



July 18 -19, 2016

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Modelica Foundations

July 18 - 19, 2016 – h 09:00 am – 01:00 pm

Blue Room – TeCIP Institute

This tutorial presents object-oriented mathematical modelling, a fast-growing area of modelling and simulation that provides a structured, computer-supported way of doing modular, mathematical and equation-based modelling of Cyber-Physical Systems (CPS). Modelica effectively unifies and generalizes object-oriented with mathematical modelling concepts in a single language.

The first part of this tutorial gives insight into the rationale behind and examples of equation-based modelling and its many application. Object-oriented mathematical modelling languages are positioned at one level in a stack of languages ranging from domain-specific languages (such as SimMechanics), over generic physics-aware modelling languages (such as Bond Graphs) and equation-based modelling languages (such as Modelica and Simscape), to computationally causal languages (such as Simulink), to discretized code for numerical simulation complying to the Functional Mockup Interface (FMI) standard. Each of these levels are introduced with a particular focus on the equation-based modelling level. A basic introduction to simulation concepts and techniques is also given.

The second part of this tutorial builds on the first part and goes "under the hood" of the Modelica language. In particular, the semantics of a Modelica model is explained in terms of flattening the inheritance and coupling structure, of causality assignment, and of algebraic loop detection and sorting. Various extensions to basic continuous-time modelling such as hybrid and dynamic structure modelling are further introduced.

This presentation was first given as a full-day tutorial at the MoDELS 2015 conference in Ottawa, Canada. The first part of the presentation is based on an introduction to Modelica by Prof. Peter Fritzson of Linköping University, Sweden, developer of OpenModelica and author of the reference book "Principles of Object-Oriented Modeling and Simulation with Modelica 3.3: A Cyber-Physical Approach".

Short Bio:

Hans Vangheluwe is a Professor at the University of Antwerp in Belgium, and an Adjunct Professor at McGill University in Montréal, Canada. He was one of the founding members of the Modelica Design Team in the mid '90s. He works on modelling language engineering foundations and tool implementations. Tools implemented pertaining to the Modelica Foundations tutorial include a prototype Modelica compiler and WEST++, a domain-specific modelling, simulation, and optimization environment for bio-activated sludge waste-water treatment plant design. He has published over 200 scientific papers in both simulation and modelling/software engineering venues. For the last six years, he has co-organized the successful Domain-Specific Modelling, Theory and Practice Summer School. He is currently the chairman of the EU COST Action IC1404 "Multi-Paradigm Modelling for Cyber-Physical Systems" (MPM4CPS).

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