Experiment 1 - Introduction to Instrumentation and Data Acquisition

Questions

1. Using the pitot and wall static arrangement and the DAQ reading, determine the wind tunnel velocity for each point.
   (a) Present the results in a table. Include values for the dial setting, $p_T - p_{wall}$ and calculated velocity.
   (b) Plot the Dial Setting vs. Velocity and find a linear fit to determine the wind tunnel velocity at a given dial setting. *This is your first tunnel calibration curve.*
   (c) Plot $p_T - p_{wall}$ vs. Velocity
   (d) Plot DAQ Voltage vs. DAQ Pressure and find the linear calibration curve for the transducer.
2. Using the pitot-static arrangement and the DAQ reading, determine the wind tunnel velocity for each point.
   (a) Present the results in a table. Include values for the dial setting, $p_T - p_s$ and calculated velocity.
   (b) Plot (in same plot as 1b) the Dial Setting vs. Velocity and find a linear fit to determine the wind tunnel velocity at a given dial setting. *This is your second tunnel calibration curve.*
   (c) Plot (in same plot as 1c) $p_T - p_s$ vs. Velocity
3. Using the readings taken with the pitot-static tube, and the hand-held manometer; determine the wind tunnel velocity for each point.
   (a) Present the results in a table. Include values for the dial setting, $p_T - p_{wall}$, the measured DAQ voltage, calculated velocity, and the uncertainty in velocity.
   (b) Plot (in same plot as 1b) $p_T - p_{wall}$ vs. DAQ Voltage
   (c) Plot (in same plot as 1c) $p_T - p_{wall}$ vs. Velocity
4. List possible sources of error in the measurements. Discuss each and how they can be reduced.
5. For the same tunnel velocity, are there any differences in the DAQ pressure readings when you use $p_T - p_{wall}$ vs. $p_T - p_s$? Were different linear fits obtained for each of the calibrations? Discuss possible reasons for this discrepancy if one exists.
6. Briefly discuss the selected sampling rate and number of samples. Why is it important to properly select these values? How many samples are required for the mean velocity to converge within 1% for your selected sampling frequency?
7. What is meant by the resolution of an analog to digital converter? How does this affect your data, if at all?
8. In your experiment, a 14-bit A/D converter is used with a range of 5 to 5 V. Calculate the quantization error in millivolts. Using the calibration curve found in 1d, what does this equate to in pressure? Is this significant compared to other errors?