REEF Subsonic Wind Tunnel Articulating Robotic Arm

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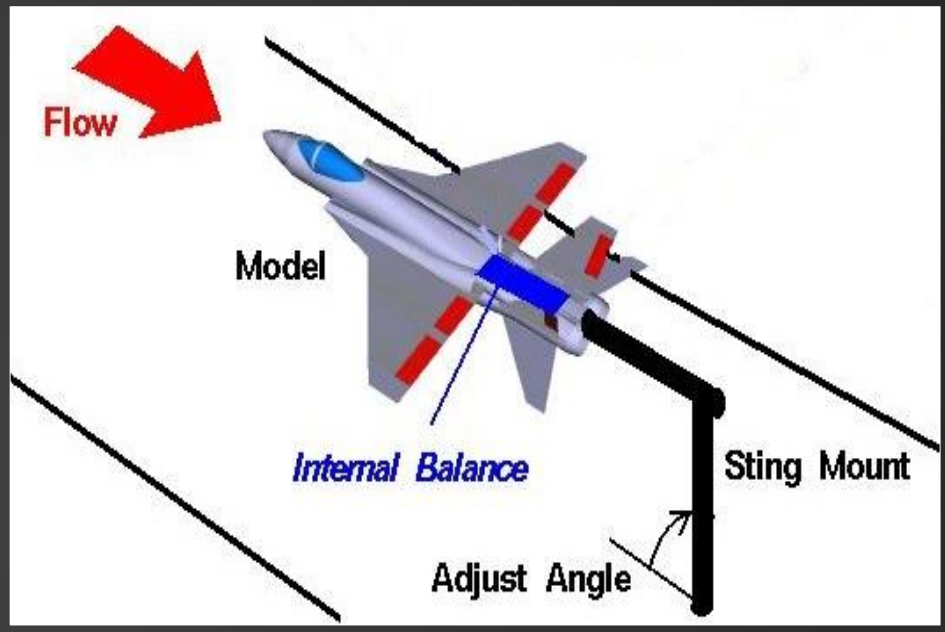
Problem Statement

- The design and production of a cost effective mechanism that would hold and adjust the orientation of a specimen being tested in a subsonic wind tunnel
- The current arm and mount are being removed, therefore a new system is needed in order for testing to continue
  - Quotes from companies that will design/build systems exceed $100,000
  - Working budget of $2,000

Wind Tunnels

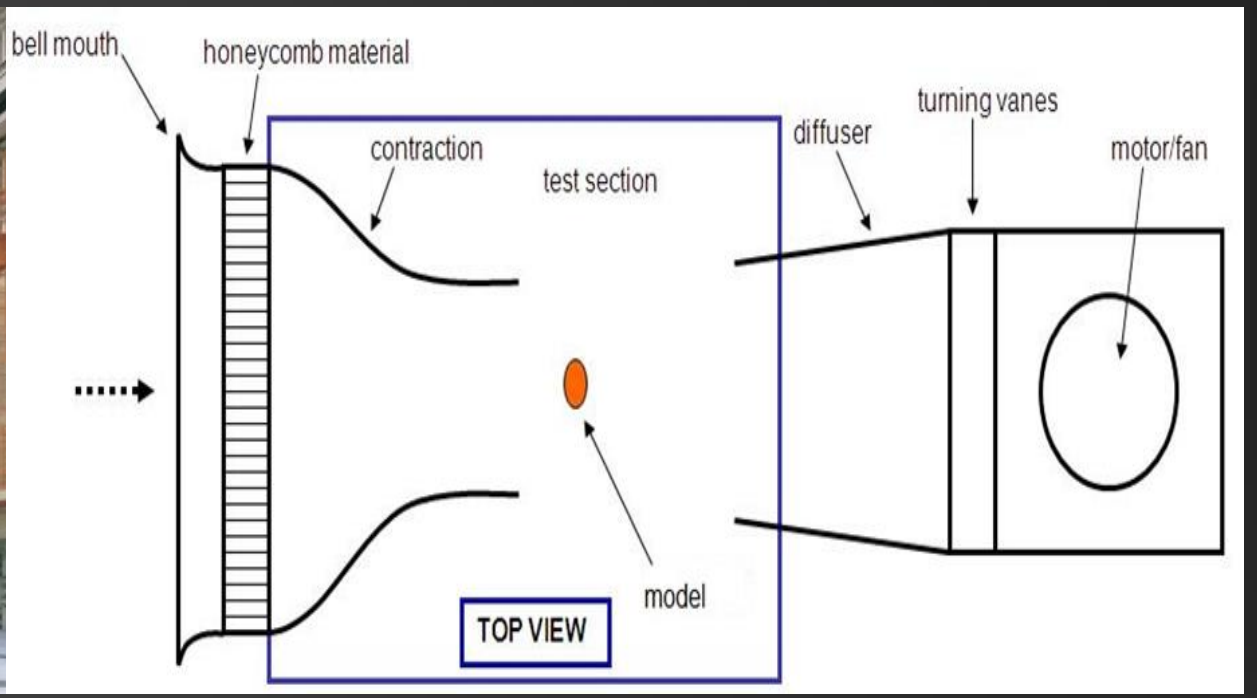
- Research tool to recreate flight conditions
- Cost effective, controlled environment
- Models scalable through the use of dimensionless properties



