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TOWARDS AUTOMATED, CLEAR AND EFFICIENT RULE-BASED CONJUNCTION COORDINATION FOR CONSTELLATIONS

Abstract

Historically, the largest share of conjunctions of satellites in space was against debris objects. Thus, the risk of a critical conjunction was reduced by performing a collision avoidance (COLA) manoeuvre by the active satellite. However, this picture is rapidly changing with the increasing number of satellite constellations in orbit as conjunctions between active satellites are becoming the norm. To handle this new situation, two corner stones are required: *data sharing* between all operators and *coordination* of conjunctions.

Data sharing can be considered the baseline requirement for an efficient space traffic management. Challenges here range from used data formats to the trustworthiness and accuracy of the data from different sources. Coordination focuses on finding a decision on whether to and who will manoeuvre in a conjunction event. Recently, the term "rules-of-the-road" has been used in the context of space traffic management to describe a set of very simple formulated rules, like priority rules in car traffic that shall apply to spacecraft during a conjunction.

CASCADE (Collision Avoidance, Satellite Coordination Assessment Demonstration Environment) is a demonstrator that is currently developed by OKAPI:Orbits and TU Darmstadt in the frame of an ESA activity. CASCADE consist of two components: The Mission Analysis Simulator (MAS) and the Operational Coordination Platform (OCP). The MAS is targeting constellation mission designers and allows to forecast frequent encounters between own and other satellites and assess the impact of different rules on the operational concept.

The OCP is a unique tool allowing *data sharing* and *coordination* for the operational phase with constellation operators as target users. It supports both conjunction partners by (a) providing a direct communication channel, (b) allowing direct data sharing so that both operators have the same understanding of the situation, (c) defining a clear COLA process including responsibilities, a timeline and deadlines with respect to time of closest approach, (d) facilitating the decision making on who should perform the manoeuvre and (e) allowing the negotiation and definition of rules between the partners for current and future conjunction events. Furthermore, it offers API endpoints to allow easy implementation in any COLA system, thus allowing an overall *efficient*, *clear* and *automated coordination* of conjunctions for constellations.

This paper provides a general overview of CASCADE and focuses on the OCP tool and first user experiences. It highlights the key features and aspects of the tool that is currently being developed closely with constellation operators and agencies.