The tiny rover payload in SLIM mission

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Abstract

SLIM is a proposal in the ISAS small satellite framework to land a spacecraft onto the Moon surface. The current target landing point is the vicinity of one of the vertical holes found at the Near side of the Moon.

There is not so much payload capacity in the spacecraft, but the authors are investigating a tiny rover payload in order to demonstrate the reachability to the place where you want to go by the combination of the lander and the rover.

This poster presentation outlines the current discussing matters about the rovers.

1 Intelligence and number of rovers

There are two concepts about the intelligence of the rover. Due to the weight budget, an intelligent single rover is the solution.

1. Multiple unintelligent rover sweep
   Unintelligent rovers make a simple movement to sweep the nearby terrain, waiting for one of the rovers to drop into the hole. When each rover just goes straight, at least three rovers are required.

2. Single rover with intelligence
   The rover has a camera and the obtained images are processed to find an autonomous path to the hole. Since the rover is small, the onboard camera may not capture the hole. The operation from the Ground is supplementally made to teach the rover about the relative position of the landing point from the hole.

2 Communication

We have currently three concepts about the communication between the rover and the ground.

1. Direct link from/to the Ground
   Antennas of large diameter on the Ground are available to compensate for the small radiation from the rover. Nevertheless the radiation power from the rover must be strengthened to secure the long distance communication. The higher frequency can be used, which makes the rover antenna smaller. There is no relay component on the mother spacecraft. The mass resource can be concentrated on the rover.

2. Link via the mother spacecraft
   A relay module on the mother spacecraft communicates with the rover. The telemetry data obtained from the rover are once stored in the relay module, then transferred to the ground. The lower frequency must be used for enabling the linkage to the rover on the bottom of the hole since the rover is not directly visible from the mother spacecraft.

3. Relay module laying
   The rover drops some tiny relay modules along the traverse. The link between the rover and the mother spacecraft is attained relaying the multiple nodes. A higher frequency can be used since all the adjacent nodes are visible from each other.

3 Prototype rigid-axle rover

The current design is a rigid-axle rover with inflatable wheels. Only two wheels are used for driving to save

the weight with another one free wheel or rod to assist the climbing performance.

The wheels are inflated immediately after the rover is ejected from the mother spacecraft by fracturing the air tanks. Then the wheels turn out to be a cushion against the impact to the surface. Magnified wheels improve the traversability over the natural terrain.

The prototype model of the deployment and wheel inflation mechanism was developed few year ago. Each wheel is equipped with a tank inside including an dry air of 1 litter (@ 1[atm]). When the ejector works, the latched cutter fractured the air tank to leak the air into the wheel. Tanks are exchangeable. Thus the multiple ground-based experiments are easily made.

4 Conclusions

The authors are investigating a tiny rover payload onboard the lunar landing mission proposal “SLIM.”

The current discussions focus on the intelligence, communication, and the hardware of the rover.