

ME 608: Homework 4

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1 Problem 1

The problem for a lid-driven cavity was considered. The mesh for the same, constructed in ICEM CFD, is shown in figure 1

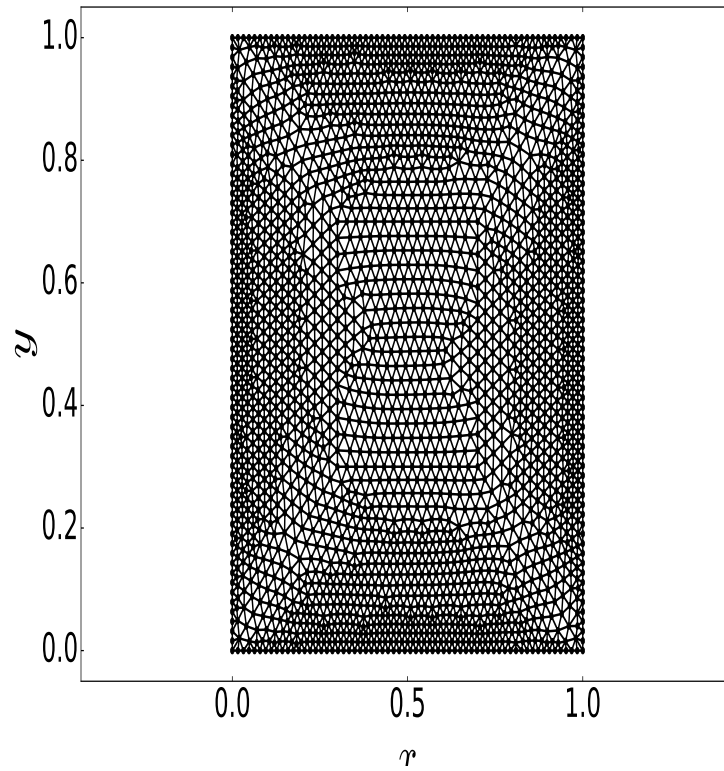


Figure 1: Mesh for the problem

The unsteady Navier-Stokes equation (including the convective terms) was solved using the fractional step method with Explicit Euler time advancement to simulate a lid velocity of 1 for the top surface. The kinematic viscosity was assumed to be 0.01, which gave a Reynolds number of 100. Data output from the code was compared against the benchmark study by Ghia et al. for $Re=100$.

1.1 Part a

Figures 2 and 3 display the value of u and v at the geometric centreline ($y=0.5$ and $x=0.5$ respectively). The data for the present code (marked by the solid line) was obtained through the use of 'griddata' in Python. The stars represent the data from Ghia et al.

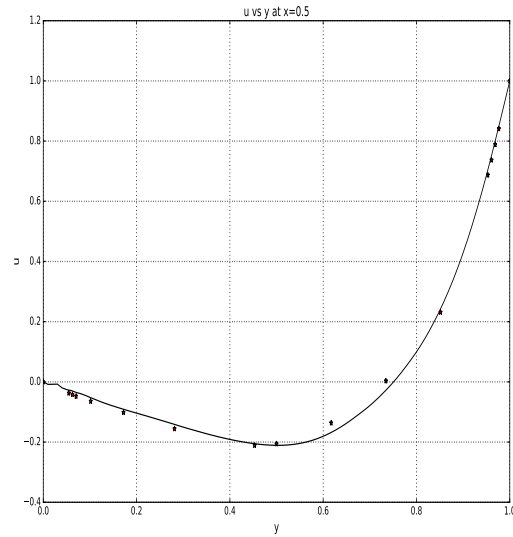


Figure 2: Variation of u with y at the geometric centre

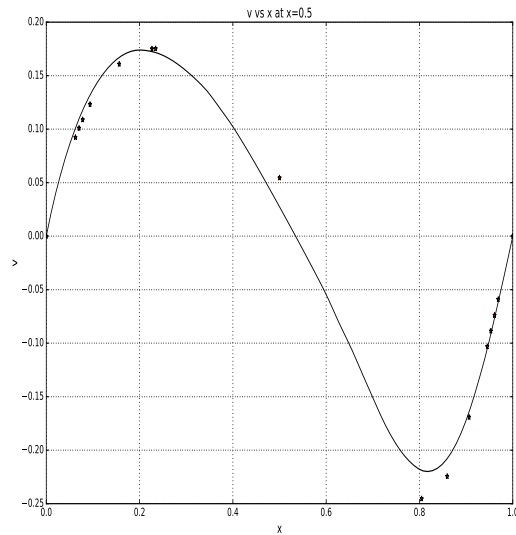


Figure 3: Variation of v with x at the geometric centre

The plots show that the results from this code agree fairly well with the results from Ghia et al. Even though a mismatch is observed in the data for v , the overall trend of the benchmark results from Ghia et al. is captured accurately.

1.2 Partb

For the second method, the code blows up beyond a certain number of time steps (≈ 10 iterations). The plots from part a, just before code blow up are shown in figures 4 and 5.

