IAF SPACE SYSTEMS SYMPOSIUM (D1)
Systems Engineering Modeling and Analysis (5)

Author: Mr. Giacomo Luccisano
Politecnico di Torino, Italy

Dr. Sophia Salas Cordero
ISAE-Supaero University of Toulouse, France
Dr. Thibault Gateau
ISAE-Supaero University of Toulouse, France
Prof. Nicole Viola
Politecnico di Torino, Italy

FORMALIZATION OF CUBESAT DATA AND MISSION PARAMETERS THROUGH SYSML FOR PRELIMINARY DESIGN

Abstract

During the past two decades, the Space Industry has witnessed a constant evolution, primarily represented by a continuous increase in the number of operational satellites and market value with for instance CubeSats. This period has been marked as well by a pivotal shift from traditional Document-Based System Engineering to Model-Based Systems Engineering and Concurrent Engineering approaches, a transition led by both Industry and Academia. This shift responds to the increasing demand for innovative space technologies, and the necessity to accelerate design processes and lower costs.

The modeling of systems is a complex endeavor. Particularly, as design team projects seem to always start from zero during the Preliminary Design Phase (Phases 0/A according to ESA's nomenclature). System models should also ideally be integrated with different external simulation tools. To this date, many issues arise when trying to tackle this integration in the order of syntax and semantics. How to effectively formalize and exchange data during the Preliminary Design phase? - This is one of the open questions that this paper addresses.

This paper presents the first efforts of the development of an open-source initiative for the modeling of CubeSats starting from the Preliminary Design studies[1]. The generic CubeSat model is generated using SysML and enhanced through UML stereotypes for efficient data storage and visualization. This proposal can allow the model to interact with a range of simulation and analysis tools, positioning the CubeSat SysML model as the central source of truth for data throughout the Preliminary Design process. This centralization can be a key factor in automating trade-off analyses, leveraging the full potential of SysML benefits, and ensuring effective data use throughout all Preliminary Design stages.

The proposed formalization is to be integrated into the Nanostar Software Suite (NSS) constellation. The NSS is an open-source software framework that aims to streamline data exchange between different domain-specific software during Concurrent Engineering sessions. This paper presents an illustrative use case of how this formalization can be applied to the design of a small generic satellite mission.

Keywords: Systems Engineering, Model-Based Systems Engineering, SysML, UML, Preliminary Design, CubeSats

---

[1]Code is open-source, available on a public repository:
https://gitlab.isae-supaero.fr/preliminary-design/mbse-cubesat-sysml