Sting Mount in Wind Tunnel

The Test Section

Open Test Section



Overhead View of REEF Center Wind Tunnel

Project Objective

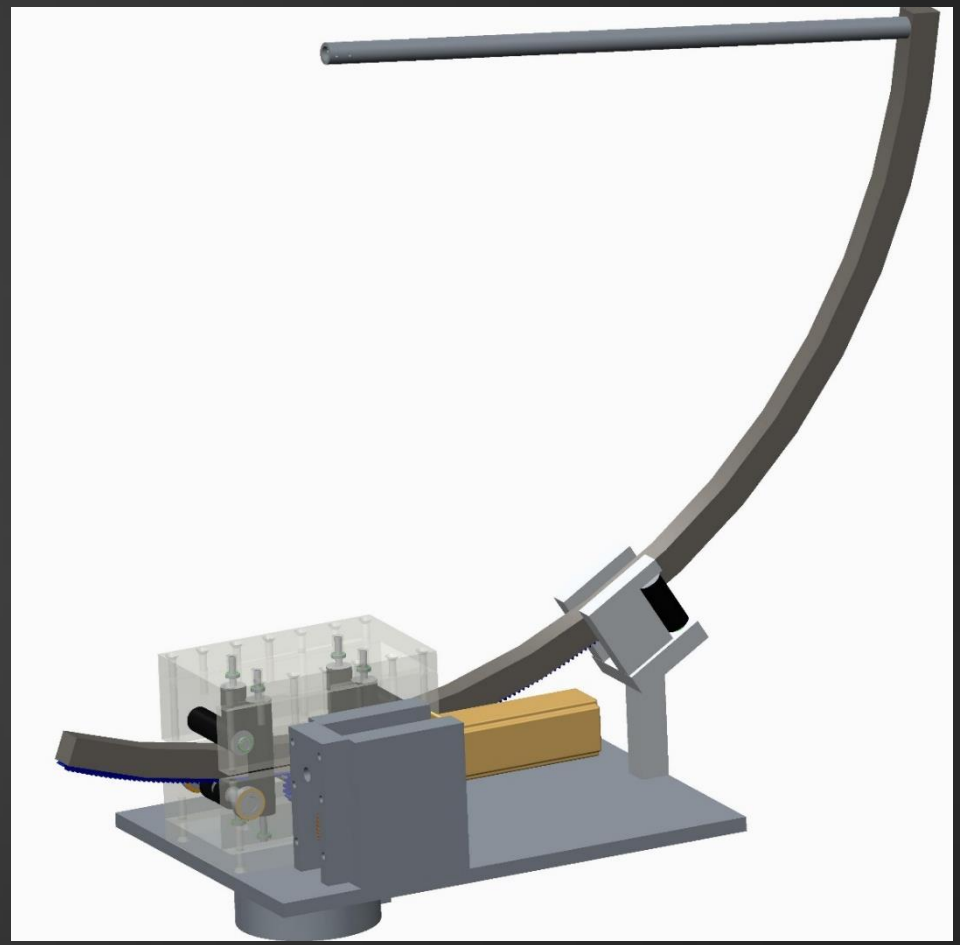
- Arm able to withstand maximum force generated by wind tunnel
  - Maximum Velocity: 22 m/s
- Center of mass of specimen must not change during manipulation
- Adjustable pitch range: -5° to +20°
- Adjustable yaw range: ±10°
- Model must not move when in set position
- User interface to control motion of arc

Design Constraints

- User interface using LabVIEW
- Motion Controller language and specifications
- 0.25° orientation accuracy
- Maximum deflection of 0.25 in.
- Factor of safety of 5
- $2,000 budget

Review

- Procurement
  - All ordered parts received
  - Remaining purchase orders in progress
- Design
  - Sting Mount
  - Turntable Plate
- Machining
  - Drawings sent to machine shop
- Hardware Constraints
- Programming
  - Hardware and Software Communication



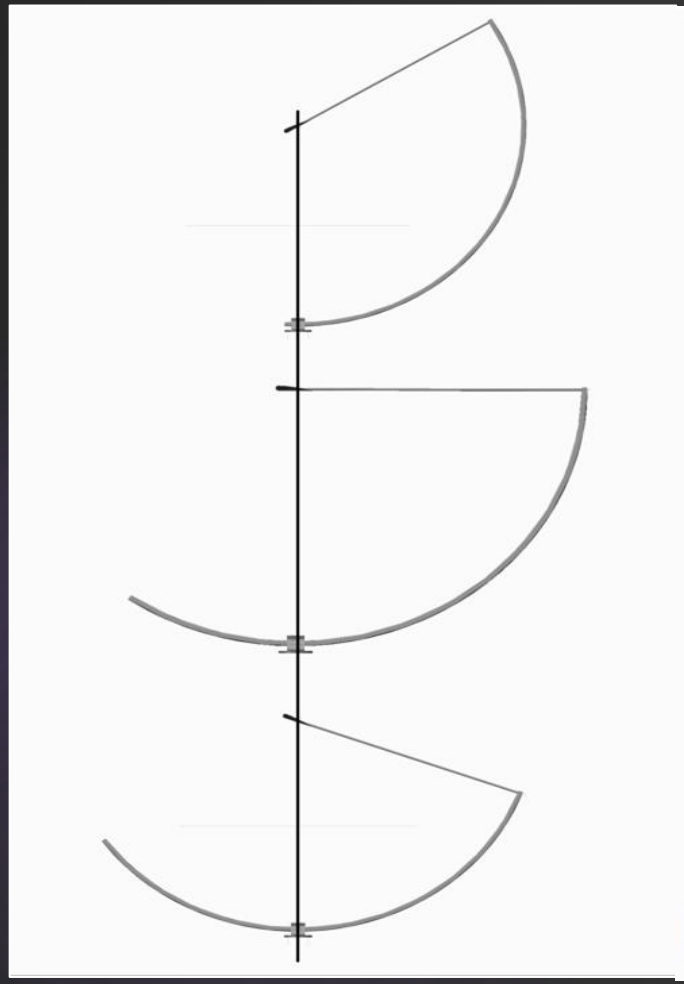
Updates

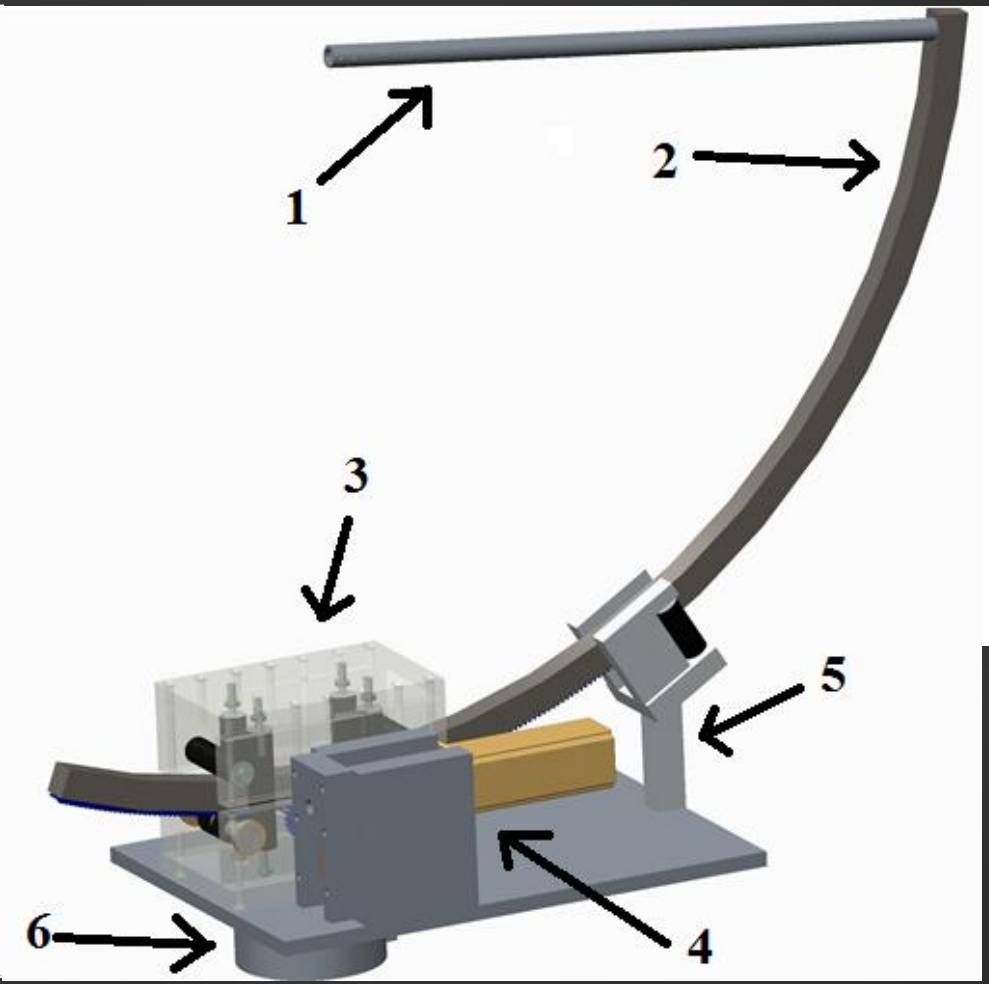
- Design of turntable plate
- Machining
  - Completed except turntable plate
- Procurement
  - Mechanical parts completed
  - Electrical components in progress
- System assembly in progress

Updates Continued

- Programming
  - LabVIEW and Galil communication achieved
  - Conditional coding in progress
- Constraints
  - Hardware received (glue, bolts, rollers, bearings, etc.)

