SPACE SYSTEMS SYMPOSIUM (D1)
System Engineering - Methods, Processes and Tools (1) (3)

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A MULTI ATTRIBUTE COLLABORATIVE TRADESPACE EXPLORATION APPLIED TO CONCURRENT DESIGN

Abstract

Nowadays space systems are becoming more complex, dynamic, interconnected and automated. Because of these trends and the increasing involvement of stakeholders, the decision makers are facing with difficult decision. Despite the fact that most of the costs are expended in the latest phases of the space mission life cycle, the majority of them are driven by the choices taken during the earliest design phases, which is also characterized by the lowest level of knowledge about the system. For these reasons several design approaches have been developed and studied. With respect to the classical sequential one, a promising alternative design approach is offered by Concurrent Engineering, in which the design method provides better performances, taking full advantage of modern information technology. In this scenario, the complete design team, composed of the various technical domain specialists, starts working concurrently on the different aspects of the project at the beginning of the design process. A potential technology for improving the design performances can be found in the so called Multi-Attribute Trade-space Exploration (MATE). The purpose of MATE is to capture decision maker references and use them to generate and evaluate a multitude of system architectures, with respect to the stakeholder values but without considering the multidisciplinary nature of complex systems. On the other hand, a well suited method used in a practical multidisciplinary design environment, such as space systems design, can be found in the Collaborative Optimization (CO). The key concept in the CO is to decompose the design problem into two levels of optimizations, the discipline level and the system level, supporting disciplinary autonomy while maintaining interdisciplinary compatibility. This paper describes the system engineering principles, models and tools, followed by an analysis of the benefits involved in the trade-space exploration and the multidisciplinary optimization methods. In addition, a hybrid methodology will be proposed, which merges the Multi Attribute Trade-space Exploration and the Collaborative Optimization within the concurrent design environment. This methodology, integrated into the spacecraft system engineering leads to a faster design process and aims to maximize the utility of the system within the subsystems optimization study. Importance is given to the coupling of design variables between the different disciplines, reaching a concurrent friendly and value driven design in the early design phases.