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SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Space Technology and System Management Practices and Tools (4)

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MDO TECHNIQUES INTEGRATED WITH SYSTEM MODELING FRAMEWORK: MBSE METHODOLOGIES APPLIED TO SPACE SYSTEM DESIGN AND ANALYSIS

Abstract

This paper presents the results of a research study related to the integration of a Design Optimization Framework in a Model Based System Engineering (MBSE) environment. The main aim of this work concerns the feasibility of such connection in order to assess actual advantages and possible drawbacks. The objective is to show how the Multidisciplinary Design Optimization (MDO) methods may be managed in the context of a MBSE environment with respect to the traditional design approach. Basically this analysis is addressed to the demonstration of the benefits of MBSE methodology in the field of aerospace engineering. In particular the design of a Space System and the related Mission Scenario is evaluated through the support of the proposed framework. Different system configurations are defined and evaluated with the final objective to identify which solutions show the better behavior with respect to the same boundary conditions. The state of the art of the considered methodology is briefly introduced in the first part of the paper where also a survey on the main MDO architectures is reported. The following part concerns the description of the modeling activities that have been used to define system characteristics. System data model is defined through a Domain Specific Language (DSL) on the basis of MBSE paradigm and managed through a web application tool. In this section the focus is on the definition of conceptual relationships between the objects involved in the modeling activities. This part allows to assess how a web service can be used to support concurrent engineering activities. In the following part is described how a design optimization functions are integrated within the proposed framework to verify if possible advantages can be obtained. In particular the evaluation of framework benefits concerns mainly the management of system configuration options and the possibility to trace their evolution throughout the design phase. A reference case referring to the space system application is presented in the following section to show how the analyzed modeling tool can be used on a project development. In particular different primary structures and electrical configurations are modeled and simulated to evaluate system performances. The related results are then reported to assess how different optional solutions of a complex system can be properly managed, reducing the possibility to neglect optimal configurations. A comparison between the MBSE proposed approach and the traditional one is then introduced in the final section to highlight benefits and drawbacks.