



*University of Colorado Model Positioning Actuation System*

Senior Design Symposium

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Nicholas Gilland, Brandon Harris, Kristian Kates, Ryan Matheson,  
Amanda Olguin, Kyle Skjerven, Anna Waltemath, Alex Wood

# Introduction

A model positioning system is a machine that provides consistent and accurate changes to orientation for a test model placed in a wind tunnel either automated or manually



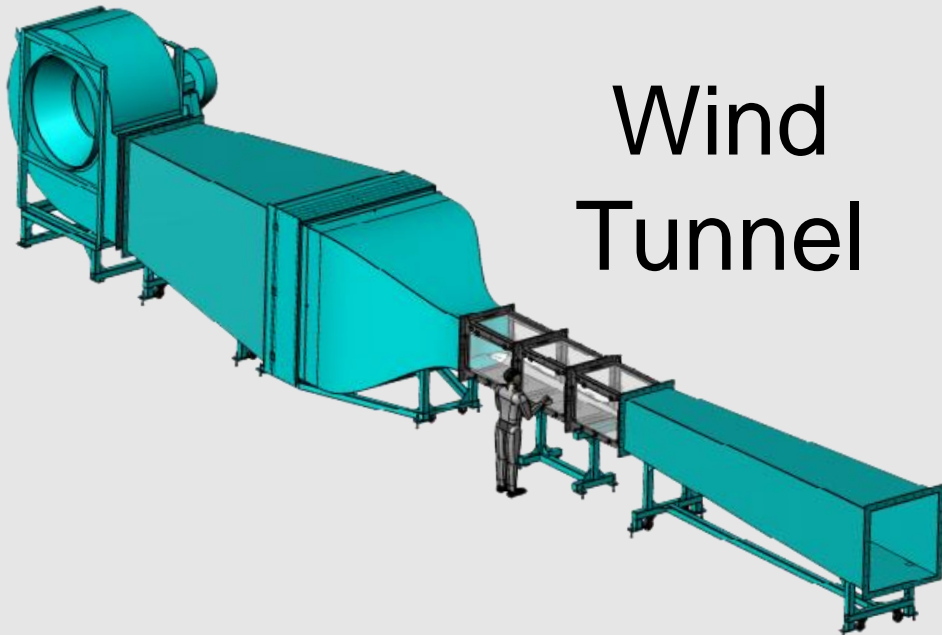
**Flow visualization of test models**

Why are these systems used in the industry? Because it allows for:

- More convenient than testing than with an actual aircraft
- Testing of aerodynamic properties with a scale model before full scale building
- Flow visualization around a body

