

# VTT Rotor: Back EMF Test Fixture Midterm Presentation I

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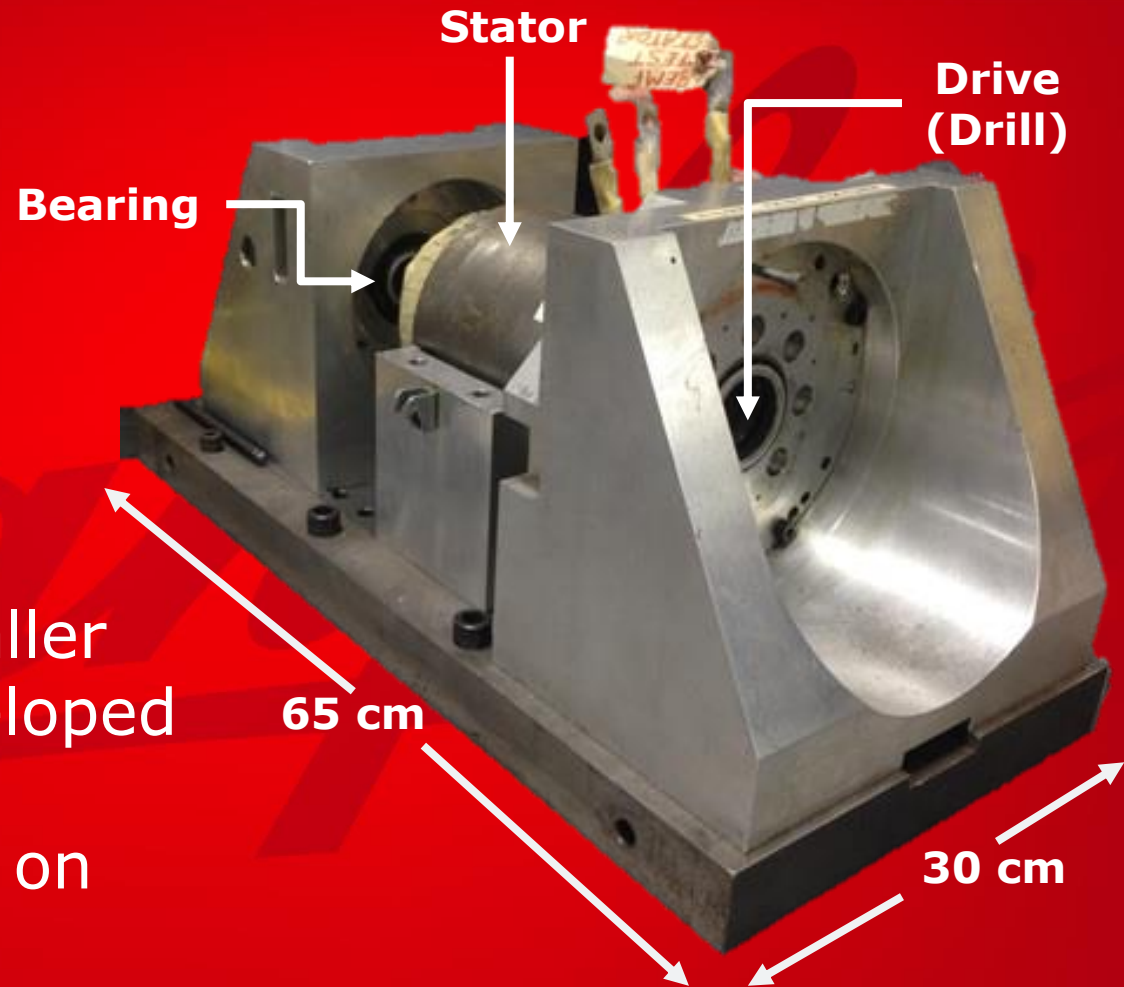
Date: 10/16/2014

# Presentation Outline

- Background
- Design Challenges
- Initial Prototype
- Risks and Risk Mitigation
- Fall Schedule
- Conclusion and Future Work

