

SYMPOSIUM ON INTEGRATED APPLICATIONS (B5)  
Tools and Technology in Support of Integrated Applications (2)

Author: Mr. Guido Ridolfi  
Politecnico di Torino, Italy

Mr. Diego Cardile  
Politecnico di Torino, Italy

Dr. Erwin Mooij  
Delft University of Technology (TU Delft), The Netherlands

Prof. Sergio Chiesa  
SPAIC srl, Italy

Mr. Giorgio Ferrari  
Thales Alenia Space Italia, Italy

A SYSTEM-OF-SYSTEMS APPROACH FOR THE CONCURRENT DESIGN OF SPACE MISSIONS

**Abstract**

The design of space missions has experienced a trend of increasing complexity in the last decades, resulting in the design of very complex systems of multifaceted nature working together to meet the requirements. This increased complexity needs to be balanced with a radical change of current design methodologies. With the objective of supporting the design team and the decision-makers during the design of complex systems, the authors developed a modeling framework for a particular category of complex coupled space systems called System-of-Systems. A system-of-systems is formed of several interacting elements and sub-elements whose overall behavior is usually different than the sum of the effect of the single elements. The system-of-systems modeling framework has been designed in a modular and expandable fashion, using an object-oriented paradigm. This allows for an efficient flow of information between all elements. The systems and the elements, which take part in a particular mission scenario can be created and linked together at run-time by the user, who's only required knowledge is on the interfaces between the elements and systems. This paper describes the developed system-of-systems modeling framework with particular focus on the modular software architecture that has been obtained. Further, as an example of the utilization of the modeling framework, detailed information on a hypothetical space exploration scenario is provided. In particular, the paper describes the mathematical models of some of the building blocks, which are linked together to fulfill the mission requirements. The developed system-of-systems modeling framework enables rapid modeling of complex, coupled systems, allowing the user to generate the system of interest and to explore the overall performance. The methodology, which allows the exploration of the design-space to search for the best compromises between objectives and constraints, based on the mathematical models implemented in the modeling framework, is described in a separate paper.