

REEF Subsonic Wind Tunnel Articulating Robotic Arm

SPONSORS

MICHAEL SYTSMA

KEN BLACKBURN

ADVISOR

DR. RAJAN KUMAR

INSTRUCTORS

DR. NIKHIL GUPTA

DR. CHIANG SHIH

TEAM 12

ANDREW BALDWIN

JUSTIN BROOMALL

CAITLAN SCHEANWALD

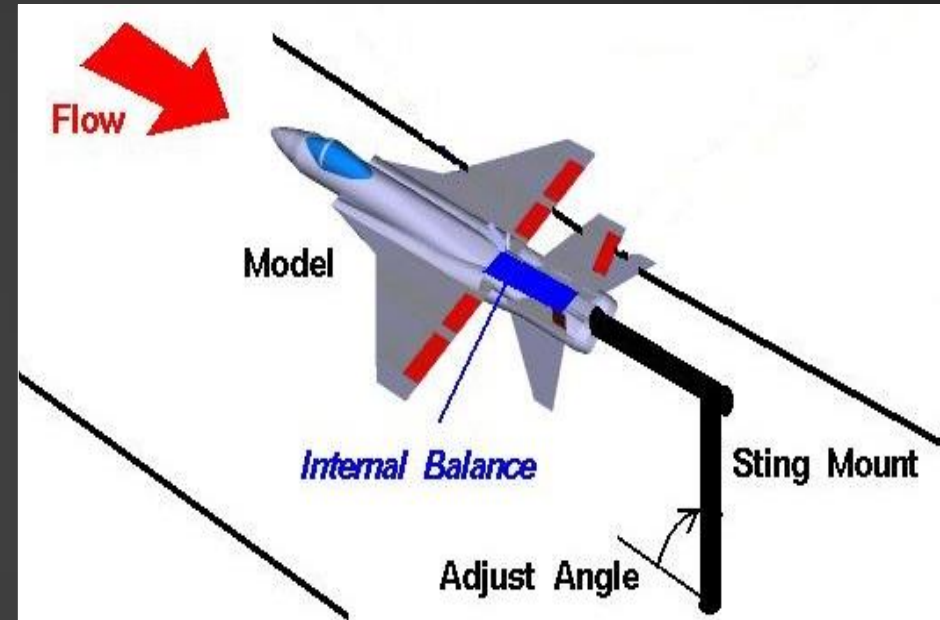
JACOB KRAFT

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

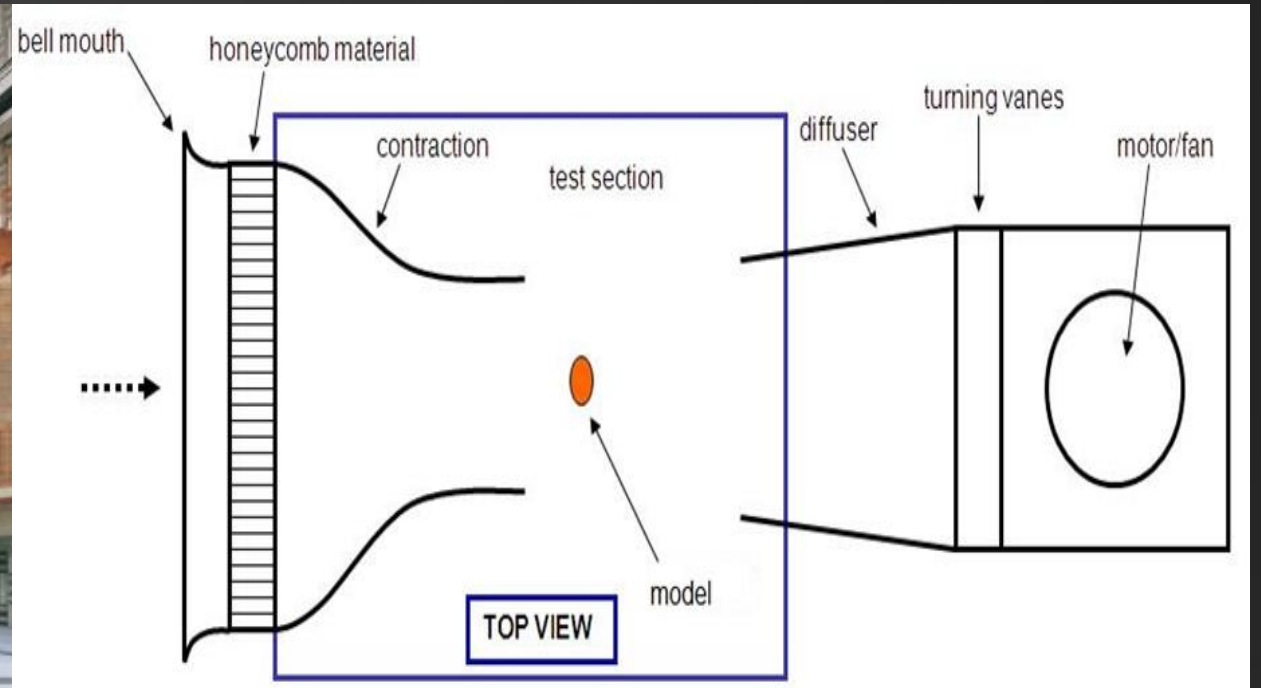


Sting Mount in Wind Tunnel

The Test Section



Open Test Section



