ME634A Assignment-4 :
3D lid driven cavity (laminar) using RK3-CN method

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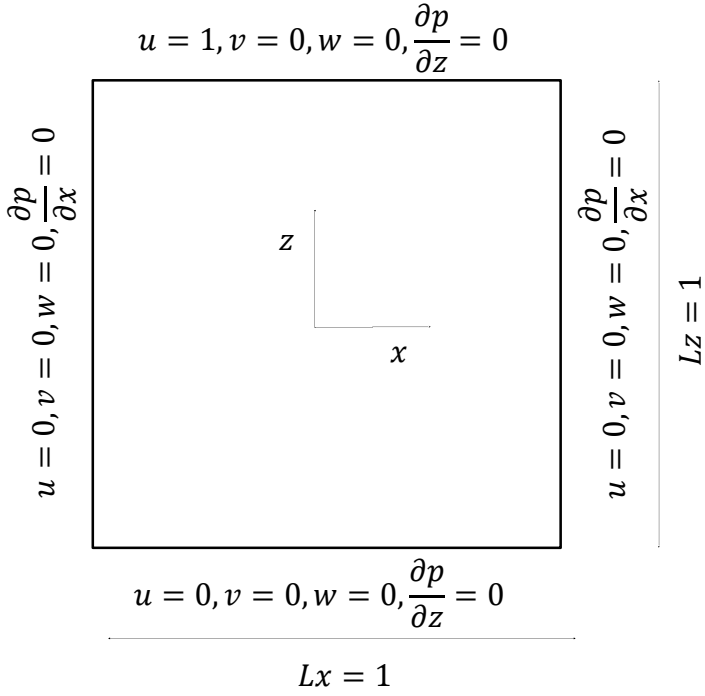
Problem Description

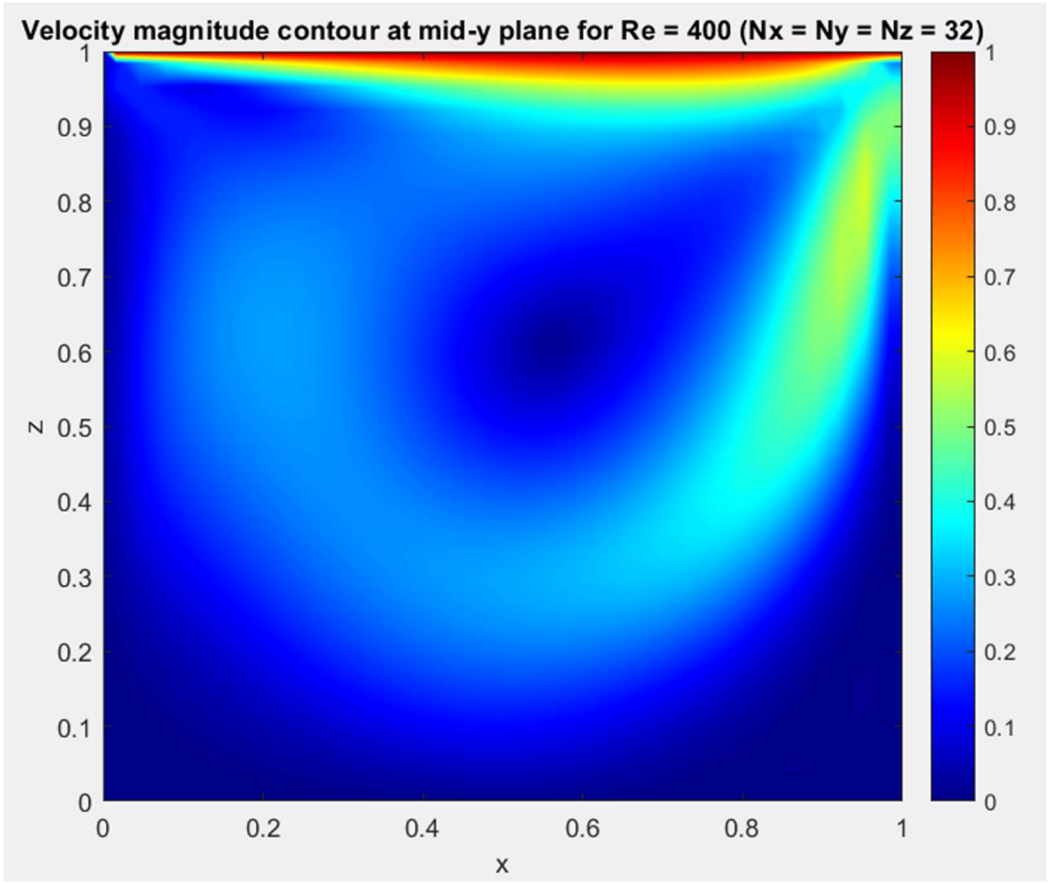
- Periodic boundary condition in y direction.
- 3D laminar problem.
- Solved for a uniform grid (though the code is well-equipped to solve for a non-uniform grid as well).
- Non-dimensional form of x-momentum equation:

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} = -\frac{\partial p}{\partial x} + \frac{1}{Re}\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right)$$

