Case Study

ANSYS + Astrobotic Technology, Inc.

Using design and simulation tools from ANSYS, Astrobotic quickly designed and refined a lightweight aluminum and composite spacecraft able to withstand static acceleration and dynamic random vibration loads of launch while maintaining an acceptable level of safety. Simulation helps reduce costs related to prototypes and physical testing.

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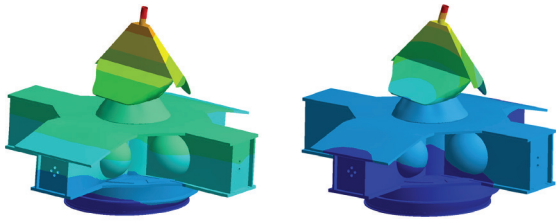
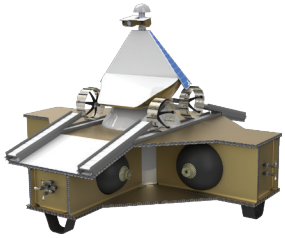
Engineering Simulation Provides a Virtual Environment for Designing Durable Spacecraft Components





Challenges

The structural components of the Tranquility Trek spacecraft comprise aluminum and lightweight composites in which carbon fiber is bonded to aluminum honeycomb to form a high-strength yet lightweight sandwich material. The layered construction and anisotropic properties of the sandwich require specialized pre-processing tools to accurately represent the fiber direction of every layer of carbon. Specialized post-processing tools are needed to predict sandwich failure. Random loads during launch must also be taken into account. Astrobotic needed to test multiple spacecraft configurations under launch conditions to select and refine the best design in a cost-effective manner.

Technology Used

ANSYS® Mechanical™, ANSYS DesignModeler™, ANSYS Workbench™

Engineering Solution

- Engineers imported CAD geometry into the ANSYS environment using a direct interface.
- The ANSYS DesignModeler tool pre-processed the model to prepare it for simulation.
- ANSYS Meshing provided automated discretization of the geometry while allowing user-defined refinement in regions of interest.
- To define the layered elements for laminate and sandwich layups, engineers used ANSYS Parametric Design Language (APDL) for ANSYS Mechanical software within the ANSYS Workbench environment.
- The team employed ANSYS Mechanical software within Workbench to define multiple analysis types (free vibration, static acceleration and random vibration) that all share the same geometry, material properties and connections.
- Using ANSYS Mechanical APDL capabilities within ANSYS Workbench, engineers compared the results against failure criteria to consider the layered construction of the materials and to identify regions of potential failure.

Benefits

Using design and simulation tools from ANSYS:

- Astrobotic was able to quickly design and refine a lightweight aluminum and composite spacecraft to withstand the static acceleration and dynamic random vibration loads of launch while maintaining an acceptable level of safety.
- The ANSYS Workbench environment provided automated communications between the CAD software, pre-processor, solver and post-processor that allowed solutions to be updated quickly and easily after changing design parameters.
- Astrobotic gained the ability to test different configurations of material layup definition with minimal effort.
- Engineers could tweak and reshape components without the need to redefine mesh controls or loading.
- Although physical testing will be conducted to validate spacecraft design, simulation helped to reduce costly prototypes and physical testing.
- The cycle time required for the tire balancing process was reduced by 20 percent.

Company Description

Astrobotic Technology, Inc. will pioneer the lunar frontier by providing commercial payload delivery and robotic services through missions of increasing scope and capability. The initial mission, Tranquility Trek™, will launch a robot to the Moon on a SpaceX Falcon 9 launch vehicle, win the Google Lunar X PRIZE, and return high-definition 3-D video and imagery.

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