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OPENSIMKIT – A STATE OF THE ART AND OPEN SOURCE SYSTEM SIMULATION FRAMEWORK APPLIED TO SYSTEMS ENGINEERING

Abstract

OpenSimKit is a free and open source system simulation software distributed under the GNU Public License. It provides the functionality to simulate systems based on their numerical properties, fully reflecting the system topology. OpenSimKit is scalable in the time as well as in the complexity domain and features a clean cut interface between simulator kernel and models. The scalability in these domains makes OpenSimKit a tool suitable for cross-phase systems engineering. This means that OpenSimKit can be used for mission design and feasibility studies as well as for hardware in the loop system integration tests, on-board software verification campaigns or operations training. By providing these capabilities in a single tool and offering a clean upgrade path it is possible to incrementally refine the system simulation as the system is developed. The OpenSimKit simulator kernel distinguishes between physical transport from model to model through ports and the so called provider-subscriber architecture. An example of the connection through ports is the exchange of material transport such as fluids or electrical signal lines. An example for the latter are forces, thermal radiation or the location and speed of an object. The OpenSimKit kernel also offers a central solver in order to integrate the left hand side of the model's differential equations, a feature that helps keeping models simple and easy to implement. OpenSimKit additionally provides connections to the visualization tool Celestia and the CPU emulator QEMU. Celestia offers real-time visualization of the space-craft attitude while QEMU offers integration of the on-board computer in the simulation and allows early software development and testing. Finally a new graphical user interface called "OpenSatDK" has been developed in order to provide an integrated systems engineering framework for space-craft development. The user interface is based on the Eclipse-RCP platform and allows developing OpenSimKit models and on-board software as well as running the simulations and analyzing the outputs. In this paper it is described how the aforementioned tools are applied to a satellite mission. First the mission architecture is defined and basic simulations of the system budgets and contact times are performed. Then the architecture of the mission is detailed and the simulations are incrementally refined, leading to a feasibility study. The mission which is used for this purpose is a mission in the "Hacker space program". The purpose of this paper is to demonstrate how to use the "OpenSatDK" in the systems engineering process.