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Solution Algorithm for the problem :

1. Define domain length, Grid spacing, Relaxation parameter and fluid property.
2. Find the Reynold's number.
3. Initialize *u*, *v* and *P* final at collocated grid. Initialize velocity star, pressure star and pressure correction at staggered grid.
4. Execute a while loop as long as convergence criteria is reached (i.e., error < 0.00001)
    - Solve X-momentum equation at interior points and obtain 'u_star'.
    - Define X – momentum boundary condition for 'u_star'.
    - Repeat this for Y – momentum at interior and boundary points to get 'v_star'.
    - Initialize zero pressure correction every time. (This is IMP)
    - Solve pressure correction equation (Continuity equation).
    - Find corrected pressure using relaxation parameter.
    - Find velocity correction from this corrected pressure.
    - Obtain the continuity residual at all points (i.e., '*b*').
    - This *b* will be the error and hence convergence criteria.
5. After converged solution is achieved determine the final velocity and final pressure.
6. Compute the centerline velocities for horizontal and vertical line.
7. Plot velocity contour.

Grid detail and Boundary condition

- Width X Breadth = 0.2 X 0.2 m
- dx = dy = 0.005, 0.02 and 0.01 (total three grid spacing)
- Input is U (2 or 8 m/s i.e., velocity of Upper lid)
- Boundary condition are :
    - u(1,:)=U
    - u(imax,:) = 0
    - v(:,1) = 0
    - v(:,jmax) = 0

