Simulating Mars Rover Touchdown Dynamics
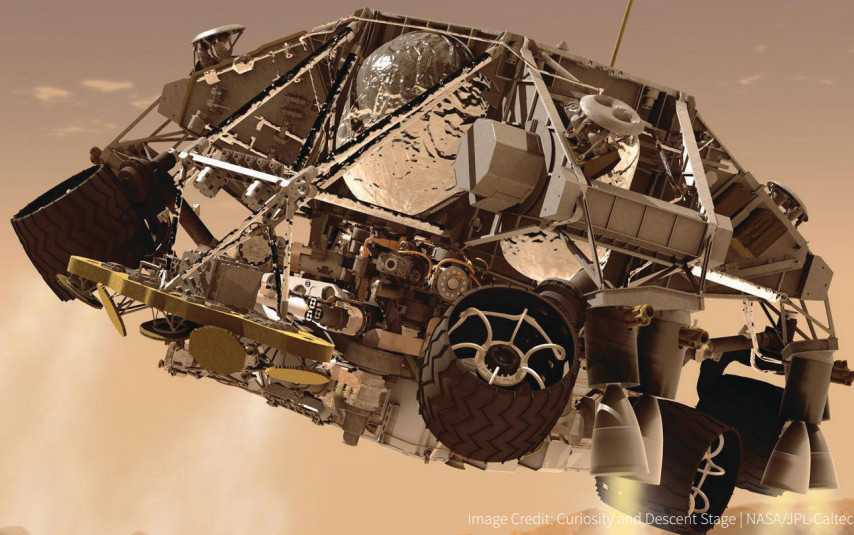
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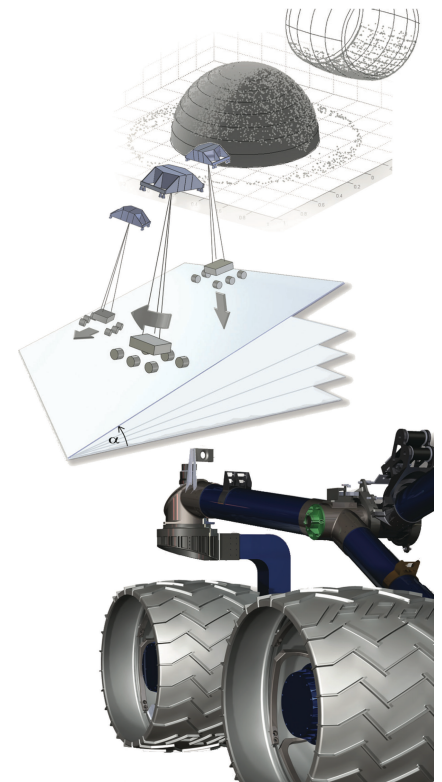
Case Study

OVERVIEW

The Mars Science Laboratory (MSL) was launched by NASA in 2011 with the unique directive of investigating whether ancient conditions on Mars could have supported the existence of microbial life. This rover represents the Jet Propulsion Laboratory's largest and most advanced rover, requiring an all-new landing maneuver. Unlike its predecessors, MSL lands on the same six-wheel mobility system that it uses to traverse the Red Planet. It uses the Skycrane maneuver to accomplish this, in which the rover is lowered from a slowly descending rocket-controlled stage via a system of bridles. ATA Engineering, Inc., provided analysis and test support for verification of the viability of this challenging touchdown maneuver.

TASKS PERFORMED & KEY OUTCOMES

➤ Design of a rover test chassis for use in a full-scale touchdown testing program.

➤ Test support and analytical modeling of progressively more complex rover tests: static loading, simple wheel drop, horizontal touchdown, and sloped touchdown.

➤ Updates and enhancements of the Skycrane system model to capture key performance characteristics of elements such as rover bridles, mobility joints, and wheel representations. Probabilistic assessment of system performance at touchdown.

➤ Creation and execution of AutoSim to manage and execute tens of thousands of Monte Carlo simulations with customized algorithms for solution convergence confirmation, error checking, and file organization to facilitate rapid data exchange and examination.

➤ Development of a methodology for rover rock strike simulations, including creation of a statistical rock placement algorithm and postprocessing/visualization tools.

Wheel-to-rock impact studies were performed using custom-made computational tools

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