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SENSIT: A SOFTWARE SUITE FOR OBSERVATION SCHEDULING AND PERFORMANCE ASSESSMENT OF SST SENSOR NETWORKS

Abstract

The ability to simulate the behavior of different sensor configurations is critical for the development of a sensor network that provides data for Space Surveillance and Tracking (SST) services. Any software suite devoted to this shall be able to assess the performance of existing networks in terms of effectiveness and robustness, as well as to estimate the effects of structural changes, such as the addition or the upgrade of sensors. This paper is devoted to describing how SΞNSIT tackles the above problem. SΞNSIT (Space Surveillance Sensor Network SImulation Tool) is a software suite designed to perform an analysis of the observational and cataloging capabilities of a sensor network. The software can model optical, radar and laser ranging sensors and simulate different operational scenarios. The user shall define the sensors composing the network and a population of space objects. Typical sensor properties that can be set include type, mode (survey/tracking), location, accuracy, pointing constraints, detectability limits and operating hours. Inputs are processed to predict transits that can be observed by each sensor. This allows to assess the network capabilities in terms of catalog coverage: the sensors are compared against each other to identify overlapping in the sets of observable objects and estimate the level of complementarity or redundancy. Afterwards, the tool can simulate the operations of the network. First, an observation schedule is compiled, using an optimization algorithm based on tunable criteria. This removes overlaps caused by objects passing at the same time. Then, the software simulates and processes the measurements gathered during passes, carrying out orbit determination, aiming at assessing the network capability in terms of catalog build-up and maintenance. The results are proposed in tables and graphs with different levels of detail, starting from a general performance overview up to the list of the passes. The user can also browse the object catalog of the network and analyze its evolution. Moreover, the tool allows to export intermediate data, such as the observable passes, the optimized schedule, and the pointing requirements.

The modularity of the software grants easy modification of the properties of the network, to carry out a sensitivity analysis to different parameters. This is expected to ease the setup process of sensor networks for SST, as well as the identification of the most promising upgrades to be recommended. The paper presents in detail the software architecture and its functionalities, and shows the results provided in typical use cases.