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REQUIREMENTS OF DEVELOPING AN AUTOMATIC COLLISION AVOIDANCE SYSTEM (ACOLAS) FOR LARGE SATELLITES

Abstract

This study is an attempt to determine the main requirements of developing an in-orbit automatic collision avoidance (COLA) system for large satellites. Developing such a system has several technical complexities. Finding a way to tackle them will pave the way for a comprehensive examination of this problem.

As it is known, developing models for in-orbit risk assessment and early collision likelihood warning is a major step towards establishing an ACOLAS. Active collision avoidance maneuvers, including evasive maneuvers are another major requirement. Researchers are working worldwide to find new methods and systems to face both issues. It is not the concern of this paper to work in these fields. Instead the major concern here is to find the threshold of technologies that make an automatic avoidance possible. To this end a systematic approach is developed based on a simple but thought-out dynamical model of the collision of medium to large objects in space. Very high velocities and very high inertia of the objects which makes them very hard to move away from each other in short periods of time are carefully considered. The scope and capability of the risk assessment techniques are also incorporated into this model. Using a large set of parametric studies, possible performance regions of main subsystems required in an ACOLAS are determined.

It is shown as a result that a combination of the current technologies and methods as found in the general market together with on-ground risk assessment methods cannot provide a plausible degree of reliability for establishing an ACOLAS. A certain degree of improvement is required in each subsystem to provide the basis for the inception of the automatic avoidance system. It is attempted here to determine most of these necessary improvements. These are calculated based on the assumption that every large satellite will be equipped with an ACOLAS that would take necessary measures to save the satellite from colliding with large objects. This task becomes much more possible if the other object itself is a spacecraft equipped with its own ACOLAS.

At the end of the paper a conceptual ACOLAS is suggested. This system would only become possible with technology improvements recommended in this study.