

Dynamic Simulation of Aerial Trolley Alternative to the *Mighty Eagle*

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Mars Exploration

Exploration of the planet Mars is one of the future objectives of launching the Space Launch System (SLS). Since information retrieval from deep-space areas will be an important component of that mission, extensive pre-flight sensor testing and validation are necessary tasks.



Figure 1: Space Launch System

Alternative Landing Simulator

A terrain field has been developed at the Marshall Space Flight Center (MSFC) to resemble lunar, Martian or asteroid surfaces, and sensor data can be gathered during simulated landings in this area. The "Mighty Eagle" is a robotic prototype lander, which, when deployed at low altitudes above the terrain field, makes sensing of the surface below it difficult. MSFC engineers are currently designing and fabricating an aerial trolley to pass, along a tether, over the simulated lunar surface in a trajectory similar to a landing. This alternative will allow the testing of sensors in a safe, repeatable, and economical way.



Figure 2: Proposed Simulation Setup; (inset) Mighty Eagle in flight

Dynamic Model

A dynamic model of the proposed aerial trolley landing setup was created using SimMechanics Second Generation, a toolbox in the MATLAB-Simulink suite, for analysis of the trolley at various positions on the tether along which it will move. The model produced data and animations of the trolley's response to tether dynamics and wind gusts, for the investigation of specific design constraints and parameters.

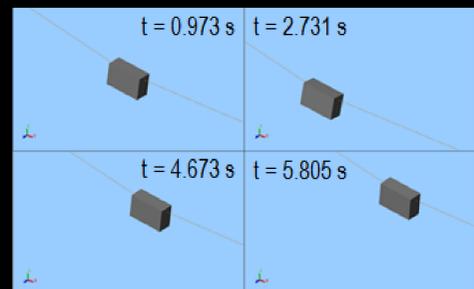


Figure 3: Animation of gust-forced trolley response

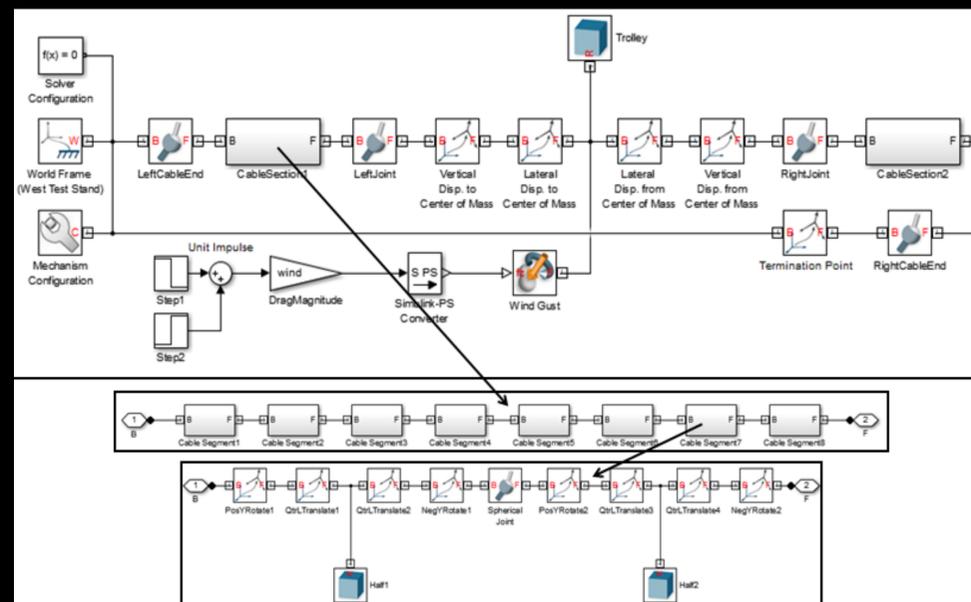


Figure 4: Hierarchy within SimMechanics model

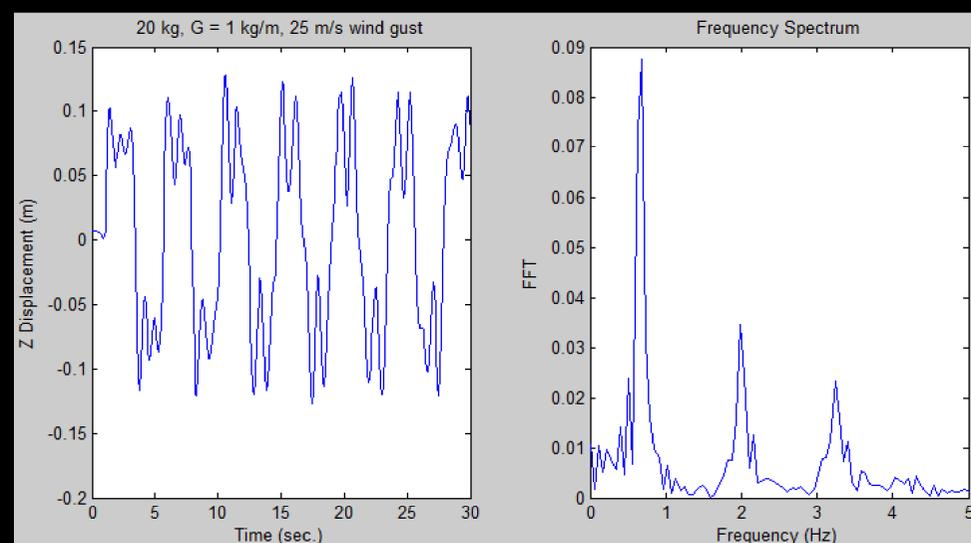


Figure 5: Results of High-Density Tether Simulations

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