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TOWARDS UTILIZATION OF AUTOROTATION IN INTERPLANETARY EXPLORATION ON THE EXAMPLE OF VENUS

Abstract

Humanity is striving to be an interplanetary species more than ever before. Therefore, not only launching but also landing is a key capability for any future spacecraft. Right now, the state of the art is either landing by parachute or a propulsive approach. Parachutes are hardly ever reused, hence not a good choice for reusable vehicles. Propulsive landings do provide reusability but demand fuel and oxidizer, which might only be safe to use for a limited amount of time, e.g. due to temperature constraints. A viable solution that combines controllability, reusability and does not require any fuel is available in the form of autorotation. This is not a new technology in itself. Helicopters use it for landing in case of an engine failure. However, in the context of space flight, this technology has hardly been investigated.

This paper shall present a number of possibilities of theoretical utilizations of an autorotation system for a Venus mission. The focus is on a number of different sized vehicles with different purposes that utilize autorotation. Furthermore the vehicles will be evaluated upon their deployment method. A mission can be a small atmospheric probe and deployed by a bigger mission or it can be a lander with direct re-entry. It is important to understand the advantages and disadvantages of autorotation in these different scenarios.

Furthermore, comparison of the viability of the missions upon different performance parameters is made. This includes TRL, overall complexity and especially in comparison with other decelerators.

The goal is to create a baseline. It shows where missions might be able to benefit by the utilization of autorotation. The possible limits of the technology are also outlined in this paper.