System Functional Simulations in the Concurrent Design Process

The study System Functional Simulations in the Concurrent Design Process comprises the design and prototyping of a simulation workbench providing support for rapid definition of System Concept Simulators (SCS), their execution, and the analysis of the simulation results in close link with the Concurrent Engineering (CE) space system databases. The SCS Workbench is meant to support the Concurrent Design Facility (CDF) team, Mission Study teams and Spacecraft Project teams, covering activities in phase 0/A, and phase B, while serving as a basis for more elaborate and extensive simulators to be developed in later phases. From interviews with stakeholders a set of specific Use Cases has been identified in which the SCS would bring a high added value to the existing design process from a user perspective. Since the foreseen usage of the SCS in the CDF context provides the most demanding constraints on criteria such as timeliness, flexibility, mixture of fidelity levels and interoperability, this context has been the major focus of the Use Cases.

The main functional components provided by the SCS Workbench are:

- A Simulation Model Development Environment;
- A Simulation Model Importer;
- A Simulation Preparation Environment;
- A Scriptable Simulation Execution Environment;
- A Simulation Recorder/Replayer combination;
- Visualisation tools like alphanumerical displays, plots, surface maps and 3D animations.

The SCS Workbench is implemented as a Java based Eclipse rich client application using state-of-the-art UI technology provided by the Sirius Eclipse project [1] leveraging the Eclipse Modeling technologies, including the Eclipse Modeling Framework (EMF) and the Graphical Modeling Framework (GMF). Although not directly exposed to the user, the simulation related parts and artefacts follow the SMP2 standard [2]. The tool chain underlying the SCS Workbench makes reuse of a number of existing tools
like ESAs Universal Modelling Framework (UMF) [3], and the SimSat simulation runtime [4].

In an iterative implementation and verification approach, several testing series have been performed based on the specified Use Cases. Within each Use Case, a number of testing steps, linked to the direct operation of the SCS Workbench, have been performed. Multiple test rounds following the implementation sprints allowed direct feedback on design and implementation, and verification of the required capabilities for the SCS.

[1] Sirius Eclipse project http://www.eclipse.org/sirius/index.html
[2] SMP2 Standard, portal.vega.de/smp
[3] UMF – A Productive SMP2 Modelling and Development Tool Chain, Ellsiepen, Fritzen, Reggestad, Walsh, SESP 2012
[4] SIMSAT as part of SIMULUS http://www.esa.int/Our_Activities/Operations/Ground_Systems_Engineering/SIMULUS