Now Grid Independence Study

1) dx = dy = 0.02 m
    - U_avg = -0.0355 m/s
    - V_avg = 0.001 m/s

2) dx = dy = 0.01 m
    - U_avg = -0.0218 m/s
    - V_avg=0.00016m/s

3) dx = dy = 0.005 m
    - U_avg = -0.0118 m/s
    - V_avg = 0.000042 m/s

The Richardson extrapolation scheme is used,

- p = 0.45.
- Error_1 = 0.037
- Error_2 = 0.027

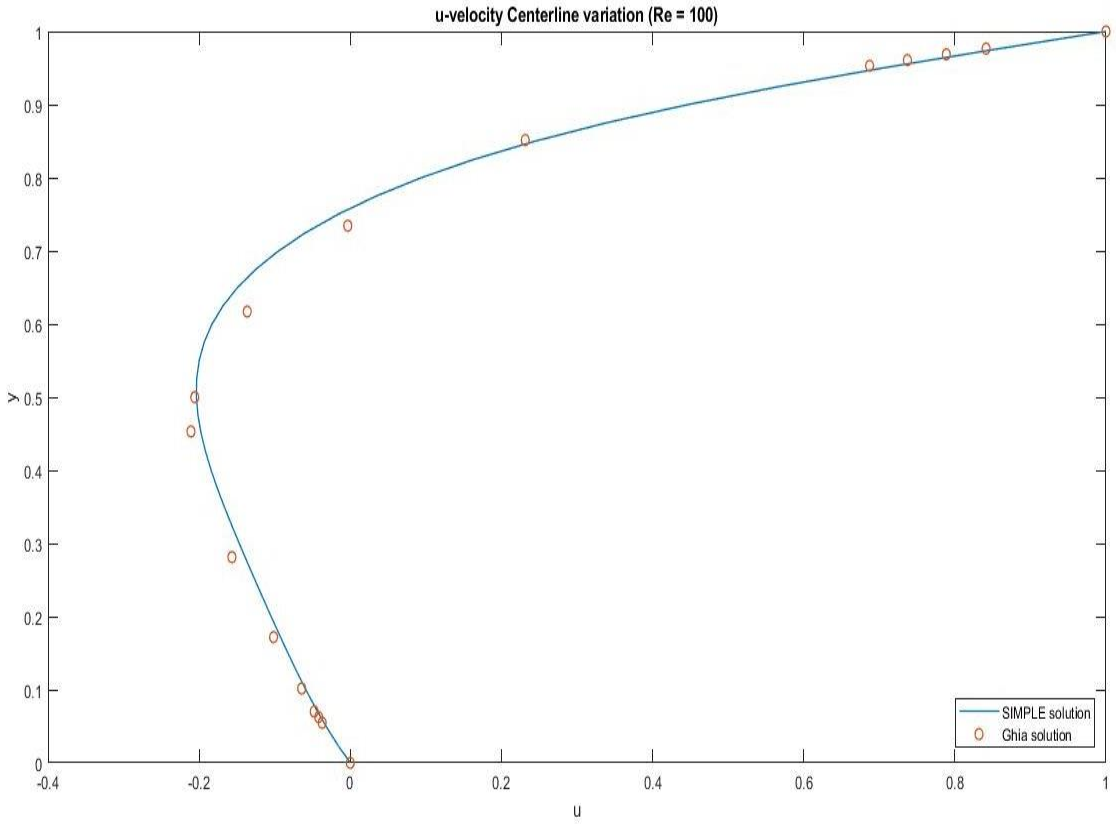
For U = 2 m/s

Re = U*L/nu

