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AERIAL VEHICLES FOR THE INSPECTION OF A MARTIAN SURFACE SETTLEMENT AND WEATHER FORECAST: TESTING AND CONSIDERATIONS FOR USE

Abstract

Aerial drones have the potential to revolution planetary exploration, as they can travel higher and faster than rovers but still allowing high-resolution sensing. In recent years, the possibility of using aerial vehicles on Mars went from concept to operations: Mars Helicopter, a small, autonomous rotorcraft developed at the Jet Propulsion Laboratory, scheduled to be launched in 2020, will demonstrate the viability of heavier-than-air vehicles on the Martian surface. Due to the delay of transmission, teleoperated flight from Earth seems unlikely; nevertheless, in a scenario where crew is settled on the Martian surface (or in orbit), aerial drones could become a key element of the mission.

Analogue missions have proved to be an effective way to simulate human activities during space exploration missions. Due to crew isolation in a setting similar to the extreme environments of space, they allow for testing of both hardware and operational scenarios.

The research project VESTA brought these two subjects together, evaluating possible uses for drones in a human settlement during a two-week experimentation at the Mars Desert Research Station. Operational complexity and utility for the crew were analysed, with regard to safety, crew time and training. A multicopter was used during Extravehicular Activities (EVA) and piloting of the vehicle from inside the station was evaluated. Because of the current absence of a global positioning system on Mars, possible alternative navigation technologies were considered. In this case, due to potential safety issues, flight operations were performed using Earth GPS; further studies are therefore required to investigate autonomous navigation on Mars.

Two different scenarios were evaluated: environment monitoring and settlement inspection. In the first, the drone was flying at high altitude to acquire a general understanding of the outside environment, and as a possible warning weathercast system for sandstorms. For inspection missions, the drone pointed its cameras and sensors at the station and navigated autonomously to specific points of interest on the MDRS facilities, allowing the crew to inspect the external elements, e.g. the solar array, where the level of dust coverage was assessed.

The main results from these evaluations were a set of operational scenarios and lessons learned that could be further extrapolated to real off-Earth conditions in future human exploration missions.