IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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CREATING A TERRESTRIAL ROVER PROTOTYPE FOR A TITAN ROVER CONCEPT

Abstract

The testing and verification stages of robotic missions to Ocean Worlds demand the simulation of physical characteristics that can be difficult to reproduce. For technologically-limited academic collaborations like Project Polaris, the adaptation of a theoretical Titan rover design to an Earth prototype provides an alternative to the development of an extraterrestrial testing environment and helps in the demonstration of key concepts. The Earth Star Rover (ESR) will use reconciling methods to achieve this adaptation, such as using gravitational acceleration and density differences to modify the original rover design. The adapted requirements and objectives will be used to design verification and validation experiments that test the viability of relevant systems.

The theoretical Star Rover takes advantage of Titan's high atmospheric density to enhance a buoyancy locomotion mechanism by reducing gas weight requirements compared to a terrestrial counterpart. Although the theoretical design requires the local production of hydrogen, the ESR chemical unit will be either replaced by a helium tank or tested separately for safety purposes. This working fluid will then be used to inflate a weather-resistant balloon with its own deployment mechanism as well as to feed a system of cold gas thrusters, designed to control attitude. Various 3D printed thrusters have already been tested on a test stand. The rover systems inside the ESR are encased by a chassis with landing gear (bumpers). The main exception is a DC power supply that replaces the Multi-Mission Radioisotope Thermoelectric Generator needed to operate on Titan's nearly sunless surface. Once in the air, the ESR will use wind currents and the help of its thrusters to accomplish an adapted scientific mission. It will navigate around a selected field in Costa Rica and use its instruments to conduct three of the eight original experiments as listed below:

- Monitor rain patterns (including shape, size, movement, location of rain clouds)
- Determine the grain size, composition, and durability of dune material

- Mapping river network morphology types and drainage patterns

In addition to physical experiments, computational simulations such as but not limited to computational fluid dynamics and six degree-of-freedom dynamics control will be performed.

This paper describes the progress made in the different engineering systems of the ESR, preliminary test results, and proposed verification and validation methods. Components and assemblies of the rover are expected to be built and tested in partner labs in the Costa Rica Institute of Technology in summer 2022.