AerE344 Pre-Lab Assignment - Experiment Design Component

Lab #06: Airfoil Wake Measurements and Calibration of a Hot Wire Anemometer

THIS ASSIGNMENT IS DUE AT YOUR LAB TIME. IT MUST BE TURNED IN FOR YOU TO PARTICIPATE IN THE LAB EXERCISE.

The integral form of the momentum equation can be expressed as:

$$\frac{\partial}{\partial t}\int_{CV}\vec{V}\rho dV + \int_{CS}\rho\vec{V}(V\bullet\hat{n})dA = \sum F$$

1. Write out the meaning of each of the terms in this equation.

2. Describe the steps needed to bring this equation to the form we will use for this lab to estimate the drag coefficients of the GA(W)-1 airfoil.

3. *What you will have available to you in the lab will include:*
   - A thermometer and barometer for observing ambient lab conditions (for calculating atmospheric density).
   - Three 16-channel Scanivalve DSA for a total of 43 channels of pressure sensors.
   - A rake downstream of the airfoil containing total pressure probes at a spacing of 2.0mm. The 41 tubes are connected to the Scanivalve scanners.
   - GA(W)-1 airfoil installed in the undergraduate aerospace wind tunnel.

   Please design an experiment (i.e., to show step by step procedure) to use the instruments listed above to acquire required experimental data to estimate the drag coefficients of the GA(W)-1 airfoil at different angle of attack.

4. Each group is required to submit a Pre-Lab report to TA before you can take measurements in the wind tunnel lab.

AerE344 Pre-Lab Assignment - Experiment Design Component

Lab #06: Calibration of a Hot Wire Anemometer System

You will need to finish this pre-lab assignment before you come to the wind tunnel laboratory to do the experiments.

What you will be given for your experiment:

- A thermometer for observing ambient lab conditions (for calculating atmospheric density).
- A pitot-static probe to measure wind tunnel test section velocity.
- A Mensor digital transducer to record the dynamic pressure (from the pitot-static probe).
- A single-wire hot-wire probe to be calibrated against the pitot-static tube.
- A Dantec mini-CTA constant temperature anemometer.
- An NI-DAQ board and acquisition PC to record hot-wire anemometer voltage output.

What your experiment needs to produce:

- Velocity versus voltage output of the hot wire anemometer (including a 4_{th} order polynomial fit).
- You will use this plot for the velocity measurements in next AerE344 lab experiment.

What you need to turn in for this assignment:

- You should review and understand the fundamental technical basis of thermal-based anemometry techniques.
- You should review the recorded video of the AerE344 Pre-lab # 06.
- You should understand the differences between CCA and CTA approaches in using hotwire anemometry system for flow velocity measurements.