Overhead View of REEF Center Wind Tunnel

Project Objectives

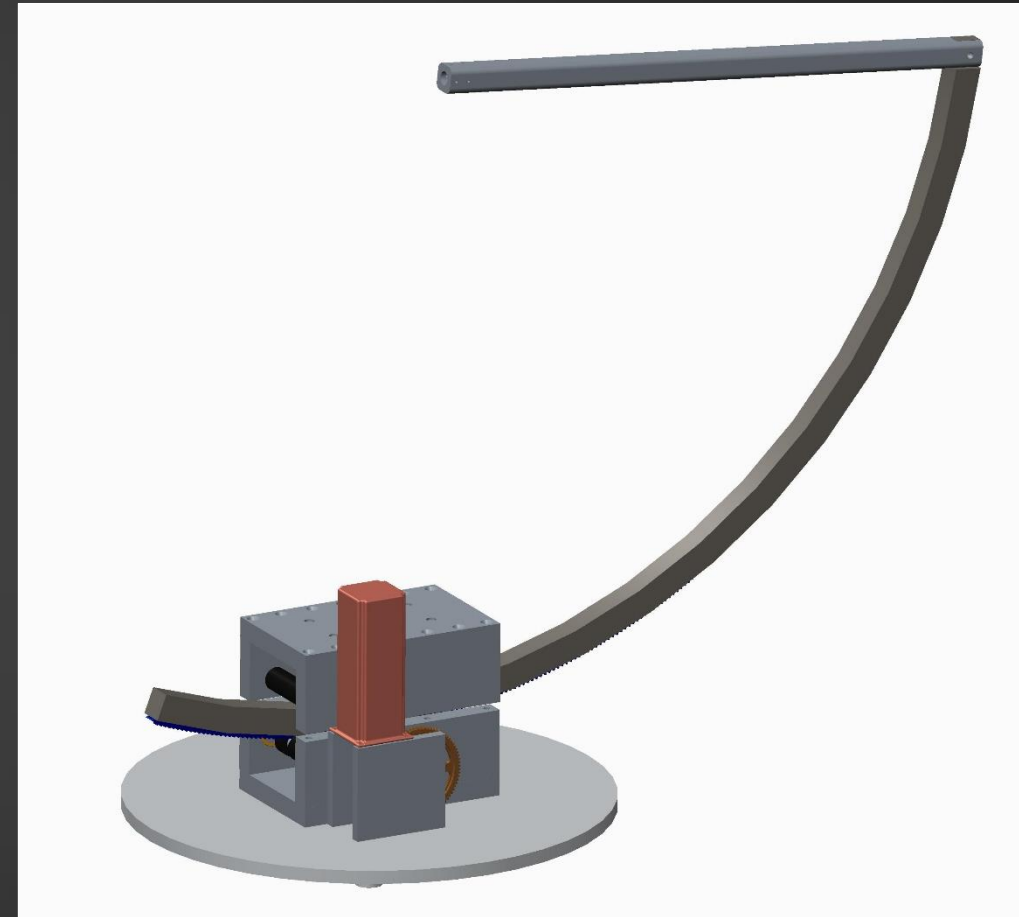
- Arm able to withstand maximum force generated by wind tunnel
 - Maximum Velocity: 22 m/s
- Center of mass of specimen must not change during manipulation
- Adjustable pitch range: -5° to $+20^{\circ}$
- Adjustable yaw range: $\pm 10^{\circ}$
- Model must not move when in set position
- User interface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

