16th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Orbit Determination and Propagation (9)

Author: Mr. Alejandro Pastor-Rodríguez
GMV Aerospace & Defence SAU, Spain

Dr. Diego Escobar Antón
GMV Aerospace & Defence SAU, Spain
Dr. Manuel Sanjurjo
Universidad Carlos III de Madrid, Spain
Mr. Alberto Águeda Maté
GMV Aerospace & Defence SAU, Spain

OBJECT DETECTION METHODS FOR RADAR SURVEY MEASUREMENTS

Abstract

Space Surveillance and Tracking (SST) systems are composed by sensors and on-ground processing infrastructure devoted to generating a catalogue of resident space objects and derive SST products (i.e. high-risk collisions, upcoming re-entries, fragmentations) based on the orbital information in the catalogue.

The catalogue of resident space objects (RSO) is one of the main outcomes of the SST activities. It is a robust automated database containing information of every detected object. During surveillance, large areas of the sky are scanned by sensors in order to obtain data for both catalogue build-up and maintenance activities. The catalogue build-up process consists in the detection of new objects in order to include them in the catalogue without any previous information, while the maintenance process consists in updating existing objects information. Therefore, the catalogue build-up depends on the capability to detect new objects from measurements, packed as tracks, provided by a sensor network.

This work presents a novel sequential filtering algorithm able to identify radar tracks belonging to the same object, i.e. association of uncorrelated tracks (UCTs). It uses several Initial Orbit Determination (IOD) and Orbit Determination (OD) methods in order to obtain a figure of merit to decide whether certain tracks belong to the same object or not. Instead of using a brute-force approach by evaluating all possible combinations of tracks, several filters are applied so as to reduce the complexity of the problem. Furthermore, the association is performed on the measurements space (track-to-track correlation) rather than in the orbit space (orbit-to-orbit correlation), because the accuracy of the estimated orbits is based on limited information (IOD) and thus not as high as an already cataloged object.

Results have shown that this strategy provides more reliable results than an association made on the orbit space, in terms of both false positives and number of missed objects. A complete validation scenario has been set up to evaluate the performance of this algorithm and the current results are very promising, even when dealing with highly eccentric orbits, such as Geostationary Transfer Orbit (GTO), and revisit times of more than one week. Besides, the algorithm performance allows real-time processing of new tracks thanks to the selective generation and pruning that avoids evaluating all possible combinations.