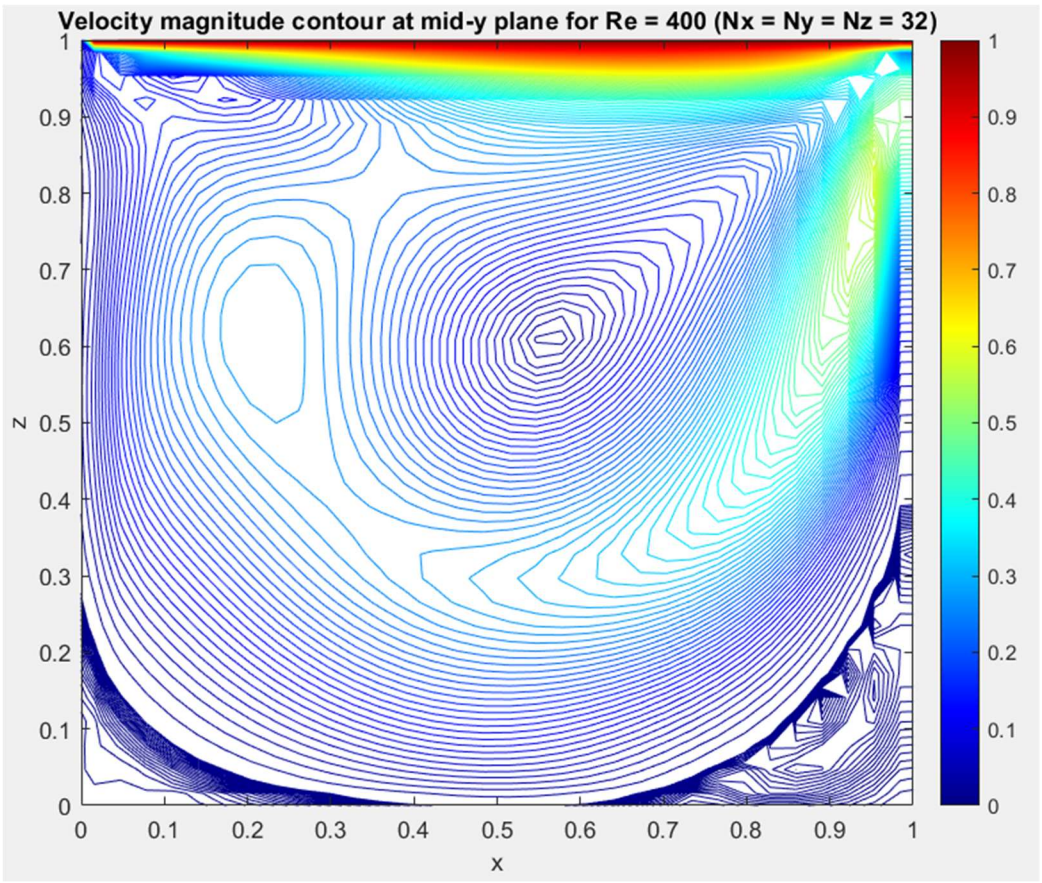
- Similarly, y and z momentum equations.
- Tolerance for time-marching = 1.0e-4 (i.e. steady state stopping criterion: residual < tolerance).



Results



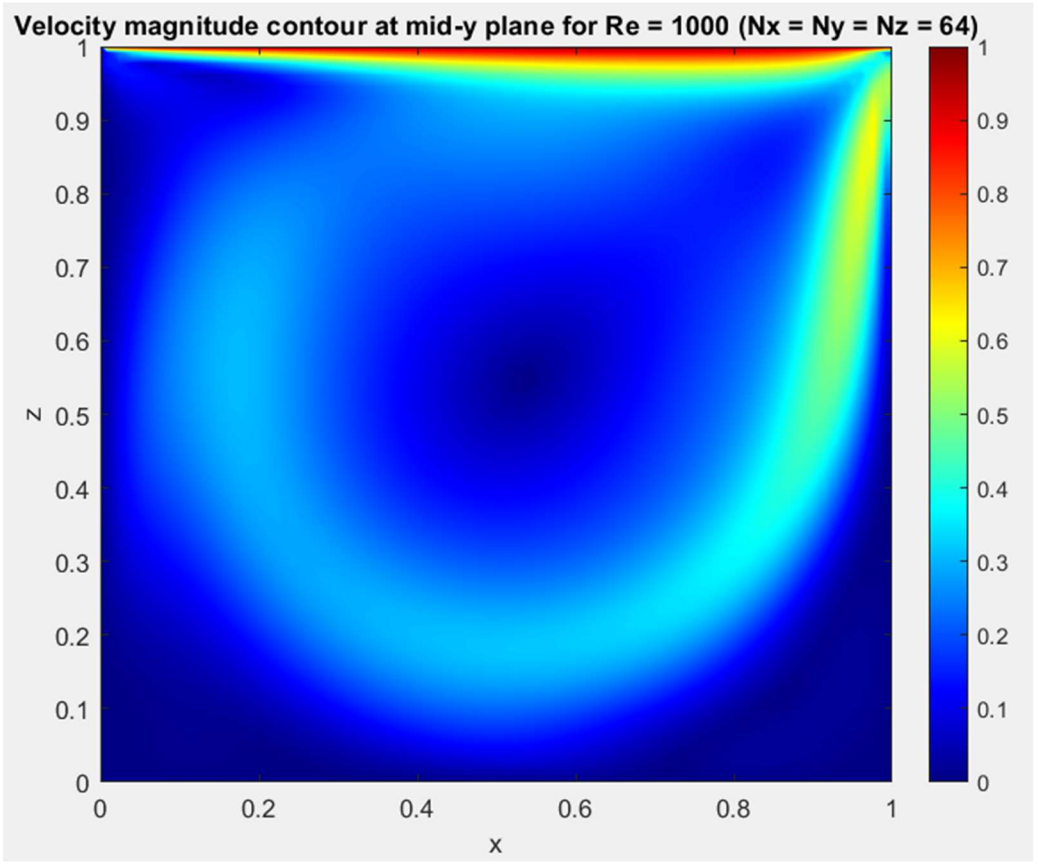
(a)



