

# Spacecraft Loads and Dynamic Analysis

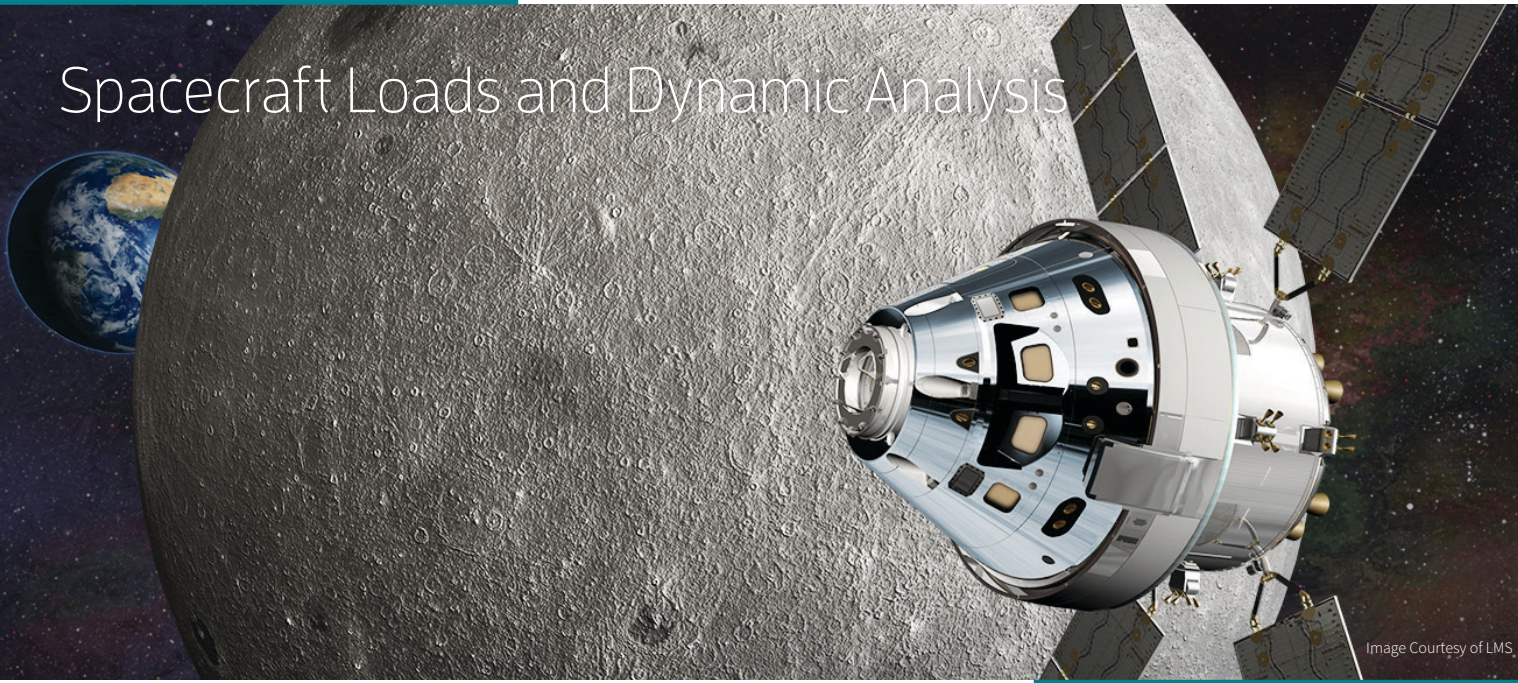


Image Courtesy of LMS.

## Case Study

### OVERVIEW

Lockheed Martin Space (LMS) is under contract to provide NASA with a spacecraft capable of enabling human exploration farther into our solar system than ever before. ATA Engineering, Inc., (ATA) has provided key design, analysis, and testing support for the Orion program since its infancy in 2005 when it was called the Crew Exploration Vehicle as part of the NASA Constellation program. ATA's support of the Orion Loads and Dynamics Group has focused on modeling, analysis, and test support to better understand spacecraft structural dynamic loading environments such as random vibration, vibroacoustics, and shock during vehicle ascent, abort, separation, orbit, and reentry events.

### TASKS PERFORMED & KEY OUTCOMES

- Developed a methodology based on empirical flight and wind tunnel test data to assess surface fluctuating pressures and vehicle responses during launch.
- Developed a methodology to couple aerodynamic loads to assessments of structural loads and contact during separation events.
- Performed nonlinear transient modal analysis to simulate spacecraft landing on water and on land.
- Created and maintained vehicle-level vibroacoustic models for analysis of aeroacoustic loads during ascent and launch abort.
- Performed multibody and flexible-body dynamic analysis of vehicle separation events and deployments.
- Created and integrated component- and subsystem-level FEMs into vehicle-level structural dynamics models and performed dynamic analyses for all phases of flight.



Orion water landing test  
Image courtesy of NASA



Underside view of Orion's heatshield,  
the largest heatshield ever built  
Image courtesy of NASA