18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Operations in Space Debris Environment, Situational Awareness (7)

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DEVELOPMENT OF A SOFTWARE SUITE FOR OBSERVATION SCHEDULING AND PERFORMANCE ASSESSMENT OF SST SENSOR NETWORK

Abstract

The ability to simulate the behavior of different sensor configurations is critical for the development of a sensor network that provides data for any Space Surveillance and Tracking (SST) service. Any software suite devoted to this purpose shall be able to assess the performance of an existing network, as well as to estimate advantages and disadvantages of any structural change, such as the addition of new sensors or the upgrade of existing ones. This paper is devoted to describing how S3NSIT tackles the above problem. S3NSIT (Space Surveillance Sensor Network SImulation Tool) is a software suite that has been conceived to perform a statistical analysis of the observational and cataloguing capabilities of a sensor network. The software can model optical, radar and laser ranging sensors and simulate different operational scenarios. The properties of the sensors provided by the user are processed to predict the passages of resident space objects that can be successfully detected by each sensor. The passages are analyzed to assess the network capabilities in terms of number of observations and catalogue coverage. The sensors are compared against each other to identify overlapping in the sets of observed objects and to provide an estimate of the level of complementarity. In addition, synthetic measurements are generated for each passage meeting visibility and detectability constraints. The measurements gathered by the network are then processed to carry out initial orbit determination and orbit determination refinement, with the aim of assessing the network performance in catalogue build-up and maintenance. All the results are prompted to the user in informative tables and graphs. Starting from the results of a first simulation, the modularity of the software allows the user to easily carry out sensitivity analysis to different parameters, such as the number and location of the sensors or their sensitivity. This is expected to ease the setup process of sensor network for SST, as well as the identification of the most promising upgrades to be recommended. As a side-product, the tool grants the opportunity to show and export all the data associated to the observable passages, including their pointing requirements. Given an existing operational network, these data are processed - with an evolutionary algorithm and based on preset performance criteria - to generate preliminary observation schedules that are eventually provided to the user. The paper presents in detail the software architecture and its functionalities, and shows the results provided in typical use cases.