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DYNAMIC SYSTEM SIMULATION OF SMALL SATELLITE PROJECTS

Abstract

At the Institute of Astronautics of the Technische Universitaet Muenchen a modular approach for modeling and dynamic simulation of satellite systems has been developed. This method called Dynamic System Simulation (DySyS) is used to model and simulate the dynamic behavior of a small satellite.

A dynamic system simulation can greatly improve the development process of a satellite. Computational simulations can be performed in an early stage of the development process to gain deeper insights into the system performance. Without having any hardware under test, design flaws can be detected and eradicated. With a dynamic simulation it is possible to test the spacecraft design with respect to the requirements to ensure that the performance will satisfy all needs. A wide range of simulation tools is available to conduct simulations for every special purpose, as there are for example: mission analysis and orbit simulation, structural and thermal analysis, or attitude and control simulation. All these tools are specialized on a certain aspect of the system. None of those tools is able to model and simulate the entire system even though many system details are similar in these separated simulations. In contrast a system simulation will incorporate many aspects into one simulation. Thus it comprises the interactions and influences between the different system aspects and its corresponding dynamic behavior.

A prerequisite to accomplish a system simulation is to have a system model holding all necessary information. A system model is able to store all information describing the project in a centralized repository that can be accessed and edited by all parties involved. Small satellite projects can act as a precursor to demonstrate the feasibility of a system model since they are less complex compared to large scaled satellite project.

The proposed new modeling method is based on the platform independent description language SysML to model a small satellite project with respect to the system composition and dynamic behavior. A metamodel has been defined that holds a kit of specified building blocks and possible relations between these blocks to represent the composition and dynamic behavior of a satellite system. From this kit a system model of the satellite of interest can be created. A mapping of this model into a C++ simulation allows the creation of an executable system model. With this executable model several simulations are performed to observe the dynamic behavior of the satellite system in a simulated environment.