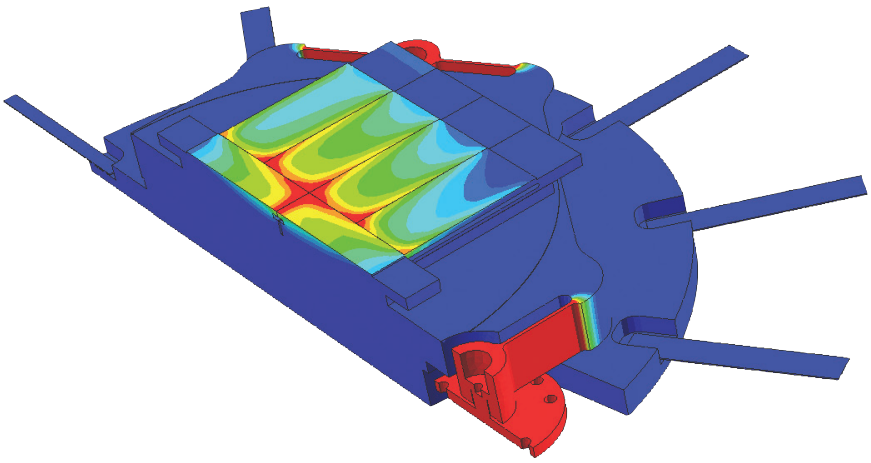
GEORGE TYLINSKI MECHANICAL DESIGN & ANALYSIS

Innovating an asteroid-detection CCD camera with SolidWorks Simulation



SolidWorks Simulation thermal and structural analyses were critical for maintaining the flatness and alignment of the CCD silicon imaging device, which generates heat but must operate at a temperature of -95°C, requiring a liquid nitrogen, cryogenic cooling system.

George Tylinski Mechanical Design & Analysis offers specialized consulting expertise for optomechanical engineering and product development. When George Tylinski founded his engineering consultancy in 1996, building upon the reputation he established as a lead mechanical engineer for two major imaging systems manufacturers, he knew he would need efficient and highly capable design and analysis tools to provide consistently high levels of service. Having used a variety of CAD and finite element analysis (FEA) applications during his career, the newly established design consultant made an evaluation of 3D design and analysis software his first order of business.

"My initial priority was selecting the best CAD system and most capable analysis application," Tylinski recalls. "I winnowed the field of design systems down first, and knew that I wanted to use the SolidWorks® 3D CAD software system. Then, I took a look at analysis packages. I evaluated ANSYS®, ALGOR®, and SolidWorks Simulation software, and determined that only SolidWorks Simulation provided the direct integration that I wanted with SolidWorks solid modeling software. The functionality provided with SolidWorks Simulation, including thermal and structural analysis capabilities, was just what I needed. I also preferred the easier, more efficient approach to meshing in SolidWorks Simulation."

Tylinski chose SolidWorks Simulation for optomechanical design analysis because of its ease of use, direct integration with SolidWorks CAD software, intuitive approach to meshing, and structural and thermal analysis capabilities.

Results:

- Saved a month's worth of time through integrated analysis
- Avoided expensive, trial-and-error testing
- Resolved complex thermal/structural challenges
- Aided effort to map near-Earth objects

SOLIDWORKS

Developing a sophisticated CCD camera

Since founding his engineering consulting firm, Tylinski has utilized the combination of SolidWorks CAD software and SolidWorks Simulation design analysis software on a multitude of projects. "I need to ensure optical stability over a wide temperature range on many of my projects," Tylinski explains. "About a third of my work relates to structural analysis, a third requires thermal analysis, and a third uses the sum of the two. One of my most challenging assignments involved the design, analysis, construction, and testing of a charge couple device (CCD) mosaic camera head as part of NASA's Near-Earth Object (NEO) program."

The purpose of the NEO program is to address the growing awareness and concern regarding the risk of asteroid collision with Earth by using sensitive CCD digital cameras to map all near-Earth objects, including those that require infrared technology in order to see. Tylinski used SolidWorks 3D CAD software and SolidWorks Simulation to develop a complex CCD camera that utilizes one of the world's largest focal plane arrays in a mosaic of ten 2000-by-4000 pixel CCDs. The camera, which attaches onto the back of a large space telescope, operates at the Japan Space Guard Center in Bisei, Japan.

Addressing thermal/structural challenges

Tylinski relied heavily on SolidWorks Simulation to address the difficult mechanical and thermal challenges related to the development of the CCD camera head. Because the CCD silicon imaging device generates heat and the imaging area was required to operate at -95°C, a liquid nitrogen cooling system cools the array area. A vacuum vessel isolates the array from the outer shell to maintain flatness and alignment upon cryogenic cooling.

"The challenge I faced was keeping everything flat—to within 0.001 inches peak-to-peak under all operating conditions—while maintaining temperature uniformity, making sure every pixel in the array was within a half-degree of each other," Tylinski explains. "SolidWorks Simulation thermal and structural analyses were critical to achieving a working design. The CCD array could not move and the temperature variation between the CCD array and the room is analogous to the difference between room temperature and boiling."

Supporting multiple design iterations

Using SolidWorks Simulation analysis software, Tylinski developed more than 60 iterations of a design that isolated the CCD array in a vacuum to prevent convection and utilized a series of three-layered copper straps that are tuned to take the right amount of heat flow from the liquid nitrogen.

Tylinski performed structural analyses on the tangential flexures that thermally isolate the CCD assembly and accommodate differential thermal expansion while rigidly supporting the focal plane. He ran thermal analyses on a set of SolidWorks software configurations at the part, subassembly, and main assembly levels. Tylinski credits SolidWorks Simulation with saving at least a month's time on the project, as well as avoiding the expense of repetitive physical testing.

"On this project, SolidWorks Simulation analysis capabilities made the difference between being able to do something and not being able to do it," Tylinski says.

"ON THIS PROJECT, SOLIDWORKS SIMULATION ANALYSIS CAPABILITIES MADE THE DIFFERENCE BETWEEN BEING ABLE TO DO SOMETHING AND NOT BEING ABLE TO DO IT."

George Tylinski
Founder

The asteroid-detection CCD camera, which was developed using integrated SolidWorks Simulation software, operates at the Japan Space Guard Center in Bisei, Japan.

george TYLINSKI
mechanical design & analysis
Portland, Oregon

George Tylinski Mechanical
Design & Analysis
3376 NE Multnomah Street
Portland, OR 97232
Phone: +1 503 515 3338

Dassault Systèmes
SolidWorks Corp.
300 Baker Avenue
Concord, MA 01742 USA
Phone: 1 800 693 9000
Outside the US: +1 978 371 5011
Email: info@solidworks.com
www.solidworks.com

SOLIDWORKS