MAE 253 - Experimental Aerodynamics I
Final Project
LabView Demonstration: 04/24/2018 – 04/26/2018
Final report due date: 05/09/2018

Problem Statement: Using the wake-rake, Velmex, and Scanivalve pressure measurement systems:

- Determine the flow quality in the sub-sonic wind tunnel at various freestream dynamic pressure settings.
- Develop a LabView VI capable of reading, writing, and plotting pressure data from the DSA Scanivalve system for a given number of ports.

Expectations:

- LabView VI (20 points):
  - You will be provided with 2 LabView VI's: (i) a basic VI consisting of the Scanivalve system's subVI and (ii) the wake-rake-scan.vi file you used during Lab-5 and will be using during the group project.
  - Using the wake-rake-scan.vi as a reference, each group is required to develop a VI capable of doing the following:
    - Reading the pressures from a given number of ports as defined by the user. (5 points)
    - Plotting the collected pressure data. (5 points)
    - Writing the pressure data into a file. The output file should list all the pressures in a single column. (10 points)
  - Each group will be required to demo the final VI during the last week of lab (04/24/2018 – 04/26/2018). You will be given 15 minutes to debug your code if you run into any issues during the demo.
- Flow-Quality Experiment (80 points):
  - Each group will be collecting the dynamic and static pressure data in the wind-tunnel test section using the wake-rake system at the following freestream dynamic pressure settings: 0.5, 1.25, 2.5, 5, 7.5, and 10 psf. (5 points)
  - The following are the expectations in the final group report:
    - Introduction section – Provide details on NCSU's subsonic wind tunnel and the importance of measuring wind tunnel flow-quality. (5 points)
    - Methodology section – Provide details with regard to the experimental methodology, measuring instrumentation, and equations (if any) used in the flow-quality study. (20 points)
    - Results section –
      - For each freestream dynamic pressure setting, plot the total pressure, dynamic pressure, and velocity contours across the wind tunnel test section. Examples of contour plots required are shown in Figs. 1 and 2. (20 points)
      - Discuss the contour plots and relate the same to tunnel flow quality. (5 points)
      - *Out-of-the-box Analysis:* Present any extra plots or discussions that help strengthen the report. (5 points)
    - Conclusion section. (5 points)
    - Appendix section – Provide the post-processing codes. Note that all the processing including data sorting, analysis, and plotting needs to be done within the code, i.e. the only input to your code should be the raw data file from the experiments and the output should be whatever is required. Points will be deducted if any sort of user-based-modification to the raw data file is required to obtain the final results. (15 points)
  - As always, all data presented in the report should be in SI units.

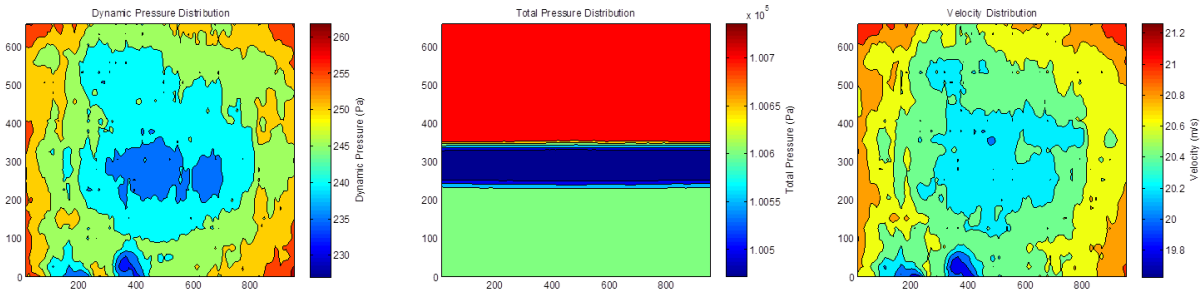

Figure 1: Flow contours of (from left to right) dynamic pressure, total pressure, and velocity.

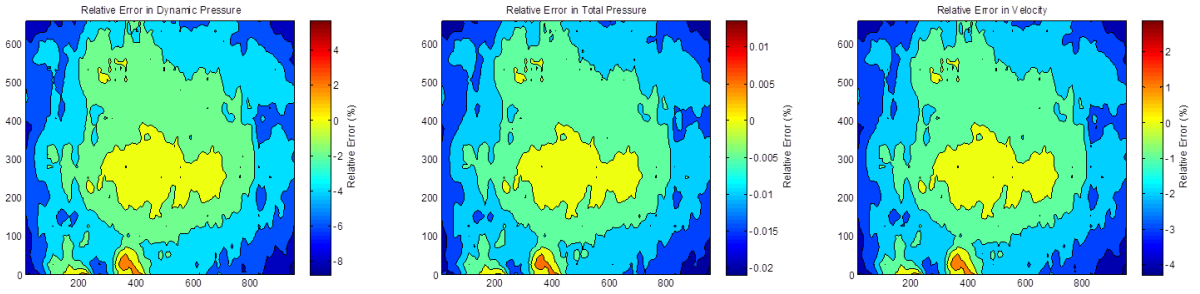

Figure 2: Relative error contours of (from left to right) dynamic pressure, total pressure, and velocity.

Notes:

- *for LabView VI:*
  - LabView is available on the EOS lab systems.
  - Both the reference and foundation VI's have been provided as compressed packaged files (*wake-rake-scan-vi.zip* and *basic-scanivalve-vi.zip*, respectively). You will need to download and unzip the folders to access the VI's. Do not move or change the names of any of the directories or files as this might affect the hierarchy of the VI and cause errors.
  - The reference VI file, wake-rake-scan.vi, used for the drag and group project experiments can be found in *'..\wake-rake-scan-vi\Users\Public\Subsonic_Labview\shreyas_mae253\group-project\'*. You will not need to bother with any of the other folders or files provided.
  - Similarly, the foundation VI, dsa_sub-vi.vi, will be the only file you will be modifying and can be found in *'..\basic-scanivalve-vi\Subsonic_Labview\shreyas_mae253\group-project'*.
  - *TIP:* In order to switch between a VI's front and back panels, you can use the short-cut 'Ctrl-E'.

- *for flow-quality analysis:*
  - Each column in the raw data file corresponds to a single reading.
  - You are required to analyze the data for all positions and dynamic pressure settings.
  - You will need to measure the density based on the idea gas equation:

$$P = \rho RT$$

    where, P is the total pressure, ρ is the density, R is the gas constant, and T is the temperature.

  - The pseudocode for generating the contour plots has been provided on Moodle.
  - Further details can be found in the *README.txt* file.