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A TRADE-OFF STUDY BETWEEN SIZE THRESHOLD OF CATALOGUED OBJECTS AND TRACK ACCURACY FOR THE DESIGN OF A SPACE SITUATIONAL AWARENESS SYSTEM

Abstract

In the design of a European Space Situational Awareness System (ESSAS), the rate of alerts for collision risks that can be managed by satellite operators is a critical parameter. As it can impact the choice for the survey sensors design, this study has been led as part of a GSTP4 study for ESA, on "Ground segment requirements for a UHF radar for the ESSAS". Indeed, the number of objects in the catalogue increases exponentially with the asset sensitivity, enabling to detect smaller objects. For a given accuracy of the catalogue information, this could increase the alert rate, possibly beyond a threshold not manageable anymore by the operators. Therefore, a trade-off has to be found, between the minimum size of the objects that can be catalogued and the track accuracy, leading to a manageable rate of alerts.

In this paper, a method for the study of such a trade-off is presented and results are provided for two LEO satellite configurations. The proposed method is divided into three steps. The probability to get an alert for a given object crossing a surface of analysis around the considered satellite is computed first, as a function of the track accuracy. It is assumed that an alert occurs when the collision probability is greater than a given threshold. The second step consists in the computation of the number of catalogued objects crossing the surface of analysis, over the period of study. This number is calculated, with respect to the size of the objects and the size threshold for cataloguing, from a flux data provided by the ESA's software MASTER 2005, including meteoroids streams and space debris. Finally, the probability to get a number of alerts lower than a specified criterion is computed by considering all the objects crossing the surface of analysis, over the period of study. Since it depends on the quantities computed in the two aforementioned steps, it is a function of both the track accuracy and the minimum size of catalogued objects. Therefore, the trade-off to be determined can be directly studied by evaluating this probability for several different values of the track accuracy and of the size threshold of catalogued objects.

Numerical results are presented, for LEO satellites at 800km and 1400km altitude orbits. The trade-off analysis is achieved for both satellite configurations by successively considering different values for the manageable number of alerts per month and per satellite.