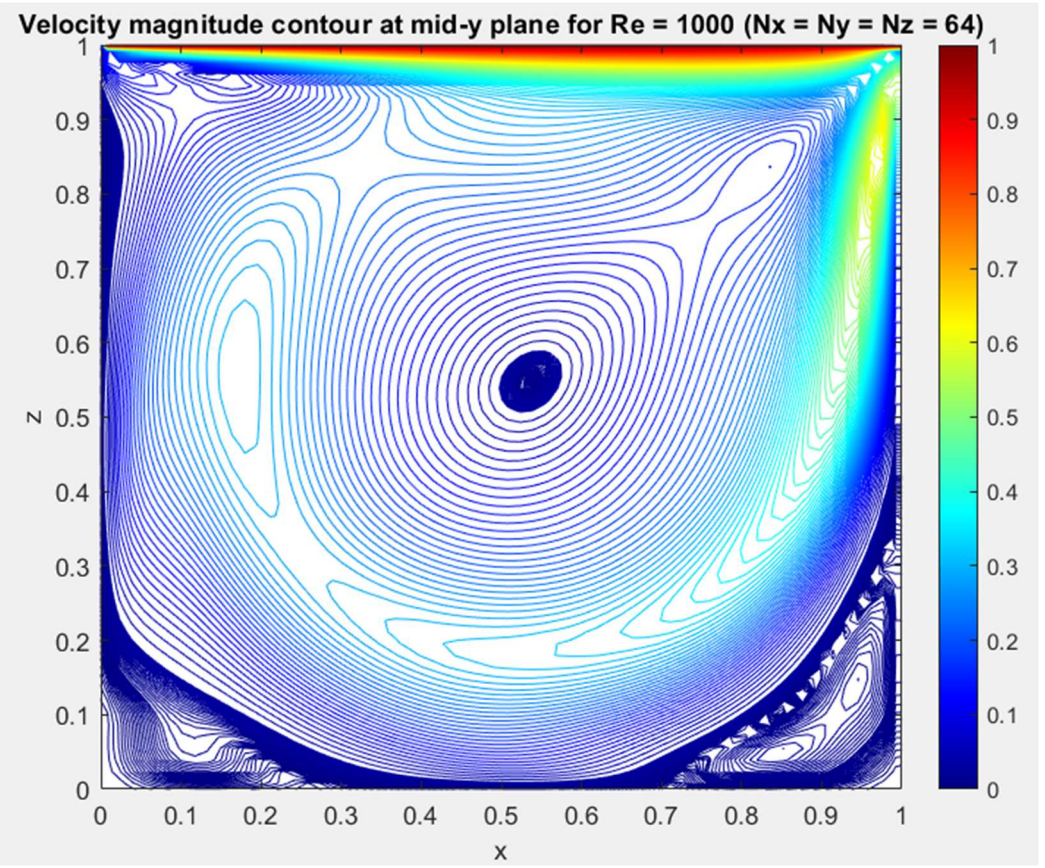
(b)

Velocity magnitude contours for Re = 400 (Nx = Ny = Nz = 32), **t = 50 s**: (a) filled contour, (b) line contour

Results



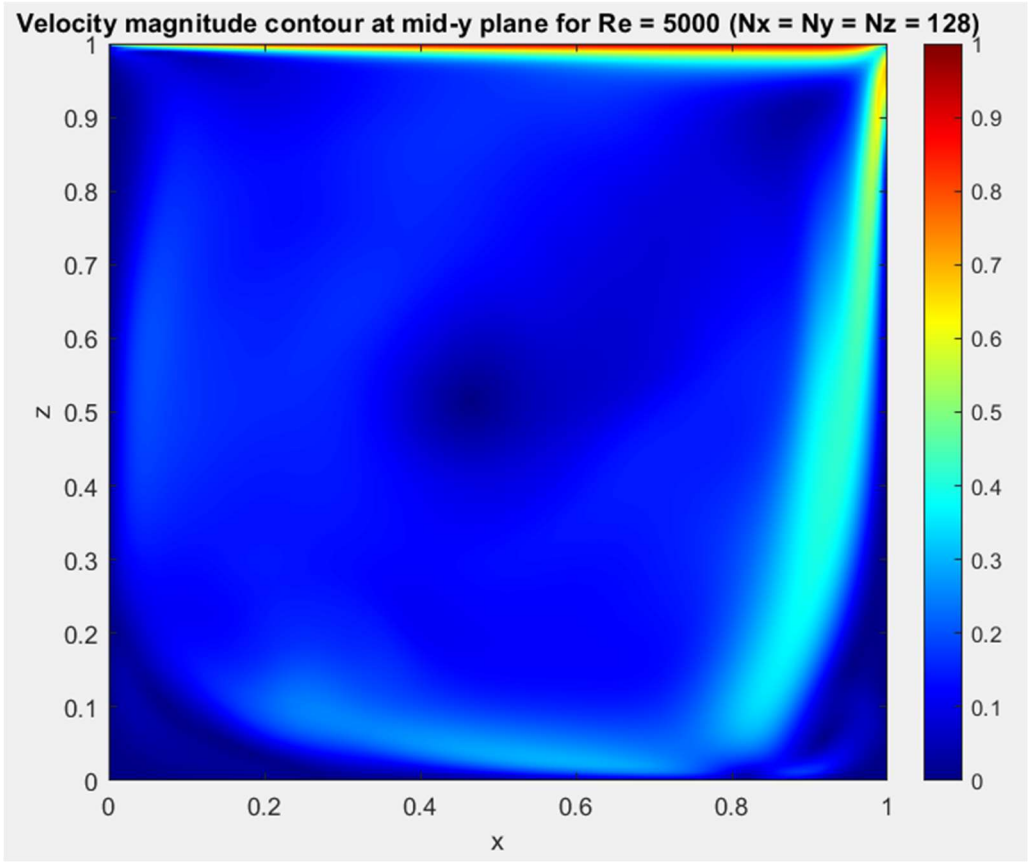
(a)

