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- DYMOLA/Modelica Online Training

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DYMOLA On Line Training

- Objective – To provide focused interactive DYMOLA/Modelica based training courses as a remotely accessed resource to aid convenience and accessibility

- The structured courses with a combination of playback sessions covering specific requirements, enabling the user to create and improve knowledge of DYMOLA, followed by tutored sessions in order to improve the effectiveness as a user and efficiency in the application of model based design and simulation.

- Courses are available to address various applications and/or specialised requirements and techniques.

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DYMOLA On Line Training – Courses

- DYMOLA Modelica Foundation Training
- DYMOLA Advanced Training
- DYMOLA Thermo fluid Applications
- DYMOLA Vehicle Dynamics
- DYMOLA Model debugging and performance analysis
- DYMOLA Troubleshooting and Optimisation
- DYMOLA External Interfacing
- FMI training

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DYMOLA/Modelica Foundation Course

- Duration – 12-14 hours
- Pre Requisites – PC with Dymola and a supported compiler

The objective is to demonstrate through examples how DYMOLA is used to construct and edit models graphically and to perform appropriate simulation and analysis of these models. This includes a foundation to the Modelica language. We demonstrate through examples how to approach model development in Modelica and to provide a foundation to the Modelica language structure and syntax.

This course will also teach you a structured and systematic approach to modelling with Dymola and Modelica that you will benefit from in every model you create.

PART 1 - Core

- Dymola interface
- Modelica principles
- Building custom models and components
  - Graphically
  - In the text layer
  - How to structure libraries – best practices
- Initialisation
- Simulation and analysis
- Inheritance

PART 2 - Modules

- Scripting
- Hierarchical/grouped connectors
- Expandable connectors
- Planar loop theory and handling
- Events theory and handling
- Templates for models and systems
- “Plug and play” modelling
- Replaceable components

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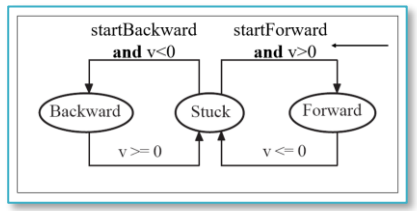
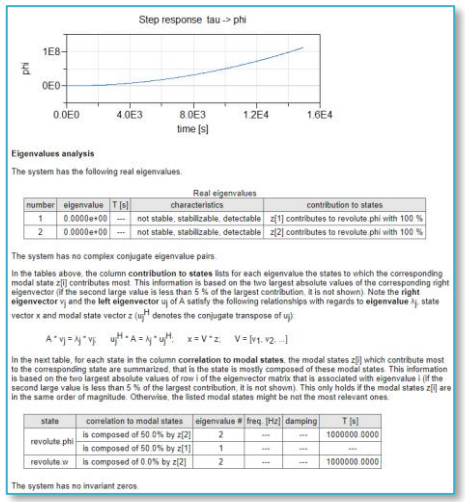
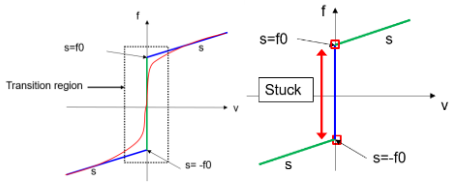
DYMOLA Advanced Training Course

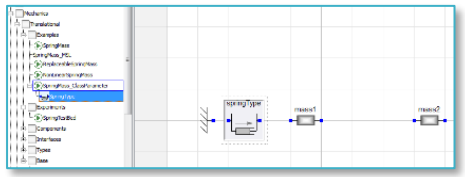
- Duration – 6-8 hours
- Pre Requisites – Basic knowledge of DYMOLA and Modelica
- Up to 6 modules chosen from the list below
- This is specifically aimed at users of DYMOLA. The objective is to demonstrate through examples how DYMOLA and Modelica are used in more advanced applications such as
  - Module - Annotations
  - Module - Friction
  - Module - Linearisation
  - Module - Records
  - Module - State Selection
  - Module - Synchronous Control
  - Module - Component arrays (scalable models)
  - Module - Class parameter (rapid redeclaration of identical components)

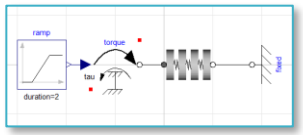
- The objective is to demonstrate through examples how to approach model development in Modelica at a more advanced stage.











