DASSAULT SYSTEMES

SOLIDWORKS

DEUTSCHES SOFIA INSTITUT

INNOVATING JOINT DLR/NASA FLYING OBSERVATORY USING SOLIDWORKS RESEARCH EDITION

DSI relied on SOLIDWORKS Research Edition design and analysis tools to facilitate collaboration and communication across the team during development of the Stratospheric Observatory for Infrared Astronomy (SOFIA), the world's only flying observatory.

DSI

Challenge:
Develop and optimize telescope stabilization, a tracking camera, and interface systems for the Stratospheric Observatory for Infrared Astronomy (SOFIA), a flying observatory.

Solution:
Utilize SOLIDWORKS Research Edition software as the primary platform for designing and optimizing telescope stabilization, tracking camera, and interface systems.

Benefits:
- Supported important achievements in astronomical discovery
- Optimized telescope/tracking cameras interface
- Decreased weight of parts by using simulation tools
- Facilitated collaboration and communication across development team

The Stratospheric Observatory for Infrared Astronomy (SOFIA) is a refurbished Boeing 747 SP aircraft that is equipped with a 2.7-meter infrared telescope, making it the world's only flying observatory. This innovative research plane enables scientists to view the infrared spectrum of light, which is only partially visible from the ground, from SOFIA's cruising altitude in the stratosphere. It was jointly developed through a partnership between the German Aerospace Centre (DLR) and the U.S. National Aeronautics and Space Administration (NASA).

Scientific operation of SOFIA is coordinated by the German SOFIA Institute (DSI), which is based at the University of Stuttgart, and the Universities Space Research Association (USRA) in the United States. A consortium of German industry designed and manufactured the telescope on behalf of DLR. The vibrational and rotational isolation systems, tracking cameras, and telescope/tracking system interface were developed by DSI. NASA was responsible for modification of the long-range aircraft, telescope installation, flight-testing, and operations. SOFIA's key advantage over ground-based telescopes is that astronomers can position the observatory at the precise location necessary to view rare celestial events, such as occultations, and make observations from the northern and southern hemispheres with the same set of instruments.

The infrared light emitted by space objects is of particular interest to scientists and only partially visible from the ground, primarily because water vapor in the earth's atmosphere blocks the passage of infrared radiation. However, from an altitude of 13 kilometers in the stratosphere, almost nothing hinders the observation of astronomical objects in the infrared spectrum.

According to Dr. Dörte Mehlert of the University of Stuttgart, DSI developed a large portion of its SOFIA systems working with graduate and Ph.D. students at the university. To facilitate collaboration and development, the team needed to standardize on a common 3D design platform. DSI chose SOLIDWORKS® Research Edition software because it is easy to use, designers have access to integrated SOLIDWORKS simulation tools, and SOLIDWORKS is popular among project participants.

"The main reason that we chose SOLIDWORKS software was that most of our industrial partners use SOLIDWORKS," explains Yannick Lammen, a Ph.D. student in mechanical engineering at the University of Stuttgart, who is working on structural optimizations of the vibrational and rotational isolation systems for the telescope. "I, and at least one colleague, had not used SOLIDWORKS prior to this project, but the software is so easy to use that learning to use it took me about a week."

"Using SOLIDWORKS Simulation tools, I conducted linear static stress and thermal expansion studies on the camera/telescope interface components. Weight is critical on aerospace projects, and SOLIDWORKS Simulation helped me reduce material and weight on components with low operating stress, as well as strengthen parts where the stress is high."

