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DEVELOPMENT OF SCIENTIFIC OBJECTIVES AND MISSION PROFILE FOR A TITAN ROVER
CONCEPT

Abstract

Project Polaris is an international student organization that seeks to design a buoyant rover capable of exploring Saturn's moon, Titan. The rover (also called the Titan Star Rover or TSR) consists of a balloon and a payload, which contains scientific instruments.

Scientific objectives and promising experiments were developed and studied. These were divided into three scientific objectives:

Aeolian processes: study the distribution and properties of dunes, understand the wind patterns that create the dune morphology and determine the grain, size, composition, and durability of dune material.

Fluvial processes: study the river network morphology types and drainage patterns as a function of location and distinguish the processes responsible for forming the rivers

Atmospheric processes: identify the methane main evaporation sources, determine if the wind reversal studied by Huygens is a global phenomenon, and monitor rain patterns.

From these objectives, a general movement pattern was designed. The TSR will follow an elliptical cycle, while it hovers above a variety of geological features such as hummocky, plains, lakes, a crater, and dunes.

This cycle optimizes energy consumption by relying mainly on wind currents and minimizing the use of onboard thrusters. Altitude control will be provided by inflation and deflation of the balloon while the thrusters can be used for attitude control and other minor maneuvers. During the course of its mission, the rover will stay airborne, with the exception of its initial “Titan Arrival” phase. After having survived its years-long trip to the moon, the rover will enter the atmosphere, land on the ground, and start generating the hydrogen it needs to inflate its balloon and take off.

Additional research was conducted into scientific devices for the experiments and environmental conditions along the rover trajectory. Some information was taken from articles and texts provided by the mission Cassini-Huygens in 2004.

In summary, this paper will explain the TSR mission, consisting of the innovative use of wind currents and buoyancy principle to hover on the surface of the Titan and complete around eight experiments during an elliptical cycle.