Design Constraints

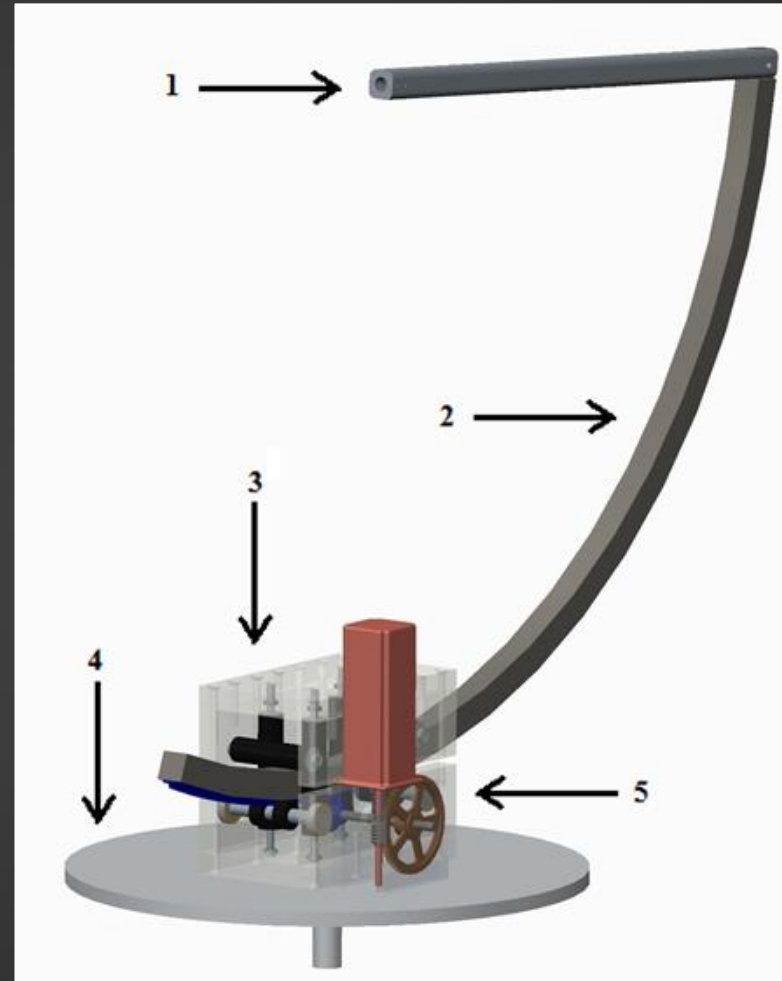
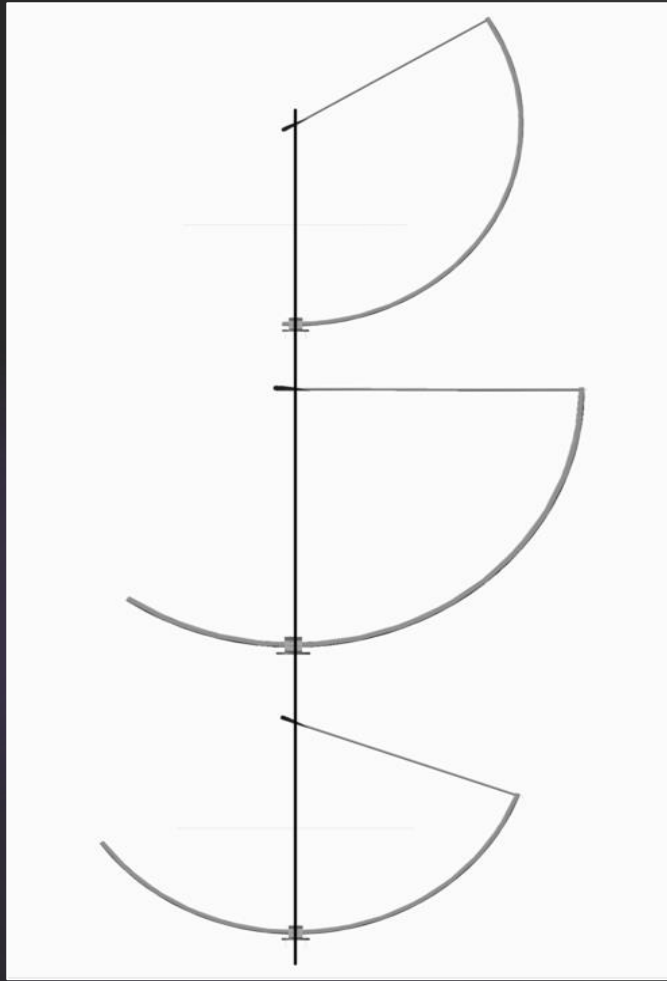
- User interface using LabVIEW
- 0.25° orientation accuracy
- Maximum Deflection of 0.25 in.
- Factor of Safety of 5
- \$2,000 budget

Progress Made

- **Designing**
 - Power Transmission
 - Mounting Mechanism
- **Dimensioning**
 - Finalized Drawing Dimensions
 - Finalized Tolerances
- **Purchasing**
 - McMaster-Carr
 - Tallahassee Metal Fabrication
 - Stock Drive Instruments
- **Machining**
 - HPMI
 - College of Engineering Machine Shop