Design Concept

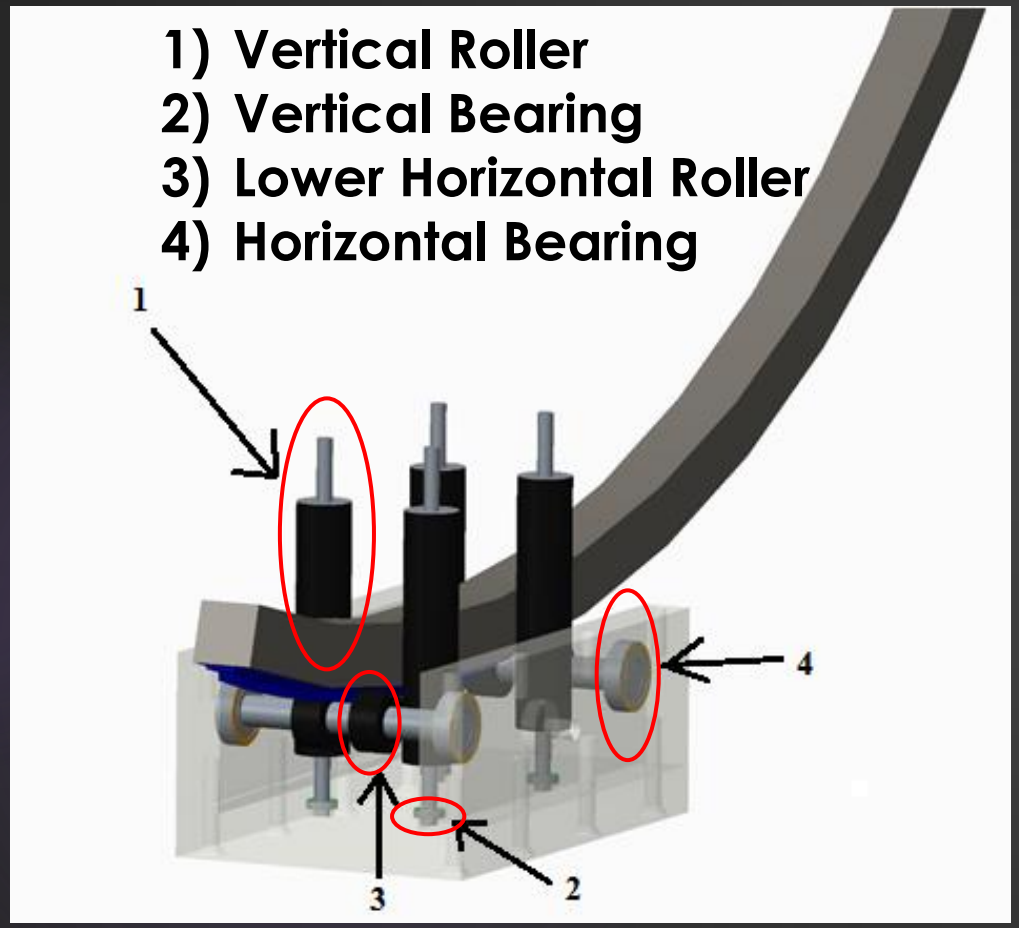


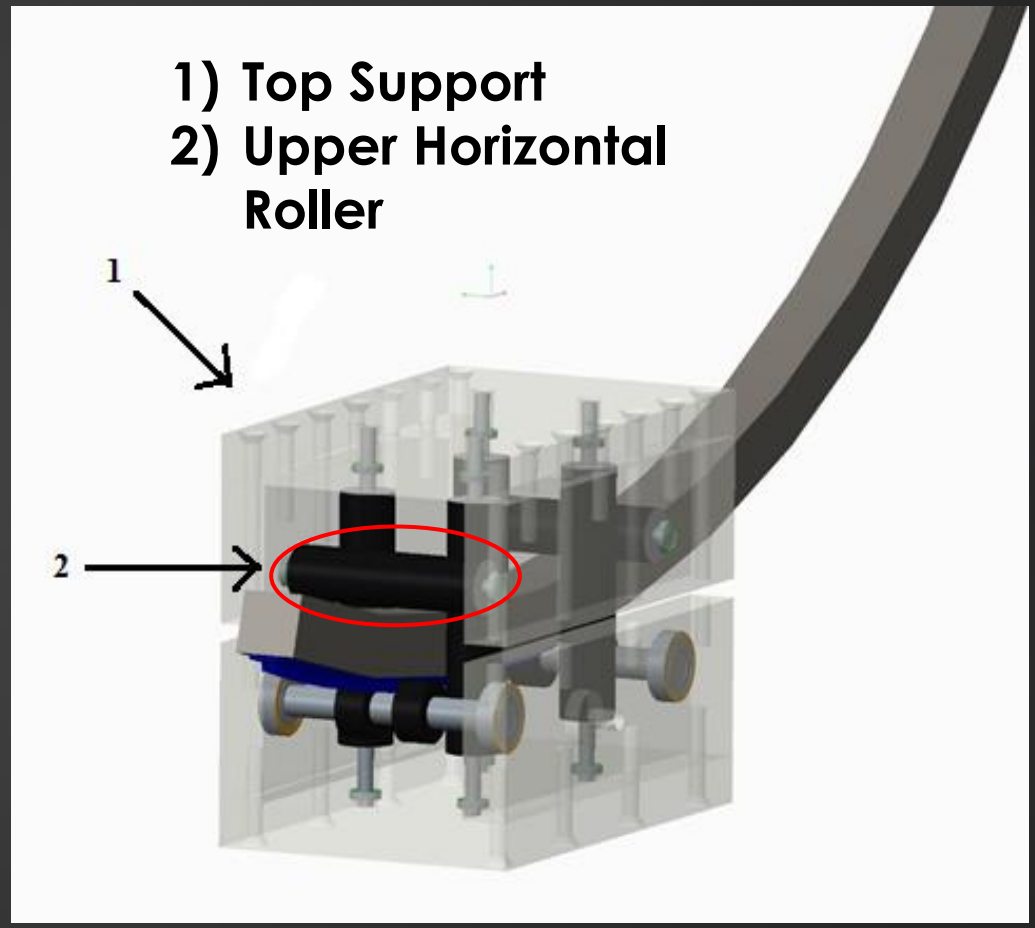


Legend

1) Sting Mount
2) Arc
3) Mounting System
4) Drive Train
5) Follower
6) Turntable

Mounting System - Assembly





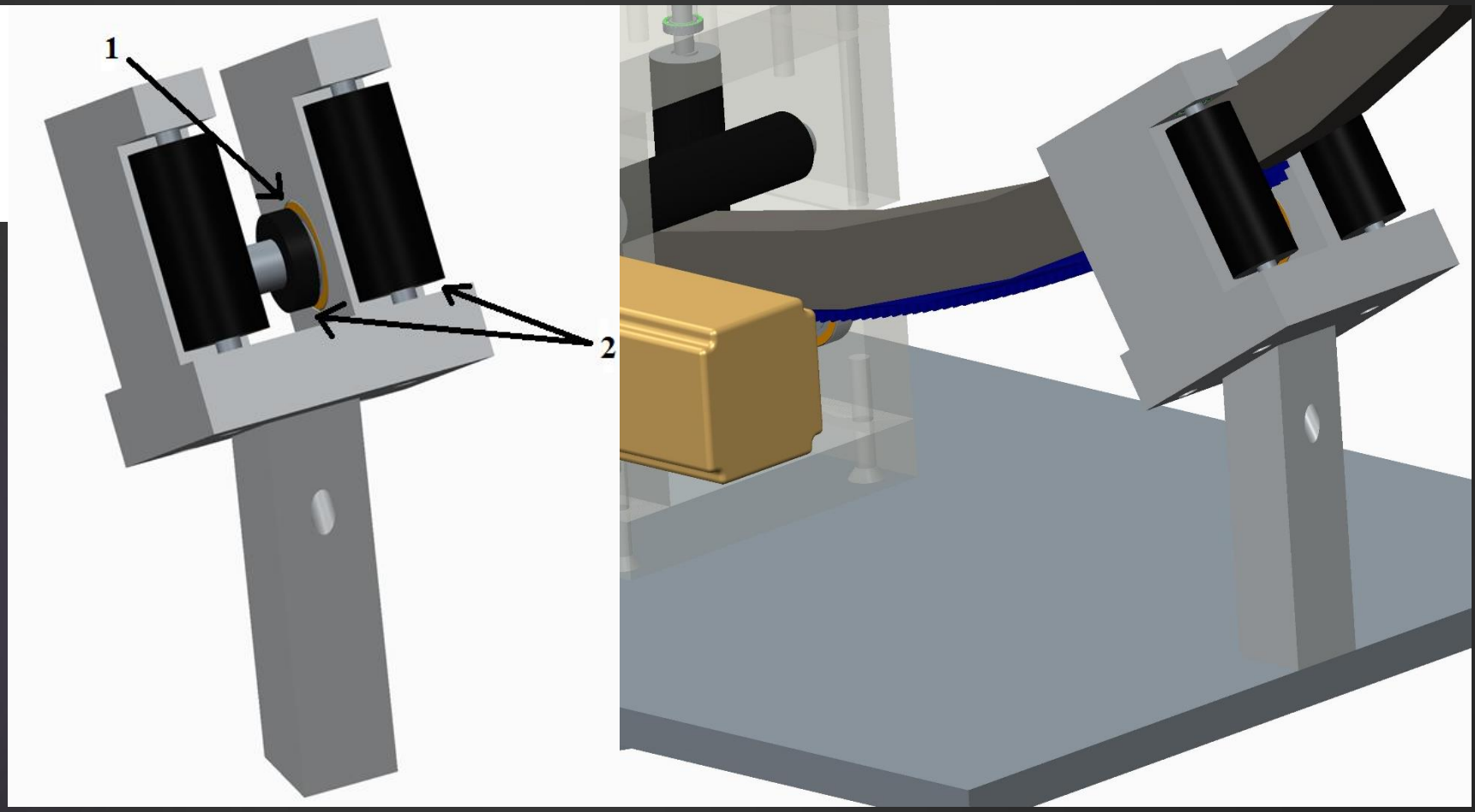
Mounting System - Construction

- Vertical Constraints
  - Top and bottom housing
  - Bearings
  - Shafts with rollers (arc support)
- Horizontal Constraints
  - Rollers, C-clips, bearings
  - Left and right housing
- Construction
  - ¼-20 bolts housing together

