Simulating 2D laminar flow in a channel using OpenFOAM

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http://spoken-tutorial.org

National Mission on Education through ICT

http://sakshat.ac.in

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Learning Objectives

- **2D Geometry of Channel**

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- **2D Geometry of Channel**
- **Meshing the geometry**

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Learning Objectives

- **2D Geometry of Channel**
- **Meshing the geometry**
- **Solving and post-processing results in Paraview**

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- 2D Geometry of Channel
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Learning Objectives

- **2D Geometry of Channel**
- **Meshing the geometry**
- **Solving and post-processing results in Paraview**
- **Validation using analytic result**

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System Requirement

- **Linux Operating System Ubuntu version 12.04**

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- **Linux Operating System Ubuntu version 12.04**
- **OpenFOAM version 2.1.1**

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System Requirement

- Linux Operating System Ubuntu version 12.04
- OpenFOAM version 2.1.1
- ParaView version 3.12.0

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System Requirement

- Linux Operating System Ubuntu version 12.04
- OpenFOAM version 2.1.1
- ParaView version 3.12.0
- OpenFOAM 2.1.1 is supported on Ubuntu 12.04

Prerequisite

- **Knowledge of how to create geometry using OpenFOAM**

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Prerequisite

- **Knowledge of how to create geometry using OpenFOAM**
- **If not, please refer to the relevant tutorials on http://spoken-tutorial.org**

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About flow in channel

- **We simulate flow in a Channel to determine**

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About flow in channel

- **We simulate flow in a Channel to determine**
- **Flow development length along the downstream**

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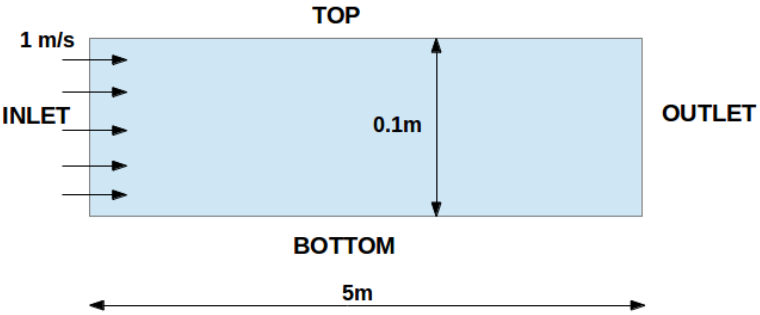
Channel flow



Boundary Conditions

- **Flow development length is given by the formula L=0.05*Re*D**

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- **Flow development length is given by the formula L=0.05*Re*D**
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Boundary Conditions

- Flow development length is given by the formula L=0.05*Re*D
- Channel is of length 5m and height 1m
- Inlet velocity is 1m/s
- Reynolds number(Re)=100

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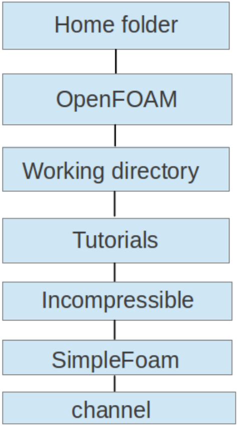
File structure



Calculate k

$$k = \frac{(U'^2x+U'^2y+U'^2z)}{2}$$

- 'k' is turbulent kinetic energy

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- **'k' is turbulent kinetic energy**
- **U'_x, U'_y, U'_z are velocity components**
- **$U' = 0.05 * u_{actual}$**

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Calculate epsilon

$$\varepsilon = \frac{C^{0.75}{}_{\mu} * k^{1.5}}{l}$$

- ϵ is rate of dissipation of turbulent energy

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Calculate epsilon

$$\varepsilon = \frac{C^{0.75}_{\mu} * k^{1.5}}{l}$$

- ϵ **is rate of dissipation of turbulent energy**
- **C$_{\mu}$ is a constant and its value is 0.09**
- **'l' is the length of the pipe**

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Solver

- **SimpleFoam**

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Solver

- **SimpleFoam**
  - Steady-state solver for incompressible and turbulent flows

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Analytical result

- **Analytical result U_{max} =1.5*U_{avg}**

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Analytical result

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Analytical result

- **Analytical result U_{max} =1.5*U_{avg}**
- **OpenFOAM result U_{max} = 1.48 m/s**

Summary

- **File structure of channel**

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Summary

- File structure of channel
- Obtained solution using steady state solver

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Summary

- File structure of channel
- Obtained solution using steady state solver
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- Validation with analytical result

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Assignment

- **Solve the problem for Reynolds Number (Re) = 1500**

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Assignment

- **Solve the problem for Reynolds Number (Re) = 1500**

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Assignment

- **Solve the problem for Reynolds Number (Re) = 1500**
- **Validate with anlytical results**

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About the Spoken Tutorial Project

- **Watch the video available at http://spoken-tutorial.org /What_is_a_Spoken_Tutorial**
- **It summarises the Spoken Tutorial project**
- **If you do not have good bandwidth, you can download and watch it**

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Spoken Tutorial Workshops

The Spoken Tutorial Project Team

- Conducts workshops using spoken tutorials
- Gives certificates to those who pass an online test
- For more details,please write to contact@spoken-tutorial.org

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Acknowledgements

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- It is supported by the National Mission on Education through ICT, MHRD, Government of India
- More information on this Mission is available at http://spoken-tutorial.org /NMEICT-Intro

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