A Toolchain for Real-Time Simulation using the OpenModelica Compiler

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Simulation is always based on models. These models can be mind-models, scaled physical models or mathematical models. No matter what kind of model is used, the purpose of simulation is mostly the validation of characteristics of physical systems. Nowadays, even detailed mathematical models can be simulated in relatively short time. Hence, computer-simulation is an important tool in the mechatronic development cycle and helps to reduce costs by shorten the development process.
Clearly, the level of detail of the employed model plays a very important role. To obtain a model with a higher level of detail, more modeling effort has to be invested and one has to expect longer simulation times. A proper model is as simple as possible, but still complex enough to reproduce the physical effects under consideration [1]. However, there exist tasks that can not be fulfilled satisfactorily with the help of non-real-time simulations regardless of which level of detail is used. These are among others:

- Setting up Simulators (e.g. driving simulator),
- Controller testing,
- Physical Component testing.

Real-time simulation refers to a mathematical model of a physical system including a numerical integration method that can execute at the same rate as actual "wall clock" time. Hence, using real-time simulation, the real system can be replaced by a virtual system which makes real-time simulation suitable for the applications mentioned above. Due to this possibility and the increased available computing power, real-time simulation became very popular in the recent years.
Consequently, many commercial simulation tools offer a complete toolchain for real-time simulation. Such a toolchain consists of a modeling environment, a simulation-runtime and a compiler which can compile the model for a real-time-target. Simulink together with the Real-time Workshop form the toolchain offered by The MathWorks. Some other tools do not offer an own compiler, but an export to Simulink, so that the real-time Workshop can be used. There are also tools which offer an integrated solution. However, currently the OMC lacks such an automated toolchain at all. In this paper a C++ Simulation-Runtime is presented which forms the basis for a toolchain for real-time simulation. This modular C++ Simulation-Runtime contains a numerical integration method suitable for real-time simulations of hydraulic systems and can also be used for co-simulation.

References

[1] T. Ersal, H.K. Fathy, D.G. Rideout, L.S. Louca, and J.L. Stein. A review of proper modeling techniques. *Journal of Dynamic Systems, Measurement, and Control*, 130:061008, 2008.