

Master Theses in Mechanical & Vehicle Dynamics

Introduction

Modelica is an equation based modelling language that is used for modelling complex physical systems. Modelon is a leading provider of Modelica solutions. The Modelica-user usually works with components from a Modelica library. A library consists of components and subsystems used to build the desired system. One of Modelon's core business is to develop libraries and to support our customers with their specific Modelica solution. At the group of Mechanical and Vehicle Dynamics we are mainly working towards the automotive industry, but projects with aerospace applications are increasing. Examples of libraries developed and used by people in the group are the Vehicle Dynamics Library, Pneumatics Library and Hydraulics Library.

Many of the employees at Modelon started as master thesis student here. Since our ambition is to keep on growing, the chance to stay at Modelon after the thesis is good. Listed are some master thesis proposals that we search the right candidate for.

Implementation of industrial thermo-hydraulic examples using Hydraulics Library

The Hydraulics Library (HL) is a Modelica-based solution for modeling and simulation of hydraulic circuits. Hydraulics library was released in year 1997 and is now one of the most common commercial Modelica-based model library. Hydraulic systems are common in industrial applications such as, heavy vehicles (trucks, agriculture and construction equipment), aviation and industrial equipment. This includes applications like braking systems, suspensions, fuels, lubrication and lubricant cooling systems etc. The Hydraulics Library was recently significantly upgraded with thermodynamics, enabling the models to capture both pressure and temperature dynamics. The suggested thesis aims to develop new example systems within Hydraulics Library, including thermodynamic effects. The work will be carried out using the modeling and simulation tool Dymola. The most commonly used hydraulic components are already available in the Hydraulics Library. It may however also be necessary to develop new components. The example models shall

demonstrate typical solutions Modelon can offer with Hydraulics Library. Information regarding appropriate examples is found in literature, in-house pre-sales cases and from new ideas.

Student profile: One or two motivated and skilled students with interest in hydraulics, thermodynamics, dynamical systems, modelling of physical systems and programming (Modelica).

Contact: Jim Claesson, Modelon AB

Multi-body mechanisms for improved simulation performance in Modelica

The Vehicle Dynamics Library (VDL) is a Dymola-based Modelon solution for simulation of road vehicle dynamics. The library is successfully used in several real-time applications, including Driving Simulators. A key to the success is the efficient representation of suspension kinematics that allows for multi-body representations of suspensions to be simulated with high performance. These models are written such that the kinematic constraint equations can be solved analytically by Dymola. The scope of this thesis is to extend the set of available suspension kinematics models.

Student profile: One or two motivated and skilled students with interest in multi-body mechanics, mathematics, and programming (Modelica).

Contact: Mattias Olsson, Modelon AB

Aircraft sizing and dynamic simulation

Modelon currently develops a Dymola-based solution for simulation of fixed wing aircraft. The scope includes both the sizing of the aircraft (i.e., the estimation of mass, inertia, and aerodynamic characteristics based on component geometry), and its dynamic simulation (the six degrees of freedom simulation of the aircraft as it moves through space). A key factor in this solution is the library framework that allows to execute these previously separated analyses, and to mix models at different fidelity levels. The scope of the thesis is to implement specific applications in

the current framework, and to identify whether/how the framework has to be enhanced or adapted for this purpose. The specific applications are:

- Aircraft sizing: Implementing an additional reference methodology for commercial aircraft
- Dynamic simulation: Implementing an additional reference application based on a fighter aircraft

The thesis can be written by one student selecting one application or by two students addressing both.

Student profile: One or two motivated and skilled students with interest in multi-body mechanics, aeronautics, mathematics, and programming (Modelica).

Contact: Michael Sielemann, Modelon AB

Vehicle Dynamics Library in Education

The Vehicle Dynamics Library (VDL) is a Dymola-based Modelon solution for simulation of road vehicle dynamics. With VDL it is straight-forward to define virtual tests of both whole vehicles and subsystems. A comparison of a vehicle's performance, with and without active safety systems, is just a few button-clicks away. At the same time the load transfer within a suspension can be examined in detail. As such, VDL can play a significant role in vehicle dynamics educations at universities and the goal is to provide academia with a tool for virtual experimentation.

The scope of this thesis work is to derive a package with exercises based on VDL that covers the scope of a vehicle dynamics introductory course.

Student profile: One or two motivated and skilled students with interest in vehicle dynamics and didactics.

Contact: Mattias Olsson, Modelon AB

Open application

We have always more ideas of potential master thesis so please contact us and tell us about your interests if you are interested in doing your master thesis within any of our businesses. You are also welcome to contact us for industry initiated master thesis proposals that use Modelica. In particular if any of our many Modelica libraries can be applied. Some additional suggestions are given below:

- Metrics for Subjective Evaluation of Vehicle Handling
- Open-loop analysis of physical models in Modelica
- Development of a Pfeffer Steering Model for Vehicle Dynamics Library

Student profile: One or two motivated and skilled students with interest in deploying Modelica in their master thesis.

Contact: Mattias Olsson, Modelon AB