Petite Infrared Mobile Pointing System for Tactical Intelligence Collection

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ME 189-3 June 7, 2013

Abstract

FLIR Systems is a leading thermal imaging company that develops products ranging from camera cores to full camera systems for both consumer and military markets. FLIR desired an exceptionally petite camera system that would exploit their smallest infrared camera core, the Quark™. The delivered functional prototype demonstrates the feasibility of a commercializable, small-scale pan-tilt infrared camera system.

Design Specifications

Table 1: Functional prototype features.

Specification	Measured Value
Overall Size	3 in. Diameter 5 in. Height
Pan Range	Unrestricted
Tilt Range	+110º, -100º wrt Horizon
Pointing Speed	105º/sec
Pointing Precision	< 0.25º
Backlash	< 1º/rev
Video Output	640x480 at 30Hz
Image Calibration	1.5 sec NUC
Storage Temperature	-25ºC to 85ºC
Vibration	IEC 60945

System Overview

Figure 1: User-operated pan-tilt system outputs infrared video.

Design History

Figure 2: Chronological design history (from left to right).

Engineering Design

Design considerations included routing wires through two axes of rotation, facilitating assembly, minimizing number of seal surfaces, balancing motor size and performance, packaging drive system, maintaining belt tension throughout operating conditions, and choosing adequate axial supports. The driving engineering objective was to accomplish all of the above challenges while achieving the small overall size specification. This required a creative design and twenty-one custom components.

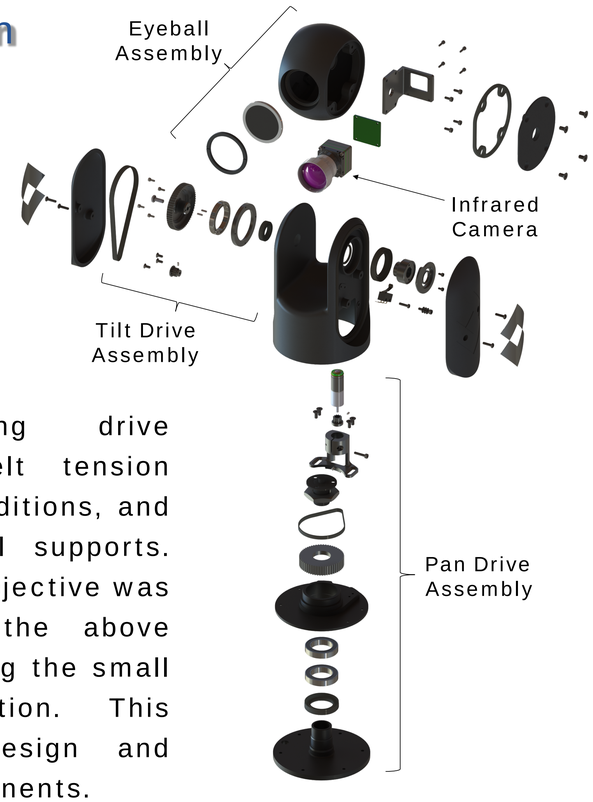

Figure 3: Exploded solid model.

Design Analysis

Flow simulation verified that the operating temperatures of the system's internal components would not be exceeded during maximum operational conditions. Analysis of the seal regions showed that the structure would maintain adequate gasket compression with an optimal number of fasteners.

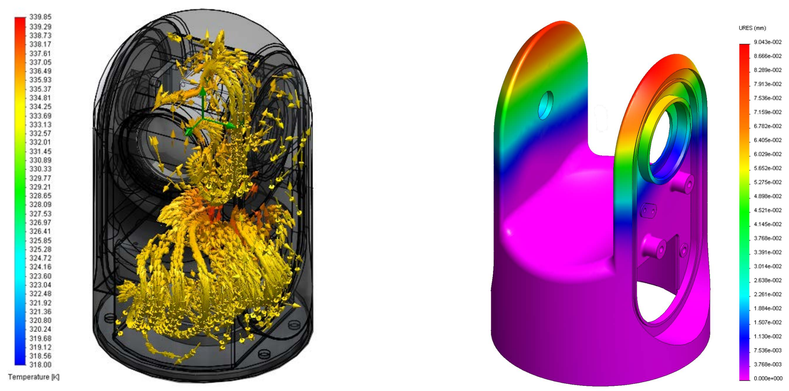

Figure 4: Internal CFD (left) and deflection resulting from seal compression (right).

Testing

In order to verify system operation over a broad range of environments, the prototype was tested for mechanical resonances and was subjected to storage and operational temperatures. The vibrational test simulated vehicle mounted operation. Thermal testing verified operation after exposure to extreme temperatures.

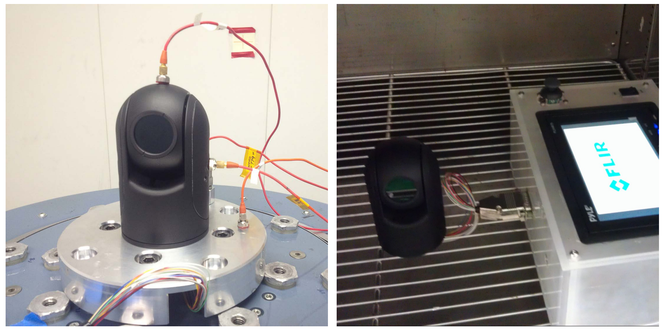

Figure 5: Vibration (left) and thermal (right) testing.

Conclusions

This project demonstrates that a commercializable, small-scale, pan-tilt infrared camera system is possible. The functional prototype features a wide range of motion and protection from the environment in a rugged and aesthetically pleasing package. This system has the potential to position an infrared video feed in security, law enforcement, military, and maritime applications.

Acknowledgements

FLIR: Marcel Tremblay, John Distelzweig, Mike Kent, Louis Tremblay, Sam Chapple, Jace Dispenza, Wayne Patterson, Bart Erwin, In-Kyu Chang

UCSB: Prof. Turner, Prof. Paden, Greg Dahlen, Dave Bothman, Steve Laguette

IR Dog: Austin Richards