Tutorial 5 at MODPROD 2015 Workshop
Debugging Equation-Based and Algorithmic Modelica Models; Dynamic Optimization with OpenModelica

by

Martin Sjölund, Adeel Asghar (Linköping University),   (part 1)
Vitalij Ruge, Willi Braun (FH Bielefeld) (part 2)

Bring your laptop –hands-on exercises

Part 1: Debugging Equation-Based and Algorithmic Modelica Models

The high abstraction level of equation-based object-oriented languages (EOO) such as Modelica has the drawback that programming and modeling errors are often hard to find. In this tutorial we present the first integrated debugger for equation-based languages like Modelica, which can combine static and dynamic methods for run-time debugging of equation-based Modelica models during simulations. This builds on and extends previous results from a transformational static equation debugger and a dynamic debugger for the algorithmic subset of Modelica.

The tutorial participants will be able to do hands-on exercises using OpenModelica, to find errors both in equation-based models and in algorithmic code in Modelica models.

Part 2: Dynamic Optimization with OpenModelica

Nonlinear model predictive control (NMPC) has become increasingly important for today's control engineers during the last decade. In order to apply NMPC a nonlinear optimal control problem (NOCP) must be solved which in general needs high computational effort.

State-of-the-art solution algorithms are based on multiple shooting or collocation algorithms, which are required to solve the underlying dynamic model formulation. This tutorial gives an introduction to and describes methods for general discretization schemes applied to the dynamic model description which can be further concretized to reproduce the multiple shooting or collocation approach.

The corresponding discretized optimization problem is solved by the interior optimizer Ipopt. Parallelized algorithms have been tested on different applications. Several industrial relevant applications on optimal control including a Diesel-Electric power train have been investigated.

The tutorial gives the participants the opportunity to solve several hands-on exercises on dynamic optimization using OpenModelica.

Short Biographies

Martin Sjölund is PhD student at the Programming Environment Laboratory (PELAB), IDA, Linköping University. He designed and implemented most of the current equation-based model debugger in OpenModelica. His research on model debugging is the main part of his PhD dissertation, planned for 2015.

Adeel Asghar is developer for the Open Source Modelica Consortium, employed at SICEast, Linköping. He designed and developed most of the algorithmic code debugger for Modelica and MetaModelica, available in OpenModelica.

Vitalij Ruge is PhD students at Fachhochschule Bielefeld in Bielefeld, Germany, and is involved in research and development regarding dynamic optimization and related compiler parts. He implemented most of the current dynamic optimization with collocation in OpenModelica.

