

Reducing Cygnus Spacecraft Ground Transportation Loads

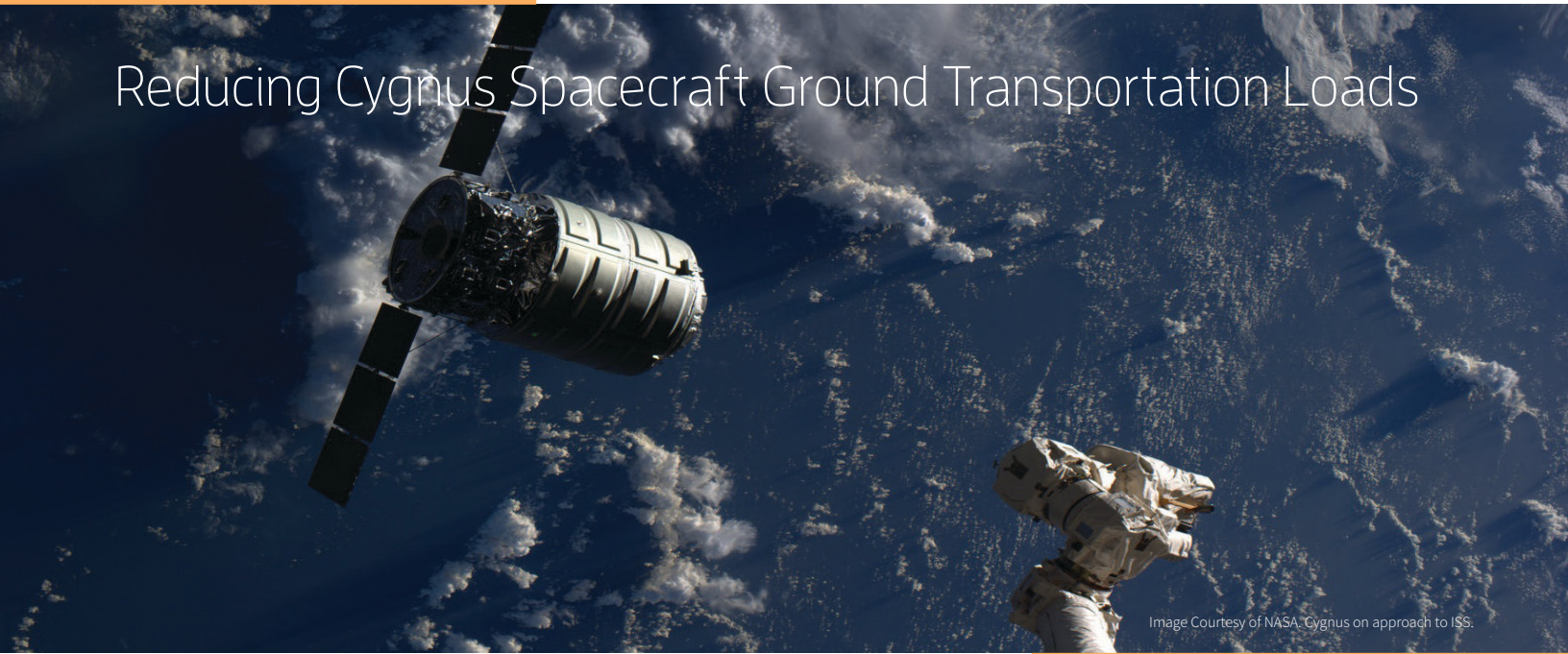


Image Courtesy of NASA. Cygnus on approach to ISS.

Case Study

OVERVIEW

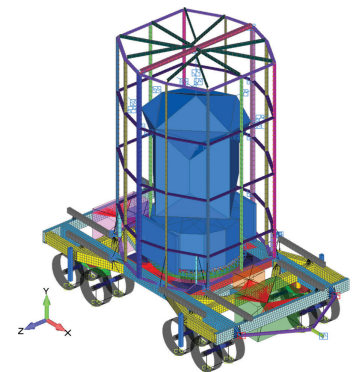
The Cygnus spacecraft is an unmanned resupply spacecraft. Vivace was contracted to design and build a unique vertical ground transporter for the Cygnus spacecraft. ATA Engineering, Inc., derived ground transportation environments and performed a comprehensive collection of modal, random vibration, nonlinear transient, and linear transient analyses to verify that the acceleration and displacement responses of Cygnus during transport to the launch vehicle integration facility did not exceed specified requirements. These analyses were critical in designing a suspension system that prevents transmission of high acceleration levels to the spacecraft and ensures proper clearance between the spacecraft and protective transporter doors during the most severe transportation conditions.

TASKS PERFORMED & KEY OUTCOMES

- Derivation of the bounding dynamic environment design requirements for transient and random ground transportation conditions.
- Performance of preliminary analytical design studies to define suspension and towbar isolation system requirements to mitigate large accelerations of the Cygnus spacecraft.
- Generation of PSD acceleration responses of the spacecraft for road surface random excitations, and evaluation of relative deflections between spacecraft and protective doors.
- Linear and nonlinear transient analyses to predict acceleration and displacement time histories due to bump excitation (rolling over an object in the road) and tractor braking.
- Evaluation of the stability of the transporter with the fully fueled Cygnus.



Cygnus vertical ground transporter



Finite element model of vertical transporter