Title:

Overview and Outlook for the OpenModelica Environment and its Use for Cyber-physical System Development

by

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Abstract:

The industry is currently seeing a rapid development of cyber-physical system products containing integrated software, hardware, and communication components. The increasing system complexity in the automotive and aerospace industries are some examples. The systems that are developed have increasing demands of dependability and usability. Moreover, lead time and cost efficiency continue to be essential for industry competitiveness. Extensive use of modeling and simulation - Model-Based Systems Engineering tools - throughout the value chain and system life-cycle is one of the most important ways to effectively target these challenges. Simultaneously there is an increased interest in open source tools that allow more control of tool features and support, and increased cooperation and shared access to knowledge and innovations between organizations.

Modelica is a modern, strongly typed, declarative, equation-based, and object-oriented (EOO) language for model-based systems engineering including modeling and simulation of complex cyber-physical systems Major features are: ease of use, visual design of models with combination of lego-like predefined model building blocks, ability to define model libraries with reusable components, support for modeling and simulation of complex applications involving parts from several application domains, and many more useful facilities. The Modelica language is ideally suited for cyber-physical modeling tasks since it allows integrated modeling of discrete-time (embedded control software) and continuous-time (process dynamics, often for physical hardware). Modelica 3.3 extended the language with clocked synchronous constructs, which are especially well suited to model and integrate physical and digital hardware with model-based software.

This talk gives an overview and outlook of the OpenModelica environment – the most complete Modelica open-source tool for modeling, engineering, simulation, and development of systems applications (www.openmodelica.org), and its usage for cyber-physical system development. Special features are MetaModeling for efficient model transformations, debugging support for equation-based models, support (via OMSimulator) for the Functional Mockup Interface for general tool integration and model export/import between tools, model-based optimization, as well as generation of parallel code for multi-core architectures.
Moreover, also mentioned is recent work to make an OpenModelica based tool chain for developing digital controller software for embedded systems, and in generating embedded controller code for very small target platforms like Arduino Boards with down to 2kbyte memory. This work is extended in the ongoing EMPHYSIS project where the FMI standard is extended into the eFMI standard for embedded systems.

