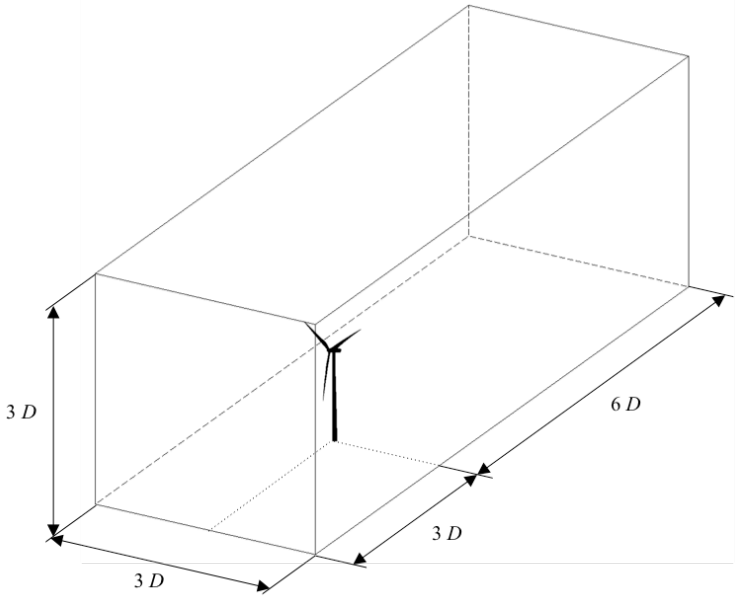
MECH 3315 – Spring 2019
Final Project description

Description of the dataset:

- Results from numerical simulations of the flow around a wind turbine are provided to you. The time-averaged velocity and pressure are provided. The flow is incompressible. The flow domain ("control volume") is shown in the figure



below.
D indicates the rotor diameter. The hub height (center of rotation) is at 0.7*D* from the ground. For this wind turbine, *D* = 126 m.

- The Reynolds number based on the rotor diameter and the incoming uniform velocity *U* is:

$$\mathrm{Re} = \frac{\rho U D}{\mu} = 7.3 \cdot 10^7$$

The velocity and pressure fields provided are normalized with the reference velocity and density.

- The simulations were performed for different rotational speeds of the wind turbine. The tip-speed ratio (*TSR*) is defined as:

$$TSR = \frac{\omega R}{U}$$

where ω is the rotational speed of the turbine, $R = D/2$. Nine *TSR*s were selected from 5 to 9, every 0.5. Each file contains the velocity and pressure field for a specific *TSR*.

Name of the file provided: "data_mod1_tsrXX.mat" or "data_mod2_tsrXX.dat"

- XX is the value of the *TSR* times 10 (e.g. 'data_mod1_tsr75.mat' corresponds to a *TSR* = 7.5)
- The file provided is a MATLAB binary file. Once loaded into MATLAB, the workspace will display the following variables:

`u`	time-averaged streamwise velocity component
`v`	time-averaged wall-normal (vertical) velocity component
`w`	time-averaged spanwise velocity component
`pr`	time-averaged pressure
`xx`	streamwise coordinate
`yy`	wall-normal (vertical) coordinate
`zz`	spanwise coordinate
`n1`	number of points in the streamwise direction
`n2`	number of points in the wall-normal direction
`n3`	number of points in the spanwise direction

Project tasks:

- Verify the conservation of mass in the domain.
- Compute the *thrust* force on the wind turbine (this force is equal and opposite to the drag experienced by the flow) applying conservation of momentum.
- Compute the power extracted by the turbine applying conservation of energy.
- Plot the pressure on a horizontal plane at hub height.
- Plot particle lines (using Matlab functions). (suggestion, release particles at the rotor plane to observe the swirl in the wake)
- Comment the results in a report