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UAV-AIDED MARTIAN GEOLOCATION THROUGH IMAGE RECOGNITION

Abstract

During the early stages of Martian settlements, the absence of a global navigation system akin to those on Earth will require the development of robust geolocation methods. These methods serve as vital backups to ensure the safe return of crewmembers to the base after exploration missions. This proposal addresses scenarios wherein a crew finds itself lost, deprived of RF communications with mission support teams, where autonomous search and rescue is rendered impractical. The proposed solution entails deploying a UAV to capture an aerial image and comparing it to a previously generated georeferenced satellite image database. When matching is achieved effectively, a single capture can be enough to determine the crew's location and their relative orientation with respect to the station. A high-precision visual positioning method based on image registration is proposed for reliable performance on martian landscapes with notable absence of roads, buildings, and manmade ground control points (GCPs). For enhanced robustness and applicability, different strategies are presented to remove false matches and increase positioning precision while keeping complexity low enough to allow on-board implementation. The method underwent successful testing using UAV images of diverse landscapes and lighting conditions gathered during Extravehicular Activities (EVAs) at the Mars Desert Research Station (MDRS) in Utah, USA. The algorithm was proven to provide accurate geolocation and orientation parameters, even with non-affine transformations and different sun orientations.