Chapter 3

MIXED-DOMAIN MODELING IN MODELICA

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ABSTRACT Modelica is a language for convenient, component oriented modeling of physical systems. In this article, an overview of the language, available libraries, the Dymola simulator and some industrial applications is given. Additionally, a comparison of Modelica with VHDL-AMS is presented.

1. INTRODUCTION

Modelica® is a non-proprietary specification of an object-oriented language for modeling of large, complex, and heterogeneous physical systems. It 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.

Models in Modelica are mathematically described by differential, algebraic and discrete equations. The set of equations does not need to be manually solved for a particular variable. A Modelica tool will have enough information to decide that automatically. Modelica is designed such that available, structural and symbolic 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.

2. MODELICA FUNDAMENTALS

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 (also called schematics) 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.

An example of a composition diagram of a simple motor drive system is shown in Figure 1. The system can be broken up into a set of connected components: an electrical motor, a gearbox, a load and a control system. The textual representation of this Modelica model is (annotations describing the graphical placement of the components and connection lines are not shown):

```model MotorDrive
  PID   controller;
  Motor motor;
  Gearbox gear (n=100);
  Inertia inertia(J=10);
end MotorDrive;
```

![Figure 1: A model of a simple motor drive system.](image)

It is a composite model, which specifies the topology of the system to be modeled in terms of components and connections between the components. The statement “Gearbox gear (n=100) ;” declares a component gear of model class Gearbox and sets the value of the gear ratio, n, to 100. A component model may be a composite model to support hierarchical modeling. The composition diagram of the model class Motor is shown in