

Verification and Validation of Titan Centaur Loads

Case Study

OVERVIEW

The Titan Centaur, a high-performance upper stage for the Titan IV launch vehicle, was developed by Lockheed Martin Space Systems (LMSS) and used primarily to launch Air Force payloads. Titan IV, as the nation's largest, most powerful expendable space launch vehicle, provided primary access to space for critical national security and civil payloads and was launched from the East and West Coasts.

ATA Engineering, Inc., (ATA) worked with LMSS from approximately 1990 to provide independent verification and validation of all Titan Centaur, Centaur phase-of-flight loads.

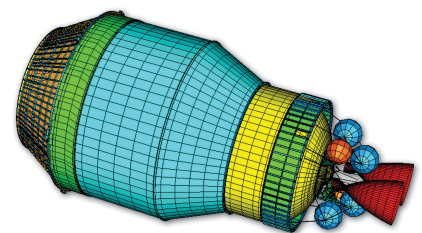
TASKS PERFORMED & KEY OUTCOMES

- Developed an independent finite element model (FEM) of the Titan Centaur.
- Supported modal tests of the Titan Centaur.
- Modified FEM to better correlate with modal-test data.
- Worked with LMSS to develop a "common model" representation.
- Developed a methodology for representing fluid sloshing in tanks in Nastran.
- Developed a methodology for representing the effect of pressure stiffening on tank walls using Nastran.
- Independently verified numerous forcing functions including buffet, ignition overpressure, and longitudinal thrust oscillations.
- Verified the control system models used to analyze autopilot.
- Assembled system models for every Titan Centaur mission and independently verified all dynamic loads.

"During the Titan IV B-35 project some unforeseen work developed which would have hindered a launch. ATA staff sacrificed much personal time to support analyses and develop a methodology which allowed for better understanding of the issues.

The work by ATA was recognized and appreciated by Lockheed Martin and the Air Force customer."

Sandra Mossman
Titan IV Technical Lead
Lockheed Martin Corporation



Titan Centaur FEM