

Structural Analysis and Test of the Messenger Spacecraft

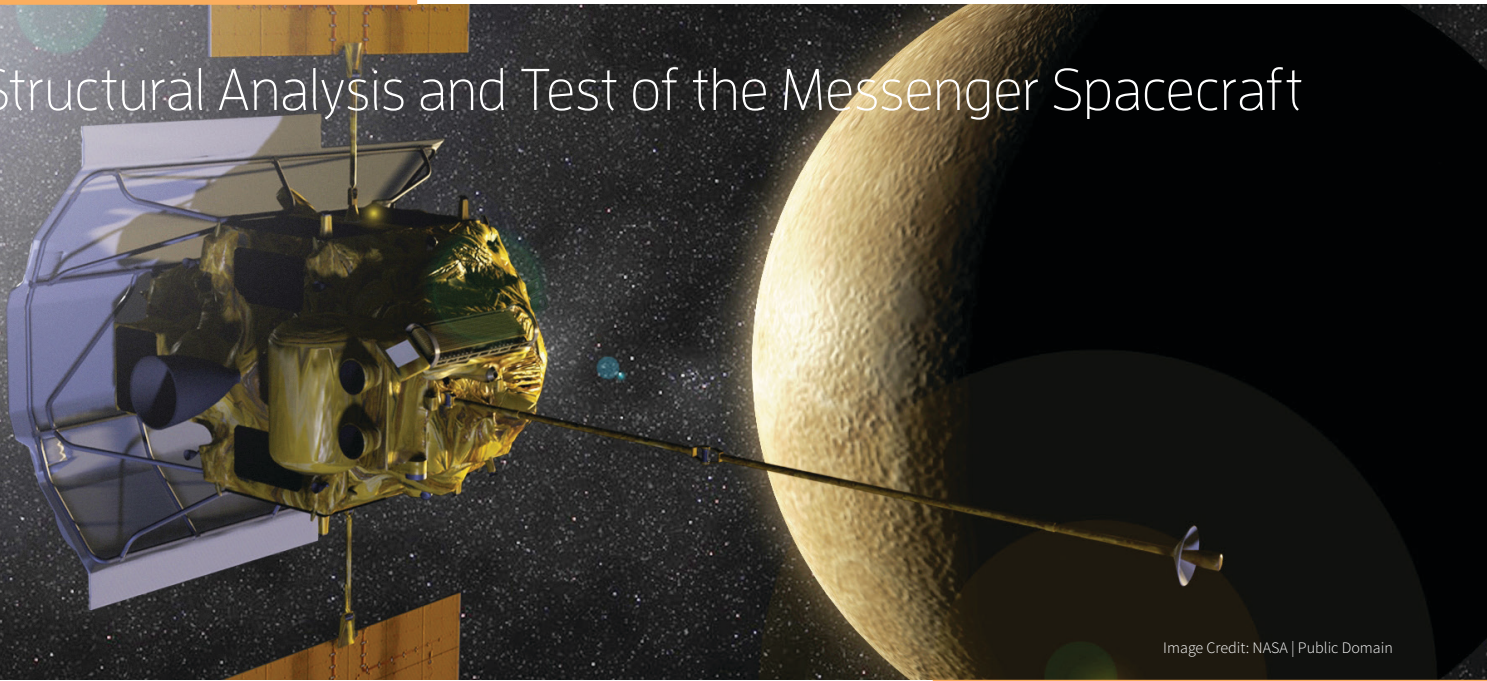


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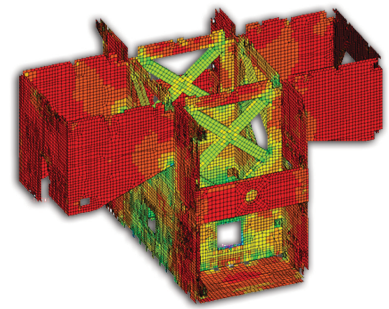
Case Study

OVERVIEW

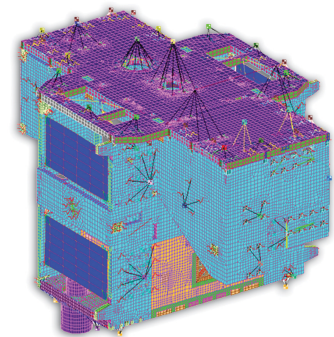
Launched in August of 2004, Messenger is the MErcury Surface, Space ENvironment, GEochemistry, and Ranging mission designed to investigate six key scientific questions about Mercury’s characteristics and environment. The Messenger mission orbited Mercury after making two flybys of the planet, using data collected during the flybys as an initial guide to perform a more focused scientific investigation of the planet. The spacecraft was inserted into Mercury orbit in March 2011 and carried out comprehensive measurements for one full Earth year. Orbital ATK (formerly Composite Optics, Inc.) was responsible for the design, analysis, fabrication, and testing of the composite bus structure of the spacecraft. ATA supported Orbital ATK by providing comprehensive analysis of the Messenger bus structure for the design limit loads.

TASKS PERFORMED & KEY OUTCOMES

- Developed a detailed FEM of the structure in combination with the nonstructural components that the bus is designed to support.
- Iteratively performed quasi-static analyses of design limit loads and the anticipated thermal environment, calculated margins of safety, and made design recommendations until all-positive margins were achieved.
- Assessed panel stresses, fitting detailed stresses, bonded interfaces, and bolted joints.
- Reduced spacecraft weight by optimizing fitting designs.
- Verified the analysis predictions by designing and directing the static load test to qualify the flight hardware.



Stress analysis of composite panels



Finite element analysis model of bus