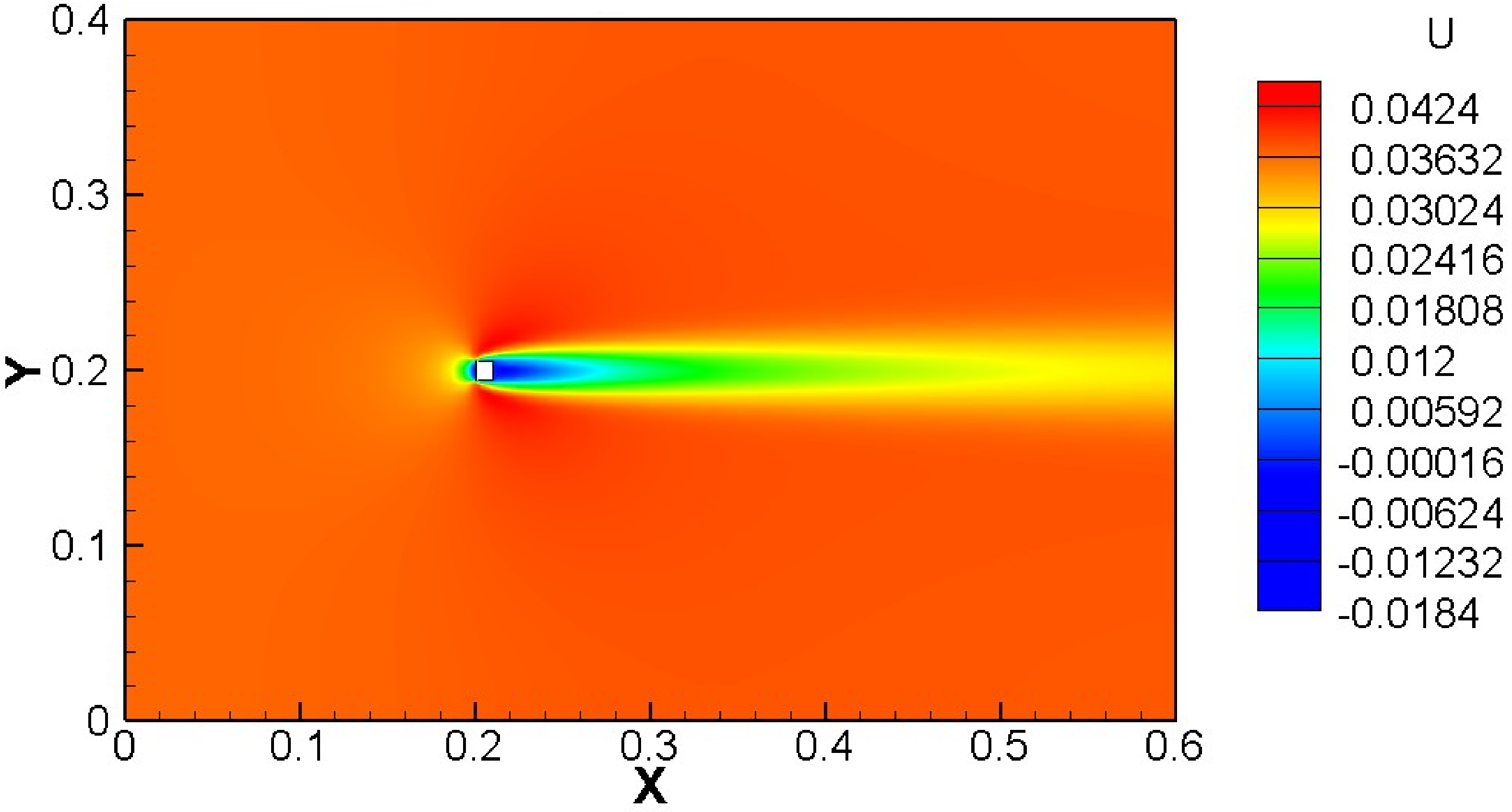


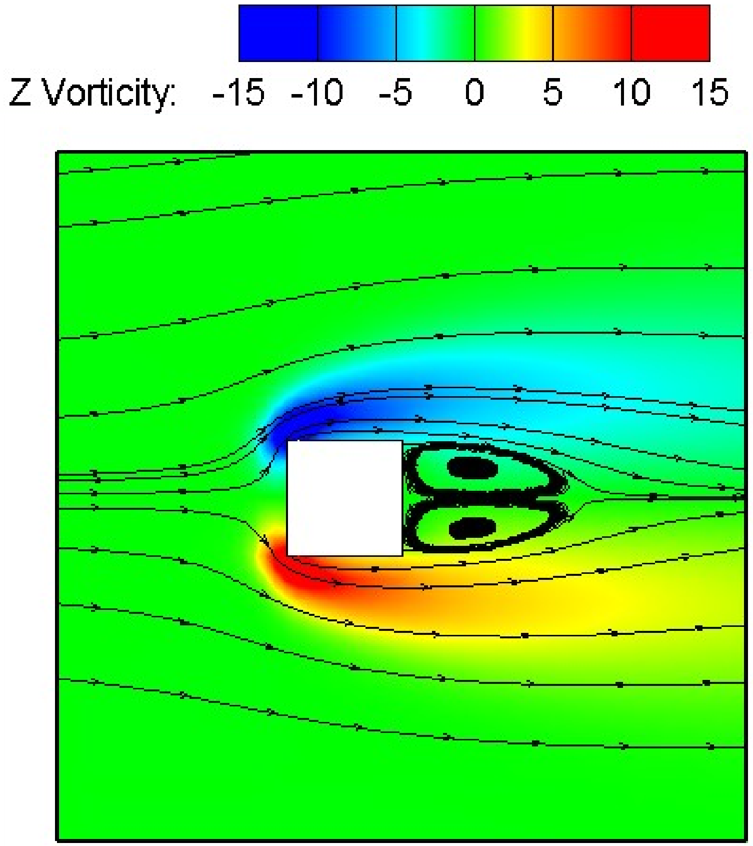
Results and discussion

Comparison of convective scheme

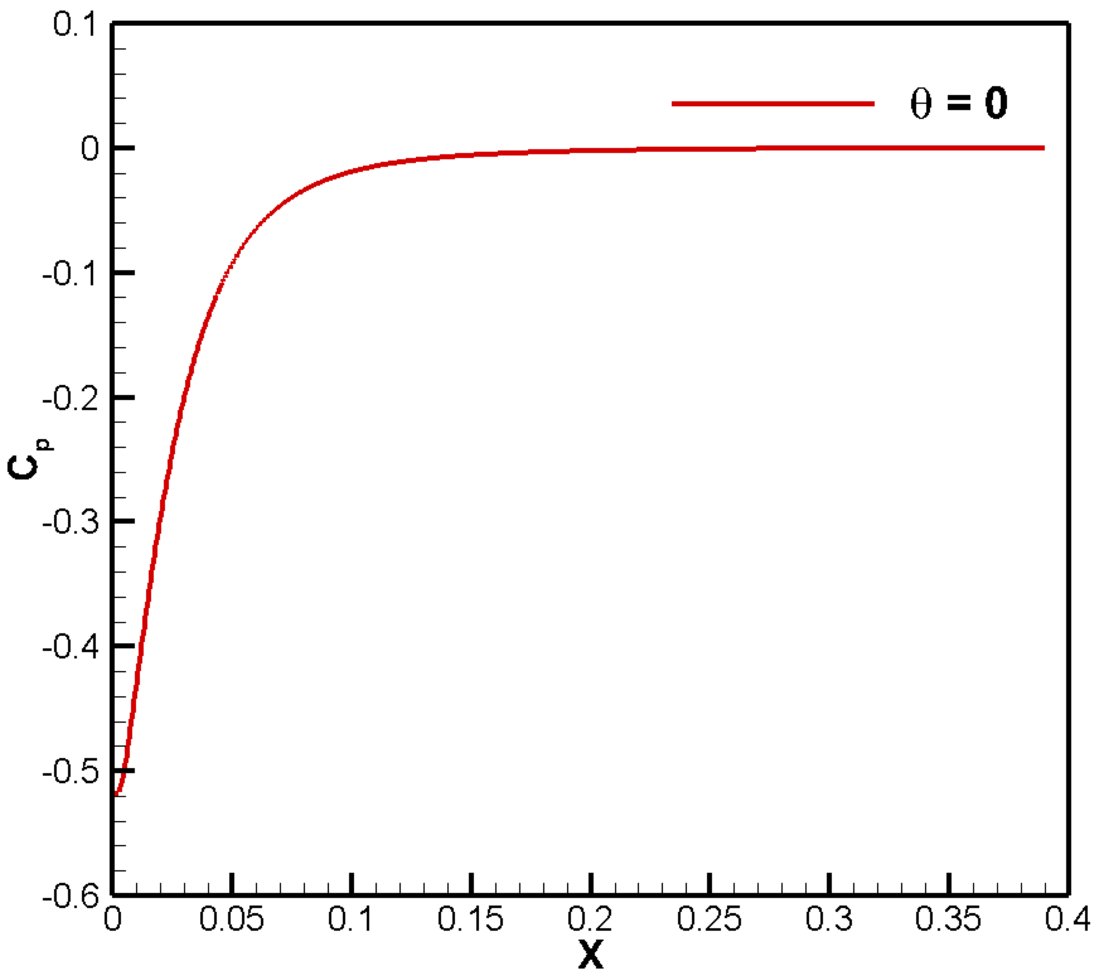


