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MODEL-BASED SYSTEMS ENGINEERING APPROACH FOR THE DEVELOPMENT OF THE SCIENCE PROCESSING AND OPERATIONS CENTER OF THE NASA OSIRIS-REX ASTEROID SAMPLE RETURN MISSION

Abstract

The Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) asteroid sample return mission, which is planned for launch in 2016, will study and return a sample from asteroid Bennu to Earth for further detailed analysis. This mission is unique in that little information about Bennu, including the gravity field, shape model, and thermal environment, is well-known at this time. This information will instead be determined via a thorough close-proximity operations phase that will fully characterize and analyze the asteroid prior to retrieving the sample, requiring a complex ground system architecture in order to provide scientists the necessary information to make key decisions regarding sample collection. Importantly, the OSIRIS-REx Science Processing and Operations Center (SPOC) is at the heart of the process to characterize the asteroid and collect the sample, as its high level functions include the data processing necessary to fully analyze the information from the spacecraft and generation of the instrument observations sequences to collect the necessary data. These factors necessitate a strong systems engineering focus across the project.

The SPOC team has chosen to tackle this problem by utilizing a Model-Based Systems Engineering (MBSE) approach to facilitate the development of the OSIRIS-REx ground system, and more specifically, the SPOC. MBSE is a relatively new approach that formally applies modeling to support system requirements, design, analysis, and verification and validation activities, and only recently been used in the development of the ground system of a space mission. As such, this approach has been lauded in key mission reviews as a significant strength of the project, especially for its ability to provide a consistent approach for the entire ground systems team.

Importantly, the MBSE approach has provided many benefits to the SPOC systems engineering team. In particular, the MBSE approach has been utilized to generate a consistent architecture across all Ground System Elements, to manage all OSIRIS-REx Ground System requirements easily in one location, to perform verification and validation of these requirements, and to validate the ground system operations timeline. Further, through the use of common tools, project systems engineers can quickly and efficiently generation documentation based on the developed model, including interface, requirements, and verification documentation. Finally, these same tools allow for the potential future reusability of the development currently being performed for use in future mission architectures.