Paper ID: 57577
student

18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Virtual Presentations - 18th IAA SYMPOSIUM ON SPACE DEBRIS (VP)

Author: Mr. Jiangtao Wei
National Key Laboratory of Aerospace Flight Dynamics, Northwestern Polytechnical University, Xi'an, China

Prof. Xin Ning
National Key Laboratory of Aerospace Flight Dynamics,Northwestern Polytechnical University, China
Mr. Qihang Wang
Northwestern Polytechnical UniversityNPU, China
Mr. Shichao Ma
National Key Laboratory of Aerospace Flight Dynamics, Northwestern Polytechnical University, Xi'an, China

A UNIFIED FRAMEWORK FOR HIGH PRECISION AND SPEED IDENTIFICATION AND TRACKING OF SPACE DEBRIS

Abstract

The collision between space debris and spacecraft directly leads to the explosive growth of space debris, so clearing space debris has become one of the most urgent space missions for mankind. Automatic observation has become the development trend of optical observation of space debris, and corresponding automatic target identification without human intervention has become an urgent research topic. This paper studies the real-time instance segmentation and tracking of space debris based on ground-based and space-based observation systems. We provide a unified, flexible and universal high precision and speed real-time target recognition and tracking framework. This framework improves the recognition speed of continuous image sequences from 5fps (frames per second) to 27fps on the premise of ensuring high precision instance segmentation and category recognition. We added a fast loop correlation detection module Siam-Mask into the deep network framework of Mask R-CNN instance segmentation recognition, and the correlation detection module and instance segmentation recognition network ran synchronously in different threads. The framework is called RT-Mask R-CNN (Real time Mask R-CNN). We innovatively divided the time-domain tasks of different modules of the framework in different threads, which greatly improved the running speed of the algorithm. After the algorithm training, we could get a good running effect without GPU acceleration. To solve the problem of multi-scale target recognition, we conduct multi-scale training through self-labeled space debris data set to adapt to the change of target scale and improve the robustness of recognition. We apply the singular value decomposition technique to convolution feature compression to reduce the computational and storage requirements of the model. Experimental results show that this technology can effectively realize the real-time detection and tracking of multi-scale debris in space, and reduce the computing cost and storage space as much as possible. This technology will promote the maturity of "visual navigation based" (VBN) technology. In-orbit satellites will be able to realize on-board processing of navigation algorithms to achieve near-real-time mapping of the movement trajectory of non-cooperative objects in space, which will form a complete "identification and tracking - motion analysis - capture - off-orbit" method of space debris removal.