Tutoriel 6: PitzDaily

Asmaa HADANE

ENS Paris-Saclay

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Introduction

In this example we shall investigate steady turbulent flow over a backward-facing step. The problem description is taken from one used by Pitz and Daily in an experimental investigation, against which the computed solution can be compared.

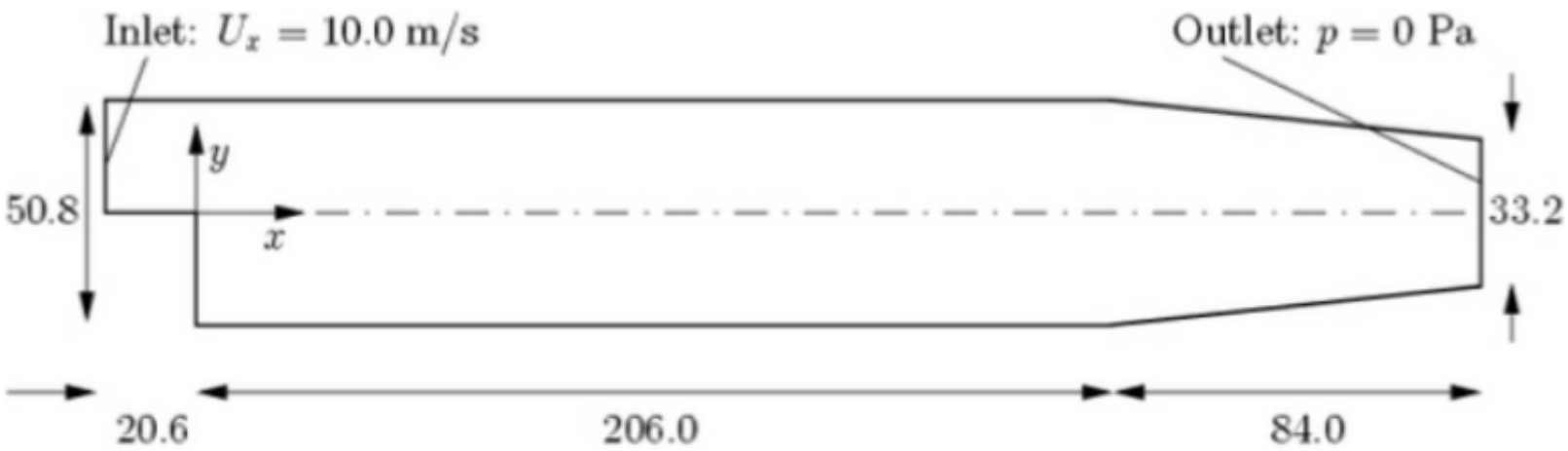
Hypothesis

Using the turbulent solvers made available in the open source software OpenFOAM, the experimentally gathered results from Pitz and Daily will be recreated in a simulation. The simulation consists of

- Incompressible flow
- Turbulent flow
- 2D flow
- Viscous flow
- Steady flow

Physics of the problem

The simulation will occur in a two-dimensional mesh consisting of a short inlet,a backward facing step, and a converging nozzle as the outlet as shown below.



Governing equations

The governing equations for the problem are as follows:

- Mass continuity for incompressible flow:

$$\nabla \cdot \mathbf{U} = 0$$

- Steady flow momentum equation:

$$\nabla \cdot (\mathbf{U}\mathbf{U}) + \nabla \cdot \mathbf{R} = -\nabla p$$

Where p is the kinematic pressure, and R is the viscous stress term with an effective kinematic viscosity calculated from the transport and turbulence models.

Setup

Initial Conditions

- $U_0 = 0 m/s$
- $p_0 = 0 Pa$

Boundary conditions

- $U_{inlet} = (10, 0, 0) m/s$
- $p_{outlet} = 0 Pa$

Turbulence

- RANS, Large Eddy Simulation

Turbulence

Compare between the two turbulence models RANS and LES:

1. /opt/openfoam11/tutorials/incompressibleFluid/pitzDaily
2. /opt/openfoam11/tutorials/incompressibleFluid/pitzDailyLES