Paper ID: 77354
student

21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 21st IAA SYMPOSIUM ON SPACE DEBRIS (IP)

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IMAGE-BASED TARGETS TRACKING FOR MULTIPLE REMOTE SATELLITES IN COMPLEX STELLAR BACKGROUND

Abstract

The space-based optical platform is the main way of monitoring satelilite targets. However, with the development of the low-Earth-orbit (LEO) satellite constellations such as OneWeb and Starlink, the number of satellites is increasing rapidly, which makes monitoring more difficult. To improve the monitoring capability of the space-based platform, it is necessary to develop an advanced recognition and tracking technology for multiple targets of the LEO satellite constellations. The recognition and tracking technology has two difficulties. First, the targets are far away from the space-based platform, which leads to the fact that the targets often appear as faint points in the image. Therefore, in the complex celestial background, point-like images of stars would cause interference and misjudgment in the tracking process. Second, the number of satellites in the constellation is large, while the detection field of the platform is limited, which may result in frequent rebirth and disappearance of satellites in the field-of-view. In this case, large detection cost is required to ensure the tracking accuracy of the targets.

Aiming at the monitoring problem of satellites in a giant constellation, this paper proposes an image-based tracking method for multiple remote targets under complex stellar background. Firstly, the information of point targets is expanded by Gaussian diffusion processing to solve the problem of weak target imaging. Then, a probability hypothesis density (PHD) update method based on target grayscale measurements is proposed. At last, an improved Gaussian mixture PHD filter is used to realize multi-target recognition in stellar background. In addition, to efficiently identify new targets entering the field of view, a two-layer judgment mechanism of quasi-true target is established, and an automatic detection method of boundary region is proposed.The simulation results show that the proposed method can improve the recognition accuracy of target number and reduce the tracking error of target position. Meanwhile, compared with the traditional multi-target tracking method, this method can greatly reduce the detection cost. Therefore, the proposed method can be used to track multiple satellites in the complex stellar background.