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

Author: Mr. Julian Rothenbuchner
The Netherlands

Mr. Lucas Cohen
The Netherlands
Mr. Felix Abel
Germany
Mr. Dimitri Buryak
Austria
Mr. Kristian Cuervo
The Netherlands
Mr. James Kingsnorth
The Netherlands
Mrs. On Mikulskyt
The Netherlands
Mr. Austin Phillips
The Netherlands
Mr. Markus Renoldner
Austria
Mr. Michael Sandrieser
TU Wien, Austria

THE TUMBLEWEED MISSION: ENABLING NOVEL MARS DATA SETS THROUGH LOW-COST ROVER SWARMS

Abstract

Current Mars surface exploration is characterized by large, infrequent, risky and relatively high-cost space missions that gather in-depth data on a small area. In order to reach the ambitious Mars exploration objectives set for the coming decades, a significant reduction of cost, risk and schedule is needed. Additionally, many current science objectives, such as improving models of Martian weather and climate as well as internal structure, require long-term surface data over large areas of Mars. We propose a mission architecture based on a swarm of wind-driven rovers that can provide these types of observations, while also reducing high mission cost and risk for Martian exploration. Following mid-air deployment, the rovers unfold and touch down on the surface, roll across the surface until a desired spread of the rovers is achieved, and are then stopped. Scientific data is collected both on-the-roll and when stationary. We show that a Tumbleweed mission has high utility with respect to Mars Exploration Program Analysis Group (MEPAG) Goal 2 (Climate on Mars) by providing environmental data including temperature, pressure and wind velocity. Goal 3 (Martian Geology) is addressed by providing highly precise geodetic data and assisting in gravimetry measurements. Moreover, Goal 4 (Human Exploration) is fulfilled by surveying large surfaces of Mars, adding crucial context to the current understanding of the Martian environment. With a sensor package consisting of a radiobeacon, laser retroreflector, atmospheric sensors and a rudimentary camera the rovers can address objectives relating to all three aforementioned high-level MEPAG goals. A subpart of this science package is treated in the abstract number 72466. While many aspects of

the mission can rely on already-proven technology, future development is needed on a miniaturized location determination system, the folding mechanics of the rover structure, and the rover's power systems. To gain further insight, a half-scale demonstrator of the rover has been constructed and tested in a Mars analogous environment. The results of the test show the general feasibility of the rover and have provided validation of visual instruments. Moreover, a novel reversible, non-destructive method for arresting the rover through reefing sails has been demonstrated. Visual data can be used to further develop a locating algorithm. Another avenue for future research is the communication with the swarm of rolling rovers on the surface of Mars which warrants unique communication strategies. This is addressed in the abstract number 71894 submitted by F. Abel.