SPACE SYSTEMS SYMPOSIUM (D1)
System Engineering Tools, Processes and Training (2) (6)

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CUSTOMIZED SCIENCE PAYLOAD SIMULATOR FOR A PARTICULAR MISSION (ESA'S BEPICOLOMBO)

Abstract

One of the core objectives of any scientific space mission is maximizing the scientific outcome. A key activity to this is to carry out a determined mission and system analysis beginning at early stages of a space project. In phase 0 and A, it starts with destined estimations about mission conditions and essential system requirements and continues with further refinement in the succeeding phases B and C/D. During these phases, the responsible institution is in charge to bring numerous verifications to assure the compliance of the spacecraft with the mission specifications and thus the scientific objectives. This is a time-consuming and iterative process in particular in the early project phases, meanwhile several configurations have to be tested and decisions on various trade-offs need to be approved.

These tasks are supported by a variety of software tools, which generally provide a very detailed but isolated view on specific subsystems. For system and mission simulations generic solutions may be available that need to be customized with some effort. This paper describes another approach of a customized science payload simulator, which has been chosen for the ESA mission to Mercury, BepiColombo. In this project, the simulator is developed from scratch and in parallel to the actual spacecraft and therefore takes several aspects of mission and system simulation into account. It comprises customized models of all mission relevant subsystems and environmental conditions, which are defined by experts from the special departments of the spacecraft manufacturer. If appropriate, these models are broken down to simplified versions for reasons of real-time capability and are calibrated with the complex subsystem models. The model parameter can be changed at run-time and different configurations can be tested. The results are immediately available via real-time charts, data tables and a graphical output that allows arbitrary points of view on the scenery. At each time, the tool represents the state of development of the mission. System level conflicts between the different subsystems and the potential impact on payload can be identified at an early stage, which can support the system harmonization.

This paper points out the benefits of the dedicated tool regarding the inter-phase and inter-disciplinary communication that occur within a space project by providing a system view on the platform and payload. Furthermore it focuses on acceptance, efficiency and learning aspects within the project team and highlights current and aspired applications in science operations.