U and vorticity contours

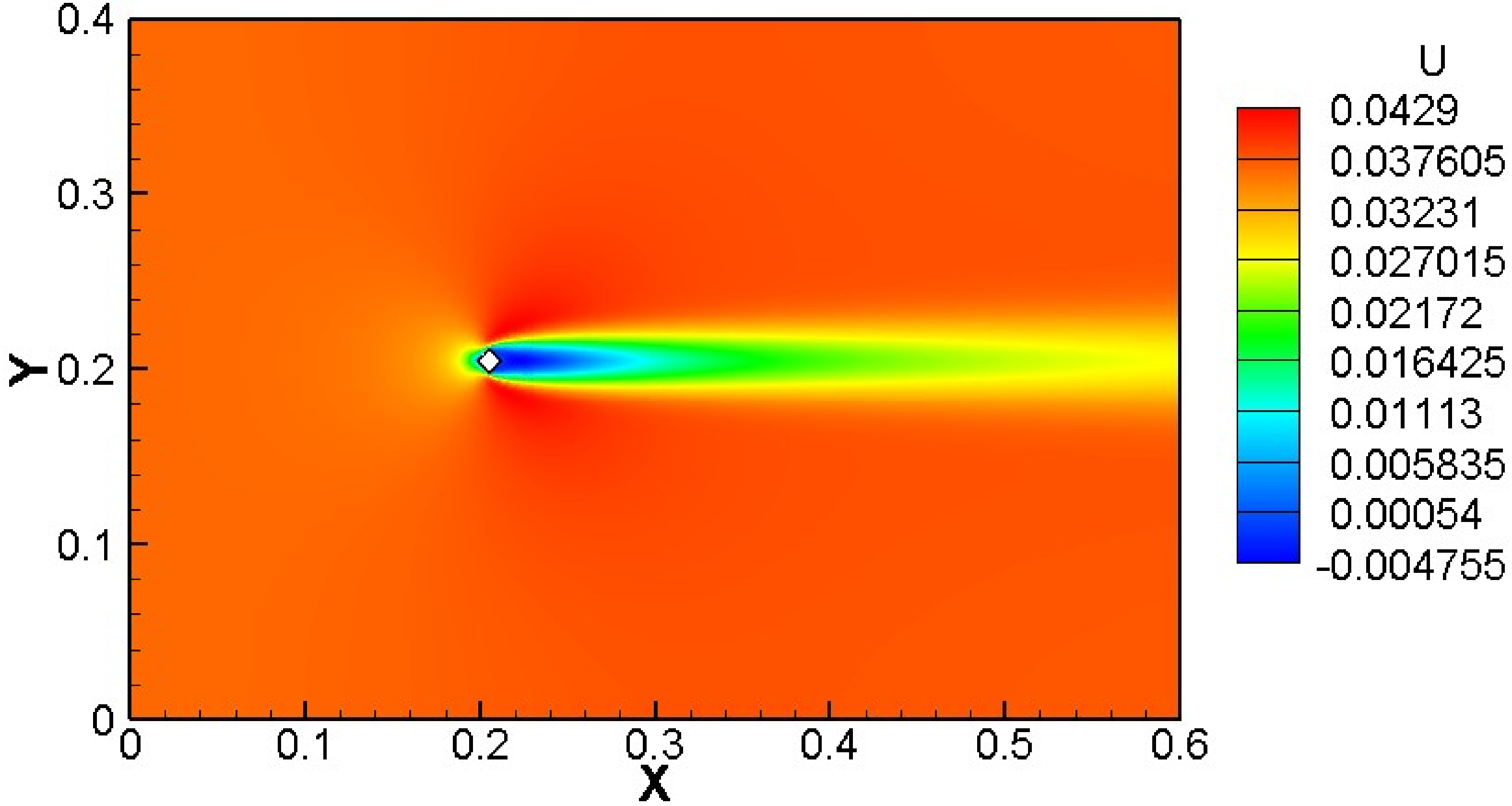


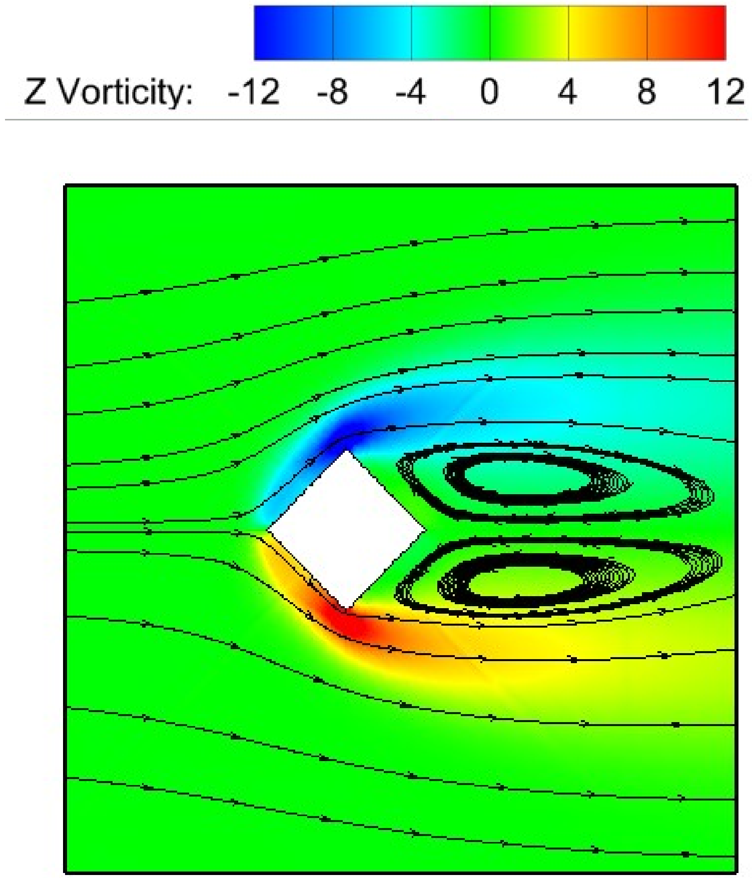


Variation of pressure coefficient in the downstream (after wall)



Square cylinder at with x-direction





Comparison of square cylinder at and with x-direction

(Mean drag coefficient)

Same mesh data	$\overline{C_d}$
$\theta = 0^\circ$	1.47663
$\theta = 45^\circ$	1.1945

The zero degree orientation of square cylinder increased drag compared to 45 degree angled one.

- **Due to higher stagnation zone in zero degree square cylinder**
- **Higher normal Surface area**