

Workshop Summary

Space Surveillance and Tracking for Spacecraft Operations – Connecting the Dots between Modelling, Design and Practice

Virtual on MS Teams, May 22, 2024; organised by OKAPI:Orbits and ESA; 3 hours duration; 124 participants

Introduction

The new ESA Zero Debris design and operation requirements, applicable to all ESA missions, introduce many new and challenging aspects to be addressed in early mission design. For spacecraft operated in the protected LEO or GEO region, the orbit determination accuracy shall be estimated and is required to stay within specified limits. The goals of this workshop were:

- to introduce to the community the available tools and models to assess the impact of observing networks on space missions;
- to discuss the accuracy of orbit determination and tracking approaches;
- to raise awareness of the community's members and different roles; and
- identify key areas of potential collaboration towards a better characterisation of key ground- (and space-) based assets in view of the requirements.

Conclusions

The workshop began with a short introduction into ESA's Zero Debris policy and related work on the development of supporting tools in the context of compliance verification. A few highlight talks further shaped the context and identified relevant points of discussion, which involved all participants and was moderated and structured with the help of Mentimeter.

One of the first discussion points was the policy's need to perform risk analyses on all objects of the **space debris population larger than 1 cm**. A major problem is that a substantial share of those objects is lethal (in terms of mission-terminating upon impact) yet non-trackable (LNT) with today's technology. It was emphasized that there is the ambition to significantly lower the sensitivity limit to, ideally, cover the entire domain of LNTs. While 1 cm appears as a proxy in today's standards, it sets a goal of what is to be the intended sensitivity limit to address the LNT risk.

An important aspect to increase confidence in assessed orbit determination accuracy and tracking capabilities, as well as system simulations thereof, is captured by the term **covariance realism**. A main point raised by the operators community is the lack of commonly shared ephemerides and spacecraft anomalies relevant to safe operations and during close approaches. Best practices have been formulated, but still lack adoption. The participants shared the view that ephemeris sharing is a bare minimum to be done by operators.

The **benefits of sharing** are recognized widely within the community when it comes to build a comprehensive and homogeneous space object catalogue, given especially the heterogeneity of existing sensor networks and approaches in spacecraft operations, as well as a variety of different data providers.

Working towards such complementary solutions requires a **well-balanced setup** consisting of "expert centres", e.g. to support sensor calibration or model validation, entangled with more decentralized architectures to cater to different existing flavours, standards, and practices.

References

1. Decentralized governance: <https://www.spacedao.ai/references/>
2. Technical library by COMSPOC: <https://comspoc.com/research/technical-library>, therein:
 - a. #339 “Deep Operator and SSA Collaboration for Space Sustainability”;
 - b. #239 “Results of comprehensive STCM data fusion experiment”
3. Download of DRAMA and MASTER software, as well as many related documents: <https://sdup.esoc.esa.int/>