Follower - Assembly

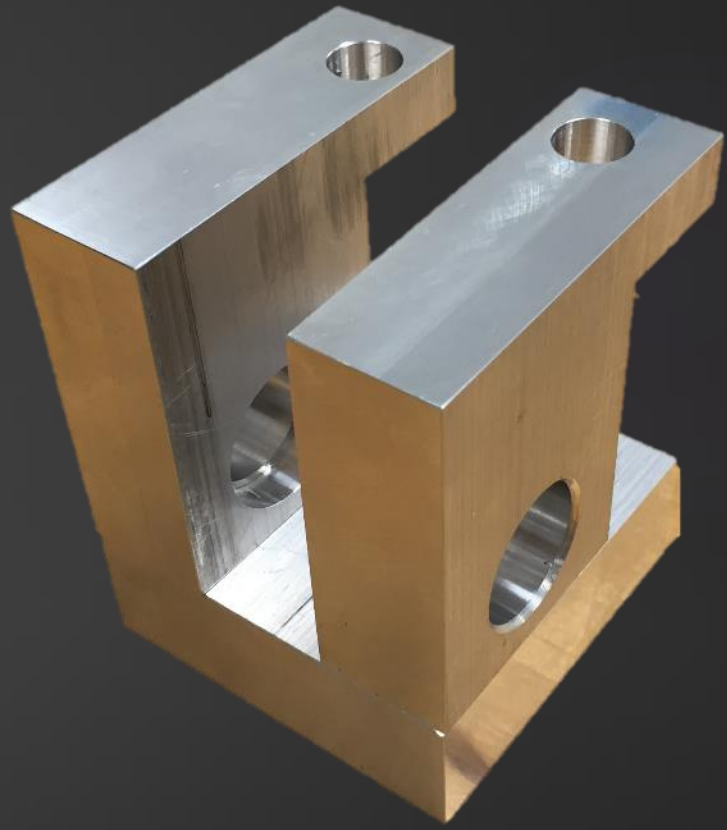
Legend

1) Bearings
2) Rollers



Follower - Construction

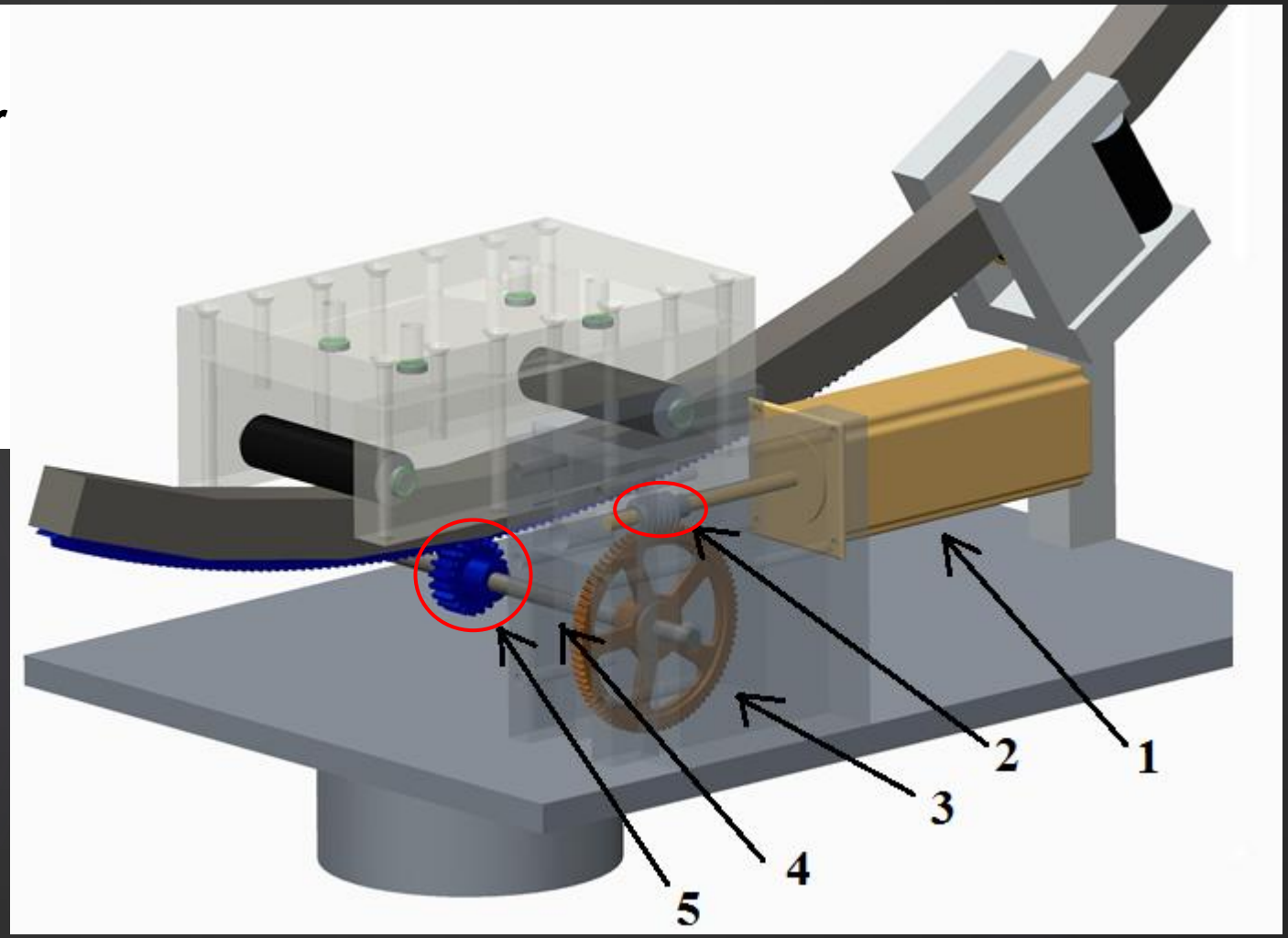
- Vertical Constraints
  - Shaft with rollers (arc support)
  - Bearings (shaft support)
- Horizontal Constraints
  - C-clips, bearings
  - Housing walls
  - Shafts with rollers (arc support)
- Construction
