SESP 2010

Session:	Session: Modelling Frameworks (11)
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Date:	Wednesday, September 29, 2010
Time:	11:30 - 13:00
Room:	Newton
Chair:	
Co-chair:	
Remarks:	

Seq	Time	Title	Abs No

1 11:30

The SimTG Simulation Modelling Framework

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In the frame of the new and harmonized simulation framework named SimTG, EADS Astrium is currently developing an Integrated Development Environment dedicated to simulation, based on the Eclipse platform.

The Simulation Modelling Framework (SimMF) is the cornerstone of this environment. It leverages the best of Model-driven technologies, EMF and GMF, to support the development of spacecraft system simulators. SimMF allows the user to design simulation models using property-based editing and diagram editing, with both editors in full interaction. It ensures the correctness of entered data, by performing live consistency checks during model manipulation.
The diagram editor of SimMF provides top-notch features like automatic arrangement and the innovative popup menus, letting you create objects in a very intuitive way. Moreover it can also be animated during simulation execution. Source code is automatically generated from the models, supporting synchronous and asynchronous modes. The generated code is SMP2 compatible and can be customized using merge sections to add algorithmic behaviour. SimMF code-generation clearly separates between automatically generated and manually added code parts. In addition documentation material in browsable and traditional document form is automatically generated from the data and diagrams. SimMF is user-extensible, giving the user the opportunity to bring his own types into SimMF very easily.
Furthermore, it brings a fully automatic compilation chain, which lets you build and deliver your models without any effort. And last but not least, it is seamlessly integrated with the other SimTG products, giving the user the ability to design, develop, test, run and visualize synoptics of his models in one single environment.

The paper will present the technologies leveraged by SimMF and the innovative features that it brings.

2 12:00

Sentinel 3 - Simulator Core

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In order to validate the Sentinel-3 avionic equipments and the Sentinel 3 Central SoftWare, Thales Alenia Space needs to develop facilities embedded simulators. All of the Sentinel 3 simulators, the Functional

Validation Testbench, the Software Validation Facility and the AOCS Functional Engineering Simulator, are based upon the same simulation core. This concept allows to reuse architecture and avionic models between simulators.
The simulator core includes the new concept of model layers. This design is mainly applicable with the avionic models but also with the architecture models. The idea is to split an architecture functionality or the function of a real equipment in several components. A component will be reused or not depending on the simulator.

For the architecture models, the application of this design is simple. The architecture models are responsible for:

- the management of the simulator times (On Board Time, mission time, EPOCH time, ...),
- the management of signals (32 Hz tick from the avionic test bench, 8Hz from the OnBoard Computer, events from the Central CheckOut System, ...),
- the scheduling of avionic models
- the management of the data flow with the test bench using a shared memory. All of these functions are implemented in dedicated models. For the FVT all of these models are used, but for the SVF the last one is not included because the functionality is useful for interfacing with the test bench, and with real equipments in real time.

For the avionic models, the purpose of the new design is to split a real equipment functions in four model categories :

- the Functional Models.
- the Service Models.
- the Coupler Models.
- the Bench Interface Models. Functional models are responsible for the mathematical simulation of a spacecraft equipment (e.g. actuators and sensors).

Service models are responsible for simulating the command and control functions of the spacecraft payload (scientific instruments) and platform (sensors/actuators) equipments. These models are primarily state machines, simulating the real equipment modes.

Coupler Models provide the interface between the Service models and the OnBoard Computer model. These models act as adapters between the Service models which handle command and control and the OnBoard Computer. Their primary task is the command/control protocol management, for example the handling of the TC/TM over the 1553 buses, then sharing data to and from the OnBoard Computer.

The function of the Bench Interface Models is only to exchange data with the avionic test bench using a shared memory.

According to this break down, it is possible to build a SVF, a FVT and a FES simulator only by assembling some of these models together. The SVF simulator is composed of : functional models, service models and coupler models.

The FVT simulator is composed of : functional models, service models and bench interface models. In the case of the FVT simulator, since the FVT simulator is scheduled at 32 Hz, the coupler function is provided by the test bench because this function shall interact in real time with the real equipments.

The AOCS FES simulator is composed of functional models only.

A data bus synchronization mechanism has been implemented in order to support the same synchronisation of data between any of these avionic simulators. This mechanism relies on three signals:

- The "From Bus" signal.
- the "32Hz signal".
- The "To Bus" signal. All of these signals are provided by the same architecture model (the RTS manager), whatever the simulator is. The "From Bus" signal is used to read data from the OnBoard Computer or the shared memory. The 32 Hz signal is the atomic signal used to schedule all the avionic models according to a scheduling table. The "To Bus" signal is used to transfer data to the OnBoard Computer or the shared memory.

The goal of this mechanism is to perform the same data time synchronisation process for all the simulators. So an execution of the same procedure on each simulator will produce the same time stamped data results.

The paper will describe in more details the Sentinel 3 simulator core, as well as the lessons learned by Thales to build these kind of simulators.

3 12:30 From Knowledge Transfer to Domain Specific Modeling: A Use Case Driven Simulation Approach from Industry Perspective

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In accordance with her primary role in the national satellite programs of Turkey, TAI (Turkish Aerospace Industries, Inc.) has recently involved in studies to develop satellite integration, verification and validation (IV &V) capabilities by establishing a research laboratory. With the purpose of reducing time, effort and cost of design, development and deployment new hardware and software while sustaining reliability, TAI has been evaluating usage of virtual satellites, i.e. simulated systems within the proposed laboratory. Already manufacturer of space-certified equipments like control moment gyroscopes, TAI also aims HIL testing capability as well as obtaining tools for supporting ground operations using the satellite simulators. This paper, summarizes TAI's effort to bring together several standards and industry practices while planning the roadmap of simulating spacecraft systems. The main focus of the paper is how productivity and reuse in multidisciplinary domain simulators can be established, applying a use case driven design approach. The optimization is required to minimize the efforts of the knowledge embedded in domains, to a common platform where simulated and real systems can interact in a controllable environment. TAI has chosen a path focusing on the development of a graphical modeling tool, to transform efforts of knowledge translation between specific domains and software engineering, to encapsulation of the relevant domain data by domain specific tools by the domain experts. The modeling tools are also considered essential to enable composition of several simulation models to enable reuse and interoperability. The paper also includes the reference architecture for a proposed spacecraft simulation software suite, with the apparent applications of emerging software engineering concepts and technologies.