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# Laboratory 05
# Turbulence Variances & Turbulent Squared Duct Flow

## CFD for Nuclear Engineering

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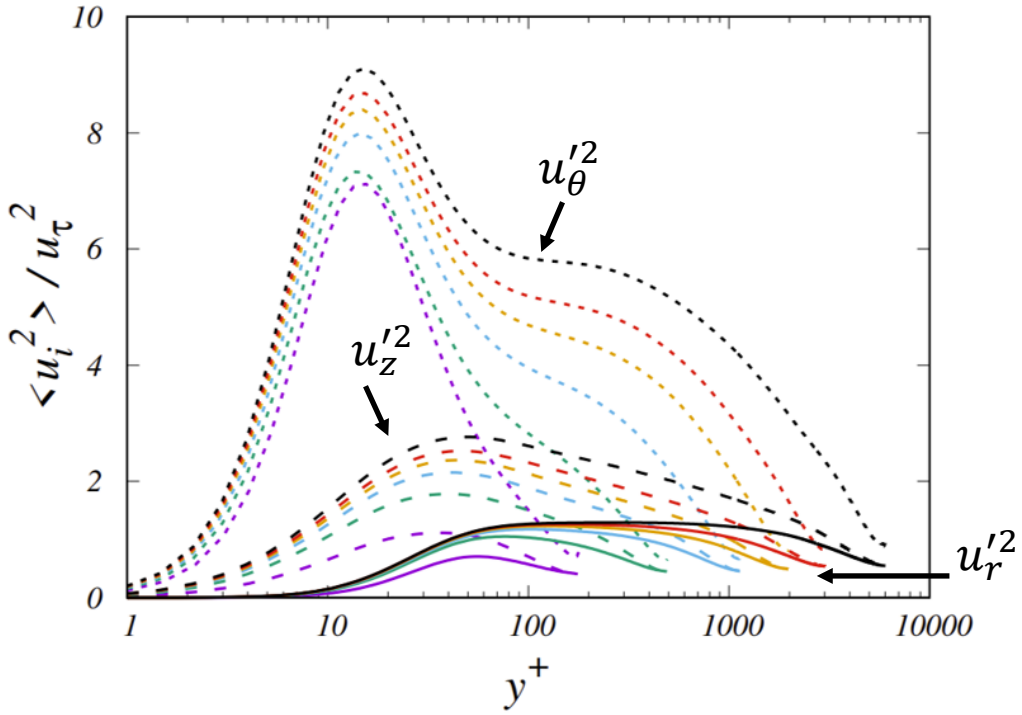
# PROJECT WORK

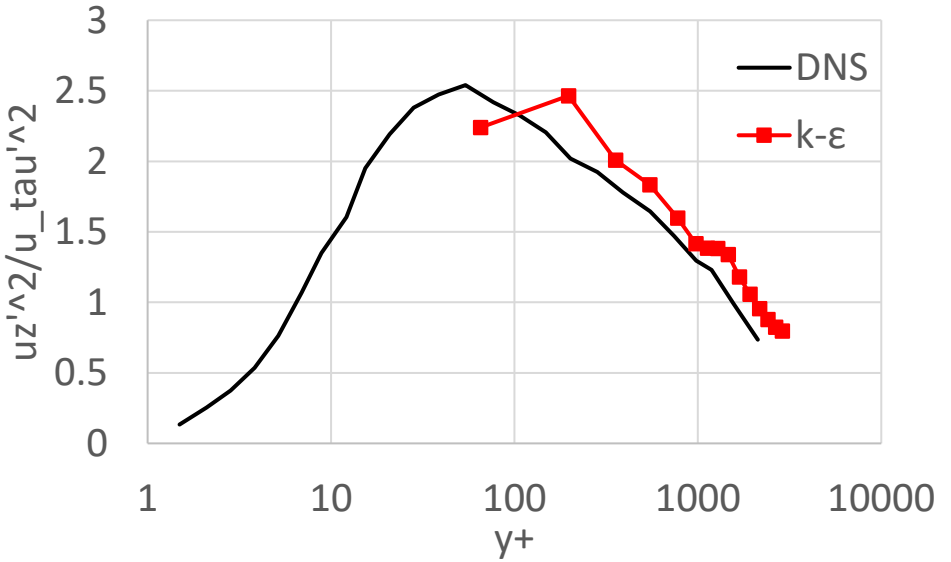
- The students need to define groups of 3 to 5 people to conduct the PW
- Let's set a **preliminary deadline by November 15th**
- Please communicate the name of the group's component by email to the instructor (marco.pellegrini@polimi.it)
- By the end of November, I will assign the Project Work (PW) to each group
- Each group will receive a different PW
- Each PW will include **two studies**:
    - One single phase flow focused on the turbulent flow
    - One two phase flow focused on multiphase physics
- The **PW can be discussed only the day of the exam** (5 times per year), face to face by all the components
- The presentation should be shared equally by all the members of the group