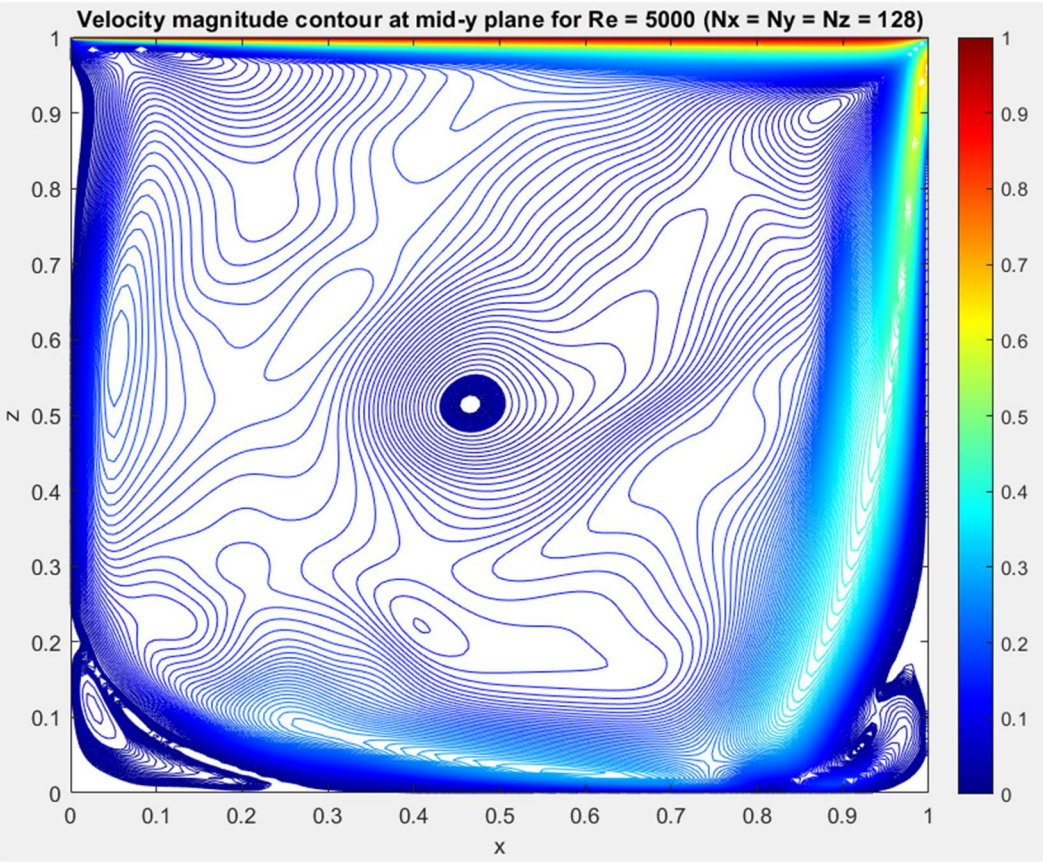


(b)

Velocity magnitude contours for Re = 1000 (Nx = Ny = Nz = 64) , **t = 100 s** : (a) filled contour, (b) line contour