# Project Purpose and Objectives

**Provide a model positioning system for the wind tunnel on East Campus**



**Statically position a model in 4 DoF**

**Mobility of entire system**

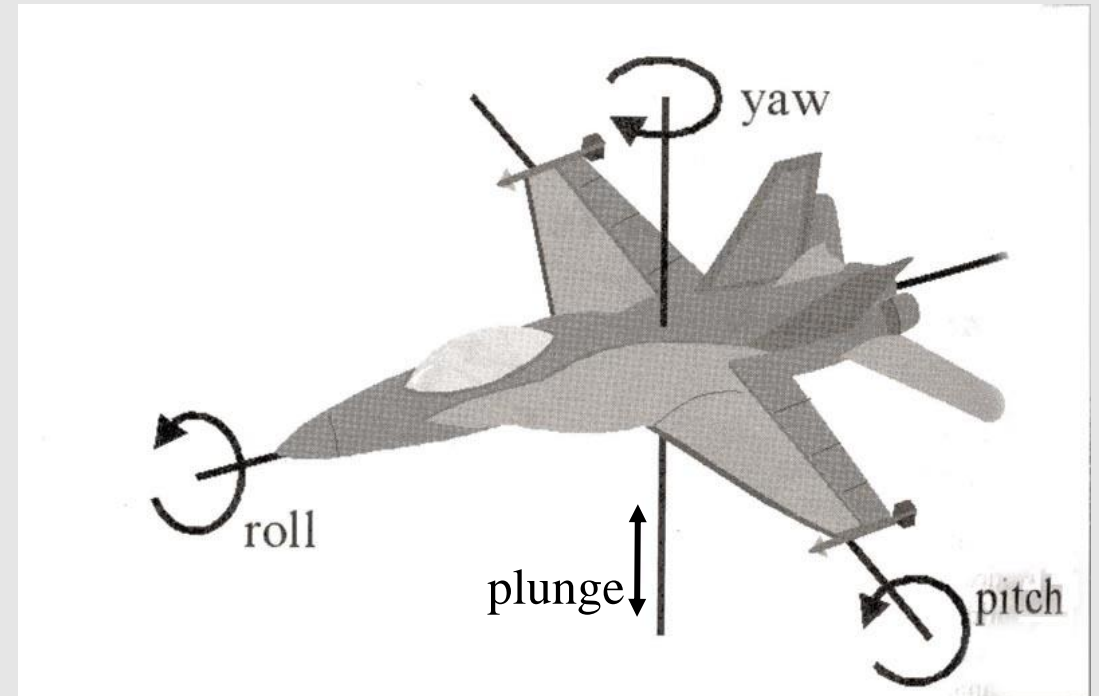
**Easily maintainable for future use**

**Interface with current wind tunnel**

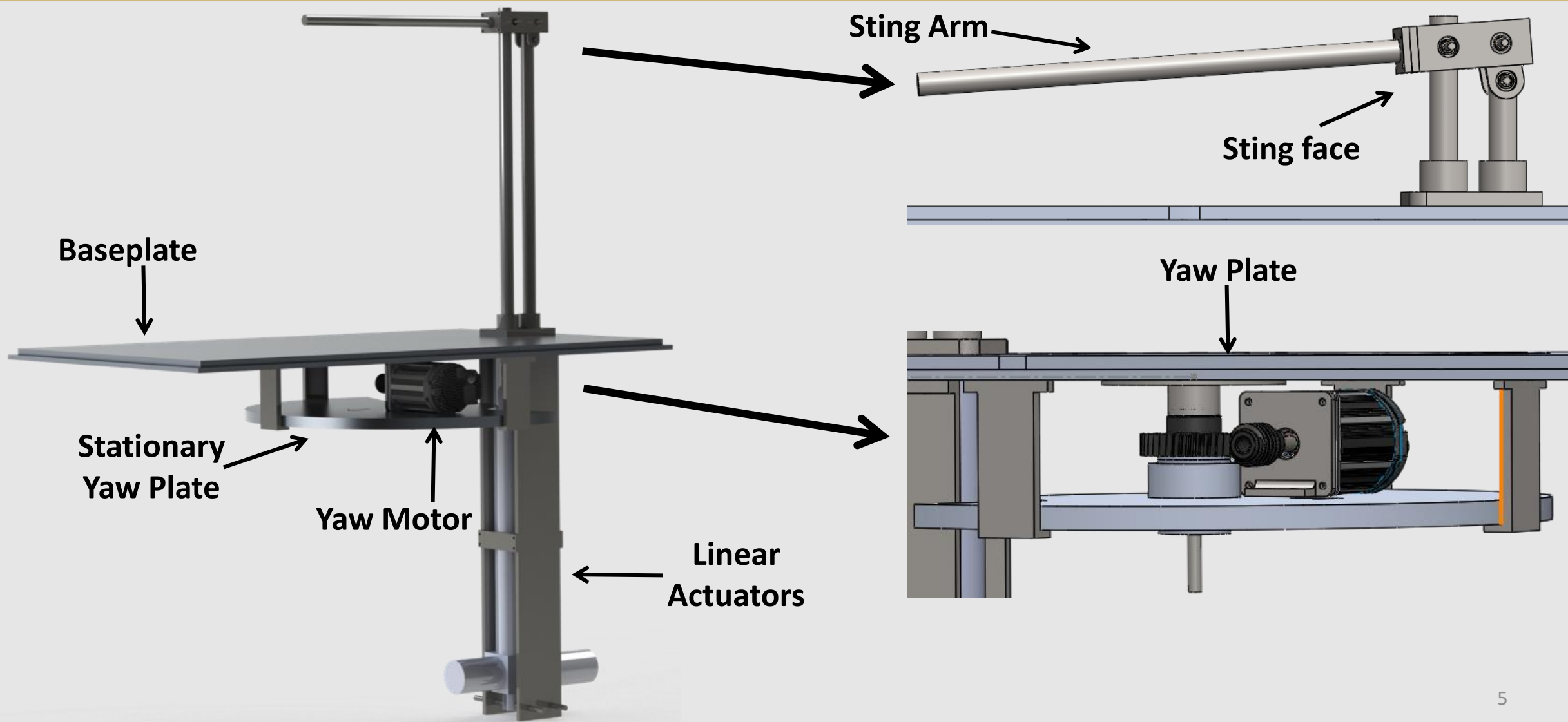
**Failsafes within hardware and software**