  - ¼-20 bolts follower and support block



Drive Train - Assembly

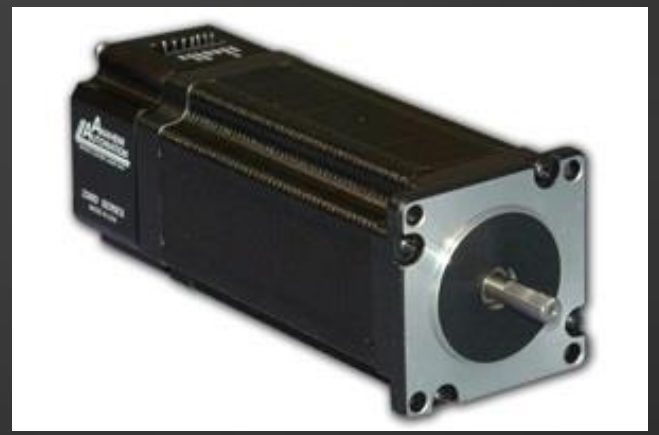
Legend

1) NEMA 23 Motor
2) Worm
3) Worm Gear
4) Drive Shaft
5) Spur Gear



Drive Train - Construction

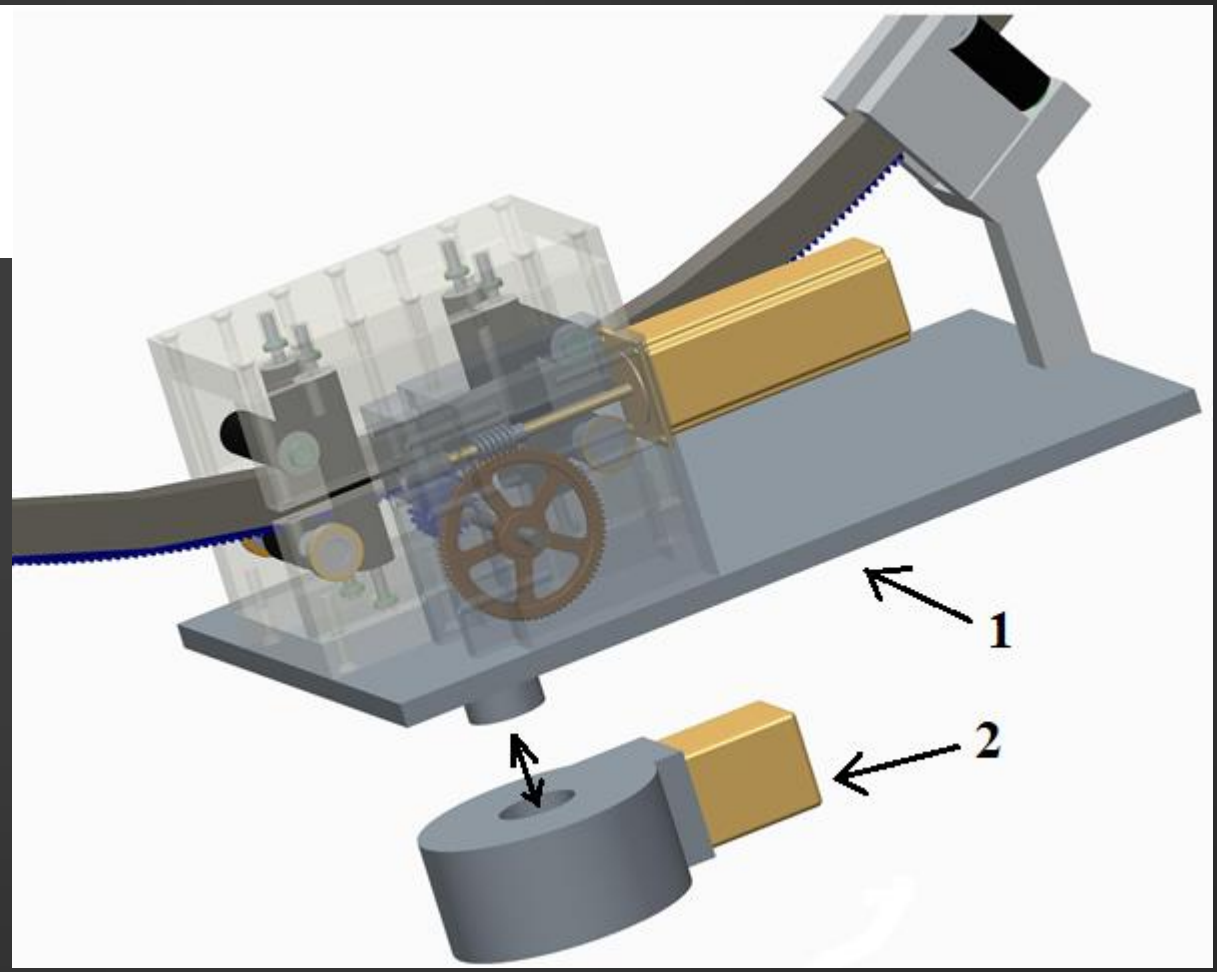
- Gears
  - Set screws and JB weld
- Drive Shaft
  - Housing bores with bearings
- Motor
  - 4 x 10-24 bolts



