Low Cost Gimbal-less Autonomous Camera System — Shrike

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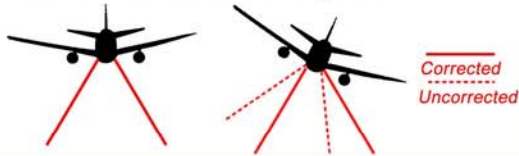
Problem Statement

Design a low cost camera system for an aircraft which reduces the effects of turbulence without use of a gimbal
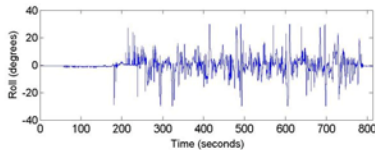
Corrected
Uncorrected

Background

Requirements

- Stabilize image
- 20° full field of view
- Low system weight
- Resolve a 4" target
- Low power usage
- Low cost
- 300 foot altitude
- 15 minute fly time

Traditional Gimbals

- High power requirements
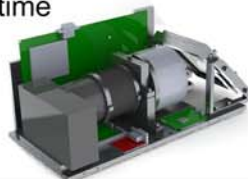- Cause aerodynamic drag
- Heavy
- Expensive

Preliminary Analysis

- Actual flight data shows motion can be corrected using Risley Prism Assembly (RPA)
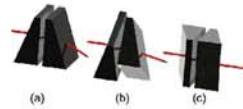
Our Solution

- Data collected in real time
- Closed loop system commands RPA
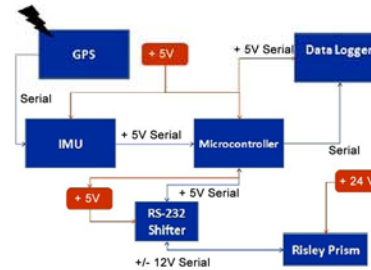- Motion of plane corrected by optical solution

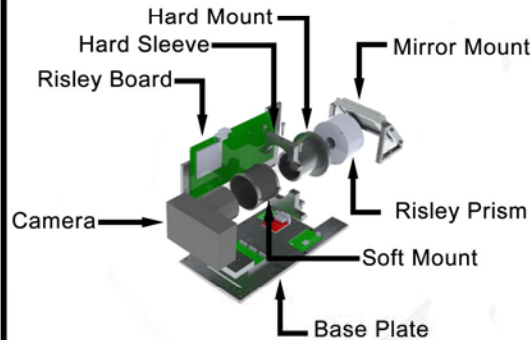## Design Overview

Optical Subsystem

(a) (b) (c)

- Rotating prisms steer the incoming light
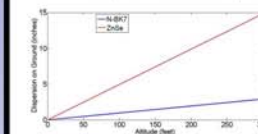- Two prisms allow for independent roll and pitch correction
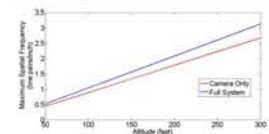
Electrical Subsystem

GPS — + 5V — + 5V Serial — Data Logger
Serial
IMU — + 5V Serial — Microcontroller — Serial
+ 5V — + 5V Serial — + 24 V
RS-232 Shifter — Risley Prism
+/- 12V Serial

Mechanical Subsystem

- Hard Mount
- Hard Sleeve
- Risley Board
- Mirror Mount
- Camera
- Risley Prism
- Soft Mount
- Base Plate

Test Results

Optical Results

Prism Dispersion Comparison

System Resolution

Electrical Results

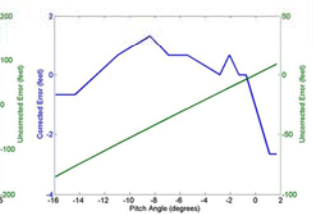| Components	Data Rates
Inertial measurement unit output	101.7 Hz
Risley prism assembly input	90.7 Hz

Components	Current Draw
Shrike Boards	202 mA
Risley Prism Assembly Standby	708 mA
Operational	397 mA

System Results

Error Correction - Roll
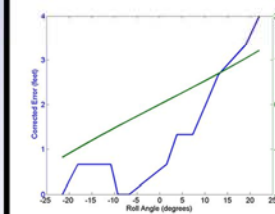
Error Correction - Pitch

Correction Range

Correction Range	Degrees
Roll Left	25 Degrees
Roll Right	25 Degrees
Pitch Up	4 Degrees
Pitch Down	19 Degrees

Correction Rate
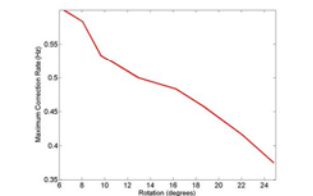
Field of View
34 Degrees

Conclusion

Requirments	Passed
Stabilizes image	✓
20 degree full field of view	✓
300 foot altitude	✓
15 minute fly time	✓
Resolve a 4" by 4" target	✓
Low system weight	✓
Low power consumption	✓
Low cost	✓

Moving Forward

- Faster data acquisition
- Use of flip zoom
- Custom Risley Prisms
- Lightweight mounts