# Movement requirements

Degree of Freedom	Range	Position/Angular Accuracy
Yaw	$\pm 30^\circ$	$\pm 0.1^\circ$
Pitch	$\pm 45^\circ$	$\pm 0.1^\circ$
Plunge	$\pm 10$ cm	$\pm 5$ mm
Roll	$\pm 45^\circ$	$\pm 0.5^\circ$



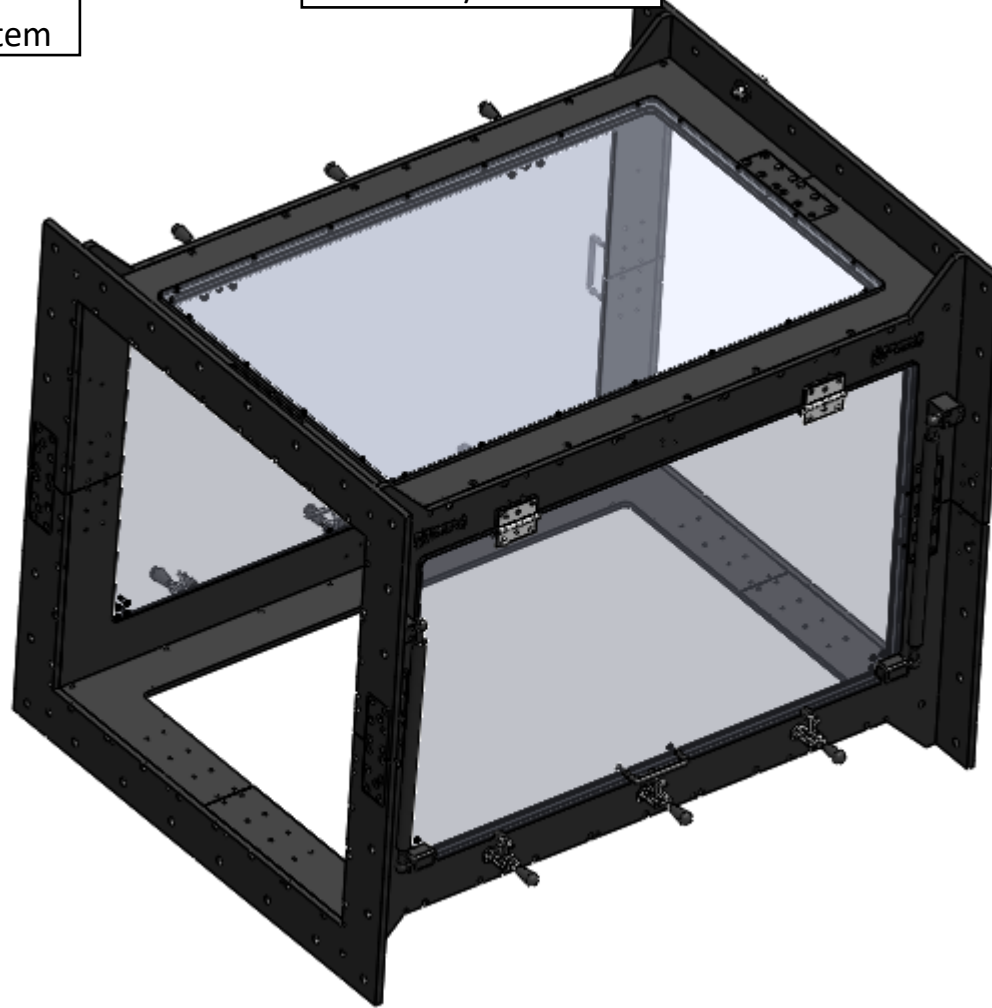
# Baseline Design



# Concept of Operations (CONOPS)

2. Install  
COMPASS system

3. Install DAQs and  
Ethernet/USB cords



# Similar Systems on the Market

**Company:** Aero Lab

**Customizable:** Yes

**DOF:** 2 (yaw, pitch)

**Cost:** \$75,000 - \$100,000

**Development Time:** 9 - 15 months



**Company:** Triumph Force Measurement Systems

**Customizable:** Yes

**DOF:** 3 (yaw, pitch, roll)

**Cost:** \$250,000 - \$400,000

**Development Time:** 12 - 18 months



# Manufacturing & Design

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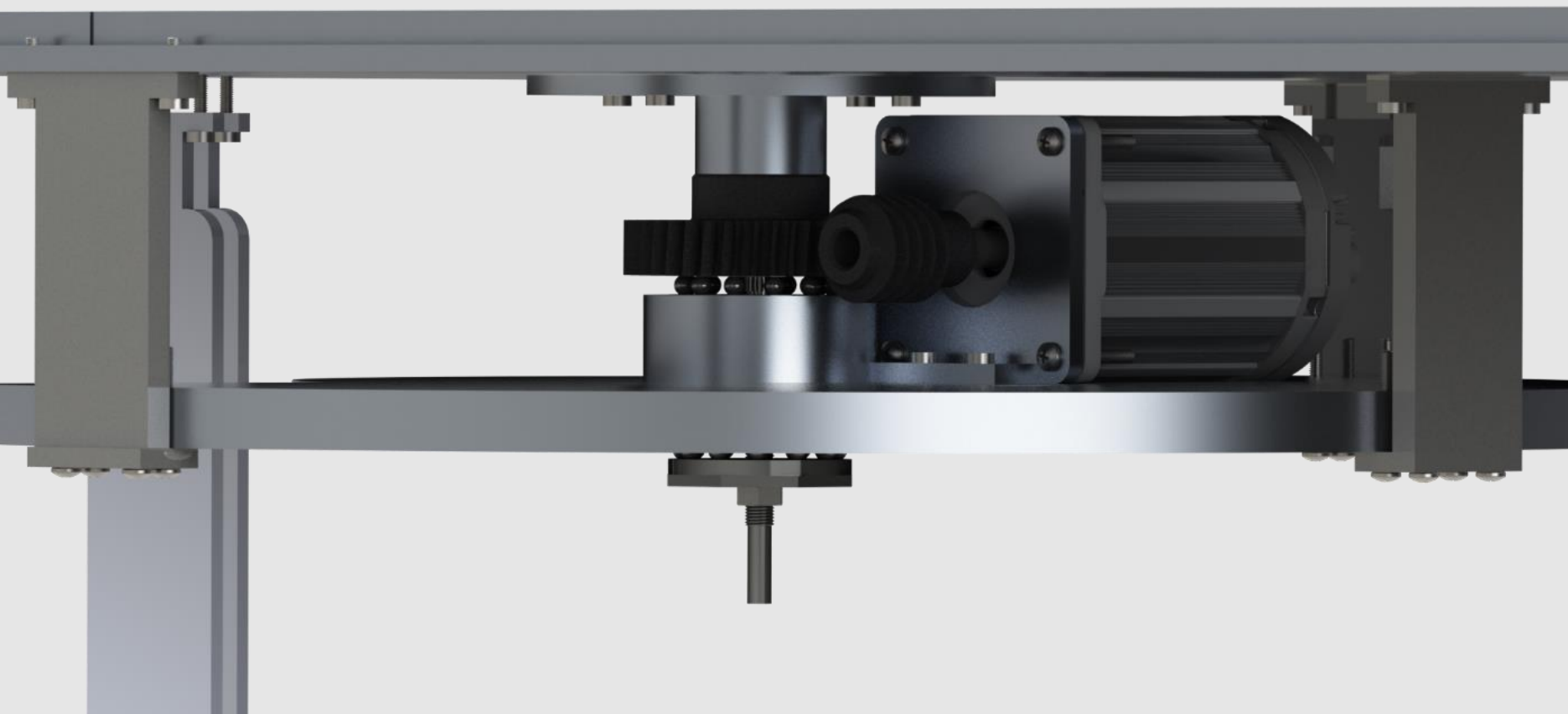
- Most components were machined in house
- Purchased components include:
  - Bearings
  - Yaw motor
  - Linear actuators
  - Worm gear and worm







