Guide for class work and measurement in the laboratory

This guide is intended to provide instruction on the code preparation and the procedure to measure data in the wind tunnel.

In class - before entering the lab

During the class time you should prepare your codes to directly process your data. You have available in AulaGlobal the following tools:

- A sample of data output from the software of the pressure scanner, called Sample. It corresponds to a generic angle, at a different velocity from the one you will use in the measurement.
- A code Read_pressure.m to read the file. The code provides in output a time vector and a matrix containing pressure data. Each column is the output of one pressure port. The last column corresponds to the stagnation pressure. All pressures are gauge pressures, i.e. the measured value is the difference with respect to p_∞.
- A file with the pressure port positions in .mat format. The columns are respectively x, y and z position, according to the Table 1 in the statement.

Before moving to the lab:

- Compute the value of $P_0 - P_\infty$ to obtain a velocity of $10 m/s$ in the tunnel. This will be useful when tuning the tunnel speed in the lab (remember that the port P14 of the scanner is measuring $P_0 - P_\infty$ of the Pitot tube).
- Decide the number of samples you want to acquire for each case. The sampling frequency is fixed to $100 Hz$. You will have to motivate your choice in the report.
- Discuss with your group on which angles you want to measure. You have to cover the range $-5° - 15°$. Remember that you only have 15 minutes to measure, and that the spacing between angles does not have to be uniform.
- Decide a strategy to identify which is the real $\alpha = 0°$. We attached a goniometer to the wall of the tunnel, but unfortunately the zero is not perfectly aligned with the effective $\alpha = 0°$. Can you use the pressures to identify the condition of $\alpha = 0°$?

If time allows, during the class:

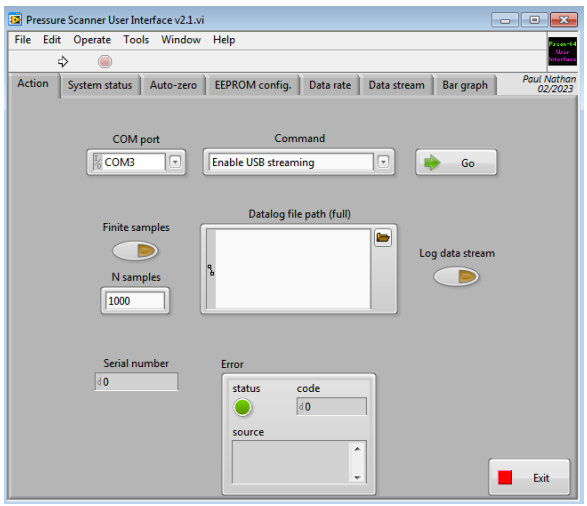
- Prepare a Matlab code which reads the pressure data (using Read_pressure.m) and computes: 1) the flow speed, from the stagnation port reading, assuming that you know the atmoshperic pressure $P = 93450 Pa$ and the temperature $T = 295 K$; the pressure coefficient on the dorsal and ventral parts of the airfoil; the lift coefficient. Assume for this purpose you know the angle of attack (set for this case $1°$).
- Adapt your code to open automatically a sequence of files (for instance Angle01, Angle02, Angle03,...), computes the lift coefficient for each case, and plots the lift curve.

In the lab

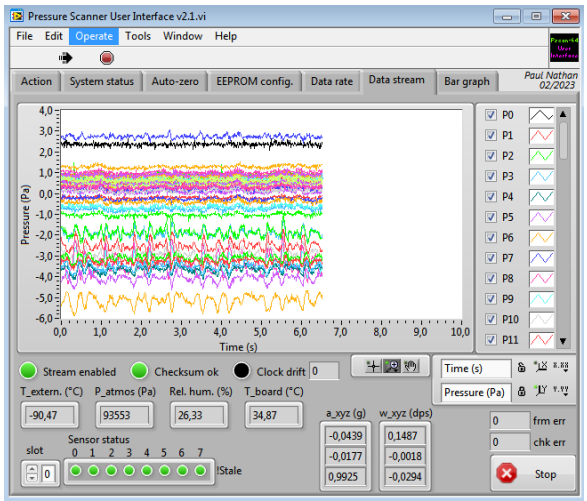
You will find two computers nearby the tunnel test section. The pressure scanner is connected to the one named "Pitot" (the name is on the case). Plug your USB drive there to transport quickly your data. The other computer controls the wind tunnel.

Follow the instructions below to perform the measurement.

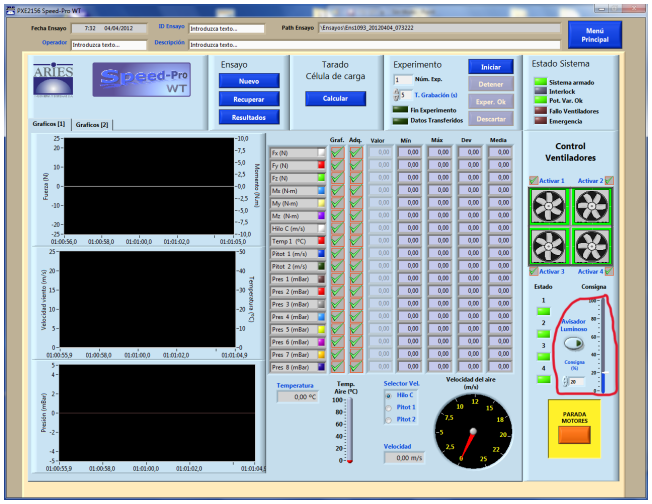
1 - Start up the pressure scanner. The interface is reported in the figure below. Make sure that COM port is selected to COM3, and click on the white arrow on top to start.



2 - Click on the Go (indicated on the right, with the green arrow). If everything works, the pressure scanner should start capturing and you will see a screen updating like the following figure. The P14 indicates $P_0 - P_\infty$. The other channels indicate $P - P_\infty$ for the pressure ports as numbered in the assignment.



3 - Increase the speed of the wind tunnel (indicated in the red circle on the bottom right in the figure below, as % consigna) from the control PC of the tunnel until you reach a stagnation pressure corresponding to a freestream velocity of $10 m/s$. For the speed control, you should rely on the reading of P14 from the pressure scanner.



Now you are ready to capture your data. Go back to the Action menu, and click on Stop (in the figure below on top, signaled with the orange arrow). Click on the yellow flags below Finite Samples and in Log data stream (indicated in figure with the blue arrows). Select the number of samples according to your criterion to reach convergence (you should have decided this in class). In the panel Datalog file path (signaled with red arrow), select a path to your usb drive and assign a name. For each angle you test you will need to change the filename. Span angles from -5 to 15 according to the goniometer included in the wind tunnel wall. You can select freely the number of angles you want to measure. For each angle, make sure you take a picture or a note of the angle in the goniometer. BEWARE that the goniometer was not accurately placed, the zero might have an offset. Use your data to understand which is the real angle of attack.