Experimental Aircraft | Flutter Stability Analysis for the Hyper-X Hypersonic Vehicle

CASE STUDY

Image courtesy of NASA Dryden

CUSTOMER:
Orbital Sciences Corporation

INDUSTRY:
Aerospace

PROJECT NAME:
Hyper-X Flutter Analysis

CUSTOMER LOCATION:
Chandler, Arizona

OVERVIEW

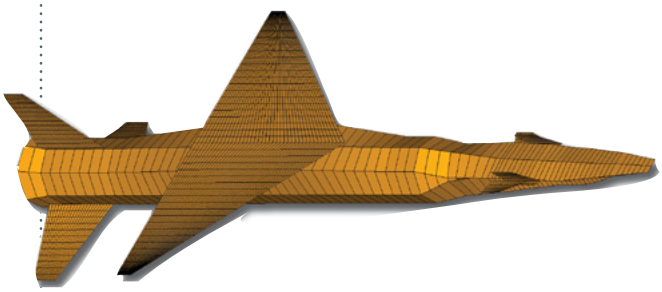
NASA's experimental scramjet flight vehicle, the X-43, defies the current standard of jet engines. Instead of carrying the oxygen required for combustion (which can be a significant weight consideration), the supersonic combustion ramjet, or scramjet, is the first implementation of an air-breathing ramjet engine that has the potential to revolutionize space travel.

In November 2004, a modified Pegasus XL launch vehicle provided by Orbital Sciences Corp (Orbital) carried the X-43 to its supersonic ignition speed and, after separation from the booster rocket, the X-43 vehicle accelerated to a record-breaking speed of close to Mach 10 (12,000 km/hr or 7,000 mph).

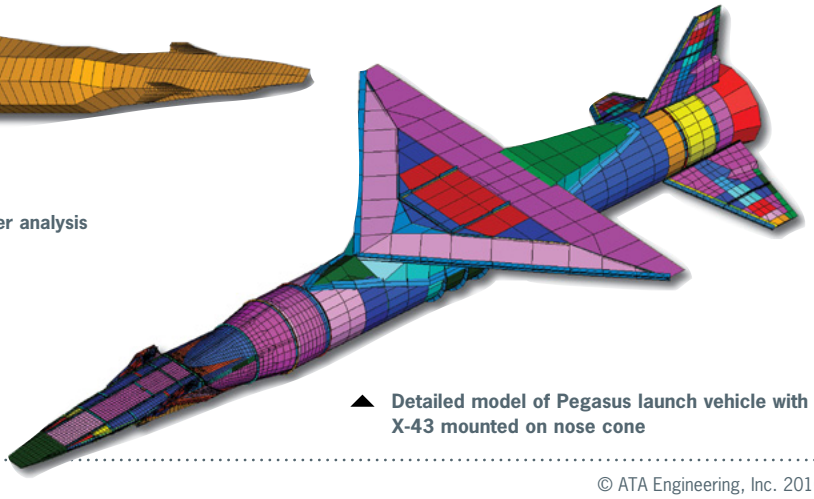
ATA provided a wide variety of support to Orbital on the X-43/Hyper-X program. While initially contracted to perform an aeroelastic stability analysis for the X-43/Pegasus launch vehicle, ATA's role expanded during the course of the program to include test, test-analysis correlation, and modeling support.

ATA SUPPORT INCLUDED:

- Performed dynamic analysis using detailed Pegasus/X-43 finite element model (FEM) to determine modal response for use in aeroelastic analysis.
- Developed panel model for aeroelastic stability (flutter) analysis.
- Performed aeroelastic stability analysis on full system for flight trajectory which included subsonic, supersonic, and hypersonic speeds.
- Developed aeroelastic models of critical subcomponents, which were used to efficiently study design changes. This approach reduced analysis time from 3 weeks per iteration for the full system analysis to less than 1 day for subcomponent design iterations.
- Modal testing of the final subcomponent designs was carried out, and analysis models were correlated and updated based on this test data.



▲ Panel model for flutter analysis



▲ Detailed model of Pegasus launch vehicle with X-43 mounted on nose cone

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