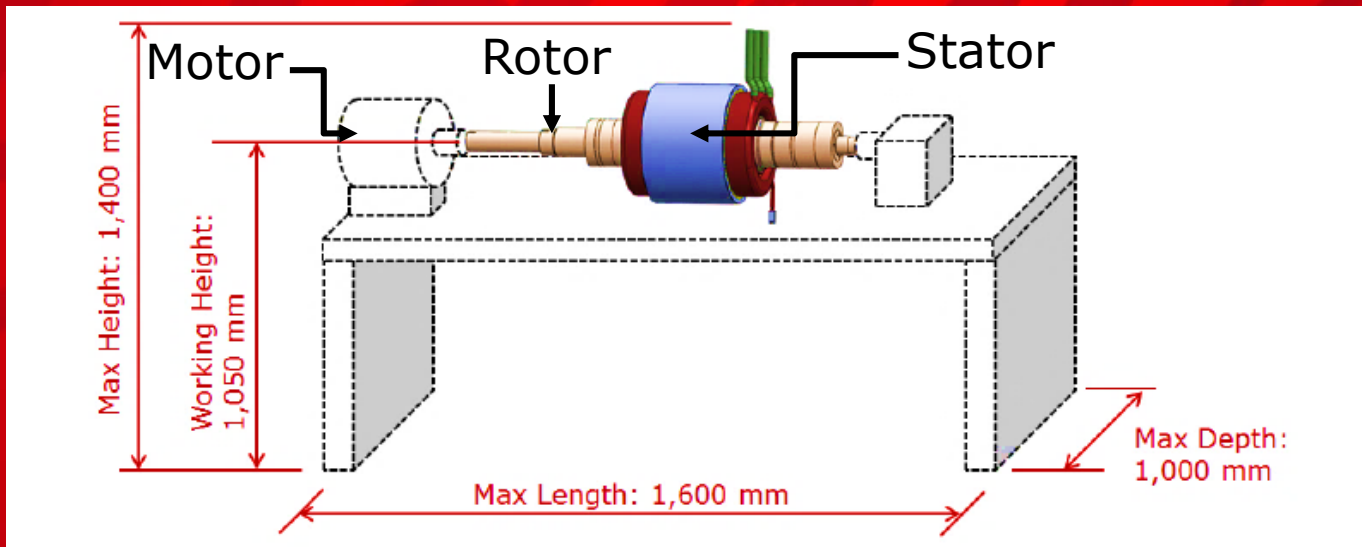
# Background

- Need test fixture to qualify rotors
- Will measure back electromotive force (EMF)
- Test fixture for smaller rotors already developed
- Several constraints on design



# Key Constraints

- Must overcome magnetic force during insertion
- Rotor must be centered within stator to specified tolerance (0.5 mm)
- Rotor must be spun at a minimum of 1000 RPM
- Spatial Constraints:



# Project Goal

- Fully designed, manufactured and tested back EMF test fixture
- Submission package to Turbocor:
  - 3D Prototype
  - Bill of Materials
  - Drawing Package
- Conform to all constraints outlined by Turbocor
- Efficient use of resources and time

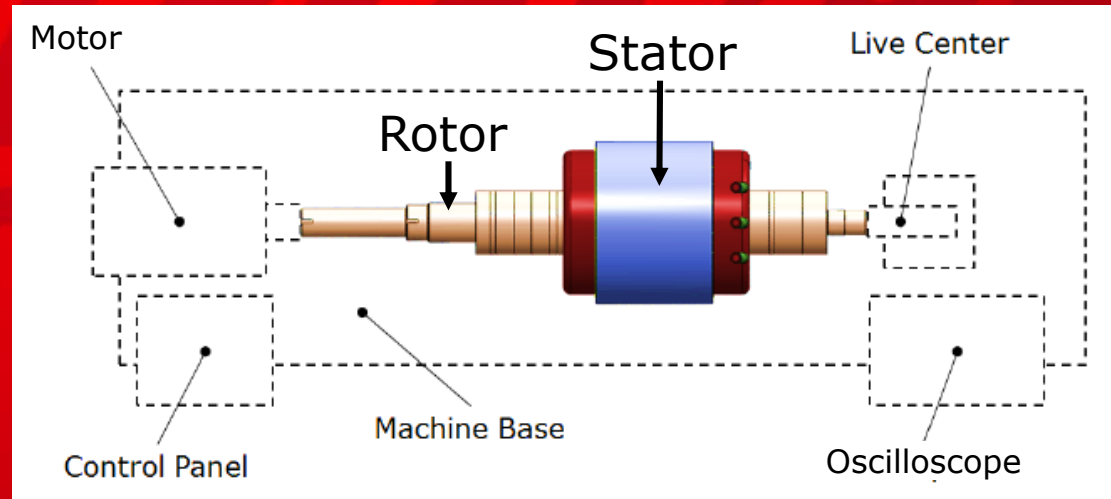
# Motor Selection

- Calculations indicate:
  - 9 ft-lb Torque
  - 0.7 HP required
- Key Considerations:
  - AC preferred
  - 1000 RPM minimum capability
  - Shank Diameter
- Marathon Electric AC Motor
  - 2 HP
  - 3600 RPM



