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Author: Prof. Leonardo Oliva
Instituto Federal de Educação, Ciência e Tecnologia de São Paulo – IFSP, Brazil

CONCEPTION OF A MICROSATELLITE SUBSYSTEM USING MULTI-PARADIGM MODELLING AND MULTIDISCIPLINARY COLLABORATIVE ENVIRONMENT

Abstract

Aerospace systems have complex nature due to a strong interdependency between its subsystems – that must be evaluated and optimized progressively during its lifecycle through experience (historic data) and context modification (mission, environment, inputs) in models. To this extent computer and communication technologies offer an increasing relevance, since systems engineering, design and simulation teams often work in different locations and have diverse technical backgrounds, using multiple approaches and tools to develop, evaluate and validate systems.

This work presents computational models based on different approaches that allow subsystems mapping, using model selection/fusion through a collaborative approach. The models developed use two main approaches: power and information flow. The first may embrace multiple physical domains such as mechanical, hydraulic and thermal, and is proper to represent physical phenomena that are governed by cause-effect law. The second is characteristic of pure information systems such as electronic devices and control laws. Remote Component Environment (RCE) developed by German Aerospace Institute, DLR, is the software adopted for tool collaboration.

As a case study it will be conceived a microsatellite system. Based on System Engineering concepts and specific literature, general requirements are captured. They allow geometry and inertial parameters determination. From this point on an Attitude Control System (ACS) is modelled, taking in consideration its main features and interdependencies (e.g. inertial properties, attitude dynamics, propulsion and external torques).

The collaborative environment allows greater integration and dynamism in the development chain of systems whose most influent phenomena present complex structure. It's possible to list three advantages this environment presents compared to methods (still) in use: (a) oriented search based on author, department, model domain, model type, simulation platform; (b) visualization of simulation results between all nodes inserted in the collaborative network; (c) tool execution from remote locations using all nodes involved in the process. The first one is possible through a common reusable model library, that links model timeline history, model characteristics and model developers; the second one gives all network nodes (tools) the information they may need to build / improve / change their particular models, considering new restrictions (subsystems and/or requirements changes) and goals (general development); the third enables anyone (in the network) to run an interrelated simulation. In other words, making use of other related tools – through multiple executions.

The conclusions of this work highlight concrete advantages in using collaborative development and different representation approaches in systems representation.