



Ansys + NewSpace Systems

“Ansys Zemax OpticStudio software turned a complex redesign into a precise and efficient process, ensuring accuracy without unnecessary overhauls.”

— **Niké Ackerman**

Design Engineer / NewSpace Systems

/ Fast-tracking and Simplifying Second-gen Sun Sensor Redesign With Ansys Zemax OpticStudio Software

The Aquila D01 sun sensor from NewSpace Systems (NSS) is a proven and reliable system with extensive in-orbit heritage. It features a detector housed beneath a metal mask with precision-cut slits. As sunlight passes through these slits, it creates a unique one-dimensional brightness profile on the detector. This pattern is then analyzed to determine the sun's position.

In 2022, the linear array used in the Aquila D01 was discontinued, prompting an effort to redesign the sun sensor to meet updated component availability.

/ Challenges

The redesign led to the development of the Gen 1.5 Aquila sun sensor. NSS needed to integrate a new detector that would maintain the form fit and function of the original design, improve manufacturability, and avoid disruptions to existing embedded processing and calibration algorithms. A replacement detector was identified. However, due to differences in the photosensitive area of the detectors, the embedded algorithm and calibration were compromised, leading to reduced accuracy.

/ Technology Used

- Ansys Zemax OpticStudio® software

/ Engineering Solutions

To minimize mechanical changes, NSS used Ansys Zemax OpticStudio optical system design and analysis software to simulate potential design modifications, identifying the simplest adjustments needed to achieve desired accuracy. Through this approach, they tested various iterations, including adjustments to the optical filter material, minor modifications in the detector's placement, and optimized component alignment. This simulation-based approach enabled NSS to quickly evaluate multiple configurations, ensuring the new sensor could meet precision requirements while enhancing manufacturability.

/ Benefits

By conducting these simulations early in the redesign, NSS streamlined the development process and mitigated costly adjustments down the line. Previously, only 13% of Gen 1 Aquila sensors achieved the desired accuracy of below 0.1°. With the Gen 1.5 redesign, all sensors now meet this stringent accuracy threshold, underscoring the value of early-stage simulation.

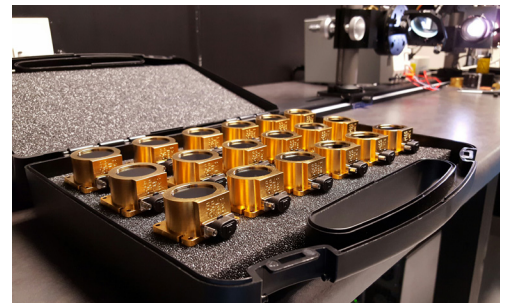


Figure 1. NSS Aquila Sun Sensor at the calibration test setup

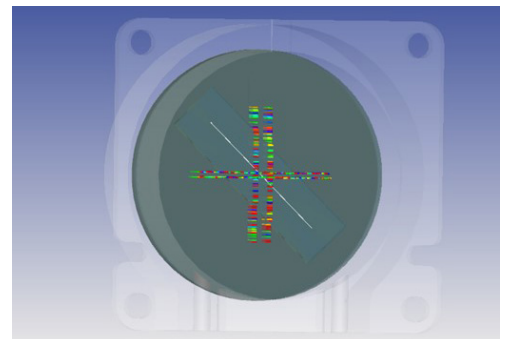


Figure 2. Simulation results showing the projected image pattern onto the detector

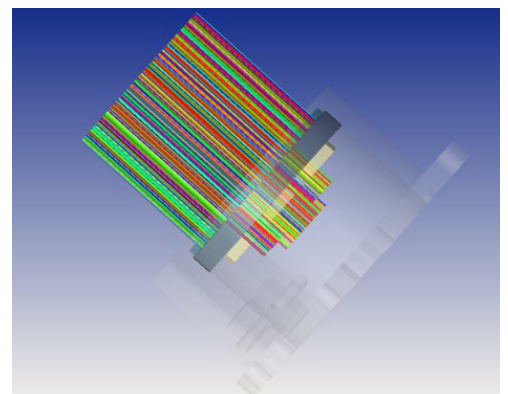


Figure 3. Simulation results from the ray tracing performed with Ansys Zemax OpticStudio software

/ Company Description

NewSpace Systems (NSS) is a trusted global manufacturer of spacecraft components and subsystems. With its headquarters in South Africa and branches across North America, Europe, and Oceania, NSS leads in providing guidance, navigation, and control (GNC) solutions. The company serves the majority of commercial spacecraft manufacturers, including multiple blue-chip clients and more than 500 satellite constellations. NSS products have been deployed on more than 2,000 spacecraft to date.

Dedicated to delivering high-quality solutions and services, NSS offers clients both flight-proven, off-the-shelf GNC products and customized solutions tailored to meet the unique needs of each mission. The NSS team prioritizes close collaboration, striving to support the success of their partners with a commitment to mission-specific innovation.



Figure 4. NSS Aquila sun sensor production in the cleanroom

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