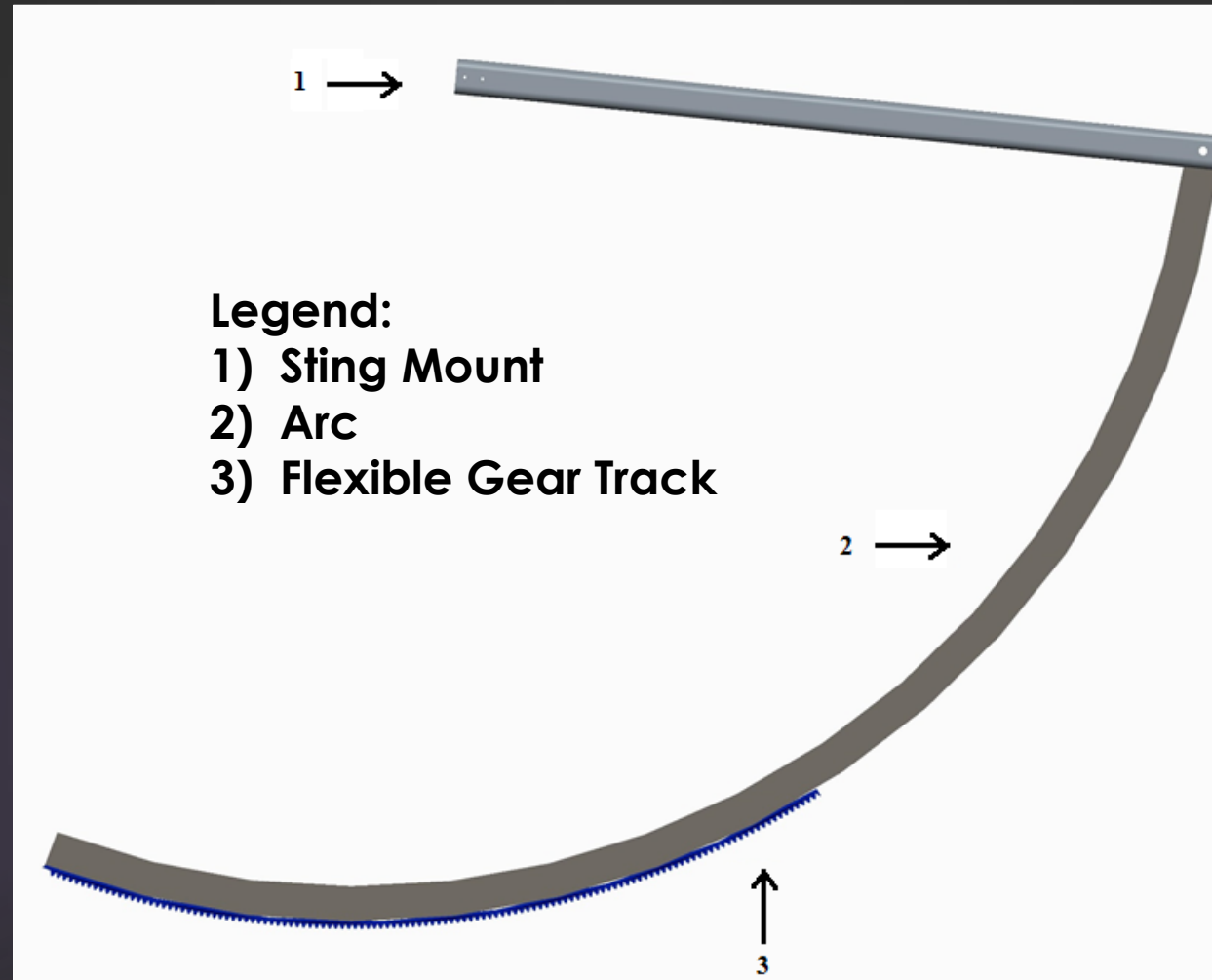


Design Concept

