

Modelica Modeling Language



Modelica is an object-oriented language for modeling of large, complex, and heterogeneous physical systems. Modelica Association, which is a non-profit, non-governmental organization, owns and administrates incorporeal rights related to Modelica. Detailed information about Modelica can be found at: <http://www.Modelica.org>.

Modelica is suited for multi-domain modeling, for example, mechatronic models in robotics, automotive and aerospace applications involving mechanical, electrical, hydraulic and control subsystems, process oriented applications and generation and distribution of electric power. Modelica is designed such that it can be utilized in a similar way as an engineer builds a real system. First try to find standard components like motors, pumps and valves from manufacturers' catalogues with appropriate specifications and interfaces and only if there does not exist a particular subsystem, a component model would be newly constructed based on standardized interfaces.

Hierarchical modeling

Modelica supports both high level modeling by composition and detailed library component modeling by equations. Models of standard components are typically available in model libraries. Using a graphical model editor, a model can be defined by drawing a composition diagram by positioning icons that represent the models of the components, drawing connections and giving parameter values in dialogue boxes. Constructs for including graphical annotations in Modelica make icons and composition diagrams portable between different tools.

Structured model libraries

A powerful package concept is available to structure large model libraries and to find a component in a file system giving its hierarchical Modelica class name.

Hybrid modeling

A unique feature of Modelica is the handling of discontinuous and variable structure components such as relays, switches, bearing friction, clutches, brakes, impact, sampled data systems, automatic gearboxes etc. Modelica has introduced special language constructs allowing a simulator to introduce efficient handling of events needed in such cases.

Arrays

Modelica supports arrays, utilizing a Matlab like syntax. The elements of arrays may be of the basic data types (Real, Integer, Boolean, String) or component models. This allows convenient discretization of simple partial differential equations.

Class parameters

Besides ordinary numeric parameters, Modelica allows model class parameters. As an example assume that a PI controller should be replaced by an auto-tuning controller. It is of course possible to just replace the controller in a graphical user environment, i.e., to create a new model. The problem with this solution is that two models must be maintained. Modelica has the capability to instead substitute a model component so only one version of the rest of the model is needed.

Equations

Models in Modelica are mathematically described by *differential*, *algebraic* and *discrete equations*. No particular variable needs to be solved for manually. A Modelica tool will have enough information to decide it automatically. Modelica is designed such that available, specialized algorithms can be utilized to enable efficient handling of large models having more than hundred thousand equations. Modelica is suited and used for hardware-in-the-loop simulations and for embedded control systems.