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POSITIONING FOR EARTH'S SURFACE CRUISER WITH THE VISION INFORMATION BY SINGLE SATELLITE

Abstract

The existing single-satellite positioning technology for targets on the surface usually adopts the method of satellite-borne interferometer location or single-satellite frequency measurement. For satellite-borne interferometer location technology, the unreliable prior information of target may cause slow results-obtaining due to the application of the Kalman filter principle. It is bad for real-time space missions. While, single-satellite frequency measurement technology is used only when the target is stationary or at low speed. Besides, two methods above rely on the radiation signal. The paper proposes a new method to determine the position of the surface cruiser at low speed using only three frames of image information acquired by the camera on the satellite. The main idea is to assume that the target heights are basically the same during imaging, and establish a satellite/cruiser distance model and a cruiser position model with the height of the cruiser as an independent variable, then solve the height information and corresponding position information according to the relative position relationship of the cruiser at multiple times. The steps are as follows: Firstly, set three time points with equal interval to establish a space vector relationship consist of satellite position vector, target position vector and satellite/target vector in the Earth-Centered Earth-Fixed coordinate system; assuming that the target height is an independent variable, and the satellite/target distance information described by height information can be obtained, by obtaining the target direction information extracted by the satellite image, the target position model described by height information can be obtained. Then, the constraint model based on the height information is established according to a constraint condition which the change of position is basically the same at adjacent time points. Finally, the height information meets the constraint model can be determined by exhaustive method and then the position information of the target at different times can be determined. The simulation analysis shows that the error of the target height information is 200 to 300 meters, so it is suitable for targets at medium and high altitude. However, the method only needs 3 frames of target image information to complete the approximate positioning, so it is with the characteristics of medium precision and high real-time performance.

Keywords: Single-satellite positioning, Image.