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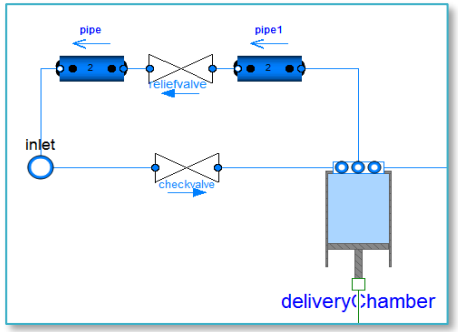
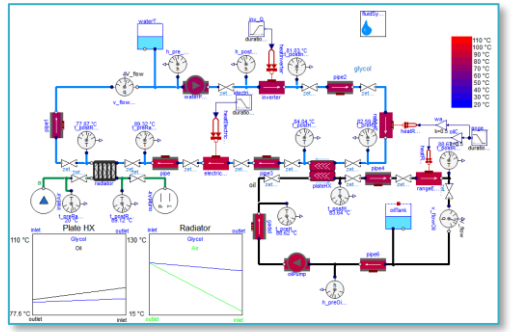
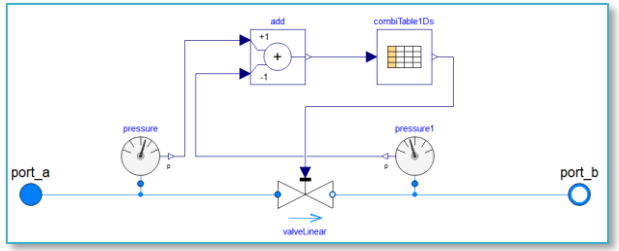
DYMOLA/Modelica Thermo Fluid Training

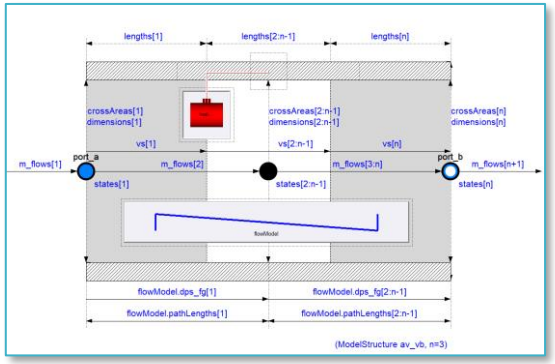
- Duration – 8 hours
- Pre Requisites – Basic knowledge of DYMOLA and Modelica

This is specifically aimed at existing users of DYMOLA. The objective is to demonstrate through examples how DYMOLA is used to construct a range of thermo-fluid systems using the Modelica.Fluid library that will then enable users to create more complex systems that also simulate efficiently.









Topics covered:

- Modelling philosophy of fluids systems
- Efficient modelling approaches to maximise model performance
- The “staggered grid” and why it is important
- Stream variables
- Construction of bespoke types of valves
- Construction of system models including positive displacement pumps with integration of swept volumes, relief valves and check valves
- Modelling two phase systems such as boilers and related control
- Setting up models for external control

