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A COVARIANCE ANALYSIS TO OPTIMIZE THE OPTICAL FOLLOW-UP STRATEGIES

Abstract

The Astronomical Institute of the University of Bern (AIUB) is conducting several search campaigns for space debris using optical sensors. The debris objects are discovered during systematic survey observations. In general, the result of a discovery consists in only a short observation arc, or tracklet, which is used to perform a first orbit determination in order to be able to observe the object again in subsequent follow-up observations. The additional observations are used in the orbit improvement process to obtain accurate orbits to be included in a catalogue. In order to obtain the most accurate orbit within the time available it is necessary to optimize the follow-up observations strategy. In this paper an indepth study, using simulations and covariance analysis, is performed to identify the optimal sequence of follow-up observations to obtain the most accurate orbit propagation to be used for the space debris catalogue maintenance. The main factors that determine the accuracy of the results of an orbit determination/improvement process are: tracklet length, number of observations, type of orbit, astrometric error of the measurements, time interval between tracklets, and the relative position of the object along its orbit with respect to the observing station. The main aim of the covariance analysis is to optimize the follow-up strategy as a function of the object-observer geometry, the interval between follow-up observations and the shape of the orbit. This analysis can be applied to every orbital regime but particular attention was dedicated to geostationary, Molniya, and geostationary transfer orbits. Finally the case with more than two follow-up observations and the influence of a second observing station were also analyzed.