20th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 20th IAA SYMPOSIUM ON SPACE DEBRIS (IP)

Author: Mr. Luca Facchini
Politecnico di Milano, Italy, luca.facchini@polimi.it

Mr. Giovanni Purpura
Politecnico di Milano, Italy, giovanni.purpura@mail.polimi.it
Mr. Andrea De Vittori
Politecnico di Milano, Italy, andrea.devittori@polimi.it
Mr. Riccardo Cipollone
Politecnico di Milano, Italy, riccardo.cipollone@polimi.it
Dr. Pierluigi Di Lizia
Politecnico di Milano, Italy, pierluigi.dilizia@polimi.it
Dr. Mauro Massari
Politecnico di Milano, Italy, mauro.massari@polimi.it
Dr. Alessandra Di Cecco
Agenzia Spaziale Italiana (ASI), Italy, alessandra.dicecco@asi.it
Mr. Luca Salotti
Agenzia Spaziale Italiana (ASI), Italy, luca.salotti@asi.it

GA-BASED OPTIMAL TASKING FOR SST SENSOR NETWORKS IN THE SENSIT TOOL

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. 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. First, the user shall define the locations and the characteristics of the sensors, and the orbital parameters of the space objects to consider in the analysis. The software processes the inputs to predict the transits that can be observed by each sensor. In general, more than one object can be observed at a given time, therefore the tool compiles an optimal observation schedule according to tunable criteria. The optimization process is heuristic, based on a genetic algorithm, which operates on a population whose individuals are different schedules. The genetic operators (cross-over and mutation) feature overlap checking, ensuring that the schedule is always free of conflicts caused by objects transiting at the same time. The algorithm iteratively selects the best schedules according to a customized fitness function, ensuring that the final schedule is suited to the user requests. The schedules can be exported and provided to sensor operators in the form of lists of passes to observe. Alternatively, they can be processed for further analyses. Specifically, the tool can simulate the operations of the network: starting from the schedule, it generates and processes the measurements gathered during the passes, and carries out orbit determination, aiming at assessing the network capability in terms of catalog build-up and maintenance. The software proposes the results in tables and graphs with different levels of detail. This paper briefly introduces the architecture and the main features of the software, then it shows the results provided in typical use cases. Several sensor networks are simulated, and different schedules are generated, each optimizing specific combinations of criteria, such as the elevation of the objects, their distance, and the duration of the observed passes. Then,

the correspondence of the obtained schedule with respect to the given requests is checked and compared to unoptimized lists of randomly selected passes, and the resulting performances in terms of cataloging capability are estimated.