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Fluid Power library

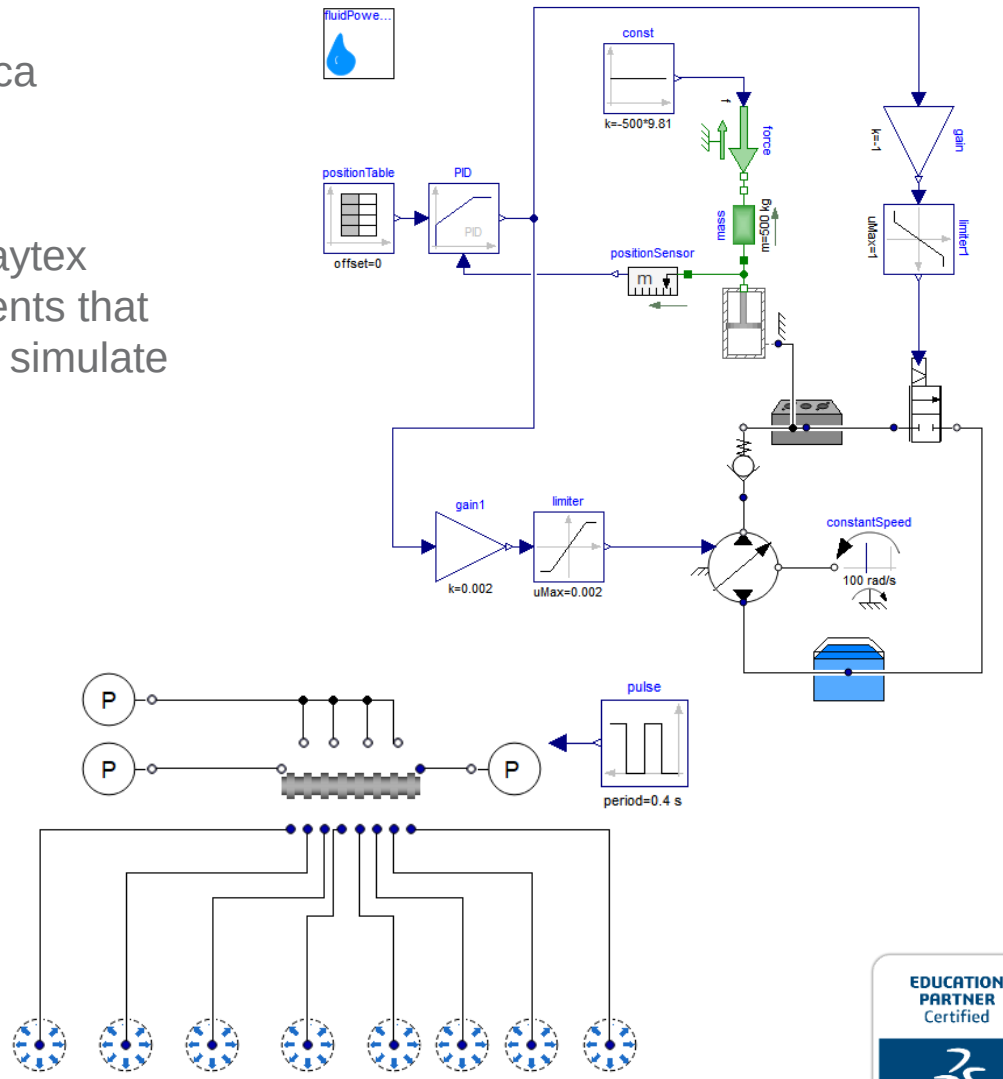
- Duration – 8 hours
- Pre Requisites – Basic knowledge of DYMOLA and Modelica

This is specifically aimed at existing users of DYMOLA.

The objective is to demonstrate through examples how the Claytex Fluid Power library is used to provide a range of fluid components that will then enable users to create basic to complex systems that simulate efficiently.

Topics covered:

- Modelling philosophy of the Fluid Power library
- Modelling circuits with entrained air
- Modelling a double acting cylinder system
- Defining your own fluids
- Troubleshooting
- Efficient modelling approaches to maximise model performance



