SIEMENS

AEROSPACE AND DEFENSE

Mynaric

Creating detailed simulations to predict thermal and structural performance of high-bandwidth satellite communications equipment

Product

Simcenter

Business challenges

Develop detailed thermal and structural analysis of laser terminals

Eliminate separate simulation systems requiring complex and time-consuming work to share information

Develop product quickly to beat competition to market

Keys to success

Use Simcenter 3D to quickly simulate and iterate design revisions

Perform GPU-based radiation simulation of thermal performance in space

Couple thermal and structural simulation within the same environment

Results

Created detailed simulations that accurately predicted thermal and structural performance

Reduced modeling time from one month to one week, a decrease of 83 percent

Reduced thermal-structural model integration time from one-half day to five minutes, a decrease of 98 percent

Mynaric uses Simcenter 3D to reduce modeling time from one month to one week, a reduction of 83 percent

Boosting satellite communications capabilities

Over the last few decades, the number of satellites being launched into orbit continues to grow, providing a variety of services to people and institutions on Earth. For most of this time, these satellites have communicated with each other and the ground via radio signal. However, while this has been effective, it does have several disadvantages.

First, this method of communication is insecure as data is being sent out to space where it could be retrieved by other devices. Second, radio waves have limited bandwidth so the amount of data that can be sent at one time is limited. Finally, operators must pay license fees for the radio frequency so there is a significant ongoing cost.

Mynaric aims to overcome these issues using secure, quickly deployable, large bandwidth optical communications products to connect satellites, unmanned aerial systems, aircraft or high-altitude platforms with each other or the ground.

The terminals use mirrors to transmit and receive the laser. Orbiting satellites undergo extreme changes in temperature as they circle the Earth, and these thermal changes can have a major impact on the shape of the mirrors. A deformed mirror means a laser will not receive the signal

"Now we use the Siemens Xcelerator Academy, which has a great library of information if we need to look up anything. And we know that we always have support available, although we rarely need it as the software just works."

Christoph Triebig
Team Leader,
Simulation Engineering
Mynaric

from another satellite. For these systems to always operate effectively, engineers need precise predictions for thermal and structural performance. Since this is a new growth area in the space industry, there are many competitors developing similar solutions, and thus speed-to-market is a constant factor in winning business. So Mynaric not only needs skilled engineers, but the right tools to complete designs as efficiently as possible.

The power of integration

Christoph Triebig, simulation engineering team leader at Mynaric, explains their previous solution to evaluate thermal and structural performance was complex and time-consuming. First, the legacy thermal simulation tool required extensive manual modeling of the computer-aided engineering (CAE) model, which could take a month to build. Modifying new design modifications further stressed the modeling process because simulation engineers needed to remodel the finite difference mesh by hand to account for the design changes. For a company that was in a fight to win business, this was not fast enough.

"We wanted a new package that would streamline our processes," Triebig says. "We were already using NX and Teamcenter so it made sense to choose something that would integrate directly. The first advantage of switching to Simcenter 3D was these systems would easily interact and automatically update with design changes. Now we can make design changes every day without worrying how long it will take to update other systems."

NX™ software, Teamcenter® software and Simcenter™ software are part of the Siemens Xcelerator business platform of software, hardware and services.

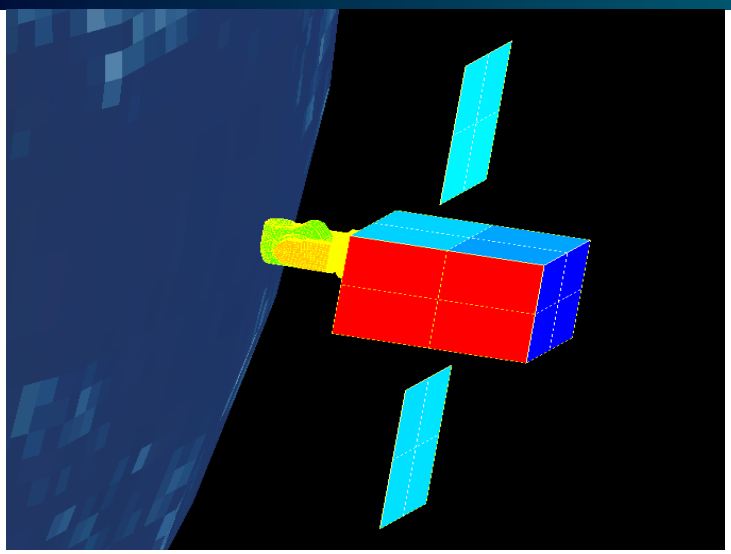
Once the team began using Simcenter 3D, they found they could work much faster than before. "With the old system, an experienced engineer would spend a

month working on a new revision of our terminal," says Triebig. "With Simcenter 3D Space Systems Thermal, it was completed in just one week. Additionally, the simulations are also more accurate as we now have 3D modeling rather than 2D shells."