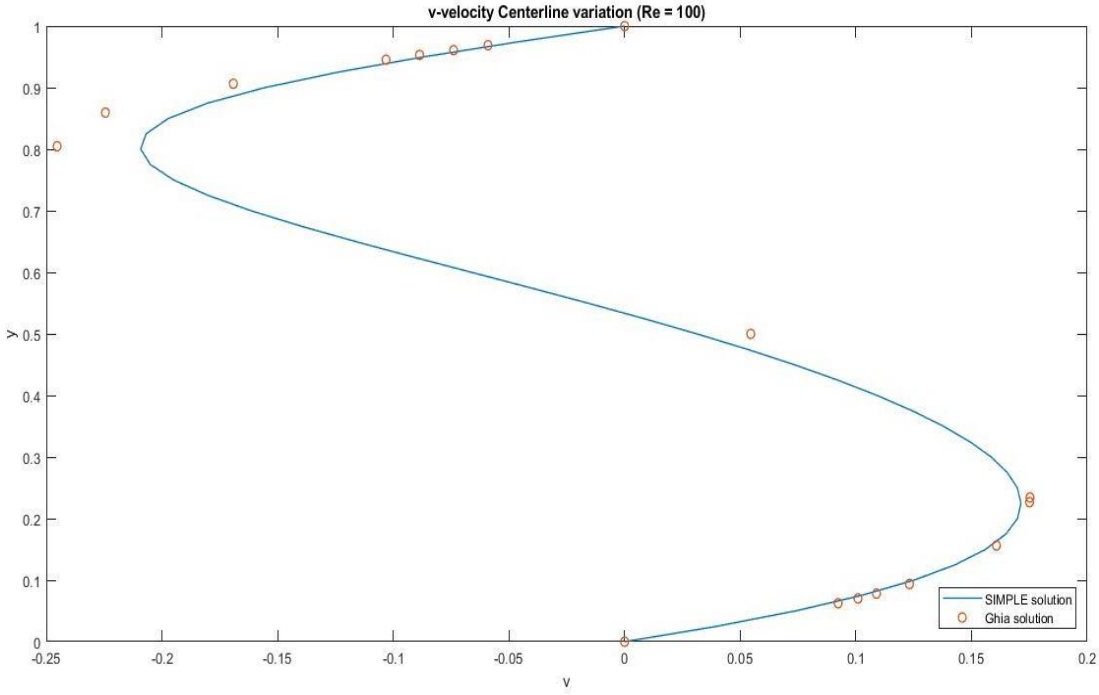
Re = 100

Grid size = 0.005 m

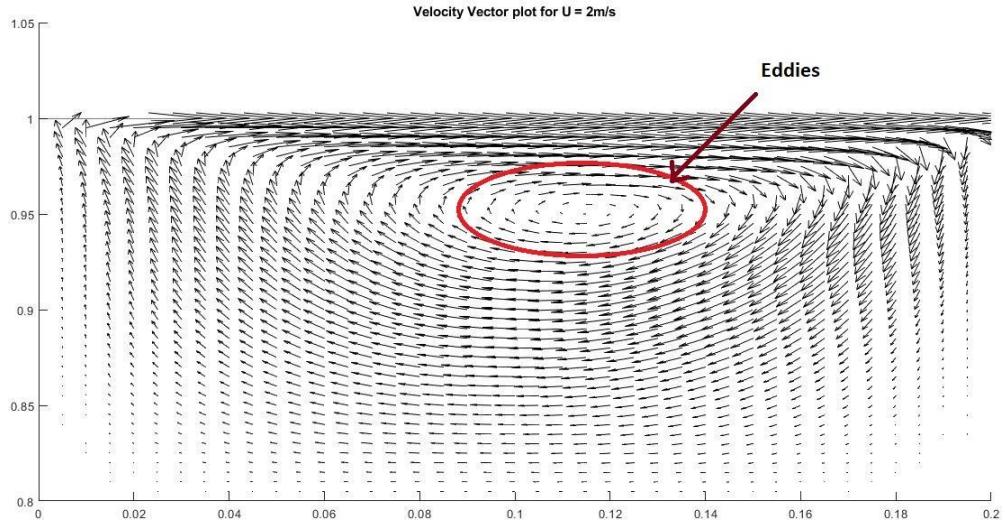
i) Centerline U- velocity



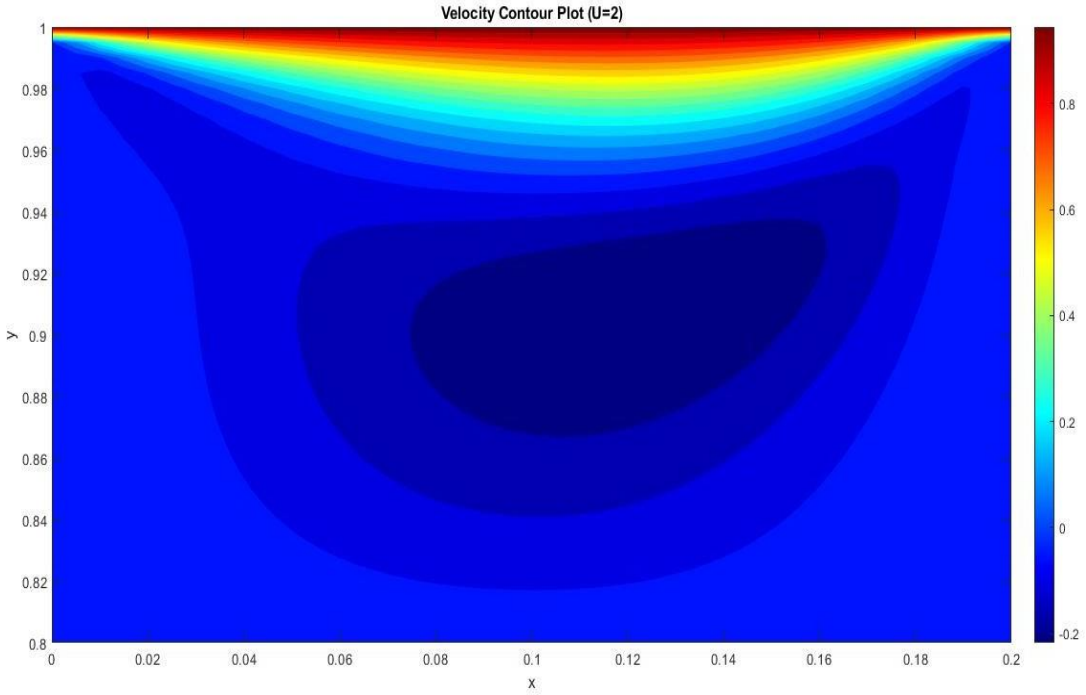
ii) Centerline V- velocity