Rotary Table - Assembly

Legend

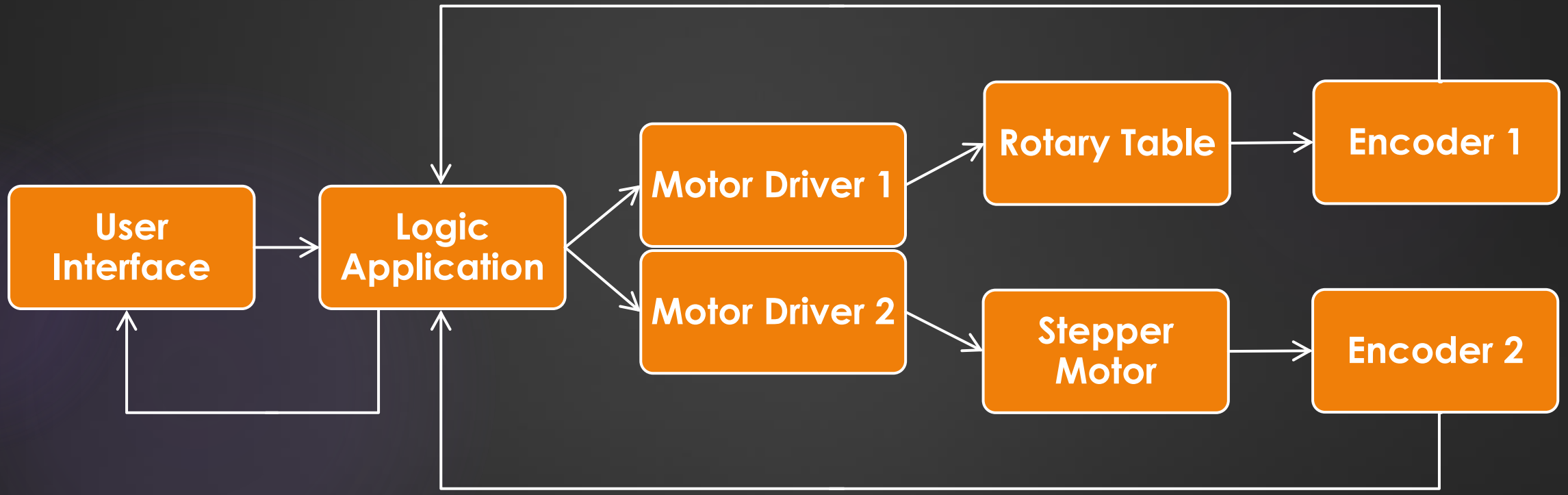
1) Turntable Plate
2) Rotary Table Motor



