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QUICK METHODS OF PLANNING OF OBSERVATION SESSIONS OF ORBITAL OBJECTS IMPLEMENTED BY SPACE VEHICLES

Abstract

Monitoring of orbital objects includes periodical updating of information on registered objects. Currently updates are done by observations from surface stations. However, observations with the use of satellite-based devices are now considered, designed and implemented. This kind of monitoring has a substantial potential stipulated by closeness to the observed objects.

We consider the problem of observation in the following formulation. An observation satellite is stabilized in a fixed attitude. A satellite may use four monitoring devices: 1 and 2 for objects above and under its instantaneous horizon plane; 3 and 4 for objects to the left and right of its orbital plane, respectively. The angle between the base plane and the direction to an object must exceed a certain threshold value. Over a period of observation, the radar axis tracks the object. The accuracy of the orbital parameters of the objects should be sufficient for forecasting its appearance in the observation zone. Observations are planned for a time interval ahead. Observation plans are developed for each monitoring device. Observations are planned at ground control centers or onboard, for current orbital parameters of the observed objects. There are two components in this. The first is determination of the time intervals when the objects are in the observation area of a particular device (scheduling the visibility). Doing this by modeling motion of many orbital objects and checking their appearance in the visibility zone takes substantial time. In this work, methods of quick scheduling of objects visibility for each of the 4 devices are proposed, which reduce the time of scheduling by several orders of magnitude in comparison with the approach based on modeling of motion. The schedule is used for observation planning. Iterative methods of building quasi-optimal plans are not suitable in this case because of substantial expenses of time. Instead, several non-iterative methods have been developed (for one-stage planning onboard and several stages of planning at the surface centers). Methods are based on step-by-step splitting of the planning interval into intervals equal to the intervals of observations and determination of the object for observation on each interval of the splitting basing of the proposed ranged rules. The rules of selection of the object for observation take into account conditions of the observations and current results of planning. The proposed methods reduce the planning time by an order of magnitude in comparison with the iterative methods for finding quasi-optimal solutions.