

Loads Modeling of the K-1 Launch Vehicle



Image Credit: Kistler Aerospace

Case Study

OVERVIEW

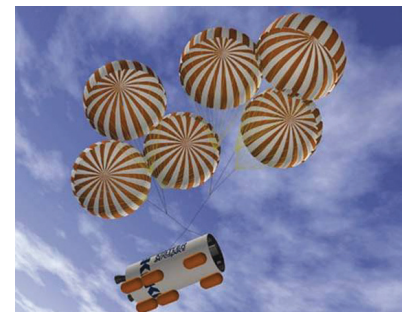
Kistler Aerospace was a private company whose mission was to develop a completely new reusable launch vehicle designed to dramatically reduce the cost of launching low-Earth-orbit communications satellites. Kistler was responsible for system integration, with several subcontractors supplying the various components of the vehicle. ATA was responsible for all system-level loads and thermal analysis of the K-1 vehicle for all phases of flight.

TASKS PERFORMED & KEY OUTCOMES

- Developed finite element model of the vehicle for multiple phases of flight.
- Developed forcing functions to represent all critical flight events.
- Created methodology to calculate buffeting loads and response based on generic wind-tunnel data.
- Performed structural-dynamic simulation of all critical flight events and pogo analysis to confirm dynamic stability of the coupled propulsion/structural system.
- Defined acoustic and random-vibration environments for internal components.
- Created system-level thermal model based on contract design information and then application of necessary heating to the vehicle.
- Applied various heat loads.
- Simplified representations of the decompression/recompression of the launch vehicle and the temperature of the ullage gas in the RP and LOX tanks.
- Verified thermal protection system (TPS) design by comparing the system-level results to the one-dimensional calculations performed by the TPS provider.



System-level analysis model



Analyses considered all phases of flight and return