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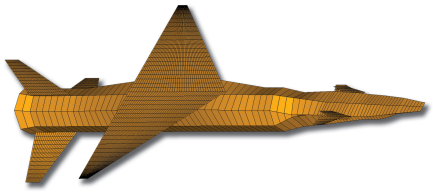
Hyper-X Flutter Analysis

Image Courtesy NASA

Case Study

OVERVIEW

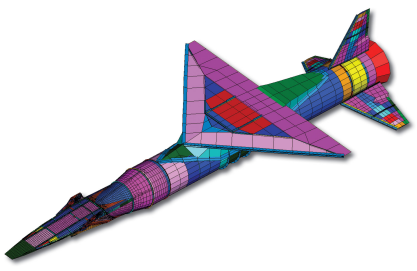
NASA's experimental scramjet flight vehicle, the X-43, defies the current standard of jet engines. Instead of carrying the oxygen required for combustion, the supersonic combustion ramjet, or scramjet, has the potential to revolutionize space travel as the first implementation of an air-breathing ramjet engine. In November 2004, a modified Pegasus XL launch vehicle provided by Orbital Sciences Corp 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. ATA provided a wide variety of support to Orbital on the X-43/Hyper-X program. Initially contracted to perform aeroelastic stability analysis for the launch vehicle, ATA's role expanded to include test, test-analysis correlation, and modeling support.



Panel model for flutter analysis

TASKS PERFORMED & KEY OUTCOMES

- 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 used to efficiently study design changes, reducing analysis time from three weeks to one day per iteration.
- Modal testing of the final subcomponent designs was carried out, and analysis models were correlated and updated based on this test data.



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

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