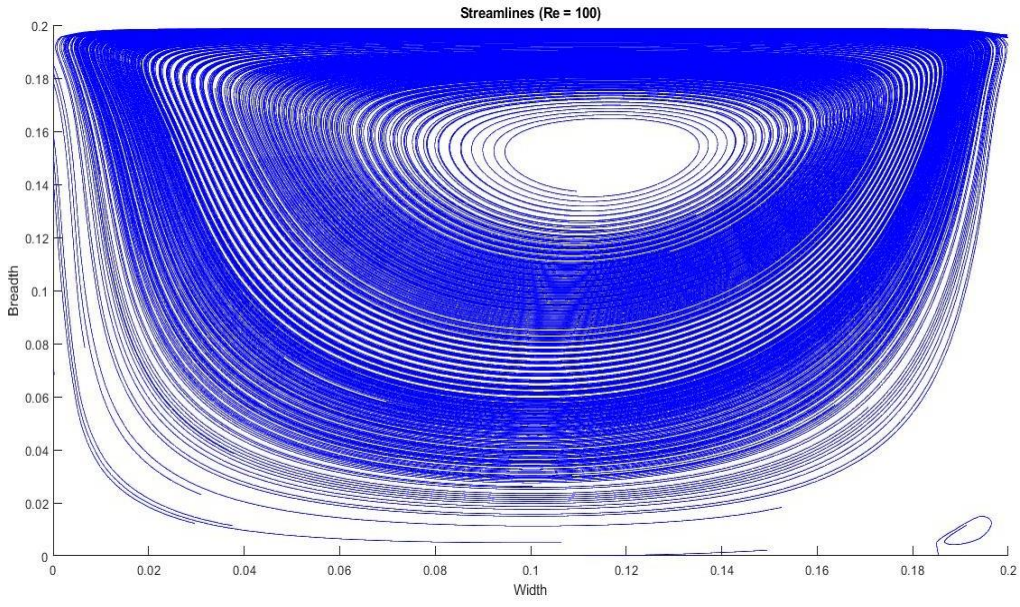
iii) Velocity vector



iv) Velocity contour



v) Streamline

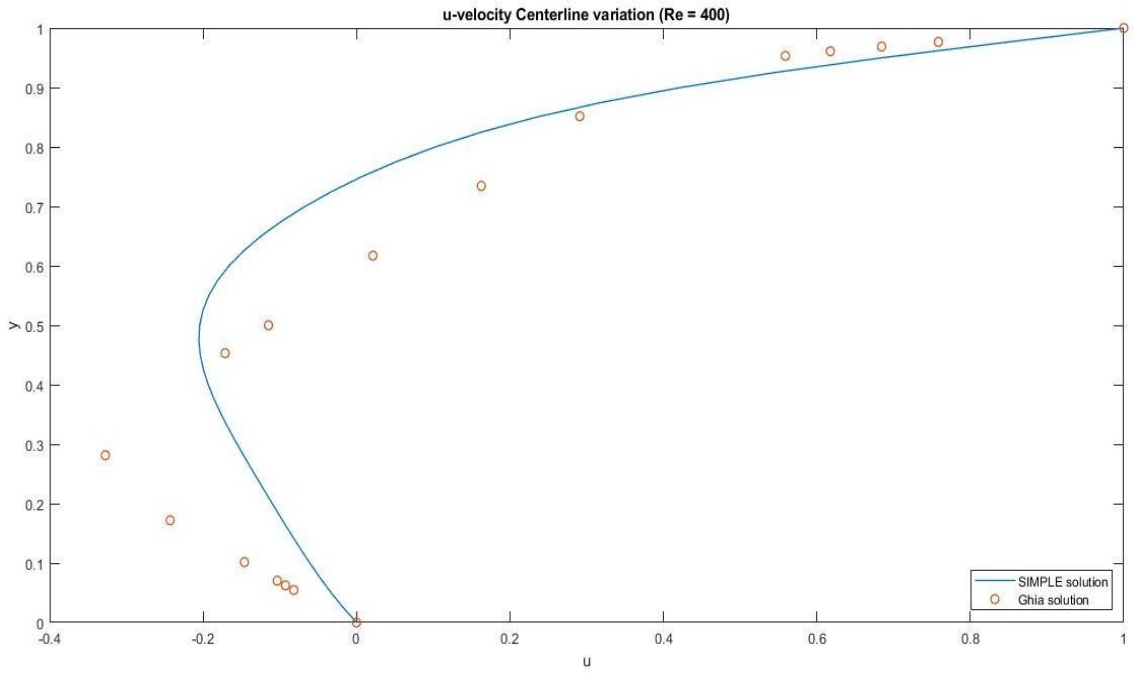


For U = 8 m/s

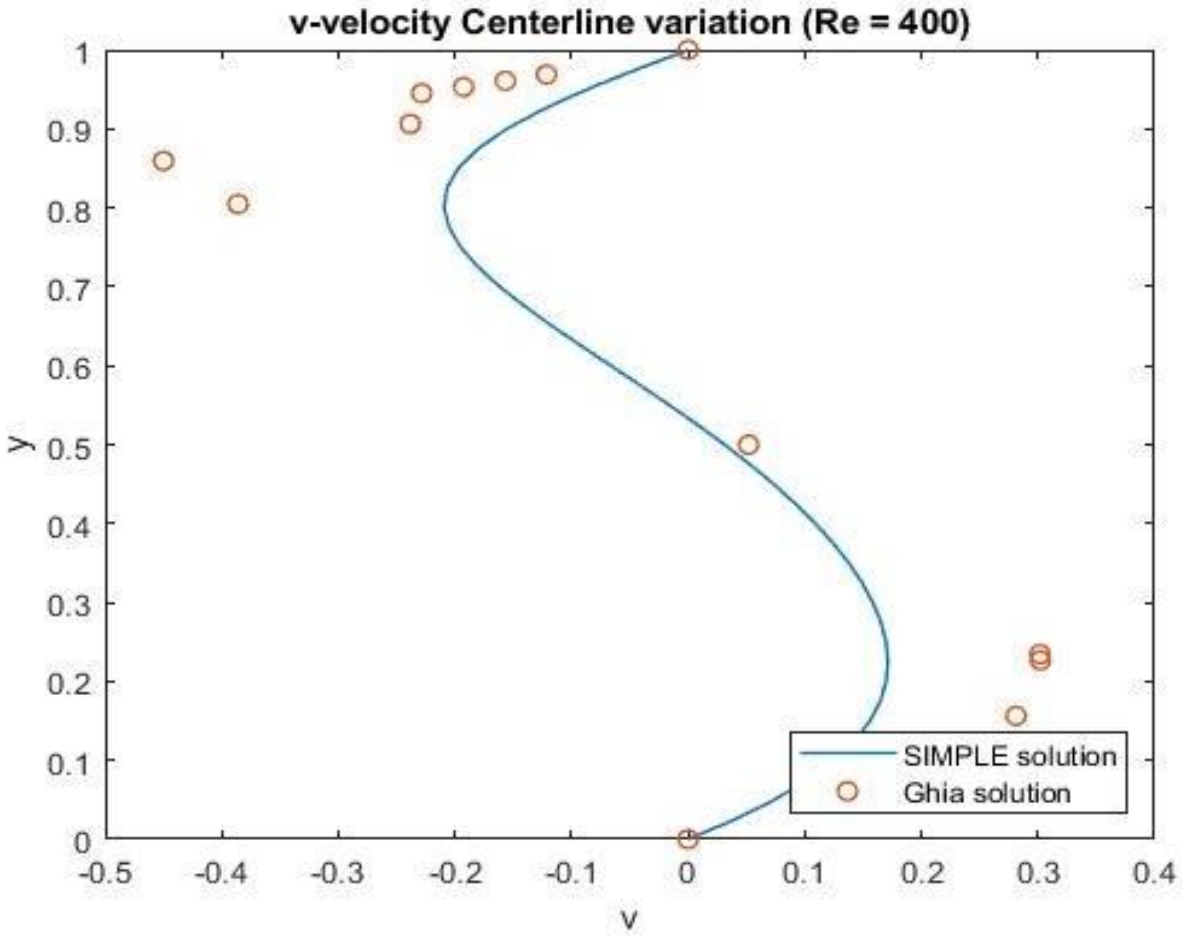
Re = 400

Grid size = 0.005 m