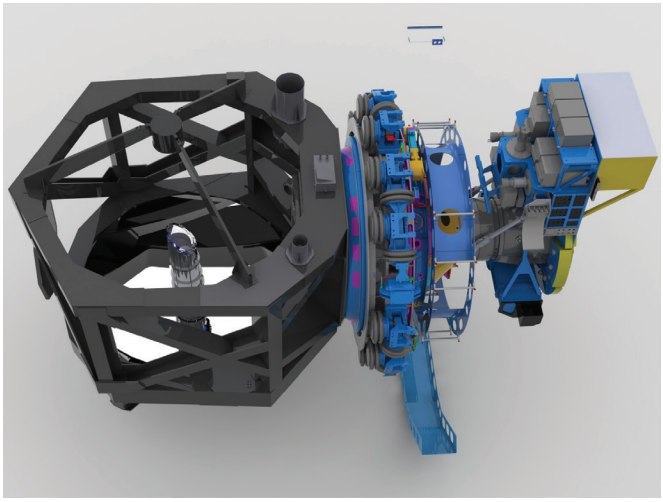
— Jan Drendel, Graduate student in mechanical engineering

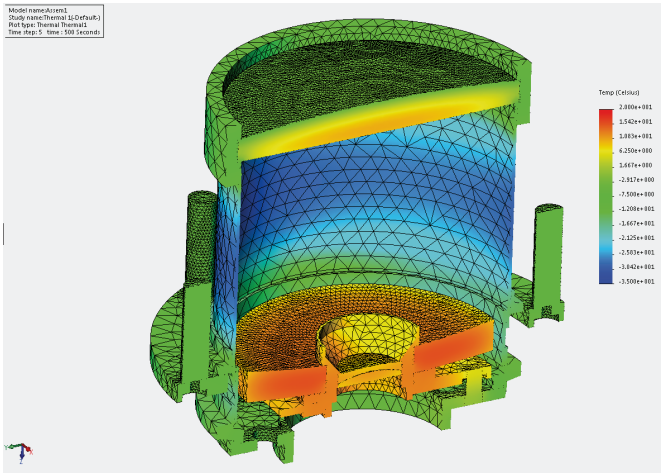
SIMULATING STRATOSPHERIC CONDITIONS

The SOFIA development team used SOLIDWORKS modeling software to design the various assemblies and components required to stabilize the telescope and tracking cameras during flight. They also leveraged SOLIDWORKS Simulation tools to validate and optimize design performance in the challenging operating environment of a moving aircraft in the stratosphere.

"The SOFIA aircraft is constantly shaking and moving, and the telescope systems must perform across a wide temperature and pressure range," explains Jan Drendel, a graduate student in mechanical engineering at the University of Stuttgart, who worked on the interface between the aircraft's three tracking/positioning cameras and the telescope. "The system is subjected to the California heat when on the ground and temperatures close to -40°C when in the stratosphere.

"Using SOLIDWORKS Simulation tools, I conducted linear static stress and thermal expansion studies on the camera/telescope interface components," Drendel continues. "Weight is critical on aerospace projects, and SOLIDWORKS Simulation helped me reduce material and weight on components with low operating stress, as well as strengthen parts where the stress is high."





The SOFIA development team leveraged SOLIDWORKS Research Edition software to design the various assemblies and components required to stabilize the telescope and tracking cameras during flight, as well as to validate and optimize design performance in the challenging operating environment of a moving aircraft in the stratosphere.

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FACILITATING COLLABORATIVE EFFORTS

In addition to easing collaboration and communication across the mechanical design team—the back-and-forth between the telescope stabilization effort and the positioning camera/telescope interface, for example—the SOLIDWORKS design platform facilitated interactions with other teams responsible for electronics, software, and optics development. "There are many other disciplines that worked on this project," Lammen notes.

"The advanced design visualization capabilities in SOLIDWORKS—including its rendering and animation creation toolkit—facilitated communication across the disciplines, as well as with partners involved with assembling and disassembling the system," Lammen adds.

IMPORTANT ASTRONOMICAL ACHIEVEMENTS

The development of the SOFIA flying observatory, which had its first scientific flight in 2010 and began its official operating status in May 2014, has led to a range of astronomical achievements. These include the occultation of Pluto, when Pluto's shadow moved across the Earth; the discovery of two new molecules in the interstellar medium, sulfur hydride and deuterated hydroxyl; and gas dynamics and star formation discoveries at the center of our galaxy, the Milky Way.

"SOFIA can be at the right place at the right time," Lammen points out. "I feel I was at the right place at the right time, having this wonderful opportunity to work on the development of a true astronomical innovation."