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AUTOMATIC OBJECT TRACKING FOR SPACE BASED SPACE DEBRIS OBSERVATION

Abstract

With the development of technology and space launches the space debris present in orbit has increased vastly becoming a serious threat to space activity, including operational spacecraft and new spacecraft to be launched. A space debris monitoring activity is carried on, on a regularly basis, by a ground network of optical and radar space surveillance sites. In this way it is possible to detect and track orbiting objects, in orbital ranging from LEO to geostationary orbit, and even interplanetary orbit concerning near earth orbit. To improve the space debris monitoring capability, space based space debris observation systems could be developed. At present, a space based space debris optical observation system made of satellites in low earth orbit is operated mainly for the geostationary ring monitoring. In the future, space based optical space debris monitoring systems made of satellites in LEO could be developed for detailed observation of LEO regions, sensitive for the safety of prefixed space assets. In these systems, the ability to detect and track fast moving objects in the instrument field of view is a relevant requirement, which can be effectively fulfilled by fast and accurate re-orientable optical systems. In this paper a fast moving target tracking system is proposed, suitable for space based space debris monitoring, based on two telescopes installed on a double-gimbal mount installed on the spacecraft. The system is based on a low accuracy, large field of view telescope, with the function of detecting potential target objects, and used to point the mount. A higher accuracy telescope, aligned to the first one, is used for accurate angular measurements of the observed object. A prototype of the system and the related algorithms was developed and preliminarly tested in the ground. The prototype uses an astronomical alt-azimuth mount that directs two aligned telescopes. The image captured by the telescopes is processed using dedicated image analysis algorithms. The algorithm takes advantage of high-level operations in order to obtain a logical image from the scanned image from the telescope. Once acquired and recognized the presence of an object within the image, the algorithm developed controls the astronomical mount so as to track the object identified. An extensive testing campaign was carried out using a ground-fixed mount and taking flying airplanes as moving targets. The results, both on the timely identification of targets and the effectiveness of the tracking algorithm, showed the feasibility of the system.