Experimental Wake Survey of Low Reynolds Number Wind Tunnel

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This poster presents the integration of a mechanical traverse and multi-hole probe for use in low Reynolds number wake surveys. Advanced testing equipment offers enhanced data processing and visualization of three-dimensional flow for wind tunnel wake surveys. The traverse and probe instrumentation can be used in many studies including research regarding advanced propeller designs for small unmanned aerial systems or upstream flow validation. This research project aims to integrate a traverse and multi-hole probe into existing LabVIEW framework in the ATRC 058 wind tunnel. The advantage to using LabVIEW rather than other data acquisition software is its intuitive visual interface and use of user inputs and automated controls. An Isel iMC-S8 controller and LES 5 linear actuator allow for full cross-sectional wake surveys while an Aeroprobe multi hole probe and air data computer stream angular flow data to the central computer. The integration of these systems allow for accurate real time measurements to be visualized and recorded directly into LabVIEW which can then be processed with MATLAB to provide informative data visualization.

Motivation

- Acquisition of three-dimensional flow data.
- Characterization of the flow quality of the ATRC 058 wind tunnel.
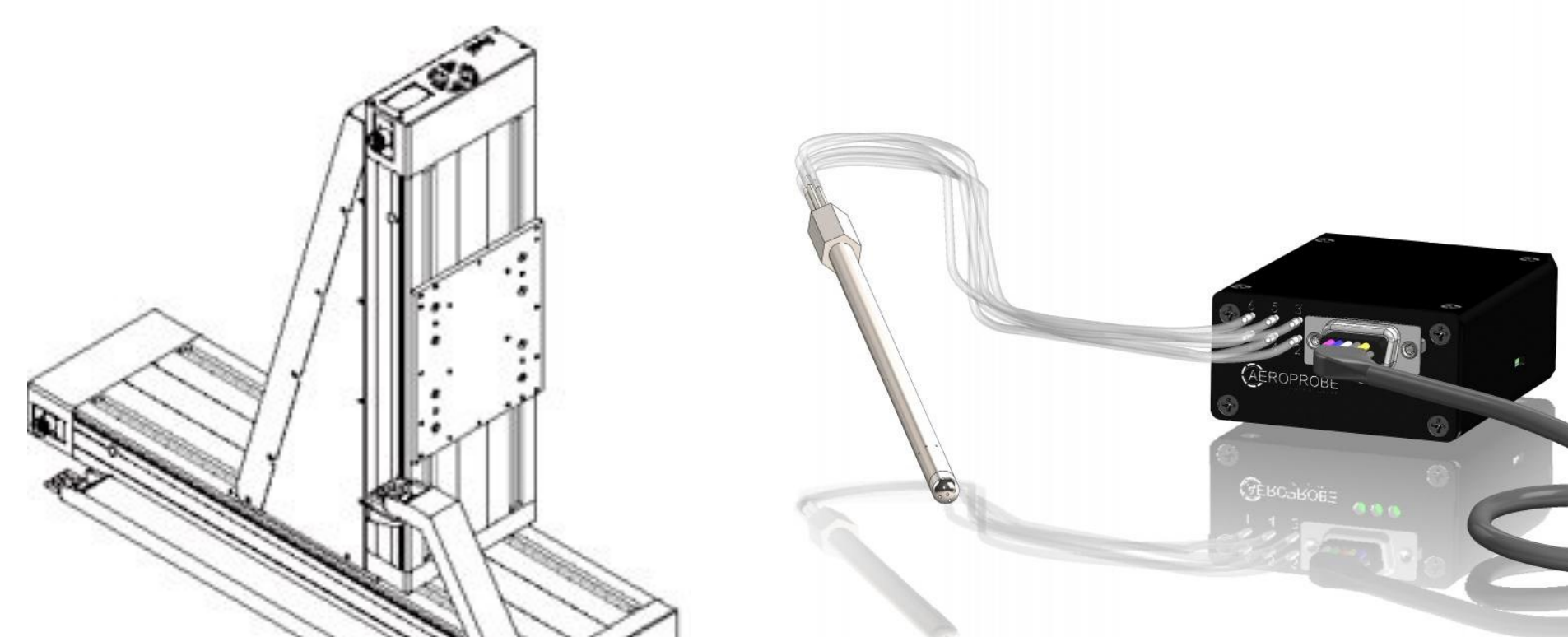