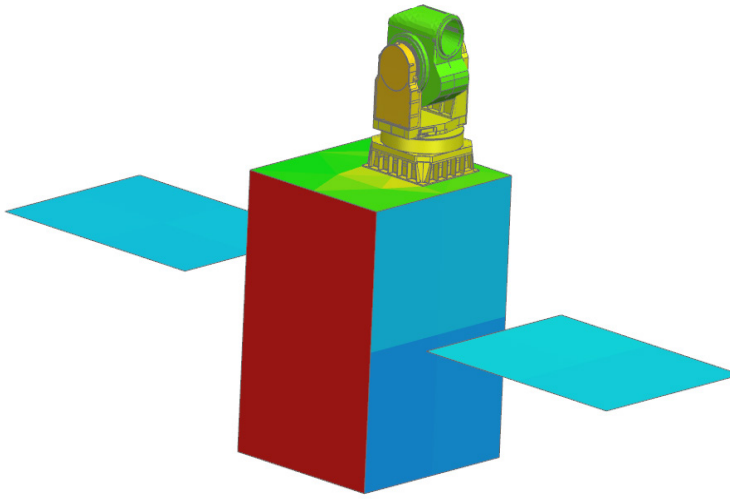
With both thermal and structural simulations crucial to the final product, connecting the two was a key part of the design process. "In the past, we had to create MATLAB scripts to extract data points from the thermal maps, then import them to another structural simulation tool and assign boundary temperatures," says Triebig. "It was very complicated and whenever anything was changed, it took half a day to update the results because so many engineers needed to be involved. Now that we're using Simcenter 3D, it's literally a click of a button to transfer the thermal results to the structural simulation model, so it only takes one engineer about five minutes."

Fast modeling with Simcenter 3D Space Systems Thermal

Mynaric use Simcenter 3D Space System Thermal to model a spacecraft and capture orbital heating loads from the sun, planet infrared radiation and albedo. For fast and precise calculations, the surface-to-surface



Simcenter 3D Space Systems Thermal in-orbit temperature results.



Simcenter 3D Space Systems Thermal in-orbit temperature results.

radiation is computed using a graphics processing unit (GPU) based Monte Carlo ray tracing algorithm. Various operating conditions are run to access critical component temperature limits and adjust the system thermal management design such as thermal optical properties. For the worst-case conditions (largest temperature gradients), these temperatures are mapped directly to the Simcenter Nastran mesh to get thermoelastic deformation that can be used to assess the optical performance of the communications system.

Intuitive automation

"With other solutions, you have to code everything," says Triebig. "So you need to learn and understand the code, which takes time. But with Simcenter 3D, you can visualize everything in the GUI, which makes it much easier to get started. With the built-in automation, we can set things up twice as fast as before.

"Siemens looked after us really well from the start," he continues. "They were always available and we could call directly and they'd help us with any issues. Now we use the Siemens Xcelerator Academy, which has a great library of information if we

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Solutions/Services

Simcenter 3D
siemens.com/simcenter3d

Simcenter Nastran
siemens.com/
simcenter-nastran

Customer's primary business

Mynaric is a manufacturer of laser communication equipment for airborne and spaceborne communication networks, so called constellations.
www.mynaric.com

Customer location

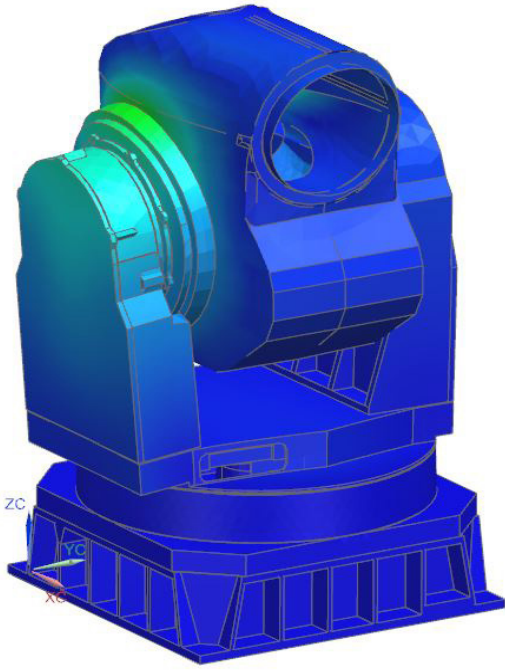
Gilching
Germany

need to look up anything. And we know that we always have support available, although we rarely need it as the software just works."

Scaling up with Simcenter

The company is aiming to deliver its first terminals at the beginning of 2024 and then scale up from there. Once installed, they will enable secure communication between satellites with gigabit bandwidth per second initially – 10 times faster than the typical home broadband speed of 100 megabits per second.

The company is also working on other applications of laser technology, such as terminals attached to aircraft to enable faster, more secure communications. Triebig would like to extend Mynaric's use of Simcenter this and other projects. "Now that we know how good the software is and how easy it is to use, we'll definitely be using Simcenter for future projects," he says. "We've already built some simulations with Simcenter STAR-CCM+ that we can see will be perfect for what we want to achieve."



Simcenter 3D eigenmode analysis of structure.

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