

CADFEM Consulting

Stiffness Investigations of Optical Instruments for Astronomical Research

Structural Analyses of the GRAAL Support Structure

Your Contact Person:

Dipl.-Ing. Thomas Iberer
Phone: 08092-7005-50
E-Mail tiberer@cadfem.de

Task

Optical instruments for astronomic observations are required to be very accurate and stiff, in an unfriendly environment (thermal variations, earthquakes ...). Typical optical sensors are very sensitive to possible deformations of their mechanical support structures. The structure under investigation has been the support of the GRAAL adaptive optics system for the cryogenic wide-field imager HAWK-I on ESO's VLT (Very Large Telescope).

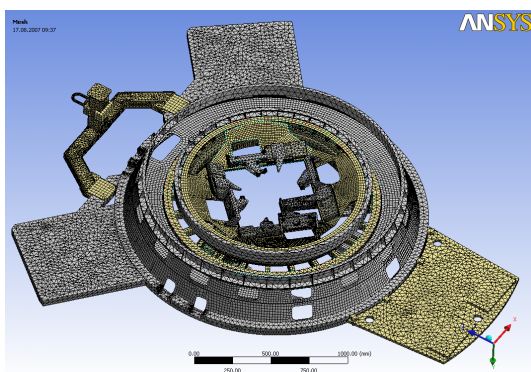
Solution

The stiffness behavior has been analyzed with respect to different load scenarios. Both gravitational loads and thermal deflection due to different thermal expansion have been of interest.

The structural finite element model has been prepared by means of ANSYS® Workbench™. Thin plate like parts could be meshed with solid like shell elements in order to get an accurate stiffness behavior with reduced modeling effort. Many attached subsystems like sensor systems could be idealized by means of single mass points. The complicated bearing systems have been idealized in different ways. Depending on the size of it the degree of idealization is different. Small compact bearings have been idealized by just a spring connection with corresponding stiffness whereas large roller bearings are considered in a more detailed manner.

Results

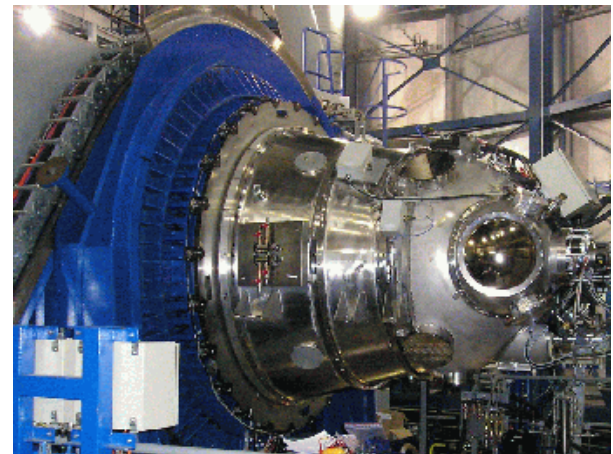
The deflection of the structure at different sensor position points showed the quality of the design with respect to their global stiffness.



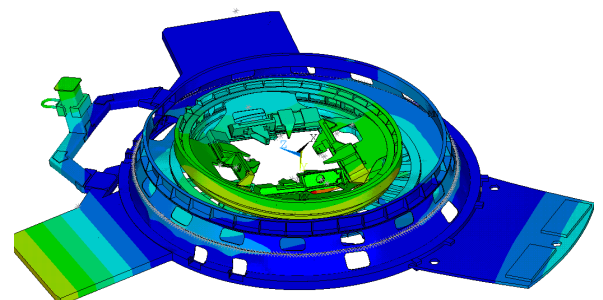
Finite element model of the GRAAL support structure



Nebula in Serpens
(recorded by HAWK-I/VLT, www.eso.org)



HAWK-I, GRAAL will be installed within the conical instrument part



Typical deformation of the structure

Figures Courtesy of ESO, www.eso.org