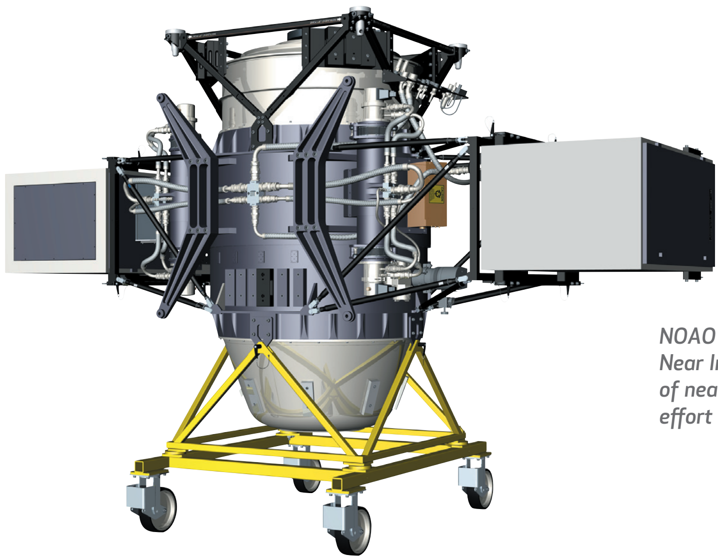
NATIONAL OPTICAL ASTRONOMY OBSERVATORY

Exploring the dark, unknown reaches of space with SolidWorks software



NOAO redesigned the complex Gemini Near Infrared Spectrograph, consisting of nearly 5,000 parts, with minimal effort using SolidWorks software.

The National Optical Astronomy Observatory (NOAO) designs and builds sophisticated instrumentation—cameras, imagers, spectrographs, and optics packages—to support its observatories and to provide the best ground-based telescopes for astronomical research. The NOAO Instrument Projects Group is responsible for the development of all astronomical instrumentation and ancillary systems. The group's most recent assignment involved the design of the Gemini Near Infrared Spectrograph (GNIRS) in conjunction with the International Gemini Project, an initiative to explore the vast infrared-light-emitting reaches of space. GNIRS is needed to support one of two eight-meter telescopes—one in the northern hemisphere (Hawaii) and a second in the southern hemisphere (Chile)—that scan the heavens searching for objects emitting light in the infrared region. GNIRS is in service at Cerro Pachón, Chile.

The GNIRS project involved distinct design challenges because the instrument consists of several large assemblies, subassemblies, weldments, CNC-machined hogouts, sheetmetal parts, electronics cabling, and hoses, according to Gary Philip Muller, NOAO senior mechanical engineer. "GNIRS consists of an outer shell that is capable of holding a high vacuum and an internal structure that rigidly supports several optical components. The internal structure gets cooled to 60° Kelvin (-351° Fahrenheit).

"The optical bench is insulated from the 'warm' outside much like a thermos," Muller explains. "There are five rotating mechanisms, including three turrets, two filter wheels, and three linear motion devices, that must work in an extremely cold, vacuum environment."

Switching to SolidWorks software to eliminate design problems

The design team initially attempted to create the instrument in 2D, but decided to move to 3D because of errors related to misinterpreting 2D views. The group tried to model the GNIRS using Autodesk® Mechanical Desktop· but encountered a new set of problems, including difficulty constraining sketches and an inability to drag and drop parts across assemblies. It became apparent that continuing with the Mechanical Desktop environment was not an efficient way to complete the project.

Results:

- Shortened design cycle by 20 percent
- Saved $300,000 in development costs
- Reduced drafting time by 50 percent
- Completed complex project faster with fewer resources

At that time, a colleague suggested Muller take a look at the SolidWorks® 3D CAD software system. "I started playing with an evaluation copy of SolidWorks software at home, and quickly discovered the power of the software, which behaves in a predictable manner, as if the product was designed by engineers. I began to appreciate and enjoy using it and soon considered switching our design platform. The more I learned about SolidWorks software, the more I wanted it. I lobbied management, and they agreed," Muller says.

Complex modeling and large assemblies

The GNIRS system is one large assembly totaling 4,916 parts. NOAO selected SolidWorks software because of its powerful large-assembly features and robust capabilities for doing complex, freeform modeling. "There's a noticeable difference between SolidWorks and other design software," Muller says. "Since there's less of a thought process on how to use the CAD system, more mental energy can be spent on the actual design."

"We chose SolidWorks software because it behaves predictably when constraining sketches; is based on a three-file architecture with associativity among models, assemblies, and drawings; and provides flexibility for easily moving part files from one assembly to another by dragging and dropping, allowing us to dissolve and form subassemblies at will," Muller adds. "The software helped us to overcome the limitations of our previous software."

Eliminating interferences and errors

One of the biggest problems NOAO engineers encountered before switching to SolidWorks software was the frequency of interferences among parts in an assembly.

"Compared to the way we have conducted design projects in the past, using SolidWorks software helped us to significantly reduce interferences and virtually eliminate drafting errors. The dynamic assembly mode allows us to check for interferences within an assembly as we design; and because models are associated with drawings, there's no need to manually redo drawings when a change is made," Muller notes.

Saving time and money

Using SolidWorks software, the NOAO Instrument Projects Group completed the remaining seven GNIRS mechanisms in less time than it had taken to design the first two. "It took us two-and-a-half years to build two mechanisms in 2D. With SolidWorks software, we built all nine mechanisms in less than two years and with fewer designers," Muller says. "Based on the reduction in design resources required to complete the project using SolidWorks software, we estimate that we saved $300,000 in development costs."

With SolidWorks software, NOAO was able to complete GNIRS in the fall of 2002 and to provide astronomers with an important tool for further exploration of the mysteries of the universe. "We probably would not have been able to complete this project without SolidWorks software."

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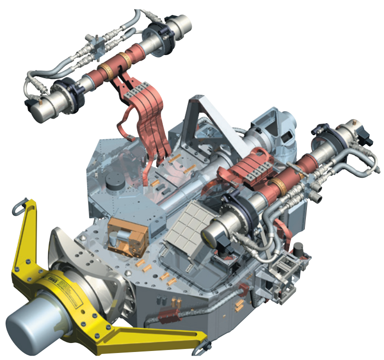

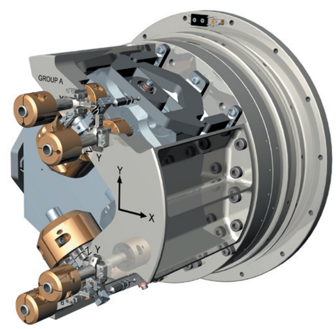

The optical bench (top) houses various optics, including lenses, mirrors, prisms, and gratings, as well as five rotary and three linear mechanisms. A mirror mount (bottom) uses counterweights to compensate for mirror tilt induced by gravity vector changes during observation.

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