VTi –
Virtual Testbed iBOSS

DLR

VTi

Overview

In order to cope with the technical complexity of modular satellites the iBOSS development methodology heavily uses simulation-technology providing simulations at system level which are still detailed on component level. The basis for this simulation-based systems engineering approach is the Virtual Testbed for iBOSS (VTi) covering all relevant aspects in the life-cycle of a spacecraft from the very first design studies up to on-orbit operation, assembly and servicing. Combining state-of-the-art Virtual Reality and 3D simulations techniques it supports customers and engineers developing and designing new components and satellites, and eases the communication with decision makers in government and industry organizations by integrating technical with economic arguments.

State-of-the-art simulation techniques

The VTi combines simulation models for all relevant physical aspects of the environment (orbital mechanics, multibody dynamics, solar energy input, etc.) with simulation models of the satellite components themselves (building blocks, mechanical interfaces, sensors and actuators, etc.) and control algorithms (robot control, attitude control, etc.). To provide reliable predictions, all simulation models are verified, validated, calibrated and adjusted. To this end, various reference experiments compare the results of physical and virtual mockups.

Simulation-based verification and validation

The resulting iSAT operates in a verified Virtual Testbed providing a simulated environment with various operational scenarios covering all mission-phases, operational conditions, fault situations etc. The success of those tests is a sine qua non for building physical components.

Comprehensive decision support

In all phases of the life-cycle, the VTi can be used for decision support and optimization. Satellite structure, satellite and robot trajectories or their combination can be optimized e.g. for optimal overall mission performance, minimal energy consumption or satellite temperature. Different options can be analyzed and compared concerning their overall risks and costs.

Seamless transition between virtual and physical iSATs

For a seamless transition between the virtual and physical iSAT, the VTi allows for the integration of physical components into a virtual iSAT and provides the necessary test stimuli in a hybrid (real/virtual) test setup. Virtual substitutes for missing components of the physical iSAT can be added at any time.

Integration in iSAT development

Starting with the very first development stages, the VTi provides a fully-functional digital twin of the system and its designated environment. It is used for development and test throughout the entire development process, allowing to continuously analyze and optimize the satellite's design and performance. This way the VTi closes the gap between design, production and test because first (virtual) tests and verification activities can be done already in early design phases. During later phases each part of the satellite is developed against the digital twin of the iSAT.

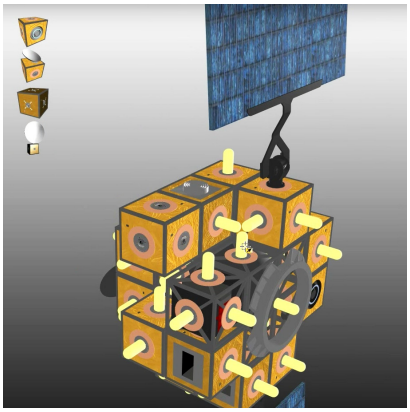

Fig. 1: Manual configuration of an iSAT using the VTi

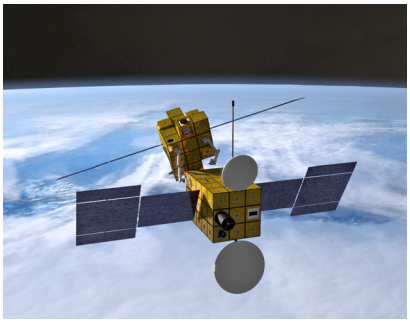

Fig. 2: High-End 3D rendering of an on-orbit servicing scenario simulation

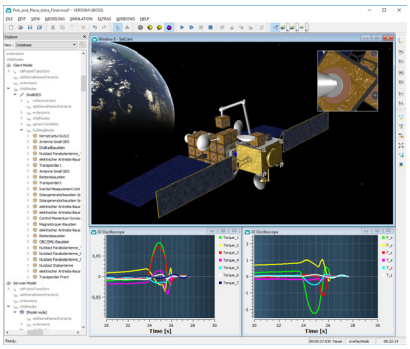

Fig. 3: User interface showing 3D visualizations and detailed performance data while running a simulation

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DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

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