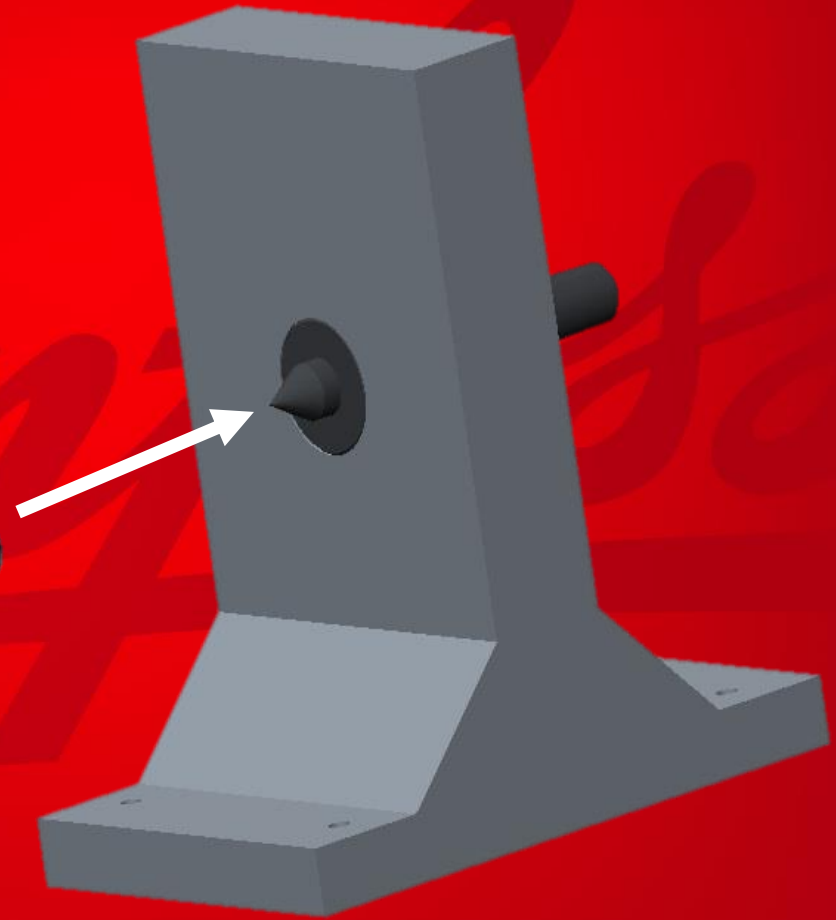
# Design Configuration

- Rotor to be lowered by a crane, then there are three options for next step:
  - Rotor can then be moved into stator
  - Stator can be moved over rotor
  - Both can be moved
- Moving both = most ergonomically efficient
- Live center connection can either hinge or slide along track



# Rotor Centering

- Rotor must be axially aligned within stator
  - Tolerance: 0.5 mm
- Old design used bearings, durability issues
- Live center to be utilized





# Overcoming Magnetic Force

- 60-80 pound magnetic force exerted when rotor is inserted into stator
- Three options considered:
  - 1) Ball Screw
  - 2) Rack and Pinion
  - 3) Pneumatic Actuator

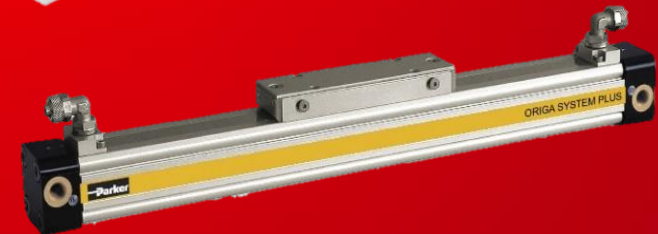
1)



2)



3)