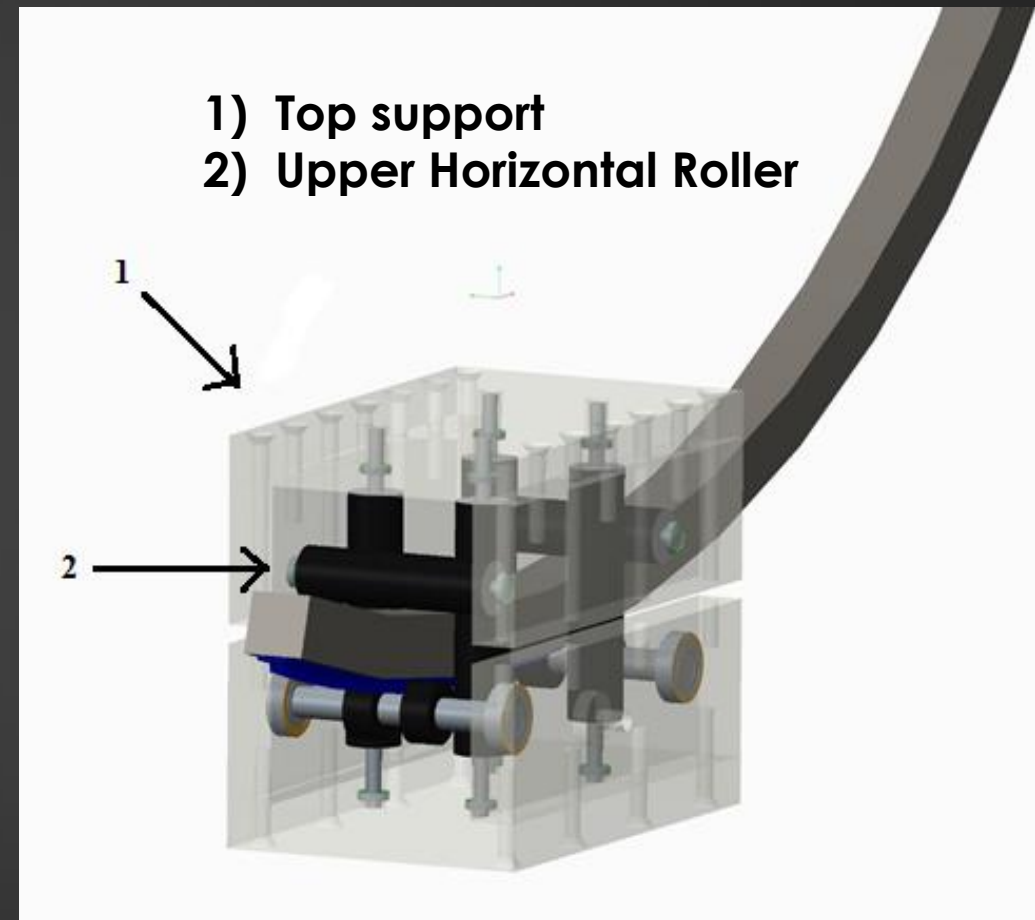
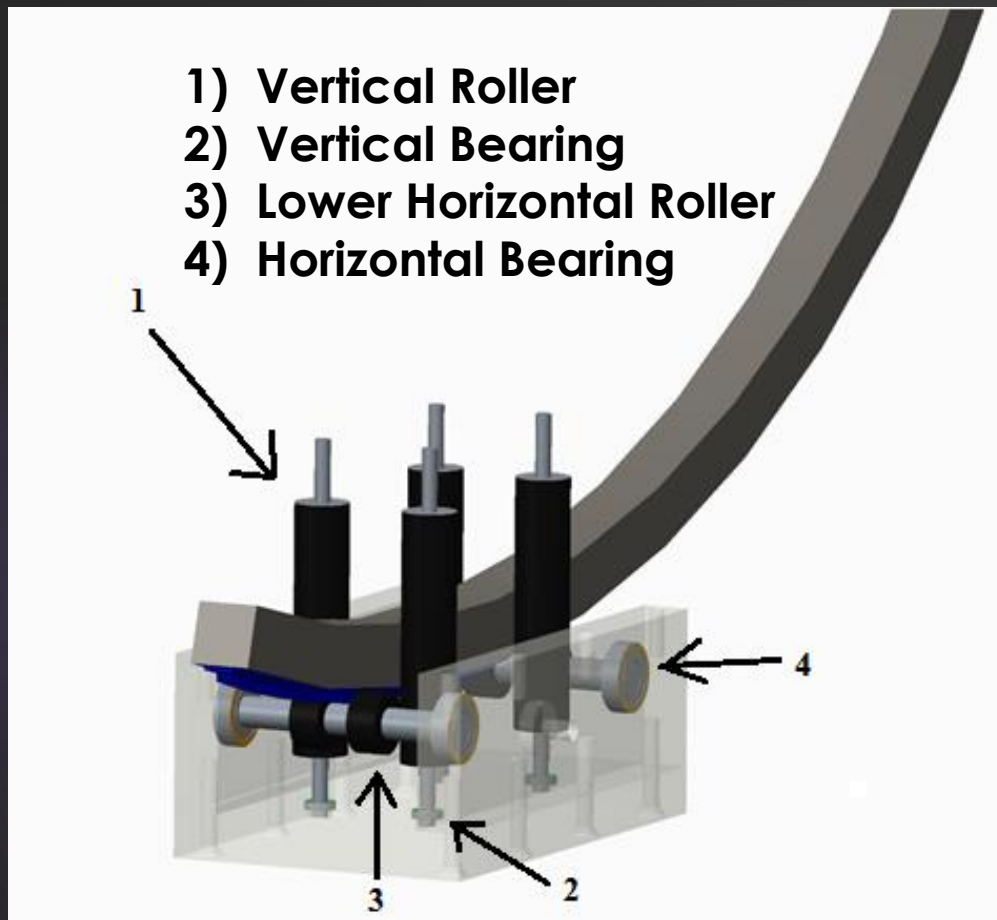


