The Mars Science Laboratory Touchdown Test Facility

NASA's Jet Propulsion Laboratory, Pasadena, California

In the Touchdown Test Program for the Mars Science Laboratory (MSL) mission, a facility was developed to use a full-scale rover vehicle and an overhead winch system to replicate the Sky-crane landing event. A driving requirement for the testing facility was the need to support a load of 5,000 lb (2,268 kg) at a minimum height of 13 m. Few facilities at JPL qualify with enough height, leaving the Building 280 Static Test Tower as the logical choice. However, this facility is popular, so an additional requirement was that the MSL test facility be temporary, and be able to be disassembled in a matter of a week or two, be stored for a period of time, and then be reassembled again quickly for V&V (verification and validation) testing.

The Building 280 Test Tower is a 50-ft-tall (15-m) steel tower structure measuring approximately 15 by 15 ft (4 by 4 m). Overhead pulleys were mounted on a new cantilevered frame so that testing could be conducted on the south face of the tower. Landing surfaces consisted of flat and sloped granular media, and rigid, planar surfaces. Various combinations of rocks and slopes were studied. Information gathered in these tests was vital for validating the rover analytical model, validating design and system behavior assumptions, and for exploring events and phenomena that are either very difficult or too costly to model in a credible way.

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Non-Contact Measurement of Density and Thickness Variation in Dielectric Materials

An improved nondestructive inspection method uses terahertz energy for density and thickness mapping in dielectric, ceramic, and composite materials.

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This non-contact, single-sided terahertz electromagnetic measurement and imaging method characterizes microstructural (e.g., spatially-lateral density) and thickness variation in dielectric (insulating) materials. This method was demonstrated for space shuttle external tank sprayed-on foam insulation and has been designed for use as an inspection method for current and future NASA thermal protection systems and other dielectric material inspection applications where no contact can be made with the sample due to fragility and it is impractical to use ultrasonic methods (the latter methods require the sample under test to be immersed in liquid).

To provide some background, a basic pulse-echo terahertz thickness measurement for a dielectric (insulating) material is made by sending terahertz energy via a transceiver into and through the material backed by a metallic (electrically conducting) plate that reflects the terahertz energy back to the transceiver. The terahertz transceiver is separated from the dielectric sample by an air path. Thickness values are calculated using the time delay between the first front surface (FS) and the first substrate/reflector plate echo (BS) and knowledge of velocity according to distance = velocity × time delay. In a similar fashion, the velocity through the material can be determined by knowing thickness. Velocity is an important parameter because density can be derived from velocity using established velocity-density relationships for the dielectric material.

The new method allows characterization of thickness without prior knowledge of velocity and characterization of velocity without prior knowledge of thickness, and it does so using the same set of measurements. The method is still based on pulse-echo measurements.