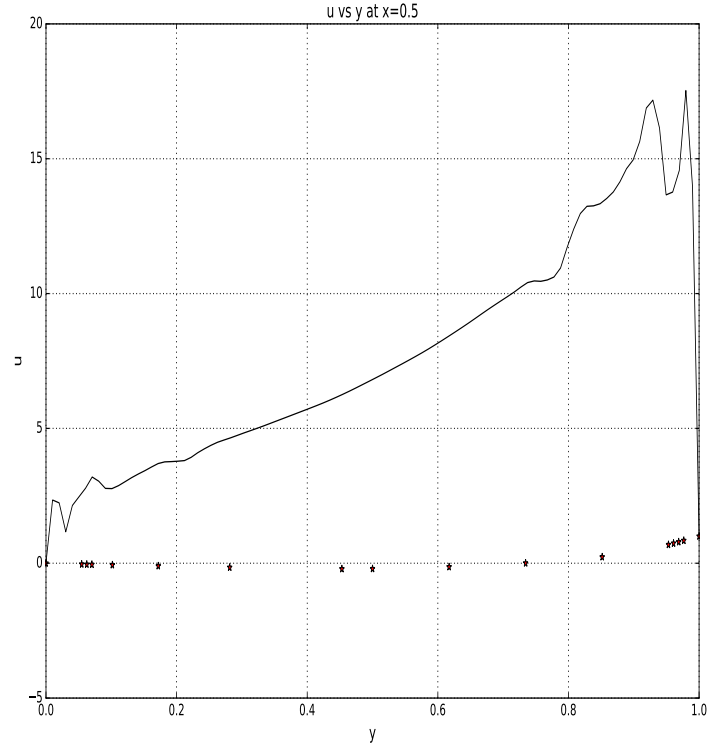


Figure 4: Variation of u with y at the geometric centre

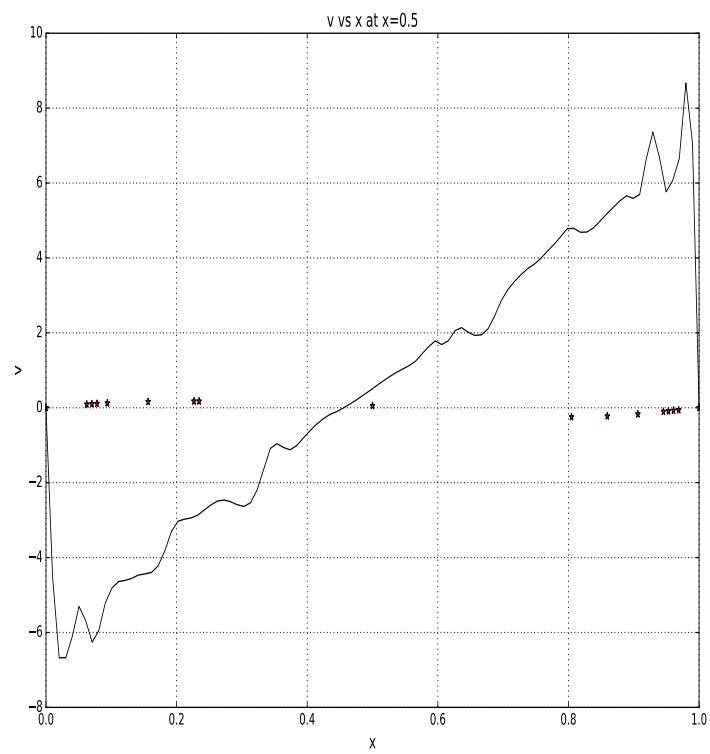


Figure 5: Variation of v with x at the geometric centre

1.3 Partc

Even for the third method, the code blows up beyond a certain number of time steps (≈ 120 , which is more than the number of iterations/time steps required for part b). The plots from part a, just before code blow up are shown in figures 6 and 7.

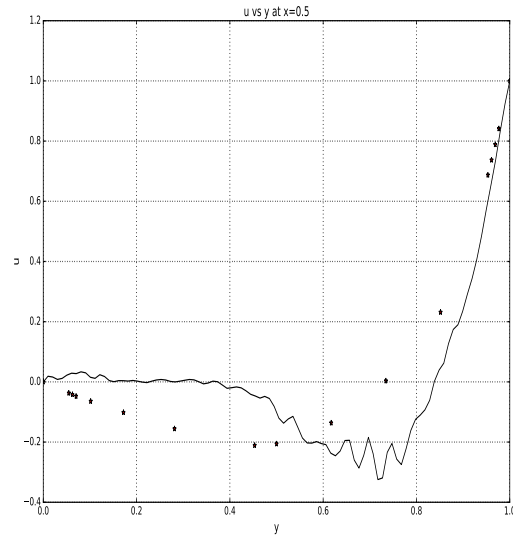


Figure 6: Variation of u with y at the geometric centre

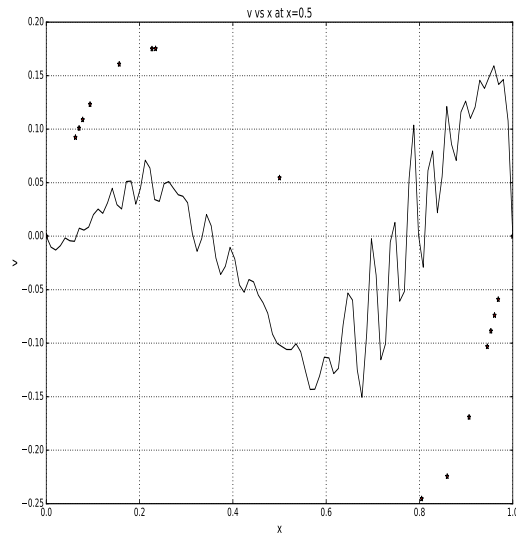


Figure 7: Variation of v with x at the geometric centre