Titan Lifting Entry & Atmospheric Flight (T-LEAF) System Concept for Exploration of Saturn's Moon Titan.

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Introduction: Northrop Grumman Aerospace Systems has been developing an innovative and versatile new class of vehicle that will serve as an atmospheric rover for exploration of planets and moons of the solar system that have atmospheres. The new class of vehicle is called Lifting Entry Atmospheric Flight (LEAF), which provides a new way to enter an atmosphere from space and transition to flight within the atmosphere. Additionally, the LEAF system is semi-buoyant and the on-board propulsion system provides the capability to adjust altitude on command and travel in specified directions. It is also robust to failures since it can safely float at full buoyancy should it lose power. The LEAF system further reduces mission risk by deploying prior to entry at a relatively slow pace and gently enters the atmosphere, thereby easing "eight minutes of terror" into "30 minutes of trepidation." Moreover, the omission of a heavy aeroshell and the gentle nature of atmospheric entry enable the vehicle to accommodate a large science payload mass, which maximizes the science that can be achieved with LEAF.

In this presentation, we discuss the application of the LEAF system at Titan. Titan offers an attractive operating environment, allowing LEAF designs that can perform operations in the surface to 15 km altitude range with minimal power (50W), with additional speed and rapid-revisit capabilities if a slightly higher power (200 W) approach utilizing thermoacoustic power conversion is employed. The Titan implementation is called T-LEAF, for Titan Lifting Entry and Atmospheric Flight.

The rich atmospheric chemistry at Titan is known to be of interest to the scientific community, and will appropriately be an important focus for a T-LEAF mission. For example, T-LEAF can provide global, in situ measurement of atmospheric methane. With the ability to operate at low altitudes and repeatedly reconnoitor targets of opportunity, T-LEAF measurements over permanent surfaces and around atmospheric storms will help constrain the methane cycle. Similarly, T-LEAF measurements by multi-spectral imagers, IR spectrometers, radar altimeters and meteorological sensors will help explore Titan's geological processes, their level of activity and their morphology.

In this presentation we provide an update on the T-LEAF atmospheric rover design for Titan, along with plans for analyses and prototyping to advance and refine that design.