Rotary Table - Construction

- Bolts needed: 10-32 UNF
- Turntable plate
  - Bolted to rotary table surface

Programming and Circuitry



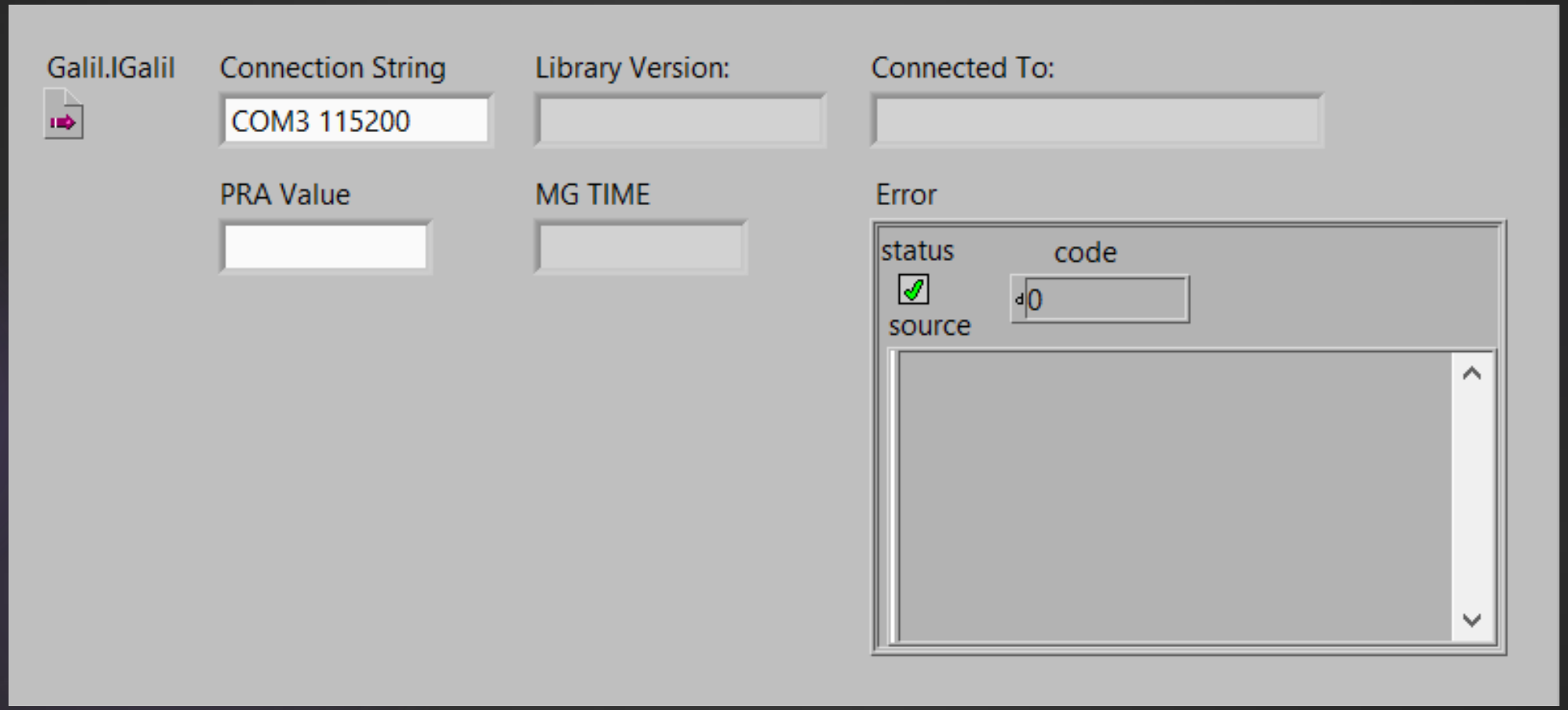
Programming Communication

- Galil motion controller uses DMC code
- GalilTools software has an integrated library to use LabVIEW with the Galil controller
- LabVIEW can download programs to the Galil and send commands

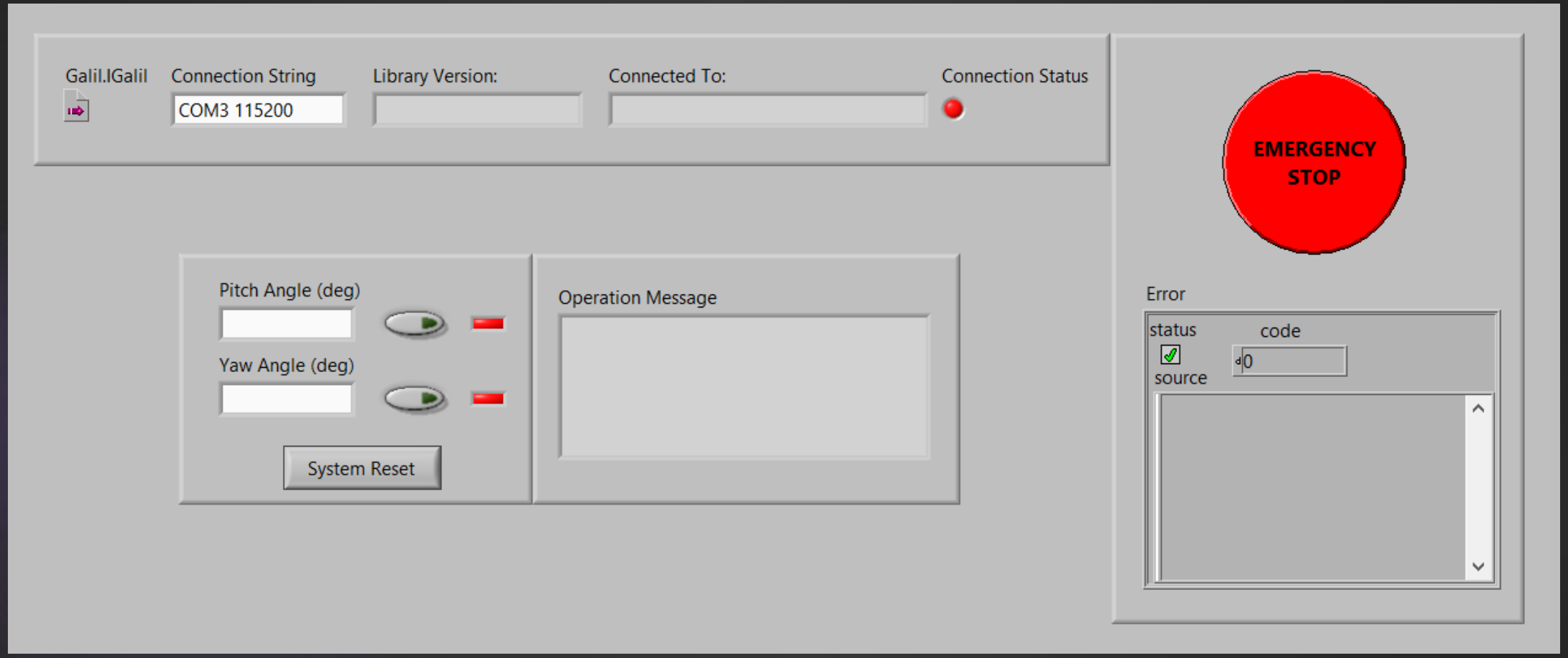
Ideal Logic Configuration

- User input of angles in LabVIEW
  - System will have a “reset”
- Input communication and processing
- Motors actuate the arc to the specified angles
  - New angles will not be able to be entered while the arc is in motion
- Encoders feedback to controller
- Return to LabVIEW interface that actuation is completed
- User can enter new angles or reset the system
- Emergency stop

