

## **Attività relative al servizio:**

### **“Enhanced SST services through data sharing and networking”**

#### Introduction

Given the increasing number of space objects orbiting around the Earth, the in-orbit overcrowding is posing many challenges that the space agencies, institutions and private companies are worldwide tackling. Since the starting of the space activities, about 6500 successful launches have taken place, for which approximately 16990 objects have been placed into Earth orbit. Among these, 11500 are still orbiting, but only 9000 are active satellites. Furthermore, about 640 break-ups, explosions, collisions, or anomalous events resulting in fragmentation have been recorded.

Those events have further contributed to the increase of the man-made objects orbiting population. As a result of that, 35110 debris objects are regularly tracked by space surveillance networks and maintained in their catalogues. In addition to them, statistical models estimate that there are 36500 objects greater than 10 cm, 1 million objects between 1 cm and 10 cm, and 130 million objects between 1 mm and 1 cm. In particular, the presence of space debris may jeopardise the operative mission of active satellites, as the consequences of a possible collision with a space debris ranges from cumulative erosion of satellite surface to possible catastrophic aftermaths for the satellite.

In this context, both national and international Space Surveillance and Tracking (SST) programs were established, such as the United States Space Surveillance Network (US-SSN), the European Space Agency (ESA) Space Situational Awareness (SSA) program and the European Union Space Surveillance and Tracking (EUSST) framework. The latter groups European national agencies and institutions from 15 member states and is in charge of carrying out the following services: collision avoidance, fragmentation analysis and re-entry prediction. These services exploit orbital ephemerides obtained through Orbit Determination (OD) procedures, which exploit measurements obtained through ground-based sensors, represented by optical, laser and radar means.

#### Objective

Within the scenario described above, INAF is involved in the observation of orbiting objects through its optical and radar sensors within the European EUSST network. To provide an ever greater contribution, we want to develop activities (target of this contract) for two specific purposes:

- The development of tailored algorithms for the characterization of resident space objects observed by the sensors, with the aim of optimizing sensor tasking and enhancing data processing through data sharing and sensors cooperation;
- The establishment, in the frame of fragmentation events, of operational and networking procedures to optimally task sensors, to safely link different uncorrelated measurements to the same target and to maintain the resident space objects catalogue with new acquisitions.

Regarding the first activity, algorithms of general applicability should be developed, both to enhance the orbital state estimation quality and to exploit the signal profile acquired by the sensors to estimate the Radar Cross Section (RCS) and the tumbling period of the target.

The derived information will be shared in the database and dispatched to all National Operation Centres (NOCs), by guaranteeing the possibility to coordinate a global tasking strategy and the association of measurements acquired by different sensors.

Concerning the second activity, the peculiarities of the fragmentation events and the fragments cloud dynamical evolution should be exploited to optimally task sensors to detect and monitor the

fragments, targeting regions with higher predicted density in terms of number of fragments. Coordinating all the network sensors would allow scanning the most promising regions, resulting in denser and prompt data collection, and better event characterization.

#### Deliverables requested

- Report describing the results of the study concerning the resident space objects characterization, by possibly including application on real data.
- Report describing the operational and networking procedures to manage the observation data acquired by the EUSST sensors during fragmentation events.