Paper ID: 57706
oral
student

48th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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PROJECT DAEDALUS: TOWARDS AUTOROTATION BASED LANDING AND DESCENT

Abstract

Humans strive to explore the solar system more than ever before. Many companies are racing towards providing launch services that are finally becoming feasible for interplanetary travel. Entry, descent, and landing from orbital and interplanetary trajectories is another important element that has to be further investigated. It also seems to get less attention than launch services. In recent history, the development of supersonic parachutes has experienced some setbacks, as it is a challenging technology.

This is why we decided to take a look at the alternatives in this field. Reusability and the avoidance of active propulsion are key goals a possible alternative technology has to fulfil. In addition to gliders, which are already under investigation, we found autorotation. Commonly used for emergency landings by helicopters, the last time it was seriously investigated for space applications was in the 1960s by NASA. One of the key features is that there is no drogue chute needed, the system can perform both supersonic and subsonic deceleration. Space-grade parachutes are also single-use components and are not considered reusable, whereas rotor-based reentry systems show much more potential to be reusable. Another key advantage is steerability. Parachutes are hard to steer, however, rotor steerability by means of a swash disk is an already well-established solution. A rotor-based landing system can also land with virtually zero velocity, significantly softening the landing compared to parachutes.

All these clear and outstanding advantages motivated us to investigate this concept. In 2016, our team was formed by more than 25 students from 4 universities, in 2 countries. The remote collaboration and sharing of workpackages was a challenge, but also our key to success for building the vehicle named SpaceSeed in just 2 years.

The first flight from a height of 80km, proved that the rotor can withstand a Mach 2 reentry and significantly slow the craft down. Flight results show that there is potential for this technology, and so the team decided to build an improved version, set to fly on REXUS 29 in March 2021. The key change

compared to Version 1 is the controllability of the collective pitch, which will allow a softer landing and inflight rotor speed control. A bigger sensor package including RADAR needs to be carried and implemented to support the flight controller. This additional objective is key for the next steps of proving that autorotation is capable of outperforming parachutes in entry, descent and landing.