Paper ID: 8091
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SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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HAZARD RECOGNITION METHODS FOR PLANETARY LANDER WITH SINGLE CAMERA

Abstract

In the lunar and planetary exploration, a spacecraft is required to select and land on a safe area autonomausly . As a hazard recognition method, obstacles detection after restoring three dimension elevation map by the laser scanning is proposed. After scanning the whole area around landing site, the method can easily and surely generate three dimensional map. However, the hardware of the laser sensor is generally heavy, consume much power, and needs long time to scan whole area. On the other hand, a camera is relatively small and less power consumption. However, it is difficult to adapt the stereo vision with multi-cameras on spacecraft because the baseline is not long enough. Though montion stereo method is also proposed, the baseline cannnot be calculated accurately. Moreover, image-based three dimensional terrain restoring does not have robustness. Therefore, we propose a method of hazard recognition directly from shadow, features of terrain, and a priori information such as sun angle or geological knowledge of an image without restoring three dimestional map. The method detects obstacles like craters or rocks as if human intuitively finds obstacles. Concretely, the method detects the edge of the obstacles (such as craters and ridge) by spatial difference of brightness obtained from the image . From shadow and sun light direction, some obstacles like large rocks or hill can be detected. That is, the method uses forward solution to reduce complexity and computational time. Moreover, to categorize the level of danger using a certain threshold, effective conbination with other obstacle detection methods becomes possible. For example, to land a spacecraft near an area of interest that is located inside an area that safe landing is uncertain. The proposed method using single camera can detect the obvious dangerous areas and laser scanning method can obtain detailed data from the intermediate areas in order to find the nearest point where the spacecraft can land safety. The paper shows the effectiveness of the proposal method by simulation using the images of the moon obtained from SELENE spacecraft.