- Legend:
- 1) Sting Mount
 - 2) Arc
 - 3) Mounting System
 - 4) Turn Table Plate
 - 5) Drive Train

Detailed View - Arc

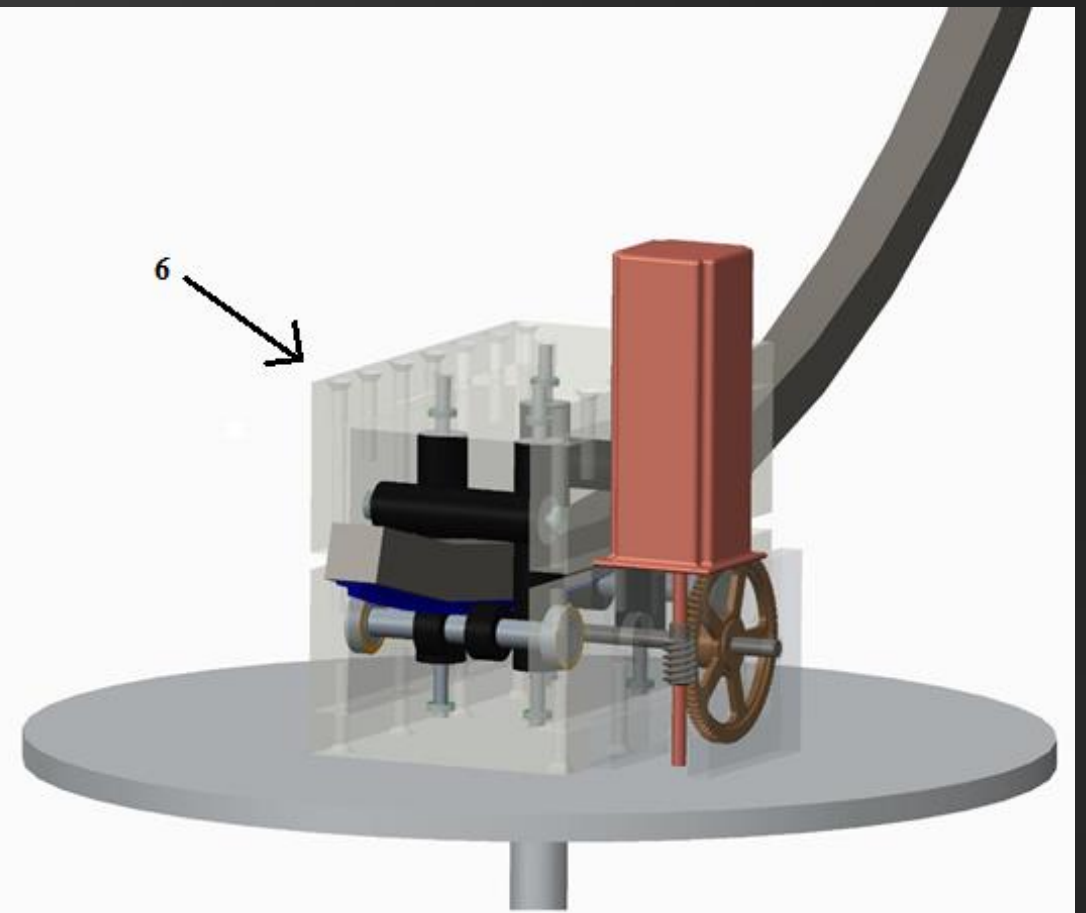
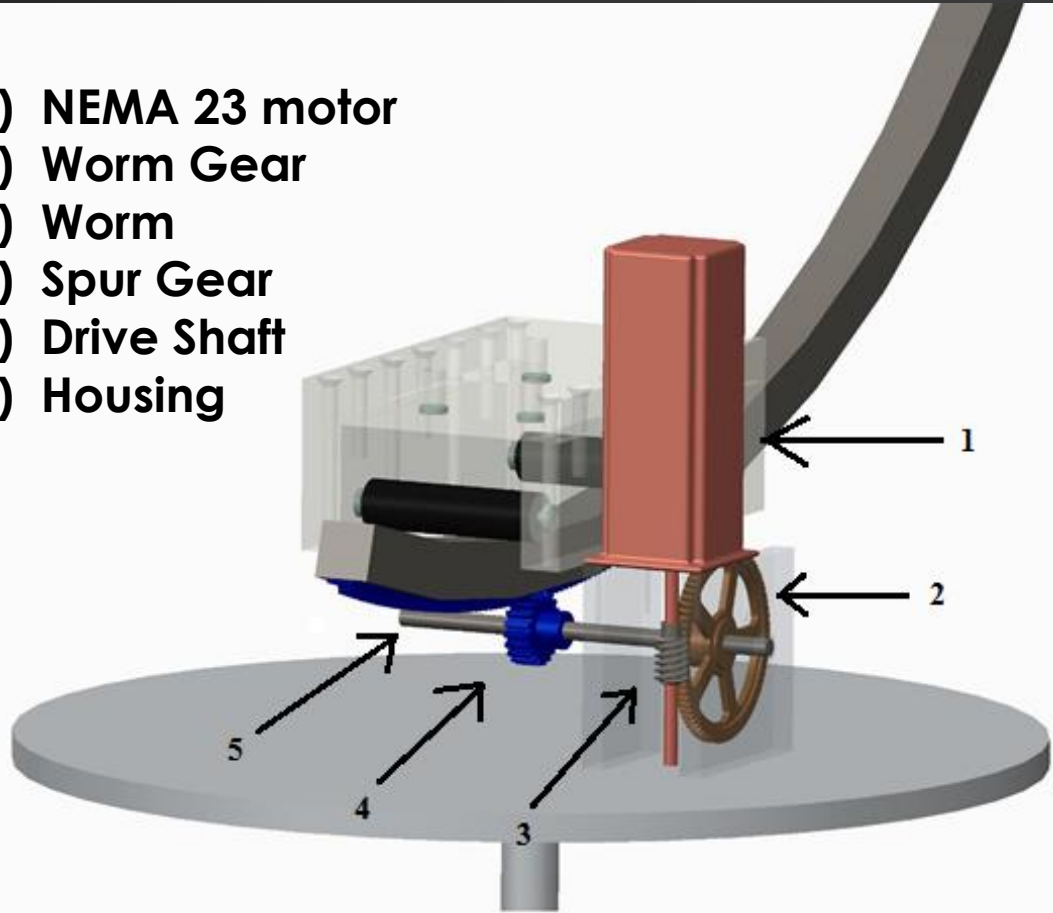