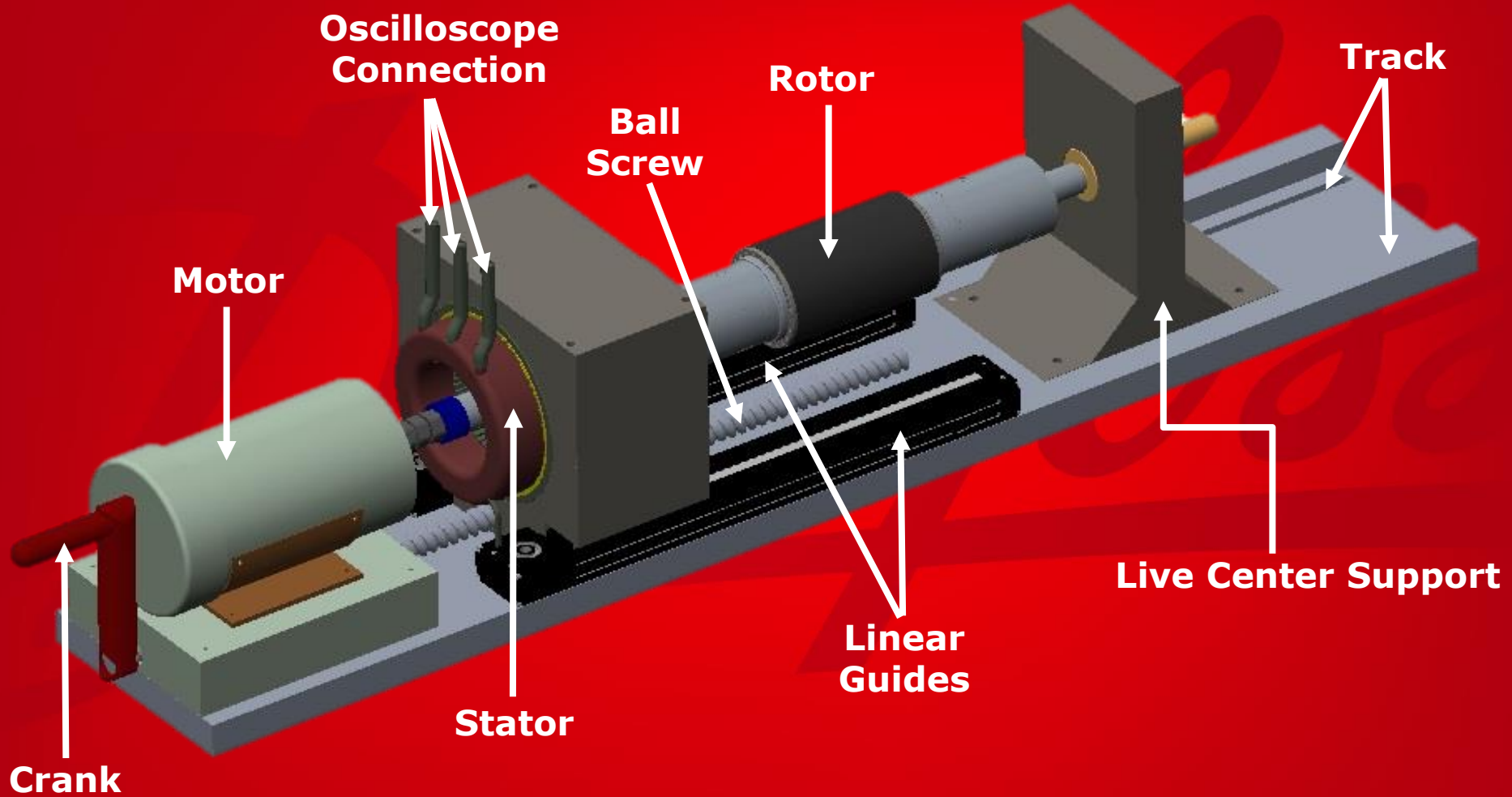


# Design Selection Matrix

Design (1-10)	Safety (30%)	Accuracy (25%)	Ease of Use (20%)	Durability (15%)	Cost (10%)	Total
Ball Screw	9	8	7	6	6	<b>7.6</b>
Pneumatic Device	3	5	2	6	3	<b>3.75</b>
Rack and Pinion	7	3	5	4	5	<b>4.95</b>

- Ball Screw most viable option
  - Durable, safe, low cost, cannot be back-driven