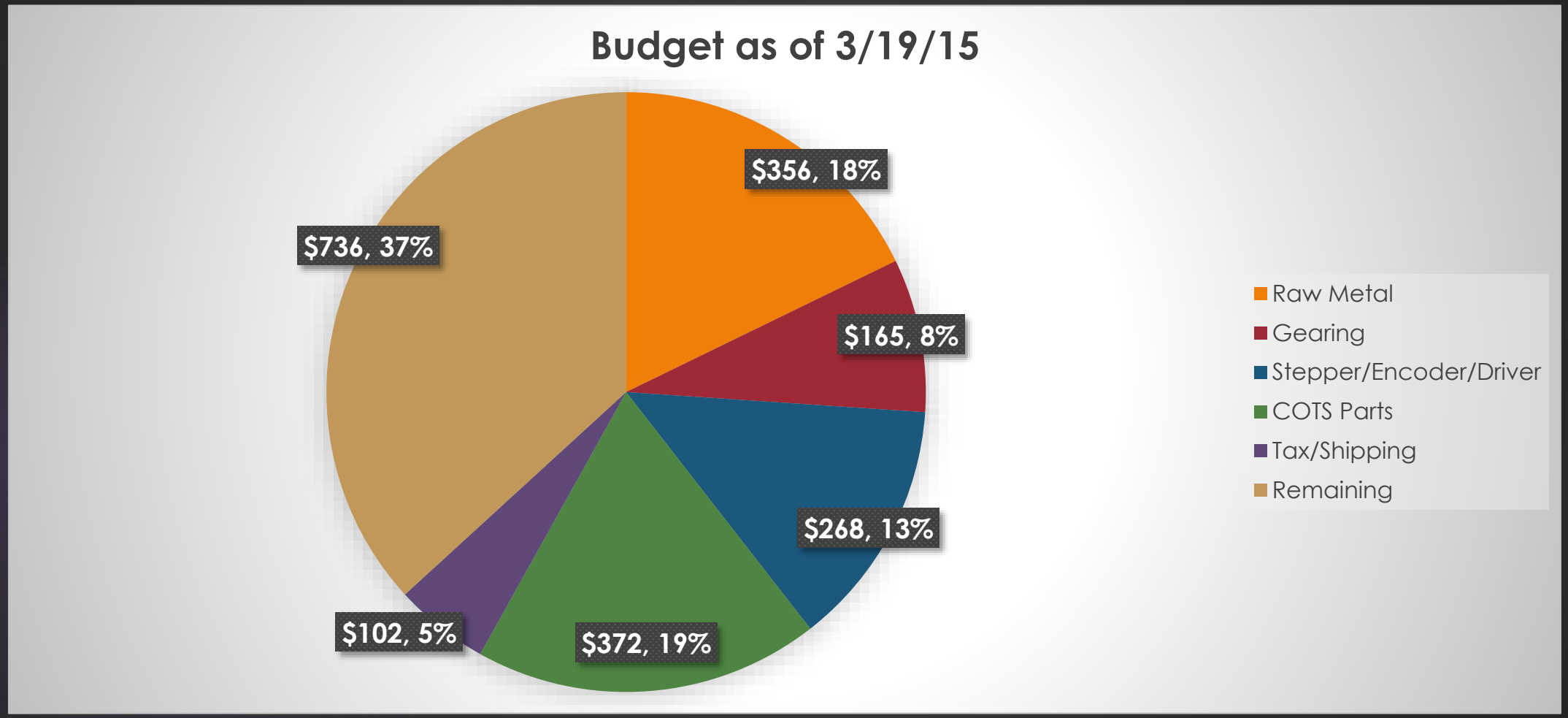
Current LabVIEW Interface



Planned LabVIEW Interface



Project Budget

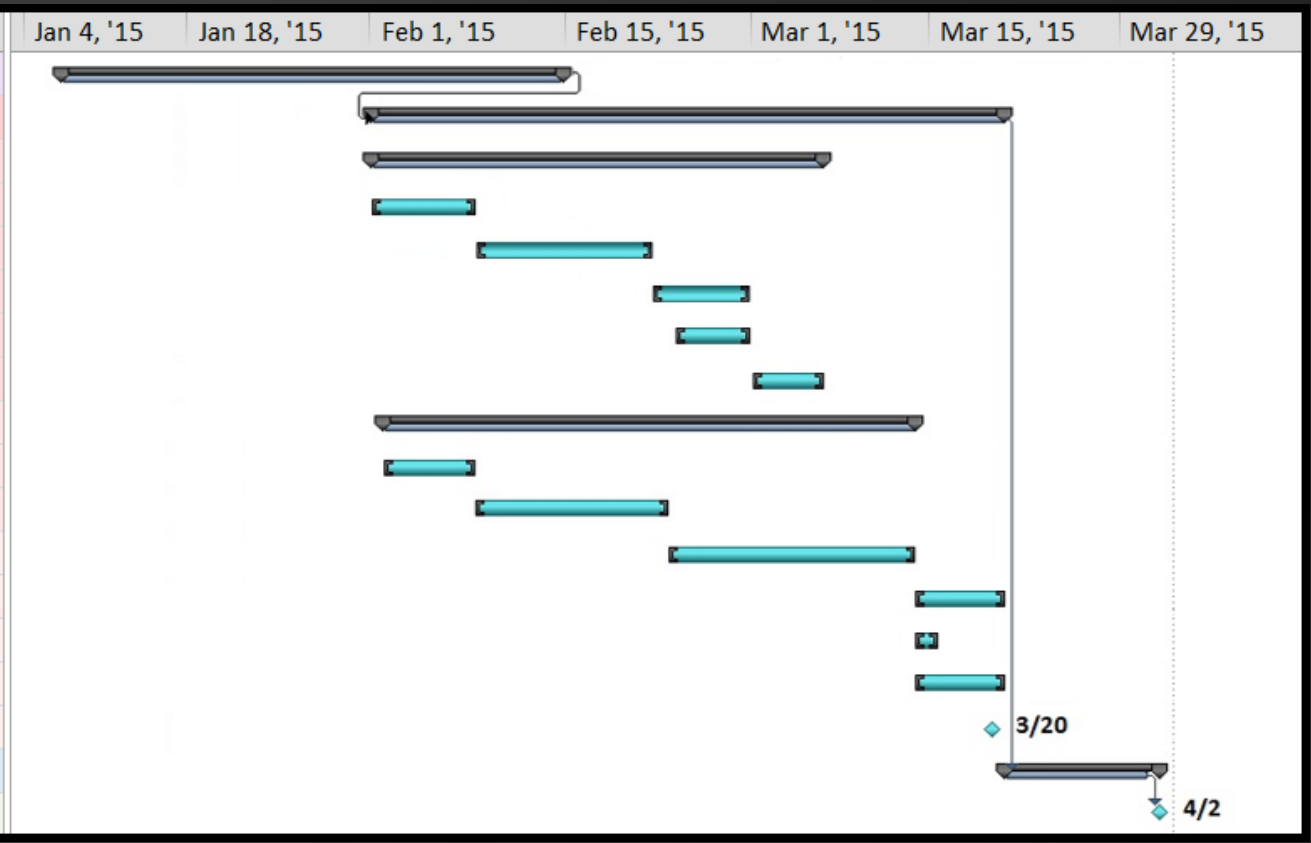


Future Work

- Programming
  - User Interface using LabVIEW communication with Galil controller
- Procurement
  - Power supply and minor circuitry components
  - Turntable plate material
- Prototype Assembly
  - Week of March 23rd, 2015
- Testing and Troubleshooting
  - Week of March 23rd, 2015

Spring Schedule

Task Name	Duration	% Complete
Gathering of all Materials and Parts	**28 days**	**100%**
System Assembly	**37 days**	**79%**
Machining and Construction	**27 days**	**87%**
Plan Machining and Inspect Drawings	7 days	100%
Machining of Arc (HPMI)	11 days	100%
Machining of Mounting Box	7 days	100%
Machining of Follower	6 days	80%
Constuction of Mechanism	6 days	40%
Programming and Circuitry	**31 days**	**84%**
Determine Power Requirements	7 days	80%
Design Circuitry Based on Procurements	12 days	90%
Plan Software Structure	16 days	90%
Program System to Sponsor Specifications	16 days	75%
Purchase Adaquate Power Supply	1 day	50%
Assembly of Circuitry with Mechanism	6 days	0%
Assembly Complete	1 day	0%
Testing and Troubleshooting	**9 days**	**0%**
Project Completed	1 day	0%



Are there any questions?

Would you like to follow our project?
Check out our website!
http://eng.fsu.edu/me/senior_design/2015/team12/