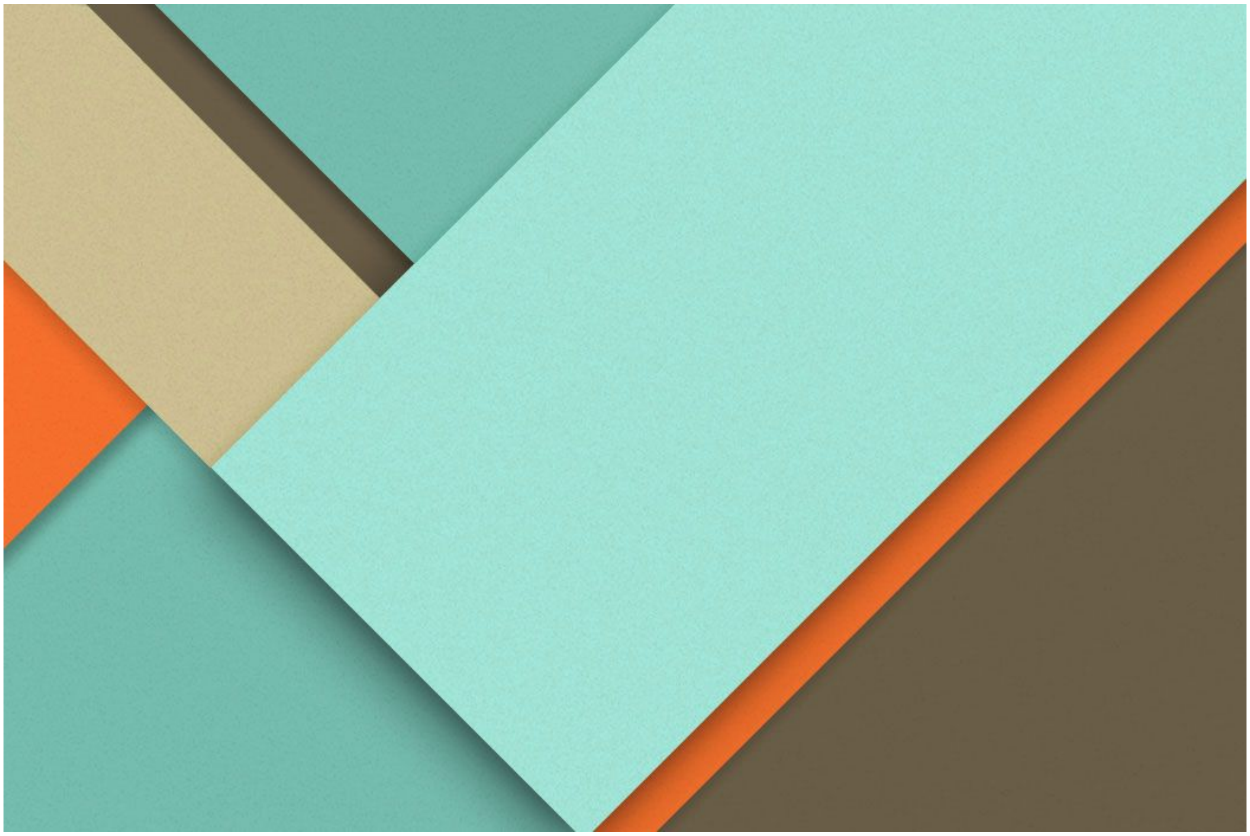


Simulation of laminar flow over a backward-facing step

24.11.2017

Vakul Kumar

Overview

The flow over a backward-facing step is one of the fundamental problems in fluid mechanics, which is important for example in hydrodynamic stability and turbulence research. Moreover, it is an established benchmark for Computational Fluid Dynamics (CFD) codes. The objective of the this task is to simulate the laminar backward-facing step flow by using SIMPLE method with OpenFOAM (simpleFoam solver).Goals

Specifications

We will perform a two-dimensional simulation, i.e. assuming that the channel has infinite width. The computational domain is as follows:

• The step is located at x=0 and has height D=0.1m

• The height of the entry channel is equal to step height H=D

• The length of the entrance channel is L_1 =10D

• The length of the channel after the step is also L_2 =10D

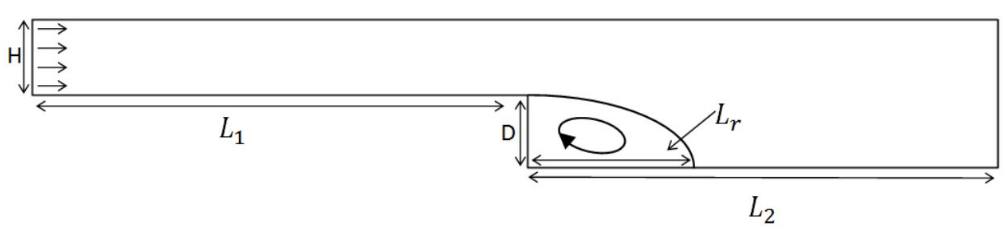
The boundary conditions are:

• No-slip at channel walls

• Uniform streamwise velocity profile at the inlet

• Neumann boundary condition at the outlet

The Reynolds number is typically defined as Re = UH/ ν , here we will take ν = 0.01[m^2/s] . The velocity in the x − and y − directions are denoted as u and v, respectively.



Milestones

- Convergence study: we will fix Re=100 and use a coarse mesh (entrance channel 50x5, second channel 50x10) to perform the simulations and obtain the **recirculation length L_r**. Then, refining the mesh and generate results for L_r with different meshes.
- Run simpleFoam solver efficiently: using the best mesh chosen ,I will change the relaxation factor of pressure and velocities. Then, Generate a table regarding the number of outer iterations with different relaxation pairs.
- Interpretation of results at Re=100: with the mesh and relaxation factors chosen above and figure out :

– the profile at various points.

– find the distance at which the flow is fully developed?

- Reynolds number dependence: the variation of value of L r /D as a function of Reynolds number Re=0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100.