

Group 12: Bevel Gear Test Bed





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Introduction

- Sponsor
- Project Scope
- Product Specifications
- Design Development
- Final Design
- Prototype Manufacturing & Assembly
- Troubleshooting
- Recommendations
- Cost Analysis
- Conclusion

<u>Sponsor</u>

 International Communications and Information Technology Company

- Markets
 - Government
 - Commercial
- Harris Project Complications
 - Gears failed before achieving expected results
- Possible Problems
 - Misalignment
 - Overloading
 - Anodic Coating Failure



Figure 1: Deployable Satellite

Project Scope

Test Bed Design

- Highly Precise
- Fully Adjustable

Bevel Gear Sets

- Variations in Size
- Variations in Materials

Parameters

- Life Span Test
- Variable Input Speed
- Variable Output Resistive Torque



Figure 2: Worn Bevel Gear Teeth

Product Specifications

| Specifications | Target Range |
|----------------------------|-----------------------|
| Variable Speed | 0 rpm – 100 rpm |
| Variable Torque | 0 in·lb – 31.25 in·lb |
| Mounting Distance Accuracy | ± 0.001 in |
| Variable Shaft Angle Range | ± 0.5 degrees |
| Shaft Angle Increments | ± 0.05 degrees |
| Gear Size Range | 1/3 in. – 5 in. |

<u>3 Conceptual Designs</u>

Rack and Pinion

 2 Translation Tables attached to a Rotary Table

Cross-Slide Rotary Table

 Integrated Translation and Rotation Adjustments





2 Translation Tables & 1 Rotation Table Video









Assembly and Calibration Steps



Step 1: Start with plain 1/2" shafts



Step 2: Attach chosen Gear Adapters



Step 3: Attach EF to Input Adapter to Calibrate Input Mounting Distance



Step 4: Attach EF to Output Shaft to Calibrate Output Mounting Distance



Step 5: Attach Input Gear to Input Shaft



Step 6: Attach Output Gear to output shaft and move both gears to correct Mounting Distance





Controller Configuration



| Controller | Connection |
|--------------|-------------------|
| High Voltage | Power Supply (+) |
| Ground | Power Supply (-) |
| Motor + | Motor (+) |
| Motor - | Motor (-) |
| +5V OUT | Potentiometer (+) |
| +Ref IN | Potentiometer Ref |
| -5V OUT | Potentiometer (-) |

Troubleshooting

Edge-Finder Calibration Electrical Insulation Failure – short, trauma

Resistive Load Control

- Power Supply / Potentiometer
 - Operation
 - Quantification

Angular Alignment Use Feeler Gauge on Orthogonal Components Time is a factor

Recommendations

Precision Alignment Resolution

Plane Surfaces of Materials
Alignment Pins

Independent X – Y Stages

- Align Axes Independently
- Align Rotary Table Center with PCC
- Increase Gear Size Range (CSRT is limited)

Simplify Resistive Load

- Controller w/ Potentiometer is Difficult to Operate
 - Simplify Controller
 - Different Source of Loading

Cost Analysis



2 Motors and 3 Gear Sets were provided by Harris Corporation

Conclusion

Resolved Issues

- Corrected Vertical Alignment
- Gears Run When Meshed
- Achieved the Product Specs
 - Variable Speed
 - Translation and Rotation
 - Gear Range
- Extended Goal
 - Mounting of Non-90° Bevel Gear Sets is Possible

Unresolved Issues

- Controller Functionality
 - Potentiometer -> Torque
- Extended Goals
 - Vibration
 - Heat Generation
 - Calculations Associated with Non-90° Bevel Gear Sets

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