Data Acquisition Hardware

Theory

- LabVIEW Programming Considerations:
- ∗ Integration with existing virtual instruments (VI's)
- ∗Communication between separate VI's
- ∗Synchronization of data acquisition across hardware
- ∗Path creation tool to see data collection points
- ∗Built in data filtering to ensure accurate results
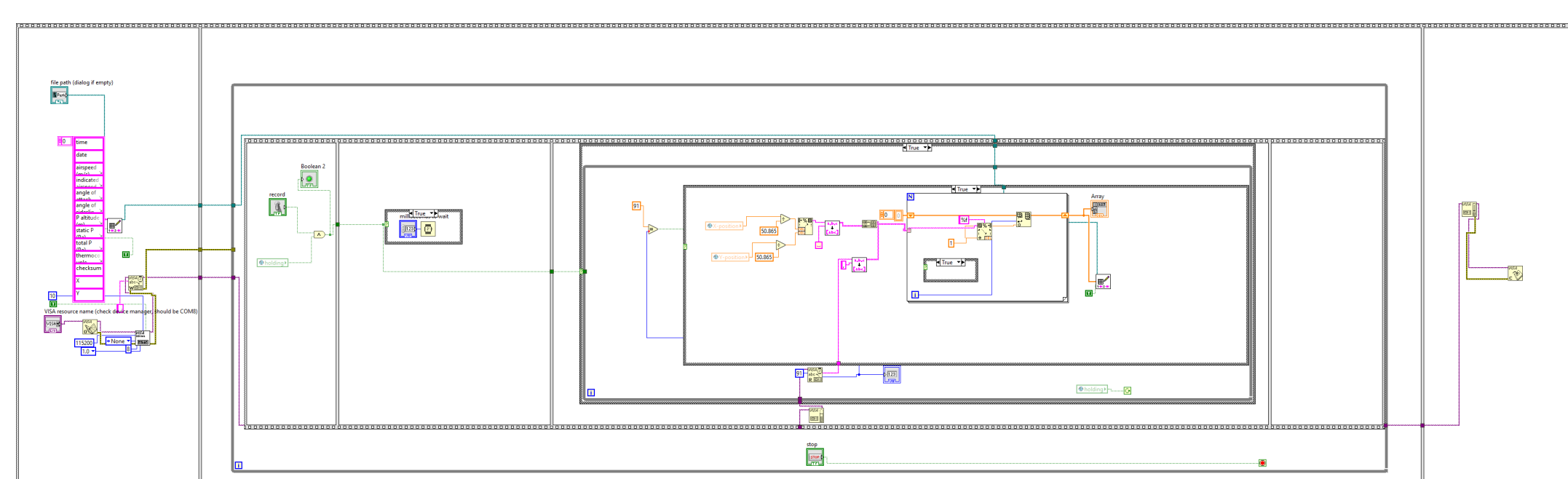
LabVIEW Probe Interface VI

Objectives

- Integrate traverse and multi-hole probe systems into existing data acquisition hardware.
- Develop LabVIEW and MATLAB software to record and process three-dimensional flow data.
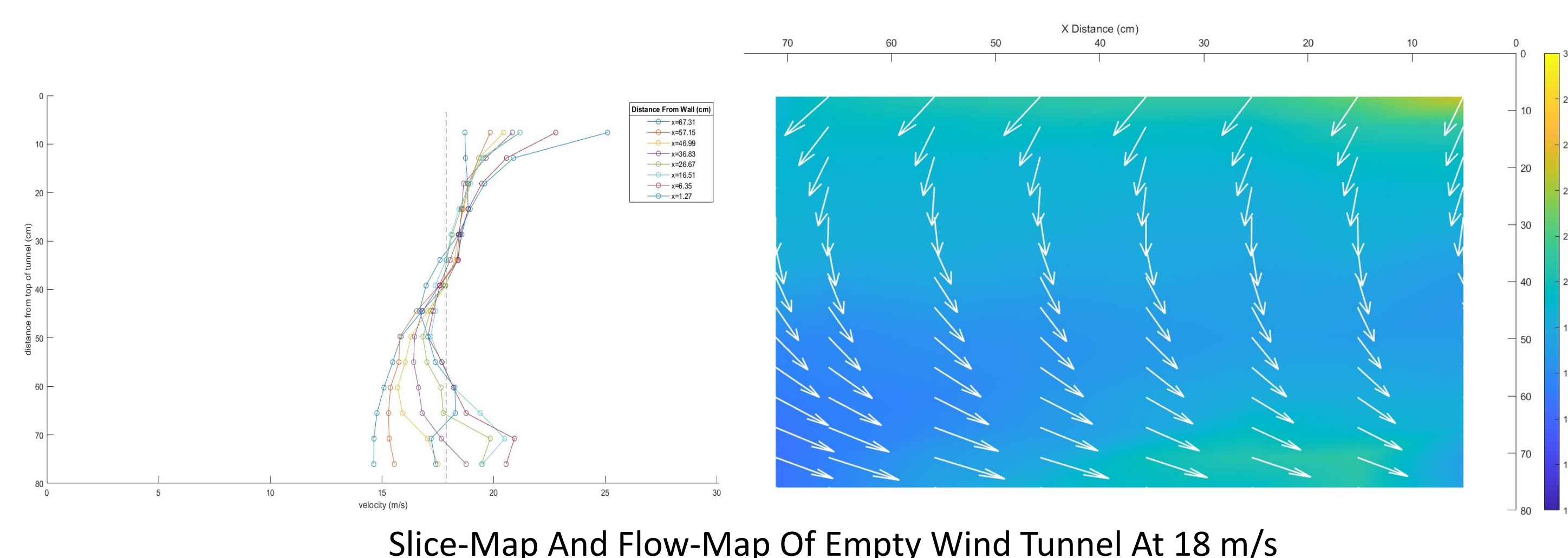
Slice-Map And Flow-Map Of Empty Wind Tunnel At 18 m/s