Willi Braun is PhD student at Fachhochschule Bielefeld, Bielefeld, German. He designed and implemented the differentiation module and the related compiler parts for the generation of symbolical derivatives.
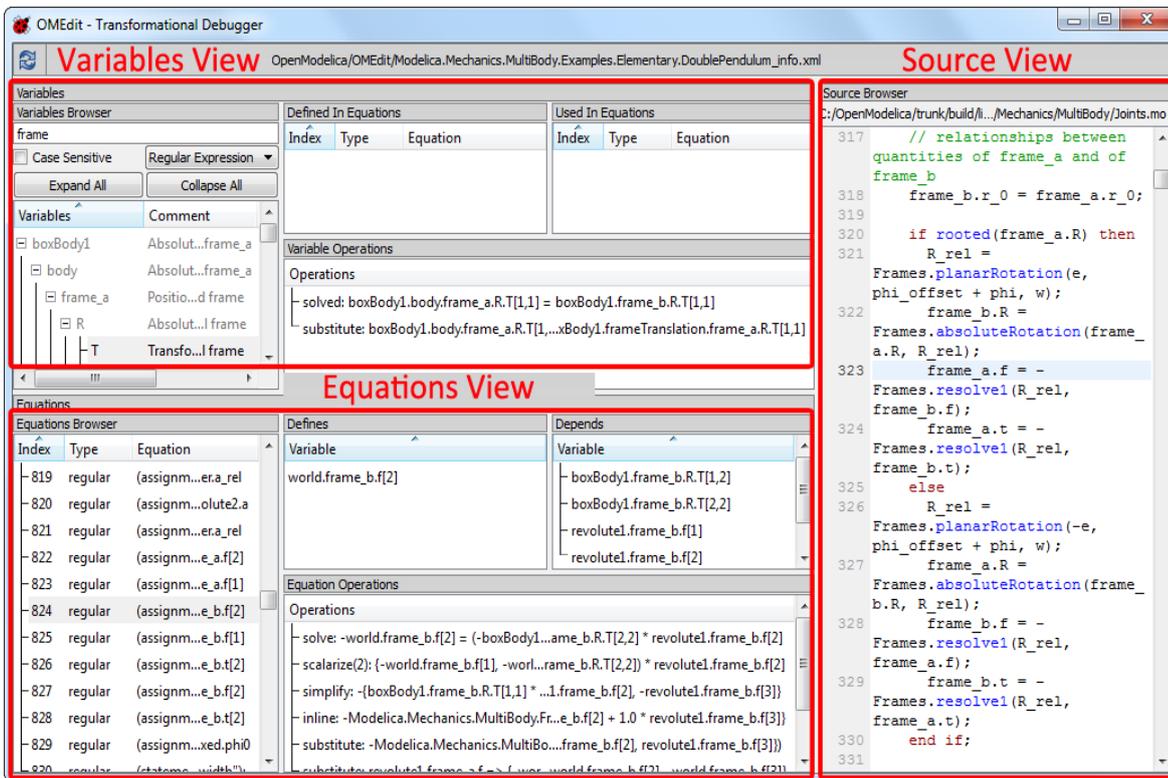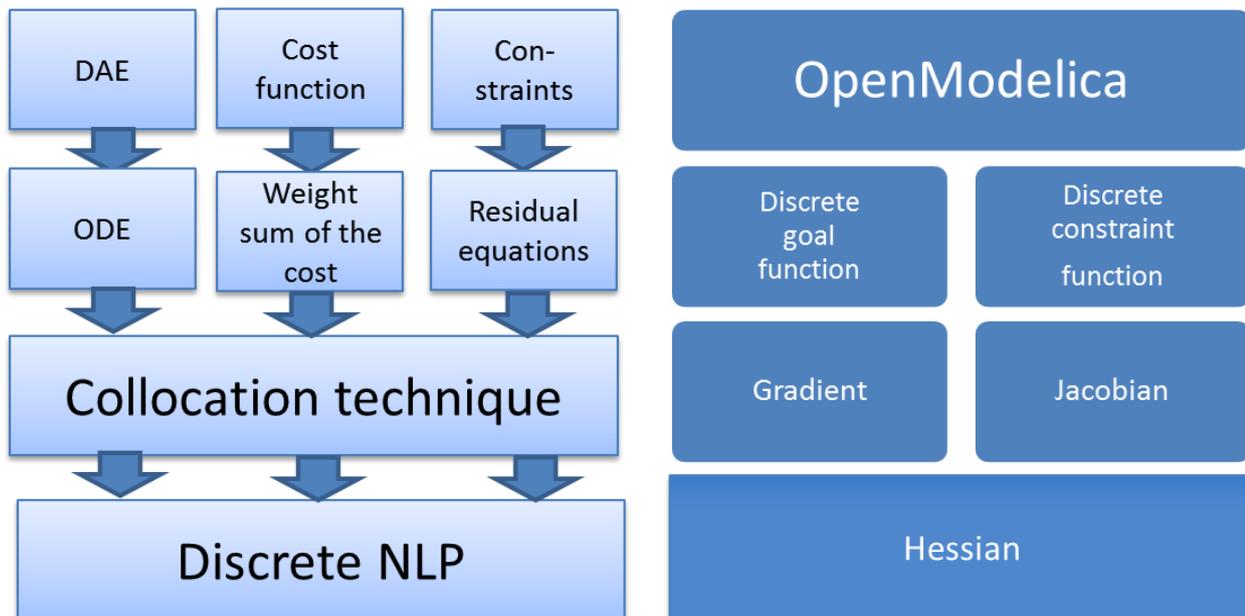
Figure 1: OpenModelica Equation Model debugger

Figure 2: Architecture of the OpenModelica Dynamic Optimization