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AUTOMATED OPERATIONS FOR THE MAINTENANCE OF A SPACE OBJECT DATABASE

Abstract

The continuous increase of the number of objects in space including both active payloads and debris is a challenge for the safe operation of satellites. One of the keys to space safety with regard to the space object population is the maintenance of a database containing their orbital information. Maintaining such a database contains several related but distinct sub-tasks. These include the association of new observations to orbits in the database, the association of observations among each other using those observations which could not be associated to a database object and the creation of new database objects based on the results of the observations' associations. With regard to the possibly large number of objects in such a database, the mentioned tasks should be performed with as much autonomy as possible.

Previous work by the authors include a method for the association of two radar observations and also the presented work here focusses on radar measurements of objects in the Low Earth Orbit. To enable the database maintenance, the analysis here includes the observation-to-orbit association for objects in the database. This analysis covers different approaches for that association regarding the usage of a single observation or a series of observations and different coordinate systems as well as a sensitivity analysis concerning the different noise sources.

In order to allow a reliable initialisation of such a database, it is also important to consider the transition from a newly detected object to a regularly maintained object, i.e. the change from observation-to-observation association to observation-to-orbit association. This transition shall be generalised based on statistical and information theoretic aspects leading to a decision threshold which is also robust against e.g. different sensor performances. The overall goal is to establish a theoretical framework which allows a high level of automated operations to minimise manual interventions by the operator.