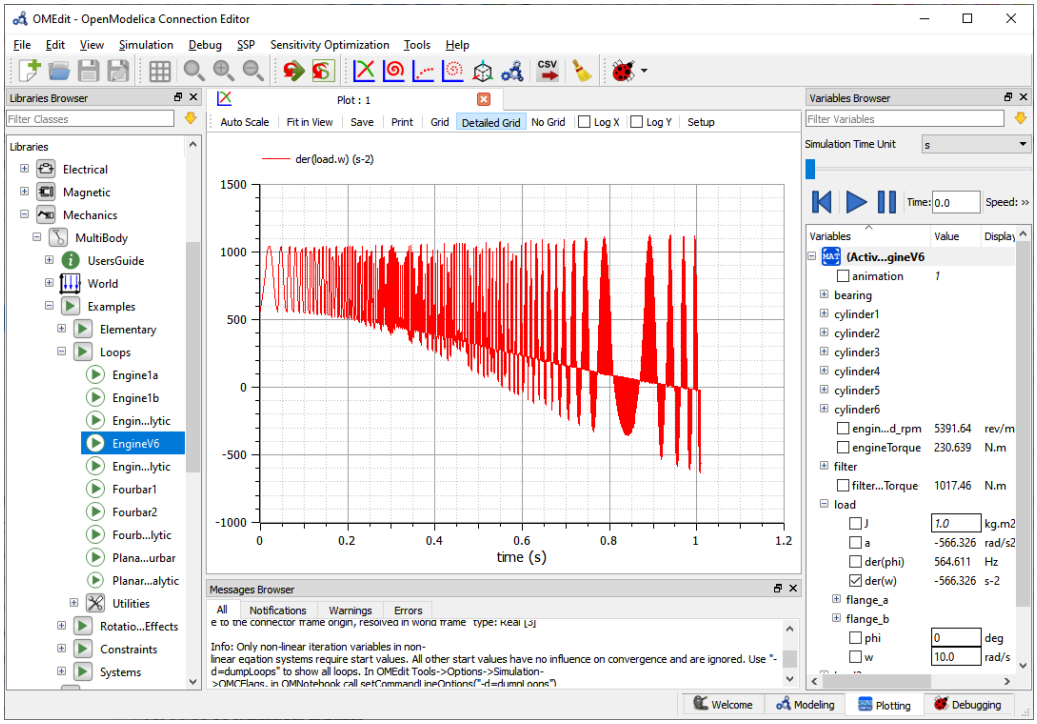

Figure 1. OpenModelica simulation of the V6Engine model with 11000 equations. Plotting simulation results using OMEdit. *Left*: Model browser. *Right*: Plot variable browser. *Bottom*: message browser window.

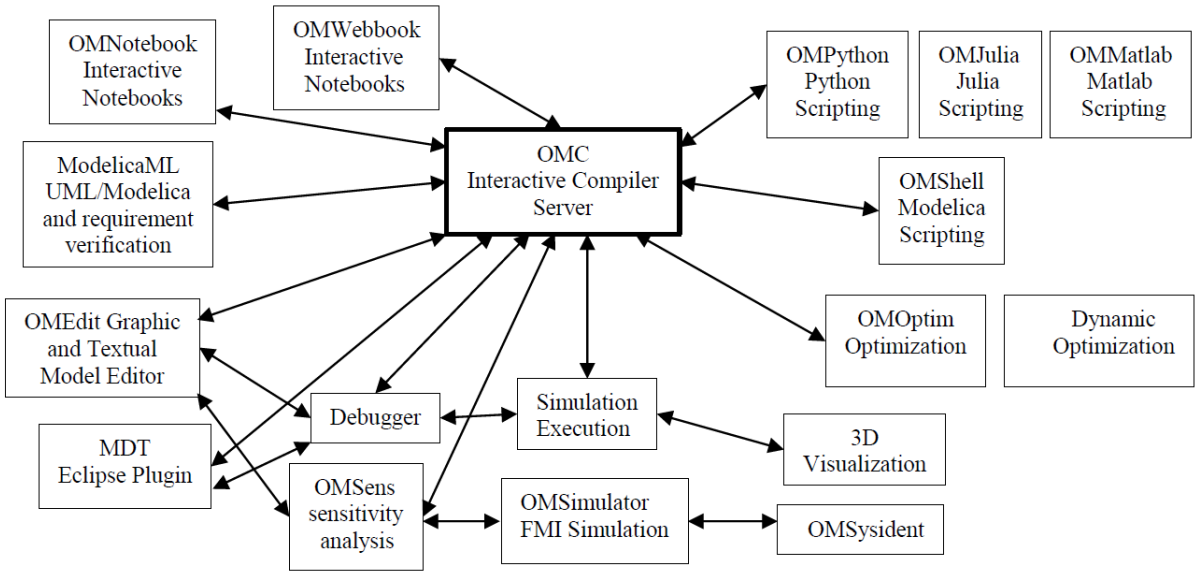

Figure 2. The architecture of the OpenModelica environment. Arrows denote data and control flow.

Biography:

Peter Fritzson is Professor and research director of the Programming Environment Laboratory, at Linköping University. He is also vice director of the Open Source Modelica Consortium, vice director of the MODPROD center for model-based product development, (previously director of both) organizations he took initiative to establish. During 1999-2007 he served as chairman of the Scandinavian Simulation Society, and secretary of the European simulation organization, EuroSim. During 2000-2020 he was vice Chairman of the Modelica Association.
Prof. Fritzson's current research interests are in software technology, especially programming languages, tools and environments; parallel and multi-core computing; compilers and compiler generators, high level specification and modeling languages with special emphasis on tools for object-oriented modeling and simulation where he is one of the main contributors and founders of the Modelica language. Professor Fritzson has authored or co-authored 319 technical publications, including 21 books/proceedings.