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# Role of shear layer instability in the transition of boundary layer on a bluff body

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The boundary layer on a circular cylinder undergoes a transition to turbulence at, approximately, Re=2 x $10^5$. This is accompanied with a significant reduction in drag. Using a stabilized finite element formulation, we have conducted two-dimensional computations for flow past a cylinder using a very fine mesh close to it. It has been shown by researchers earlier that the genesis and formation of shear layer vortices is primarily a two dimensional phenomenon. Our present computations confirm this finding. Shown in Figure 1 is the vorticity field for the flow past a cylinder at various Reynolds numbers. With an increase in Re the transition point of the shear layer, beyond which it is unstable, moves upstream. At the critical Re, the shear layer instability moves very close to the cylinder surface and the shear layer vortices interact with the separated boundary layer. These eddies result in mixing of the flow in the boundary layer with the more energetic outer flow causing the boundary layer to reattach. The narrowing of wake and delay of flow separation, at Re=$10^6$, is clearly observed from the figure. At Re=$10^7$ the shear layer instability moves further upstream. A finite element mesh with 116,116 nodes and 231,484 triangular elements has been used to solve the incompressible Navier-Stokes equations in primitive variables.

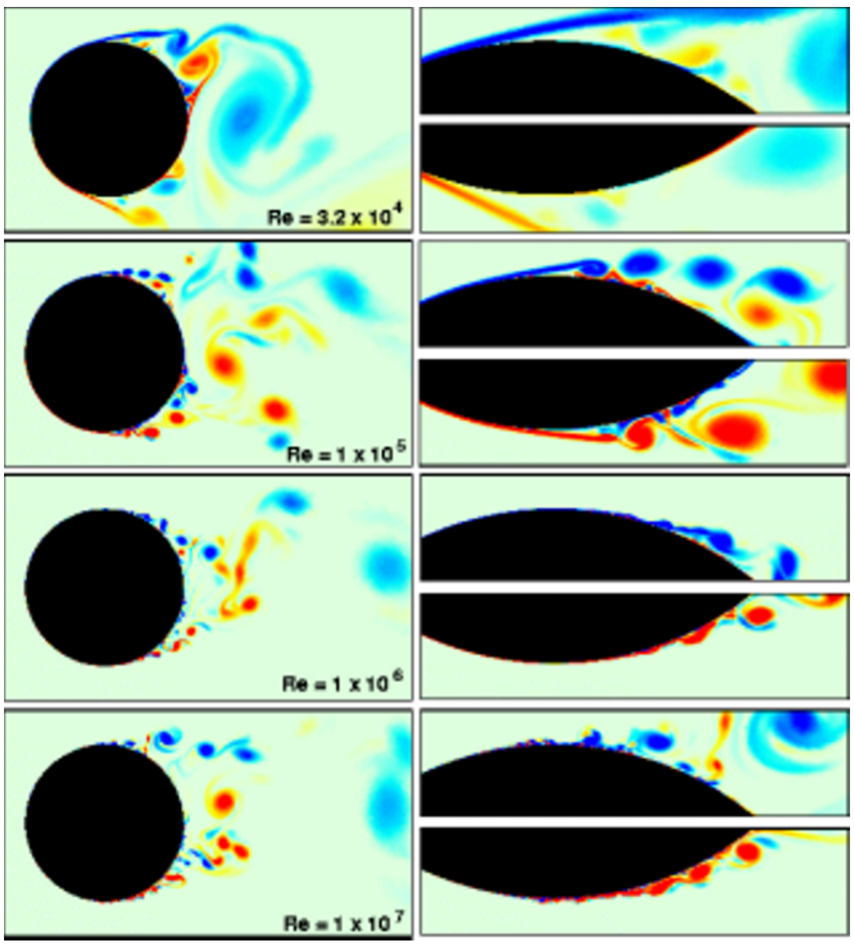


Fig. 1. Instantaneous vorticity field and its close-up near the upper and lower shoulder of the cylinder at various Reynolds numbers. Blue denotes negative and red denotes positive vorticity.