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TECHNOLOGIES PAVING THE WAY TOWARD SPACE DEBRIS OBSERVATION NETWORK IN  
SUPPORT OF SPACE TRAFFIC MANAGEMENT

**Abstract**

Modern society relies on satellites for communication, navigation, weather forecasting, and many other important functions. However, they are also vulnerable to collisions with other objects in space, such as debris or other satellites. The number of launched satellites per year is continuously increasing together with the amount of space debris in space created through fragmentation events. To ensure the safe and responsible use of space for all users it is important to identify potential collisions and track debris to provide warnings to satellite operators and allow them to take steps to mitigate the risk and avoid collisions. Space Surveillance and Tracking activities are therefore fundamental for protecting the assets and infrastructure that rely on space. ESA, within the Space Safety Program (S2P), is also contributing to the development of related technologies. In this paper the current progress will be presented focusing on the recent developments to support both LEO and GEO space traffic management (STM) focusing on both, active and passive, optical techniques. We will present main use cases (such as collisions, cataloguing, fragmentation, re-entry, manoeuvre and payload separation confirmation) and the proposed solutions for the establishment of space debris tracking networks. The increased space debris tracking capabilities and the diversification of the tracking techniques, together with the increasing number of objects urges as well for the development of more robust data processing approaches which ESA is also currently fostering through the Space Safety Programme. Finally, looking ahead, for future active debris removal and in-orbit servicing missions, we will present the recent outcomes on space debris characterization exploiting the light signatures of the observed objects.