

SPACE DEBRIS SYMPOSIUM (A6)  
Measurements (1)

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## TRAJECTORY DETECTION OF GEO DEBRIS UTILIZING FEATURES OF IMAGE MOTION

**Abstract**

This paper proposes a novel method of detecting and tracking for the images of debris in Geosynchronous Earth Orbit (GEO). The proposed method utilizes several features of the image motion appearing in observation image sequence, which are obtained from the telescope fixed for the azimuth and elevation angles at certain frame rate. Conventional debris image detection methods for ground-based observation are categorized into two types; (1) Track-before-Detect (TBD), and (2) Detect-before-Track (DBT). The former is represented by a stacking method in which a faint and small debris image is detected by stacking the block image frames including the same debris searching all the direction of possible debris motion, whereas the latter is represented by a line-identifying technique in which a linear trajectory of each debris image is detected after the debris candidate images are extracted through an image binarization technique. The TBD methods can obtain bright and visible image by stacking faint debris images included in different frames while it usually needs much computational load during random search for the debris image motion. On the other hand, DBT methods can be derived from various image-processing techniques if only the target debris images are included in the preprocessed image frames. The method proposed in this paper is categorized as the latter DBT method, and in order to guarantee the existence of the debris images in the binarized image frames, extremely low threshold value is given for the image binarization during the preprocessing. Then, utilizing a histogram features on motion direction and displacement of the binarized and labeled images in the image sequence, debris images are uniquely detected as linear trajectories in the image frames. The proposed method needs neither to tune shape parameters in order to remove the background star images nor to empirically determine a threshold value for the image binarization during the preprocessing. The effectiveness of the proposed method is finally demonstrated through real observation image sequences obtained from telescopes of the Taiwan American Occultation Survey (TAOS) project in Taiwan. (331 words)