# Yaw Mechanics



# Pitch/Plunge Mechanics

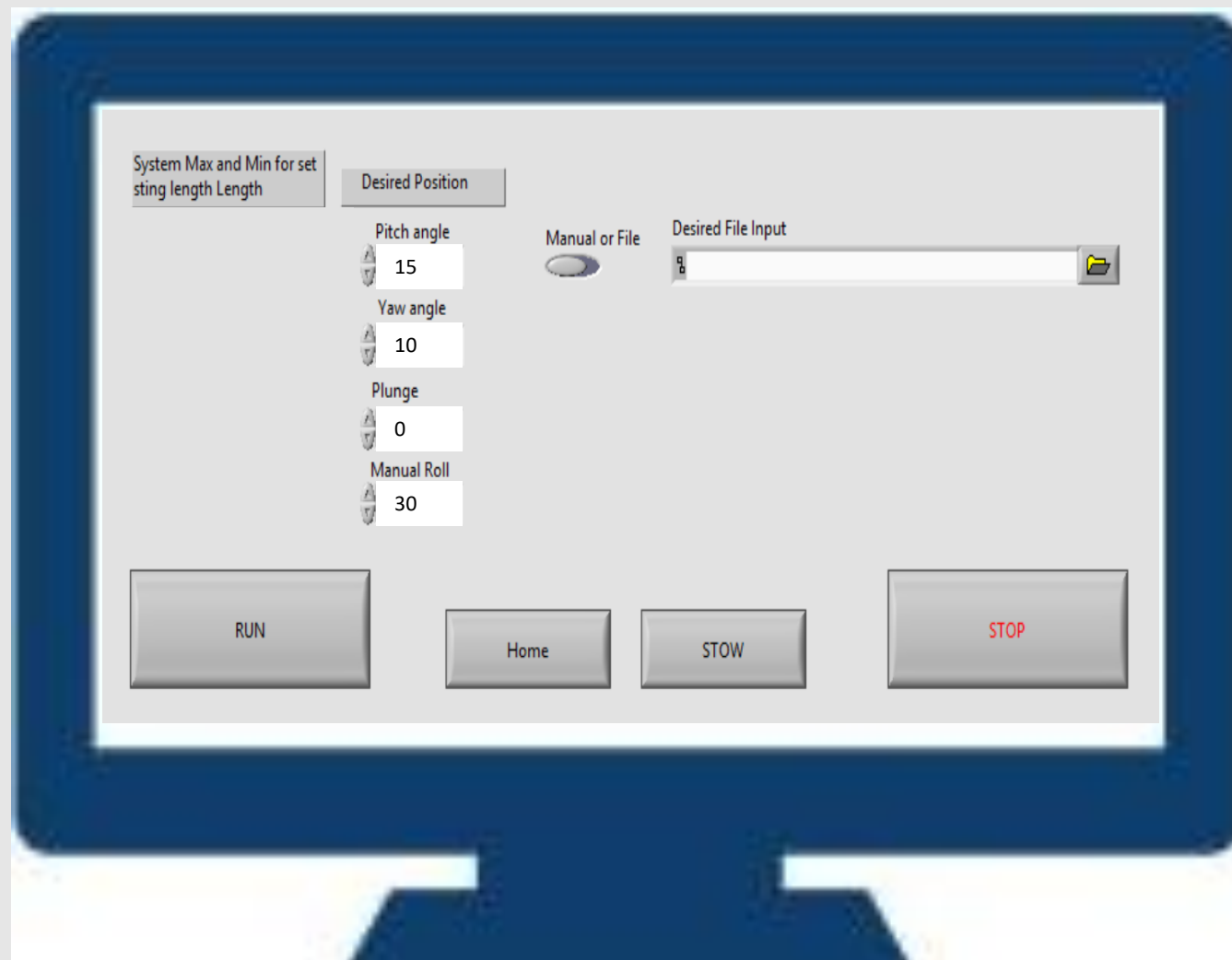


- Coupled motion to achieve pitch angle and keep AC in middle of test section

- Uniform motion for vertical plunge

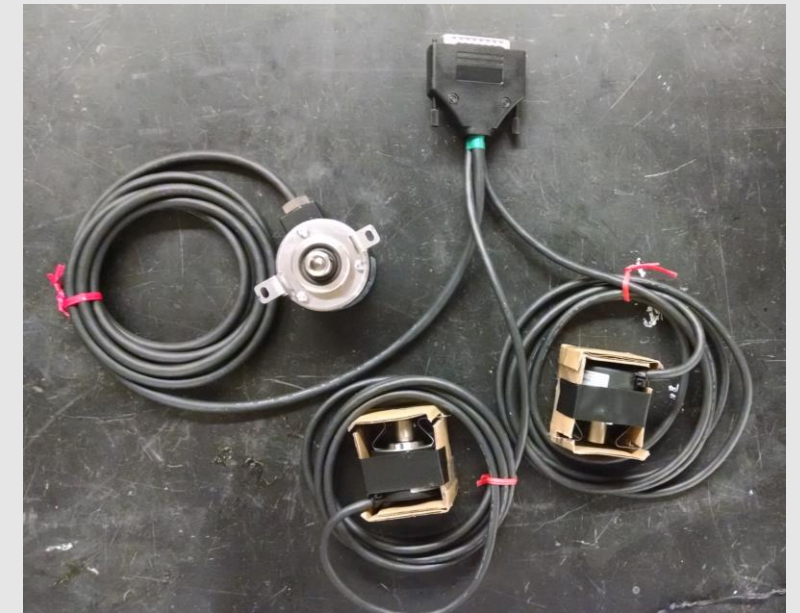
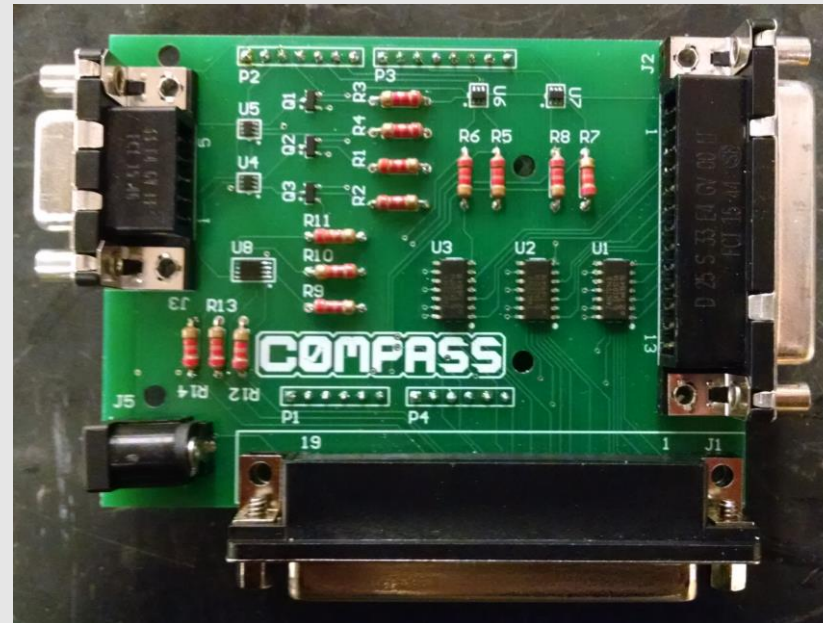
# Control Software

- Allows for Single and Automated Input positions
- Displays System limitations
- Customized for COMPASS system
- Calculates all system movements



# Control Interface

- National Instruments DAQ Chassis and CompactDAQ Modules
  - NI 9401 Digital I/O and NI 9361 Incremental Encoder Modules
- Custom Printed Circuit Board for Breakout to Different Components
  - NI Modules to Motors and Incremental Encoders



# Questions?

For more information or if you would like to see the system, please visit our display during the poster presentation

