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SPACE-BASED PSEUDO-FIXED LATITUDE OBSERVATION MODE BASED ON THE CHARACTERISTICS OF GEOSYNCHRONOUS EARTH ORBIT BELT

Abstract

The US Lincoln Laboratory proved that space-based visible (SBV) observation is efficient to observe space objects, especially Geosynchronous Earth Orbit (GEO) objects. After that, SBV observation plays an important role in the space surveillance. In this paper, a novel space-based observation mode is designed in order to observe all the GEO objects in a relatively short time. A LEO satellite, especially a dawn-dusk sun synchronous orbit satellite, is useful for Space-based observation. Thus, the observation mode for GEO objects is based on a dawn-dusk sun synchronous orbit satellite.

It is found that the pitch point (PP) regions proposed by the US Lincoln Laboratory are spreading based on the analysis of the evolution principles of GEO objects. As the PP regions becoming more and more widely in the future, many strategies based on it may not be efficient any more. Hence, the key point of the space-based observation strategy design for GEO objects should be emphasized on the whole GEO belt as far as possible.

The pseudo-fixed latitude observation mode is proposed in this paper based on the characteristics of GEO belt. Unlike classical space-based observation modes, pseudo-fixed latitude observation mode makes use of the one-dimensional attitude adjustment of the observation satellite. The pseudo-fixed latitude observation mode is more reliable and simple in engineering, compared with the gazing observation mode which needs to adjust the attitude from the two dimensions. It includes two types of attitude adjustment, i.e. daily and annual attitude adjustment. Therefore, the pseudo-fixed latitude observation mode has two characteristics. In a day, the latitude of the observation region is fixed and the scanning region is about a rectangle, while the latitude of the observation region center changes each day in a long term based on an annual strategy.

The capabilities of a pseudo-fixed latitude observation instrument with a 98° dawn-dusk sun-synchronous orbit are discussed. A satellite with multiple sensors which can establish a broad scanning region by combination with each other is proposed. It is found that most of the GEO objects can be visited every day and almost all the GEO objects can be visited in two days in the whole year using two sensors, each of which has a $10^\circ \times 4^\circ$ FOV. The seasonal drops which caused by the GEO characteristics and the influence of earth shadow at the two equinoxes have been overcome under the pseudo-fixed observation mode.