Results

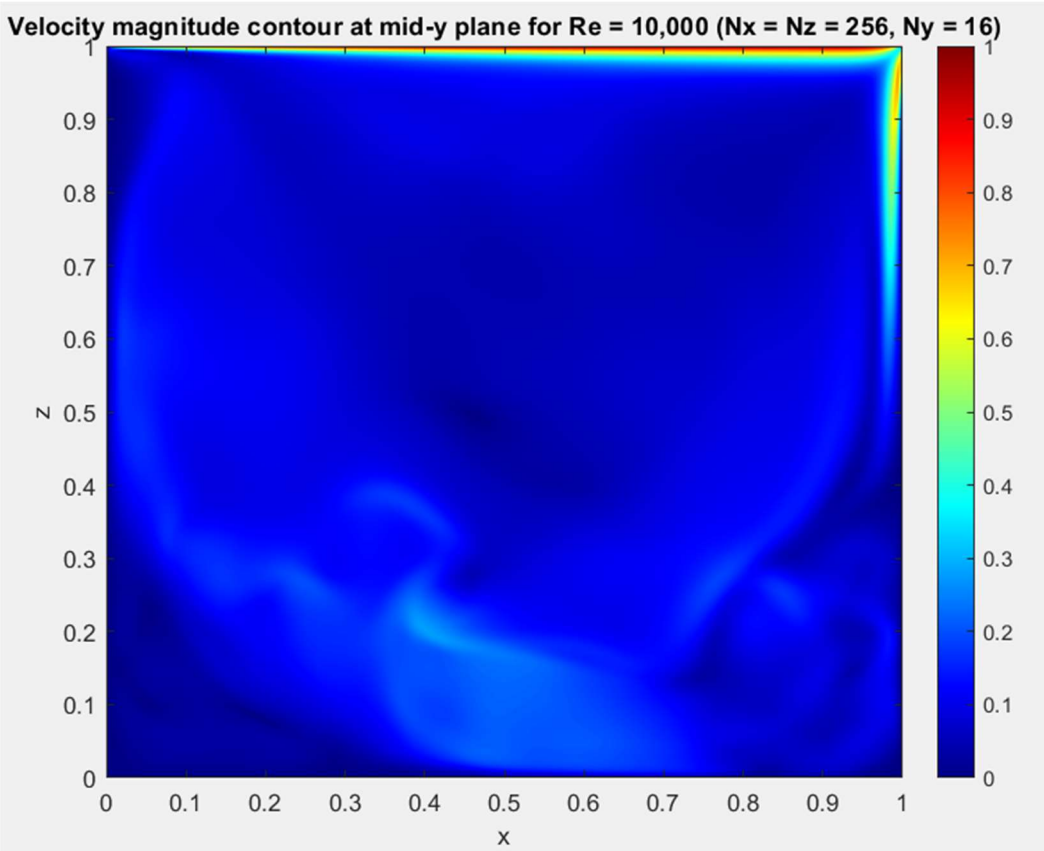




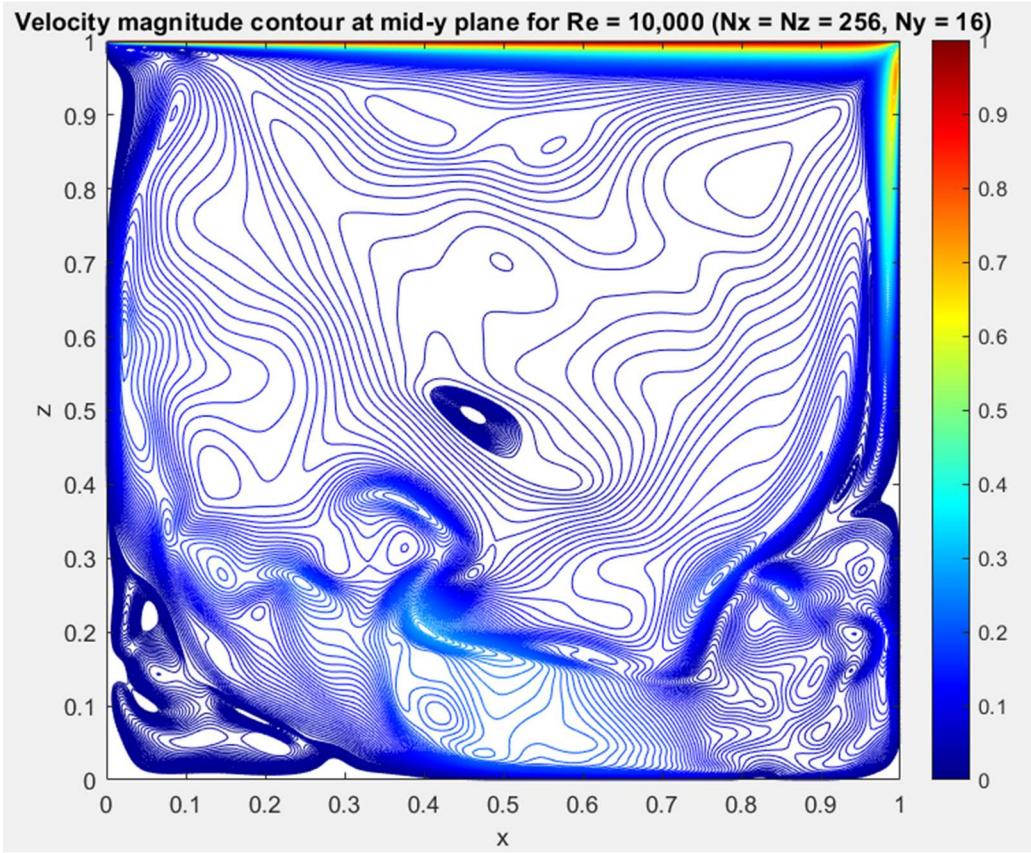
(a) (b)

Velocity magnitude contours for Re = 5000 (Nx = Ny = Nz = 128) , **t = 100 s** : (a) filled contour, (b) line contour

