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Space Systems Engineering - Methods, Processes and Tools (1) (4A)

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MISSION-AWARE DIGITAL CONTINUUM IN SYSTEMS DESIGN WITH DATA-DRIVEN SYSTEMS ENGINEERING AND DIGITAL MISSION ENGINEERING

Abstract

Digital Engineering has transformed conventional industry sectors with a significant increase in efficiency throughout the life-cycle. In the space sector, it is still a dormant possibility due to the complexity of the systems involved. With increasing systems complexity and the expected decrease in time-to-orbit, the space systems design processes of the future need a paradigm shift. In this work, the critical problem of closely connecting mission design and analysis with the systems design process is tackled. Considering the complex interaction and data flow between system and mission models in typical design iterations, a digital integration framework is formulated that brings together the principles of Data-driven Systems Engineering (DDSE) and Digital Mission Engineering (DME) enabling digital continuity across disparate models. In collaboration with Valispace and Analytical Graphics Inc. (AGI), the integration is developed between Valispace and AGI's Systems Tool Kit (STK) platforms. Valispace's DDSE platform empowers complex hardware development with collaboration and persistently linked models at a component level by giving teams a single source of truth to work from. AGI's STK, a proven DME platform enables multi-domain analysis, planning, and design at a mission level.

The integration framework presented combines these elements to provide digital continuity in the complex design space with auxiliary automation of repetitive high and low-level tasks. Ensuring necessary control and traceability, the integration framework maintains persistently linked models throughout the lifecycle. The framework is implemented as a software plugin which interfaces with both Valispace and STK. The plugin is tested on a preliminary case study on the design of a geostationary transfer mission with representative objectives and indicative tasks. The integration plugin shows objective improvements in terms of design reconfiguration time, model consistency and manual interference during the design process. By projecting these results to the entire lifecycle, we posit that the respective tools along with this integration framework have the potential to deliver an unprecedented level of agility, quality, and efficiency in space systems development.