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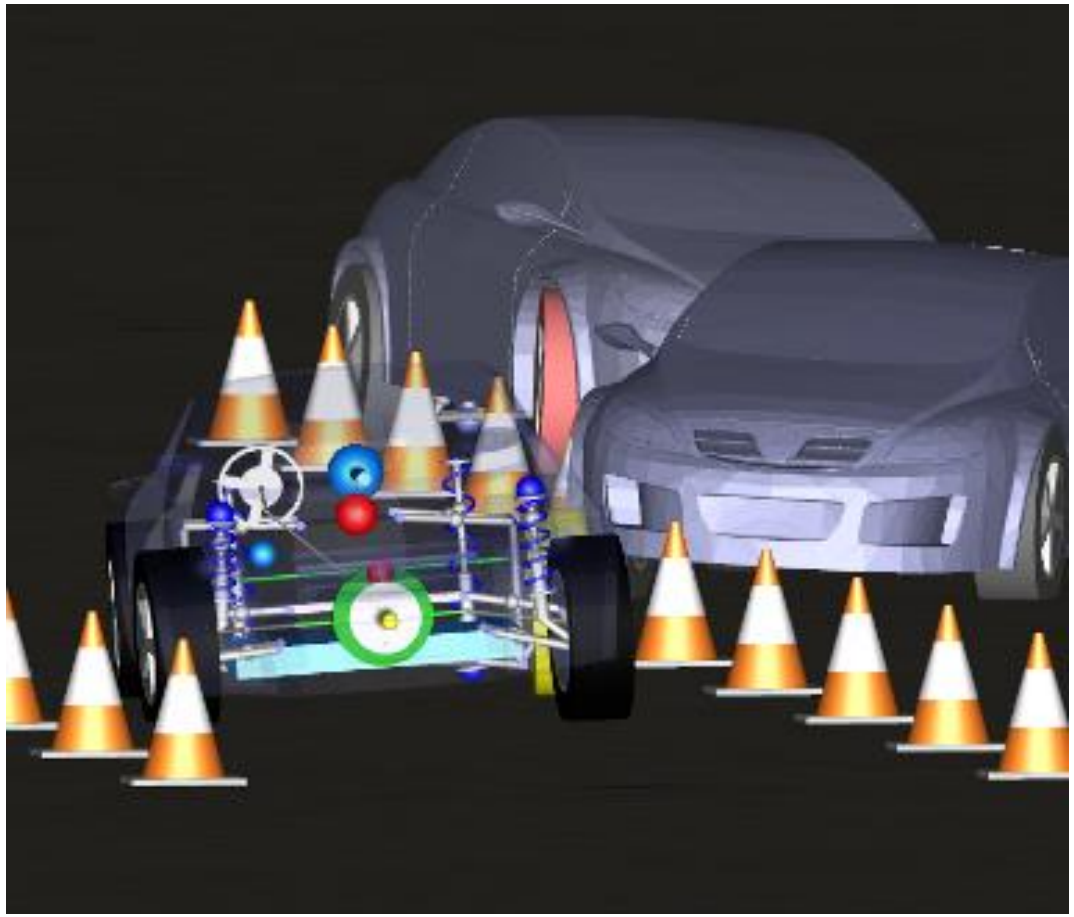
DYMOLA/Modelica Vehicle Dynamics

- Duration – 12-14 hours
- Pre Requisites – Basic knowledge of DYMOLA and Modelica

This course is created for relatively new users of DYMOLA looking to be more proficient in conducting vehicle dynamics studies with DYMOLA. This course includes introduction to the Multibody package within the Modelica Standard Library, as well as introduction to VeSyMA, Suspensions, and optionally the Motorsports library. Through examples, the trainee will be introduced to the use of experiments, templates, as well as some of common pitfalls and solutions when modelling multibody systems with DYMOLA.



