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MODELLING AND SIMULATION OF A COMPLEX PAYLOAD SYSTEM USING SYSML AND A MODEL BASED DESIGN APPROACH

Abstract

Fundamental in the ExoMars mission is the rover that will take soil samples from Mars and analyse them for traces of life. One system of the rover payload has the tasks of retrieving, processing and distributing the Martian soil samples. Among of its components there are a positioning system, a crushing station and a powder dosing station. The paper will describe, using the example of this payload, a method to model and simulate a complex system.

The aim of this research is to develop and investigate methods suitable for modelling and simulating complex systems. In this context, 'complex' means to have broad simulation coverage of the system such as functional and logical aspects as well as physical behaviour.

The central part of the simulation is an executable SysML model of the system where the structural design, the interaction and the behaviour are described. The second part of the simulation is a virtual reality (VR) which is based on CAD models of the current design. It also contains a physics engine and represents a fully measurable system.

For the simulation the model based design approach is used. The modelling takes place in SysML and for the executable simulation the code generation is done automatically by Rational Rhapsody. The translation of the model in to c-code enables to implement almost unrestricted functionalities in the simulation. For the creation of the VR OGRE as 3D rendering engine is used. During the real-time simulation the application parts exchange information with each other. In general attributes and state charts of the executed SysML model are influenced by the actions within virtual reality and vice versa.

This approach aims to demonstrate that the description and simulation of complex systems is eased using the benefits of SysML and code generation. It enables the integration of add-ons and any desired behaviour functionality from different sources (e.g. generated code out of other simulation programs). Building and executing the simulation within the "SysML domain" has the benefit of already build-in features of the used software tools, like state visualisations, data recording and automated testing. The simulation contains also a model of the main control system. On one hand is needed to run the simulation, while on the other hand it enables to develop and experiment with implementations of a control system, thus it might also provide help for the design of the main control software.