Results



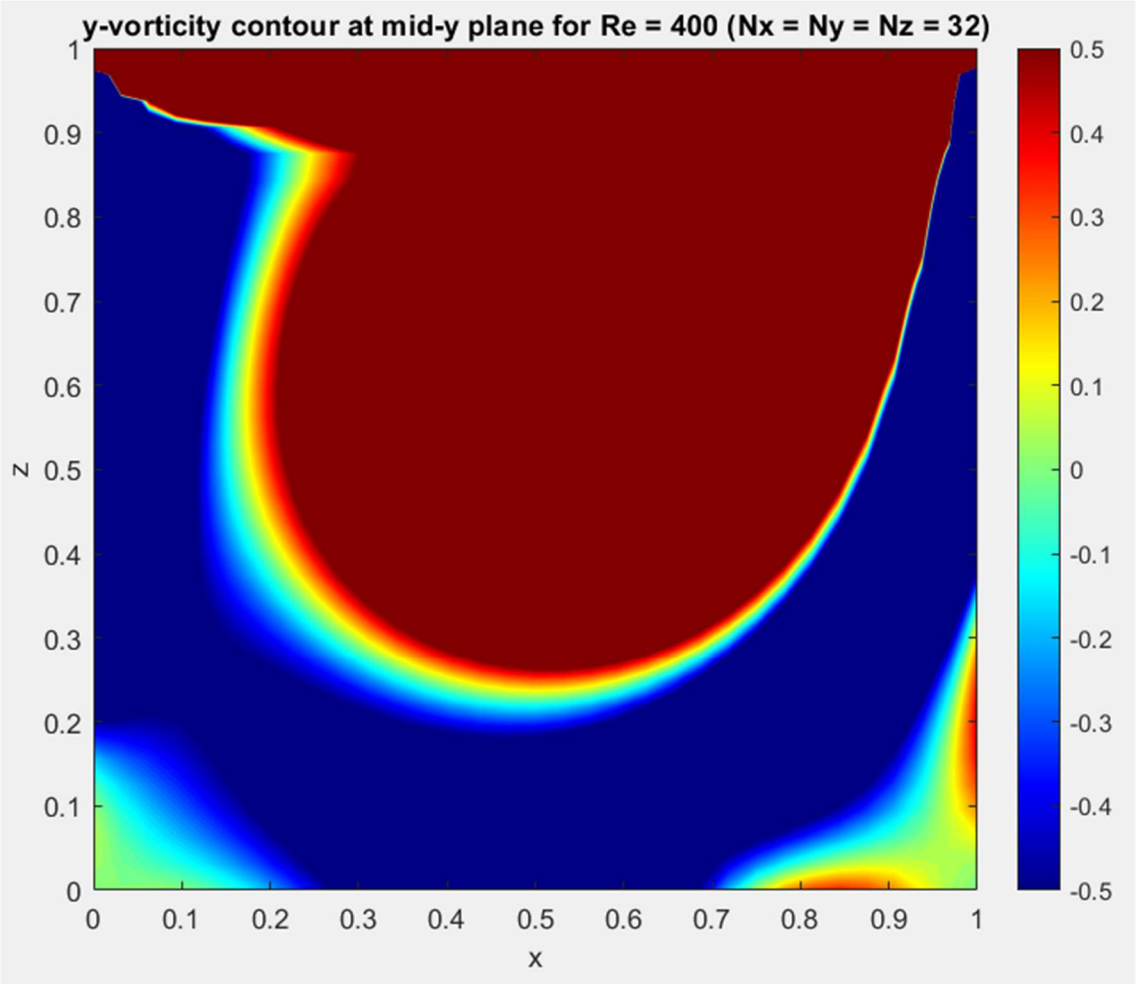
(a)



(b)

