Paper ID: 67891
oral
student

20th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 20th IAA SYMPOSIUM ON SPACE DEBRIS (IPB)

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AUTOMATIC IDENTIFICATION OF SPACE OBJECTS IN ALL-SKY PHOTOS FROM A SYNOPTIC SURVEY SYNTHETIC TELESCOPE ARRAY

Abstract

Many areas of inquiry rely on the detection, categorization, and characterisation of Space Objects (SOs). SO detection is critical for forecasting collisions with debris that might endanger satellites or space operations in Near Earth orbit. This work offers a versatile pipeline for automatically detecting sunlight SOs in photos captured with an all-sky camera with a wide field of view (FoV). The proposed pipeline includes the following main steps: image distortion correction, noise reduction filtering, generation of a background model for subtraction, star elimination using a star catalogue, local-based contrast enhancement, and, finally, two methodologies for detecting line segments were developed for automatic SO detection. The approach was used on a dataset of 22x3 pictures from the Omnidirectional Space Situational Awareness (OmniSSA) Array at the Georgia Institute of Technology in downtown Atlanta. The OmniSSA array includes three sensors that capture high-resolution pictures (3352 2532 pixels) concurrently utilising a large field of view for each camera. An intensity scaled by noise (ISN) signal was constructed and evaluated to objectively demonstrate progress in SO detection. After background reduction, fusing pictures from the three OmniSSA sensors enhanced both the ISN and visualisation during the detection stage. To confirm the pipeline's conclusions, ground-truth data were collected from a Space-Track catalogue and tagged by human specialists using information from Astrometry.net. The process accurately recognised virtually all of the SOs, according to the results.