Detailed View - Mounting System



Detailed View - Drive Train

- 1) NEMA 23 motor
- 2) Worm Gear
- 3) Worm
- 4) Spur Gear
- 5) Drive Shaft
- 6) Housing



Electrical Components

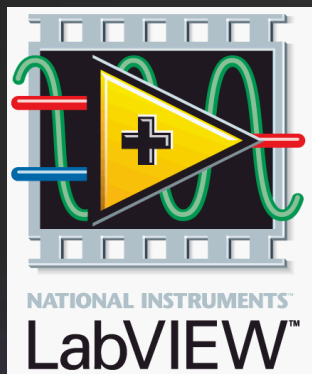
Selected

- Motion Controller
- NEMA 23 Motor
- Motor Driver
- 1000 Line Encoder
- Turntable

To be selected

- Power supply
- Inclinometer

Programming and Circuitry



User Interface



Motion Controller



Motor Driver 1

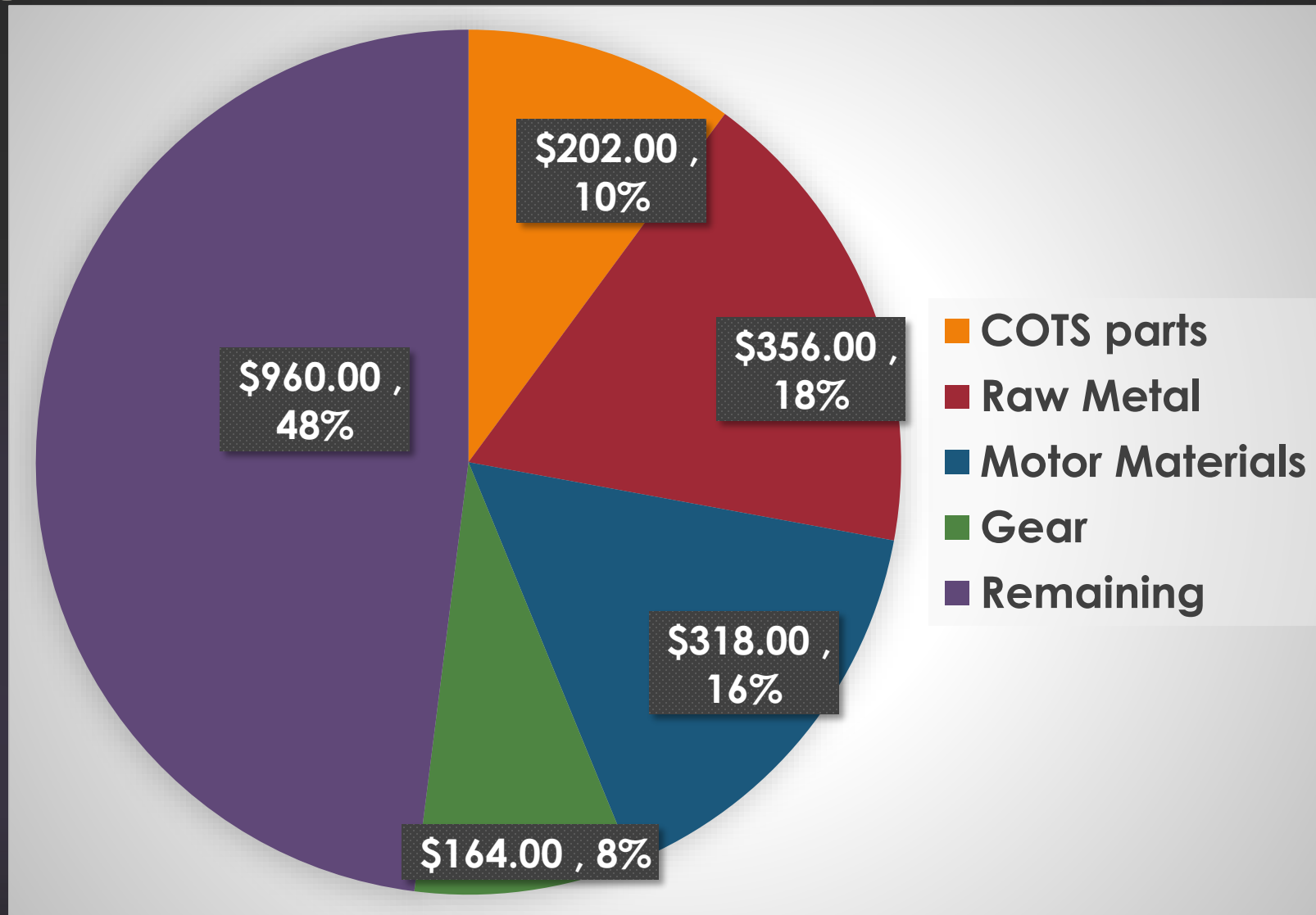
Turntable



Motor Driver 2

Stepper Motor

Budget



Future Work and Allocation

- Design
 - Follower
 - Power Requirements
 - User Interface with LabVIEW
- Purchasing
 - Purchase orders (1/23/15)
- Machining
- Assembly
- Prototyping
- Testing and Troubleshooting

Task	Member Responsible	Estimated time
Finalize CAD drawings	Justin Broomall	1 week
Finalize purchase orders	Andrew Baldwin	1 week
Construct Mechanism	Justin, Jacob, Andrew	2 weeks
Build User Interface	Caitlan Scheanwald	2 weeks
Construct Full Prototype	Team	1 week
Testing without wind tunnel	Team	1 week
Troubleshooting	Team	1/2 week
Testing with wind tunnel	Team	1 week
Troubleshooting	Team	1 week
Finalize and Make Ops manual	Team	2 weeks
Estimated Completion		12 weeks

Spring Schedule

	Task Name	Duration	% Complete	Jan 4, '15				Jan 18, '15			Feb 1, '15				Feb 15, '15			Mar 1, '15				
				F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S		
1	<input type="checkbox"/> Gathering of all Materials and Parts	28 days	19%																			
