SPACE SYSTEMS SYMPOSIUM (D1)
Hosted Payloads - Concepts, Techniques and Challenges, Missions and Applications (7)

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A MODEL-BASED SYSTEMS ENGINEERING APPROACH TO DESIGN GENERIC SYSTEM PLATFORMS AND MANAGE SYSTEM VARIANTS APPLIED TO MASCOT FOLLOW-ON MISSIONS

Abstract

A closer look at future mission planning of space agencies all around the globe strongly suggests that in the coming years missions to small bodies in general and NEOs in particular will be gaining more and more importance in our strive to enhance our understanding about the origin and history of our solar system. One of such missions is the Japanese Hayabusa-2 mission, launched in December 2014, realized by the Japan Aerospace Exploration Agency (JAXA), currently on its way to its target destination: the asteroid 1999 JU3. Onboard is a small landing package called MASCOT – Mobile Asteroid Surface Scout, which has been developed by the German Aerospace Center (DLR) cojointly with the French Centre National d'Etudes Spatiales (CNES) as a scientific add-on capability for the main mission.

In a nutshell, the MASCOT lander is an extremely lightweight (around 10 kg), highly integrated mobile small body landing system with onboard autonomy which now, after having been launched may serve as a benchmark for future applications.

Now at DLR we are carrying forward the idea of more generic MASCOT variations to be developed for future possible follow-on missions. The focus here is on the advancement of the design from the dedicated lander MASCOT, to a generic instrument carrier, which would be able to deliver a variety of P/L combinations on different mother-missions to different target bodies. From a systems engineering and methodological point of view, several aspects come into play here: (i) the reuse of knowledge from MASCOT, e.g. from the various studies performed at the DLR Concurrent Engineering Facility in Bremen as well as from the hardware-intense phases, to reduce development time and cost of follow-on missions. (ii) The systematic analysis of the system platform architecture with respect to its ease of generalization and standardization and its ability to create enough variety (to fulfill a multitude of science scenarios) while maintaining enough commonality (to keep non-recurring cost low).

Specifically, in this paper we will discuss an approach to designing a small body landing platform supported by MBSE methods and tools. For that purpose, we have established a model of the MASCOT system using the SysML language and have evolved it into a generic platform model, which can be used to derive variants. We will furthermore describe benefits and pitfalls when re-using the model in the face of new missions, e.g. when performing requirements engineering, interface management and system capabilities analysis.