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

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PROTOTYPE OF A HOPTER - A HOPPING SCOUT ROBOT FOR PLANETARY EXPLORATION

Abstract

The article presents design description and outcome of prototyping campaign for Hopter, a hopping scout robot for planetary exploration. This simple and flexible design gives an excellent solution for science and prospecting for locations that are reachable and inaccessible or unfeasible for classical landers and rovers, especially in scenarios requiring coverage of large area in limited mission lifetime [1].

A mobility system architecture comprises of three actuating legs arranged around a disc-shaped main body. The mechanism allows to store up to 50 J in each actuating leg which, given its mass of up to 10kg, should allow for jumps of several meters on Mars and even grater on bodies with lower gravity like Moon or asteroids. Its horizontal symmetry makes it ready to jump without the need to reposition from the previous leap.

Following the design described in [2] and [3] the robot has been prototyped and tested against its expected performance. Focus is put on reliability aspects of the mechanism, and its dynamic performance with the surface.

The article brings also operational measures allowing to compare Hopter with other types of platforms and future missions requirements. To deliver that, it presents an update of terrain accessibility analysis assuming prototype test based performance data and additional metrics like number of necessary jumps or estimated energy to reach particular location.

Prospects for feasible parameters ranges and future design optimization are discussed, e.g. system configurations, (re-)loading sequence and operational timing.

References:

[1] Mege et al.: The Highland Terrain Hopper (HOPTER): Concept and use cases of a new locomotion system for the exploration of low gravity Solar System bodies. Acta Astronautica 121 (2016) 200–220.

[2] Wisniewski et al.: Mobility and terrain accessibility analysis for HOPTER – an underactuated mobile robot for planetary exploration. ASTRA 2017.

[3] Wisniewski et al.: Design features of novel high energy impulsive drive of underactuated mobile robot for planetary exploration. ESMATS 2017.