



Case Study

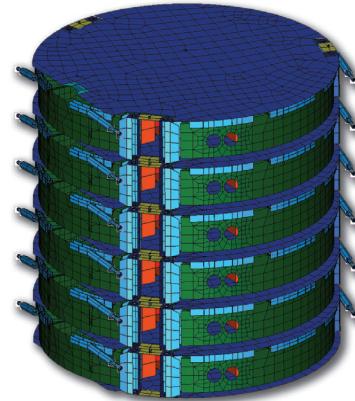
Load Analysis of Minotaur Launch Vehicle

OVERVIEW

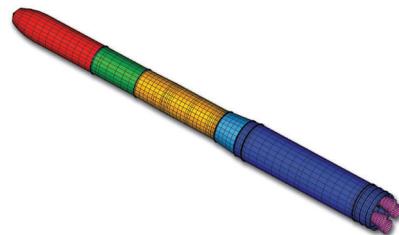
Orbital Sciences Corporation (acquired by Northrop Grumman) developed a variety of launch vehicles designed to place a wide range of satellites and spacecraft into orbit. One such launch vehicle is the Minotaur, developed for the U.S. Air Force's Orbital/Suborbital Program. The Minotaur rocket uses a combination of U.S. government-supplied Minuteman II motors and proven Orbital space launch technologies to create a low-cost four-stage launch vehicle. ATA helped Orbital maintain a 100% success rate with the Minotaur by supporting the required preflight dynamic analyses for an assortment of launches. ATA's input also helped Orbital update their standard analyses and methodologies, increasing the efficiency of the analysis process.

TASKS PERFORMED & KEY OUTCOMES

- Developed a model that coupled the payload to the Minotaur.
- Analyzed a variety of transient events and postprocessed vehicle and payload results.
- Created a new stage 2 ignition methodology that was both repeatable and provided statistical confidence in the results.
- Identified peak loads experienced, which were used to verify launch survivability.
- Performed a Monte Carlo bending modes simulation with up to 600 perturbations for each of seven different launch vehicle configurations encompassing different times of flight.
- Identified nominal and peak changes to the bending modes and bending gains for use in control system analyses.
- Provided many critical results ahead of schedule, allowing Orbital additional time to complete complementary analyses.



Component model of Minotaur payload



Launch vehicle coupled loads model used to predict loads under a variety of conditions