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A GENERAL CONCEPTUAL MODEL FOR LAUNCH VEHICLE DESIGN AND ANALYSIS

Abstract

In this paper, we present LCM, a conceptual model for launch vehicles. LCM describes static configurations of launch vehicles and their dynamic flight missions. Launch vehicle design, simulation, and analysis tools can utilize this model to improve flexibility. The importance of a standard launch vehicle data model to unify data interfaces between different disciplines has long been addressed. The aim of LCM is not only to provide a common data presentation language, but also to provide a basic mechanism of reusing common analysis methods among different launch vehicle configurations. Launch vehicles are often developed in a series of configurations, differed by the number of stages, boosters, engines, etc. In analysis tasks such as conceptual trade studies, the number of configurations that are analyzed often reaches hundreds. Analysis tools has to cope with all possible configurations in a general way, but it is not easy, especially when dealing with new design patterns such as propellant cross-feed. If not built in a systematical way, the tools are prone to software maintenance problems. In an LCM model, static and dynamic components of a launch vehicle design are defined in a general way, data structures are standardized for each component. According to the model, analysis tasks can be easily broke into smaller units, which can be performed by general algorithms. A key problem in software architectural design of analysis tools, the decoupling of volatile launch vehicle configurations and general analysis algorithms, is resolved. This enables analysis tools to be flexibly applied to a variety of launch vehicle configurations, and improves software quality.