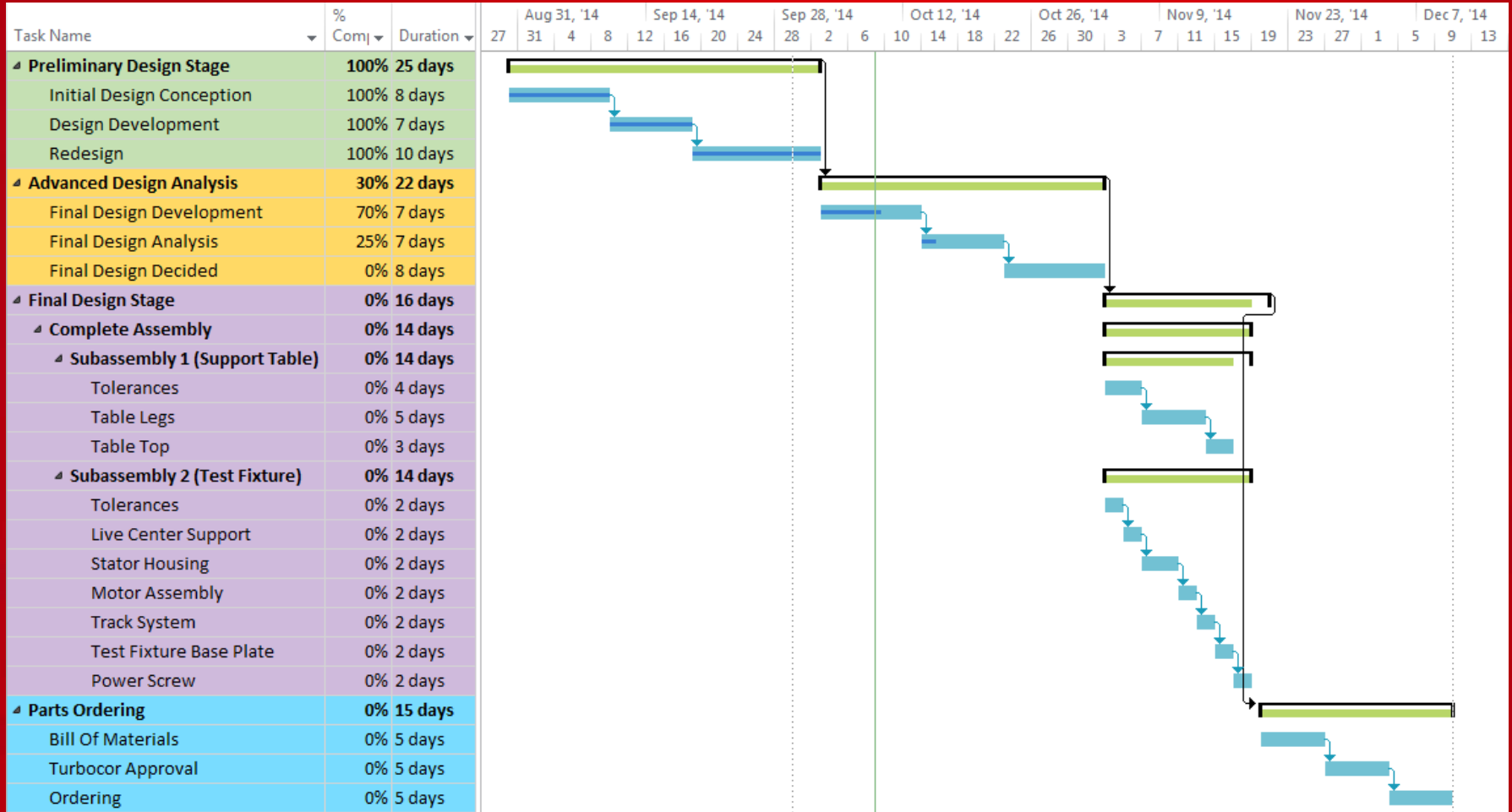
# Initial Prototype



# Risks and Mitigation

- Scheduling Setbacks
  - Delay in ordering parts, manufacturing
  - Mitigation: Set deadlines ahead of class schedule
- Design Risks
  - Vibration at motor to rotor connection
  - Mitigation: Nylon/rubber boot, vibration analysis
  - Misalignment of rotor within stator
  - Mitigation: Live center, FMEA
  - Other design risks (failure of shank, live center)

# Fall Schedule



# Conclusion & Future Work

- Initial design has been decided upon
- Individual components (linear guide, motor connection, ball screw) need to be selected
- Dimensions and tolerances to be determined
- Final Design Review at Turbocor:
  - November 20<sup>th</sup>
- Spring Semester: Manufacturing and Testing

# Questions or Comments?

- For more information, see our website:
  - [VTT Rotor Back EMF Test Fixture Website](#)

