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WIND POWER-ENABLED MISSIONS FOR SURFACE AND ATMOSPHERIC EXPLORATION OF TITAN

Abstract

The ongoing Cassini mission to Saturn is considered to be one of the most successful international collaborations in the history of space exploration. The mission included the Huygens probe, which landed on the surface of Saturn's largest moon Titan in 2005 and returned nearly five hours worth of data, generating a huge amount of scientific interest in further exploration of Titan.

We propose a sustainable, three-phase mission to explore Titan, featuring power generation and system reuse. The three phases are: a rotary wing decelerator (RWD) phase for the landing craft; a landed phase featuring a tethered, variable-altitude wind turbine for power generation and atmospheric research; and a mobile exploration phase utilizing an inflatable balloon for rapidly surveying Titan's surface and atmosphere.

A comparison and feasibility study of various entry, descent, and landing (EDL) technologies applied to Titan shows RWDs to be of significant merit. Further analysis and down-selection results in a single, fully articulated rotor design, which allows for heading control and zero-velocity touchdown. RWDs also potentially allow for up to 3 kW or more of electric power generation during descent.

We discuss the feasibility, benefits, and challenges of transitioning the rotor and generator used as the decelerator system into a wind turbine for power generation. We also discuss the additional possibility of releasing the tether and reusing the inflatable wind turbine as a balloon, serving as a platform for additional atmospheric research and surface imaging toward the end of the mission.