Method

- Data Collection Procedure:
- ∗ Set tunnel to 18 m/s velocity measured by pitot
- ∗Create a virtual path for the traverse to map out
- ∗Measure data points at specified intervals

- Data Processing Procedure:
- ∗Import recorded values into MATLAB
- ∗Remove erroneous data and average remaining values
- ∗Plot velocities as a function of position for slice-map
- ∗Create three-dimensional mesh of velocities
- ∗Plot angular vectors on top of mesh

- Repeat for 13, and 16 m/s velocities

Results/Future Work

- Results
- ∗Observed swirl is confirmed from flow map.
- ∗Reverse shear in slice-map suggests turbulent flow at low Reynolds number.
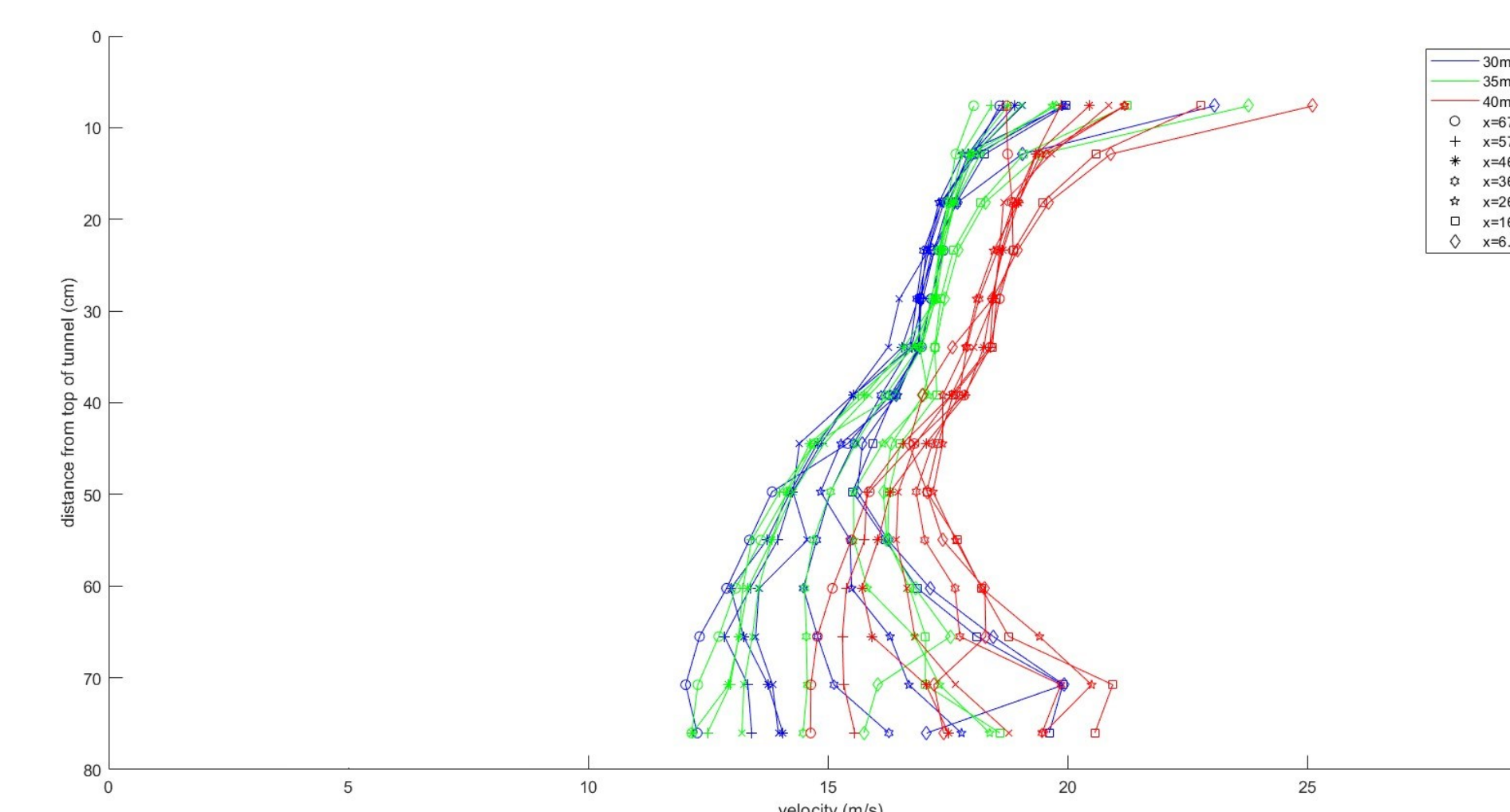
Combined Slice-Map At 13, 16, And 18 m/s

- Future work:
- ∗Perform wake survey on small propellers with experimental flow controls.
- ∗Remove flow straighteners at inlet to observe change in performance.