IAF SPACE OPERATIONS SYMPOSIUM (B6)
Ground Operations - Systems and Solutions (1)

Author: Mrs. Elke Gross
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

Dr. Matthias Dauth
DLR (German Aerospace Center), Germany
Dr. Thomas Fruth
DLR (German Aerospace Center), Germany
Mr. Andreas Petrak
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
Dr. Falk Mrowka
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

SCOTA – THE MISSION PLANNING ORBIT ANALYSIS TOOL AT GSOC

Abstract

Spacecraft operators always strive to maximize a mission's output. A key to tapping the full potential of a mission is to arrange a mission's timeline in an optimal way based on all possible events of a spacecraft. Example events are up- and downlink opportunities, shadow phases during which batteries cannot be charged, or when an area of interest is in the field of view of a sensor.

Since 2010 the SpaceCraft Orbit and GroundTrack Analysis Tool (SCOTA) provides the automated Mission Planning systems with event information. This is done with a single code base for multiple low-earth orbit missions flown at the German Space Operation Center (GSOC).

A central requirement to SCOTA is to be versatile in functionality and to provide multi-tenancy. The TerraSAR-X mission with its unique radar instrument and precise pointing requirement mandates, for instance, the use of a digital elevation model for calculations. However, basic support has to be available for missions with a lower budget without adaptations to the code base itself. To serve both needs, one of the design principles of SCOTA is to strike a balance between being highly mission specific while remaining generic. We achieve this by providing a generic library of reusable code that has a modular structure, a high level of abstraction, and is easily extensible in functionality. As an example for such multi-tenancy, SCOTA is agnostic to the input of orbit data. Orbit data from TLE propagation, external services (e.g. GSOC internal Flight Dynamic Services [1]), or ephemeris files can be easily exchanged via a simple configuration, and orbit information is available through a common interface to all components of SCOTA.

This paper gives an overview on SCOTA also evaluating it in the context of other internal and external orbit event calculation tools. It first covers SCOTA's multi-mission requirements and how the software evolved to meet changing requirements, including a focus on its maintainability over time and testing. Second, its layered architecture is described: This includes basic libraries (e.g. math and geodesy), core orbit analysis functionality, as well as an extensive application layer that enables to use SCOTA through the API itself or a command line interface (XML), or to embed it as a micro-service through a REST API (JSON) or an ActiveMQ broker (XML). The third part then presents a set of selected SCOTA features in more detail, e.g. the possibility to reuse existing algorithms for new tasks. Specifically, events such as earth target visibilities or ground station contacts share the same basis and can be implemented by only adapting a few lines of code. Moreover, the application layer has access to all SCOTA building blocks and pre-defined events to efficiently implement new customized events.

References: 1. Hackel, S. et al (2018) - "Flight Dynamic Microservices"; 69th International Astronautical Congress (IAC), Bremen, Germany, 1-5 October 2018