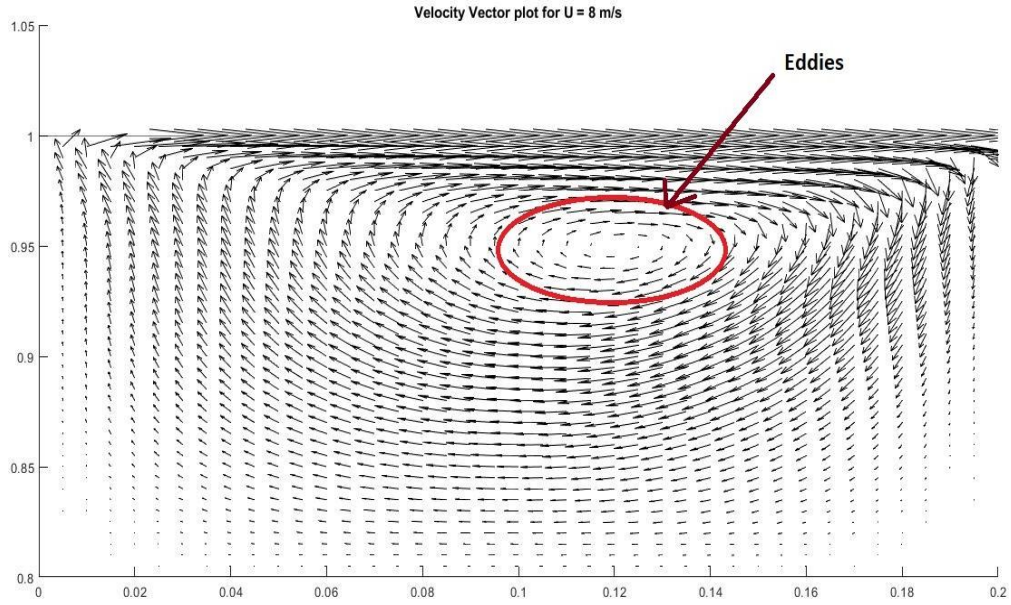
i) Centerline u –velocity



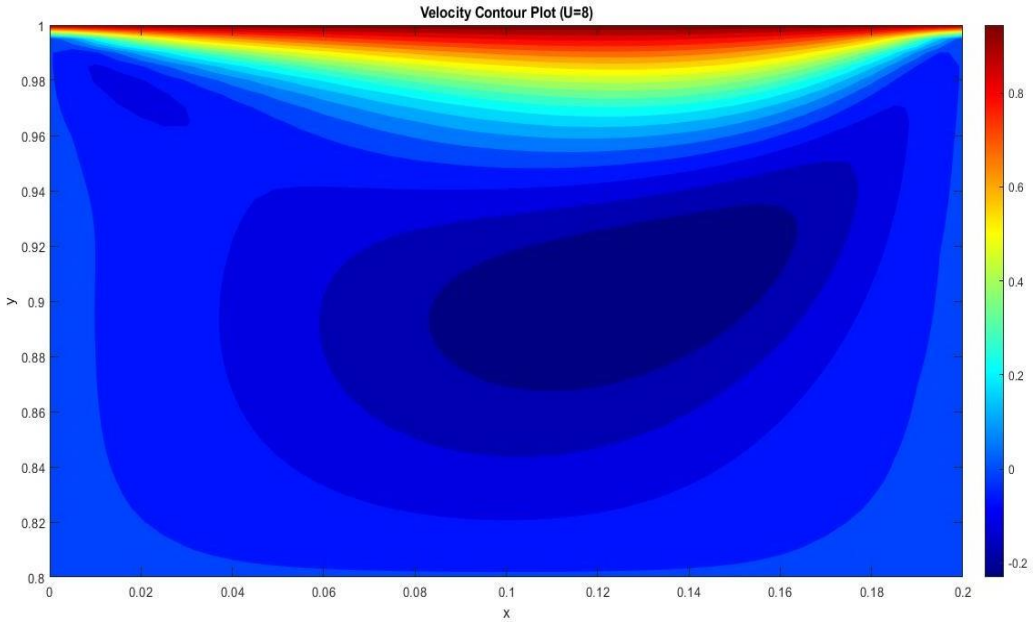
ii) Centerline V- velocity



iii) Velocity vector plot



iv) Velocity contour plot



v) Streamline