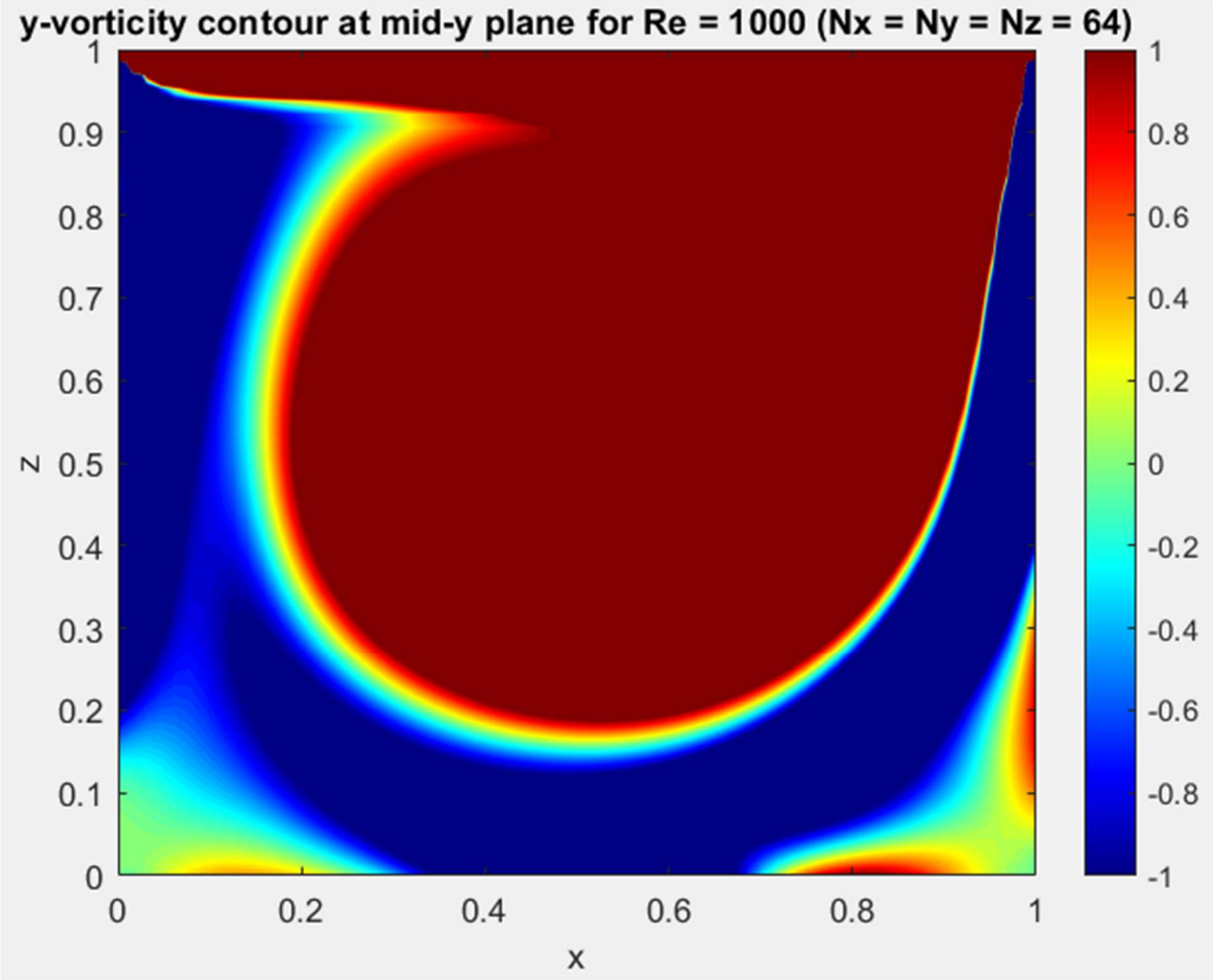
Velocity magnitude contours for Re = 10,000 (Nx = Nz = 256, Ny = 16) , **t = 150 s** : (a) filled contour, (b) line contour

Results



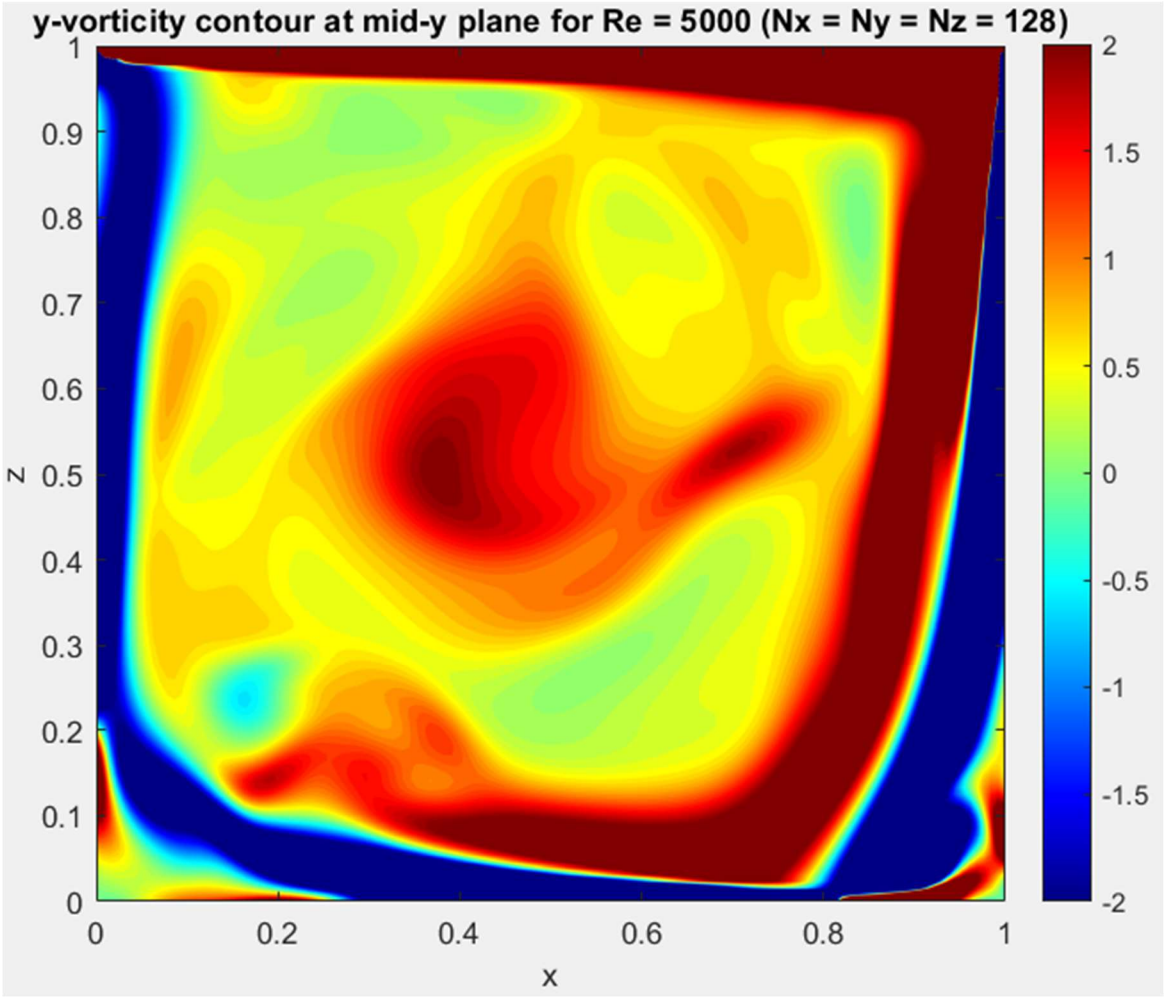
y-vorticity contour for Re = 400 (Nx = Ny = Nz = 32) , **t = 50 s**

