AERO96028
High-Performance Computing
Coursework Answers
2019–2020

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1. Question

The answers are answered by my serial code. Figure 1 displays the horizontal velocity u at $x = 0.5L$ and v at $y = 0.5L$, for the steady-state Lid-Driven Cavity problem. This means that the flow field has converged to its final equilibrium state. This is achieved by running each simulation for a long time or by setting convergence criteria between two different time-step successive flow fields. Each curve represents the solution of a simulation for a particular Reynolds number. The computational domain discretisation, concerning the total of the questions, is $Nx \times Ny = 161 \times 161$ grid points. The time-step chosen for this resolution is $dt = 0.001\ sec$

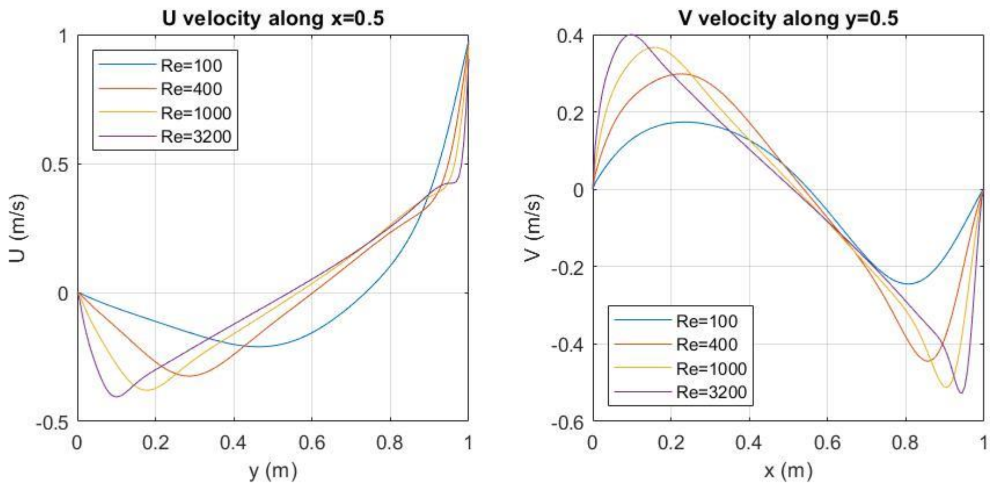


Figure 1: U velocity at $x = 0.5L$ and *V at $y = 0.5L$*, for the Lid-Driven Cavity problem, *for $Re = 100, 400, 1000$* and 3200.

2. Question

Figure 2 displays the steady-state stream function and vorticity contours for $Re = 100$.

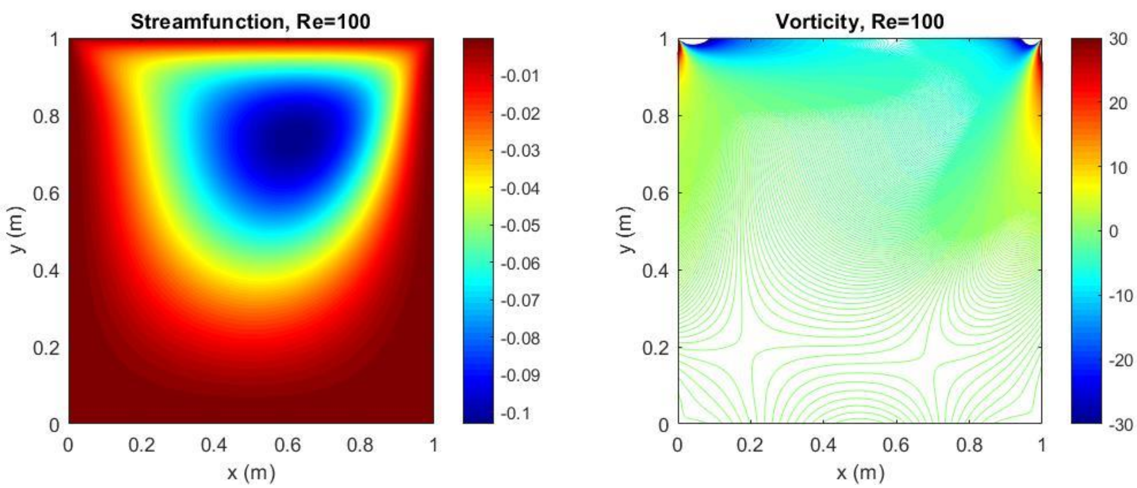


Figure 2: Steady-state stream function and vorticity fields at $Re = 100$.

3. Question

Table 1 presents the coordinates of the points with the lowest stream function value, for the different Reynolds number simulations.

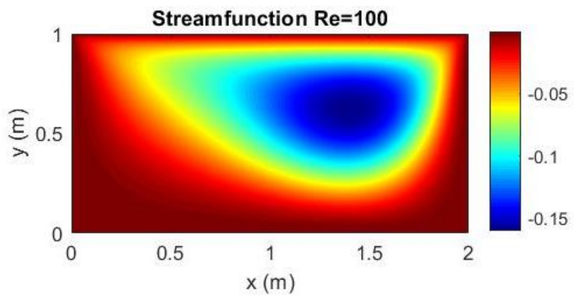
	Re=100	Re=400	Re=1000	Re=3200
X	0.62	0.56	0.53	0.52
Y	0.74	0.61	0.57	0.55

Table 1: Point coordinates of the lowest stream function value, for $Re = 100, 400, 1000$ and 3200.

From the table above, it can be deduced that, as the Reynolds number keeps increasing, the point with the lowest vorticity moves towards the centre of the computational domain.

4. Question

The figures below illustrate the stream function distribution of the Lid-Driven Cavity problem with edges $(L_x, L_y) = (2,1)$ and $(L_x, L_y) = (1,2)$. The Reynolds number of the flow is $Re = 100$. In this case, the simulation was run for a total time of $20\ sec$ for a time step of $dt = 0.001\ sec$. Larger step-times would cause instability and the solution would diverge.



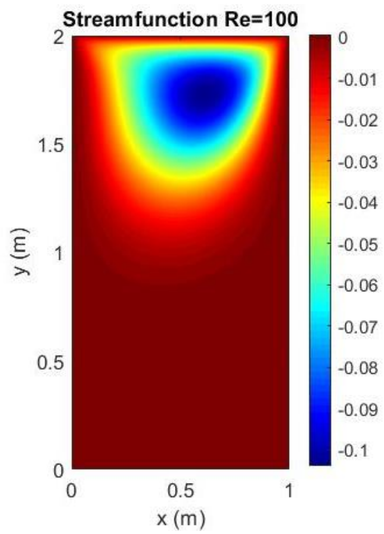


Figure 3: Stream function field contours for the Lid-Driven Cavity problem with $Re = 100$ and edges: $(L_x, L_y) = (2,1)$ and $(L_x, L_y) = (1,2)$