# COMPARISON OF VELOCITY AXIAL VARIANCES IN THE FULLY DEVELOPED TURBULENT PIPE FLOW




*Pirozzoli et al. 'One-point statistics for turbulent pipe flow up to Reτ ≈ 6000*

Let's try to extract the normal variance $u_z'^2$ from the simulation done last week for the fully developed turbulent pipe.
DNS data are uploaded on WeBeep. File name:
**AxialVariances.csv**

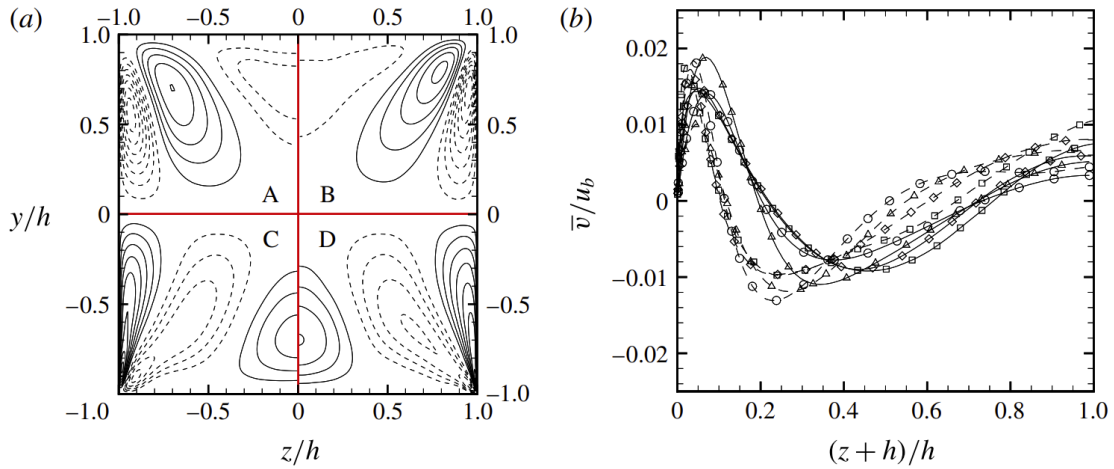



An **addendum** is uploaded in the Lab 04 to explain how to create Custom Field Functions.

# SIMULATION OF A FULLY DEVELOPED TURBULENT FLOW IN A SQUARED DUCT

By now, you have all the tools to make your own simulation from scratch. Let's add one level of difficulty from the fully developed turbulent pipe flow, changing the geometry into a squared duct. Let's simulate it with Standard k-ε and Standard k-ω model.

Our objective would be to capture the **secondary flows**.




Pirozzoli et al, Turbulence and secondary motions in square duct flow, J. Fluid Mechanics, 2018

Let's simulate the case with Re = 40,000

$$Re_b = \frac{2h \cdot U_b}{\nu} = 40{,}000$$

A basic hands-on session is provided in Lab05 but the detailed steps are all given in the previous hands-on sessions.