2	<input type="checkbox"/> Purchase of Materials and Parts	9 days	79%																			
3	Selection of Stepper Motors Based on Previously Calculated Requirements	7 days	70%																			
4	✓ Find Vendors for all Parts and Materials	7 days	100%																			
5	Sponsor Approval of Purchases	2 days	40%																			
6	Submission of Purchase Orders	0 days	0%																			
7	<input type="checkbox"/> Procurement of Materials and Parts	21 days	0%																			
8	Procurement of Drive Train	10 days	0%																			
9	Procurement of Raw Materials	10 days	0%																			
10	Procurement of Hardware	10 days	0%																			
11	Procurement of Motors, Encoders, and Drivers	20 days	0%																			
12	Inventory of all Purchases	0 days	0%																			
13	<input type="checkbox"/> System Assembly	37 days	0%																			
14	<input type="checkbox"/> Machining and Construction	27 days	0%																			
15	Plan Machining and Inspect Drawings	7 days	0%																			
16	Machining of Mounting Box	7 days	0%																			
17	Machining of Arc (HPMI)	11 days	0%																			
18	Constuction of Mechanism	6 days	0%																			
19	<input type="checkbox"/> Programming and Circuitry	31 days	0%																			

Team #12

Jacob Kraft



Are there any questions?

Would you like to follow our project?
Check out our website!

http://eng.fsu.edu/me/senior_design/2015/team12/