SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 1 (3A)

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AN INFLATABLE AUTO-ROTATION SYSTEM CONCEPT FOR ENTRY, DESCENT AND LANDING ON MARS

Abstract

Entry, Descent and Landing (EDL) on Mars is in the focus of on-going engineering activities in support to future interplanetary missions. While previous EDL missions targeted for reaching easy to access landing sites with minor precision requirements, the more ambitious scientific missions will have to cope with new issues. Main technology drivers in this context are:

- the requirements to be able to land at higher altitudes,
- to perform precision landing and finally
- to perform hazard avoidance manoeuvres.

The typical approach for such an EDL scenario, to use supersonic parachutes in combination with powered soft-landing, reaches its limits when being confronted with these new requirements. The performance of a powered lander is restricted by its amount of propellant, while all of its initial kinetic energy is dissipated during entry and parachute descent. This disadvantage might be avoided by the implementation of an auto-rotative descent and landing system.

It is proposed to implement such a system, in which the air stream around a free-falling vehicle propels a rotor such that the rotor produces thrust. Due to the low density atmosphere of Mars such a rotor system needs to support large rotor blade length and hence needs to be very lightweight. An inflatable system is therefore foreseen within this concept. With an auto-rotating vehicle it is possible to perform precision landing while maintaining complete controllability.

A Martian DLS based on auto-rotation can, therefore, decelerate after entry like a parachute equipped system and glide to a dedicated landing site reaching down-range capability as high as 26 kilometres. Within this paper such a system concept is presented. The regime of applicability is defined as well as technology demonstration needs identified. Test results of a first rotor deployment test are presented and discussed.