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SHOULD I STAY OR SHOULD I GO? MACHINE LEARNING APPLIED TO CONJUNCTION ANALYSIS

Abstract

The number of orbiting objects is increasing at an ever growing pace. Inevitably, this is also driving up the number of conjunction events, especially in LEO. This is forcing the Space Situational Awareness (SSA) actors to expand the proportion of automated tasks within their conjunction detection and analysis pipelines. During SSA providers' nominal operations possible conjunctions are identified, tracked, assessed and, if necessary, a manoeuvre recommendation plan is created and iterated with the satellite operator along the event duration. The increasing workload of the conjunction analysis service and the growing number of satellite operators demanding this service, yields to the need to explore new techniques like **Machine Learning (ML)** to decrease the time needed during the tracking phase of a conjunction event, by anticipating its evolution.

Thanks to the fact the **S3TOC (Spanish SST Operations Centre)** is one of the two operational centres in charge of the Collision Avoidance within the **EU SST**, working in a hot redundancy schema, a large amount of detailed datasets has been generated over time with all the information along the conjunction events evolution being available. This has allowed to start research on ML algorithms and techniques considering the big quantity of data required.

The work presented in this paper is focused into two main tasks: First, the determination of the probability of escalation or de-escalation of the risk level, which depends on the **Probability of Collision (PoC)**. Therefore, during the event, attempts are made at anticipating whether it can be disregarded as a low risk event or if it should be included on a watchlist in case its alert level is to be increased.

Second, the prediction of the elements used to compute the PoC. The information of an event is updated along its duration through Conjunction Data Messages (CDMs). The CDMs contain all the information needed to compute the PoC such as the relative position between the objects and their covariances. In this second task, some of the elements in the CDM are predicted into the future, so that a future estimation of the PoC can be computed.

This is just the beginning of the long journey of introducing Artificial Intelligence in the SSA field and S3TOC and EU SST are on-board.