IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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POSITIONING METHOD OF CHANG'E-4 LANDER BASED ON MULTI-SOURCE IMAGES

Abstract

The Chang'E-4 lunar probe will land on the lunar farside for the first time at the end of 2018. Fast and high precision positioning of the landing point is essential for safe and efficient mission execution. In this paper, we proposed a method for positioning of Chang'E-4 lander based on multi-source images

including LRO NAC images, landing zone Digital Orthophoto Map (DOM) and the descent images. First, several descent images were selected from sequence images. The selected images are subsequently matched with Scale Invariant Feature Transform matching, during which gross errors are eliminated by a Random Sample Consensus algorithm. All matched feature points are used to calculate the parameter of a similarity transformation model between the initial image and the last image using the least-squares principle. The image coordinates of the landing position at the initial image are solved. Second, the initial image is matched with the landing zone DOM. Consequently the preliminary landing position can be determined. Third, all the LRO NAC images that cover the landing position are retrieved. Feature point matching is performed between initial image and each LRO NAC image to calculate the transformation relationship between them. Image coordinates of the landing position in each LRO NAC image can then be calculated based on the coordinates in the initial image and the transformation parameters. Finally, multiple observations are averaged as the final position result with a consideration of the existence of random errors, e.g. errors of track measurement and control, image matching and lunar elevation. With LRO NAC images used which are of the highest resolution, feature point matching can achieve high accuracy. Furthermore, the speed and precision of determining the landing point can be improved. Landing position experiment was performed for Chang'E-3. The descent images were selected from the power descent phase with the DOM accuracy about 1.5 meters per pixel. The matching accuracy of descent image can reach the sub-pixel. Furthermore, the matching precision is higher than 1 pixel for the initial descent image and DOM and for the initial descent image and the LRO NAC image. The landing position result is 44.1213N and 19.5115W, which is equal to other published results. Experiments show that the method has merits of high calculation speed and mapping accuracy and not entirely depending on the landing zone DOM. It will be applied to Chang'E-4 lunar lander position.