Results



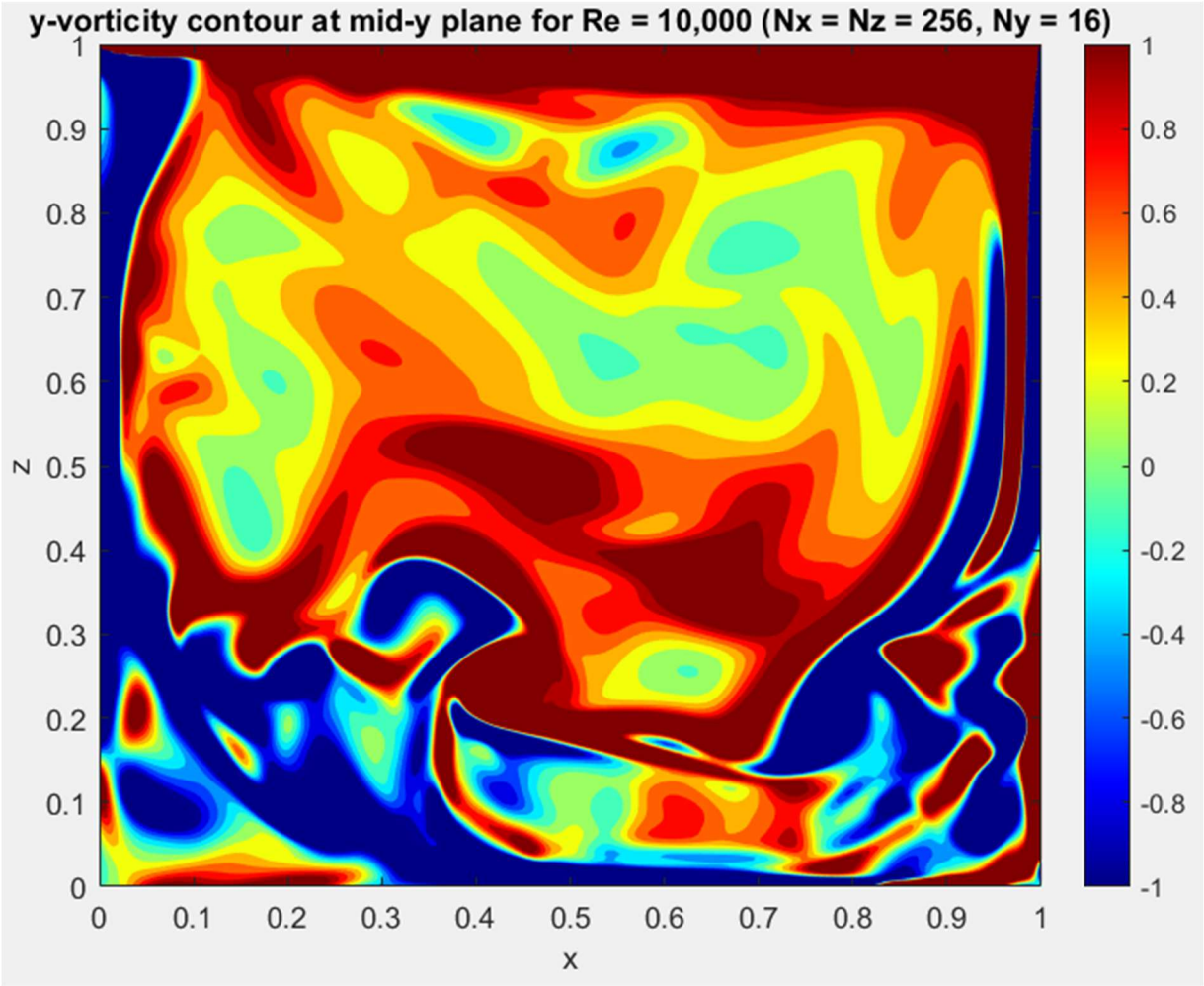
y-vorticity contour for Re = 1000 (Nx = Ny = Nz = 64) , **t = 100 s**

Results



y-vorticity contours for Re = 5000 (Nx = Ny = Nz = 128) , **t = 100 s**

Results



y-vorticity contours for Re = 10,000 (Nx = Nz = 256, Ny = 16) , **t = 150 s**