Optikos Case Study
Giving Stray Light a Home

The Customer

As a leading environment sensing company, the customer in this case study develops technologies such as LIDAR systems for situational awareness, oceanographic instruments for environmental monitoring, and unmanned aerial system detection tools. With a strong presence in defense, aerospace, energy, and commercial sectors, the company has been at the forefront of innovation for national and global security challenges since its founding in the 1970s.

The Problem

The customer wanted to change sensors on two pre-designed optical assemblies while making minimal opto-mechanical updates. With this change, a stray light issue was encountered, impacting the overall image quality of the system. Specifically, dim glares or flares were observed from out-of-field light sources when using the new sensor.

How Optikos Solved this Problem

Step 1: Modeling and Visualization

Optikos reevaluated the stray light analysis of the previous designs, incorporating new parameters and using non-sequential modeling in Zemax, optical design software. This included evaluating the mechanical design of the lens assembly and camera body, along with material surface properties. Models simulated a bright source projected into the lens pupil, measuring the image plane irradiance while varying the source's angle of incidence, ultimately supporting the causation hypothesis.

Step 2: Metrology

The Optikos metrology team then took the theoretical output of the Zemax modeling and replicated the occurrence using an Optikos OpTest® system. A collimated light source was projected into the lens entrance pupil and the irradiance at the image plane was evaluated. The lens and image analyzer were rotated about the entrance pupil of the lens to simulate different incidence angles of the source beam.

Through modeling and subsequent metrology, it was confirmed that stray light was present at the image plane at specific field angles, outside the field of view of the sensor. The source of the stray light was coming from exposed flat barrel sections and annuluses.

Step 3: Redesign

The Optikos engineering team made two adjustments, implementing both textured inserts and additional baffles. These updates significantly reduced the specular stray light off of the long-exposed sections of the blackened barrel and were designed to fit into the existing lens seats without impacting the existing mechanical design, thus achieving a >10x reduction in stray light (Figure 1).

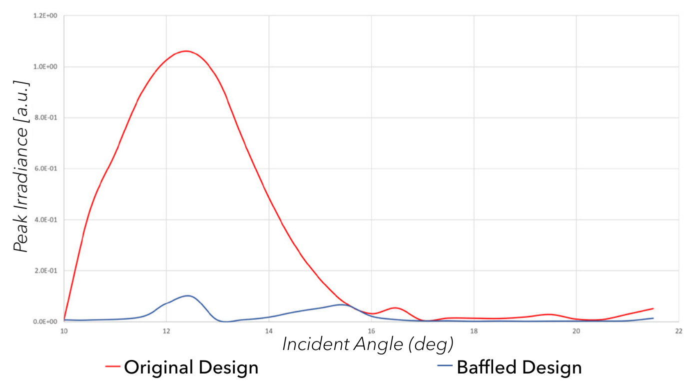
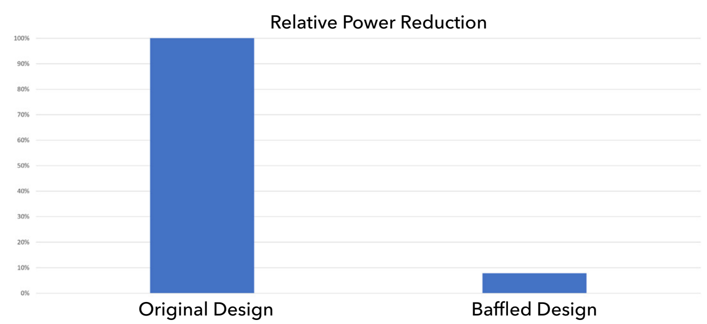


Figure 1 – Irradiance vs. Incidence Angle (above), Optical Power Reduction (below)



The implemented fix did introduce other effects, including some vignetting in the lens assembly. While raytracing showed minimal changes to MTF (modulation transfer function) performance, measurements verified that the MTF was maintained with the newly implemented baffles (Figure 2).

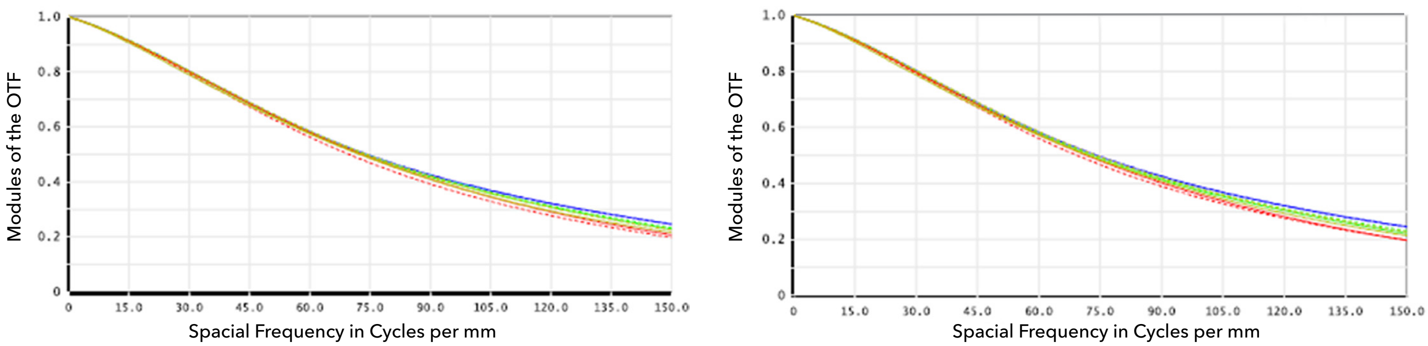
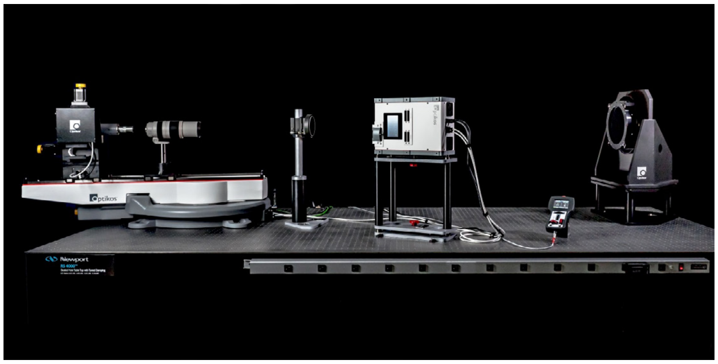


Figure 2 – Nominal MTF of imaging assembly without (left) and with baffles (right)

Conclusion

Optikos resolved a critical stray light issue that was degrading imaging performance by leveraging advanced stray light modeling, precision metrology, and targeted opto-mechanical design enhancements. Through the integration of textured inserts and laser-cut baffles, unwanted reflections and scatter were reduced by over 10x, dramatically improving image quality—all while preserving the existing mechanical architecture. This outcome underscores the power of precision engineering and strategic design modifications in addressing complex optical system challenges, especially in high-performance imaging applications.

Learn more about Optikos metrology products & services



OpTest® System for testing lenses above 50mm

Lens performance is CRITICAL for accurate data, predictable outcomes, and repeatable use in optical systems. Customers choose Optikos for lens testing to recognize potential problems before they hit production or to classify why their lens isn't performing the way it was designed.