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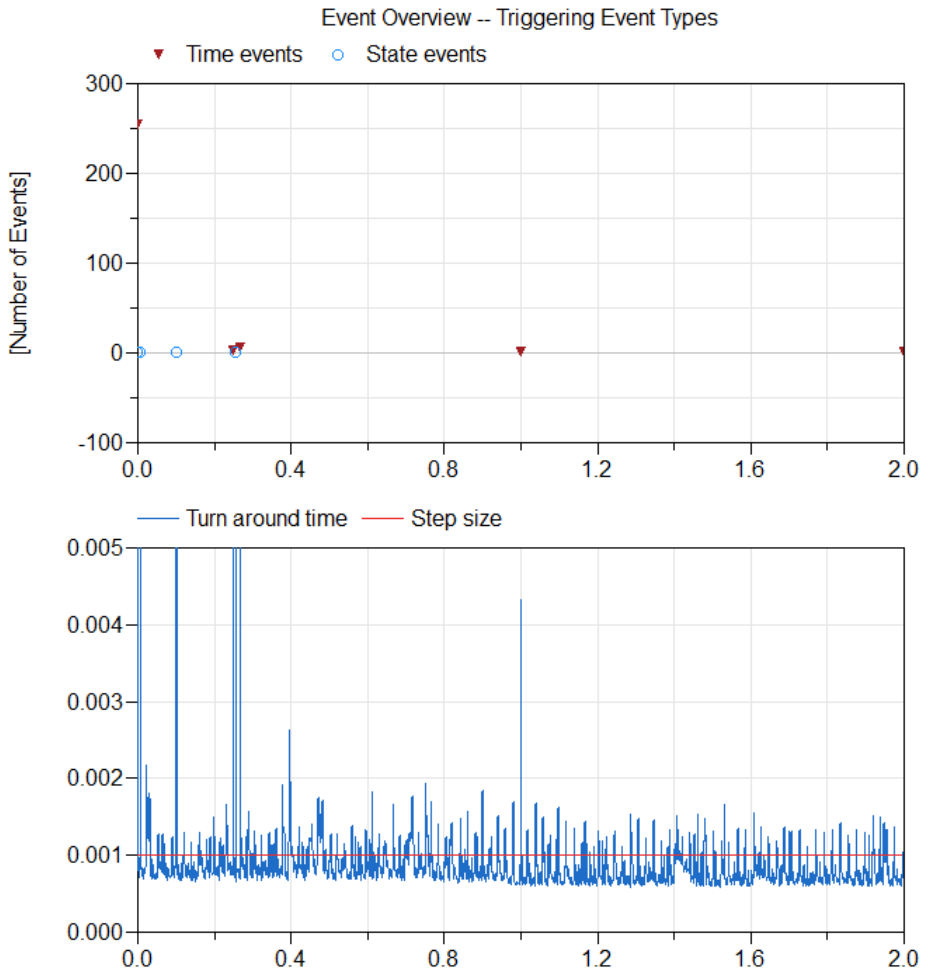
DYMOLA Model Debugging and Performance Analysis

- Duration – 8 hours
- Pre Requisites – Active DYMOLA user

This course is created for active users of DYMOLA looking for more advanced training in model debugging and performance analysis within DYMOLA. Through examples this course outlines how to find inefficient / problematic portions of models, and demonstrates the process one can take to make the models more robust and improve performance. Also covered in this course as an option are advanced flags and solver options including Inline Integration and preparation of models for realtime use.



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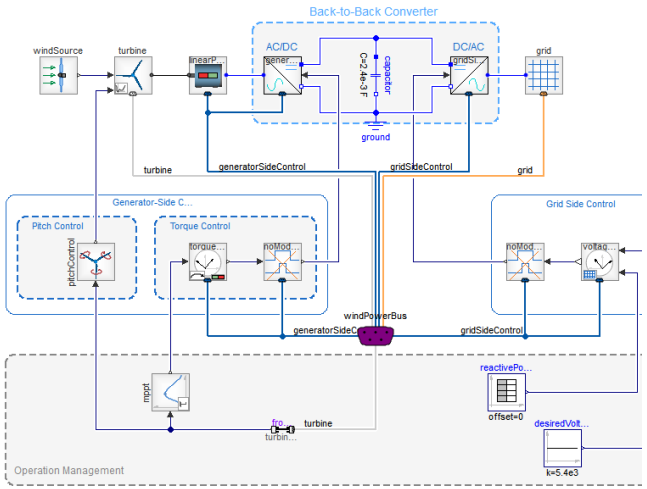
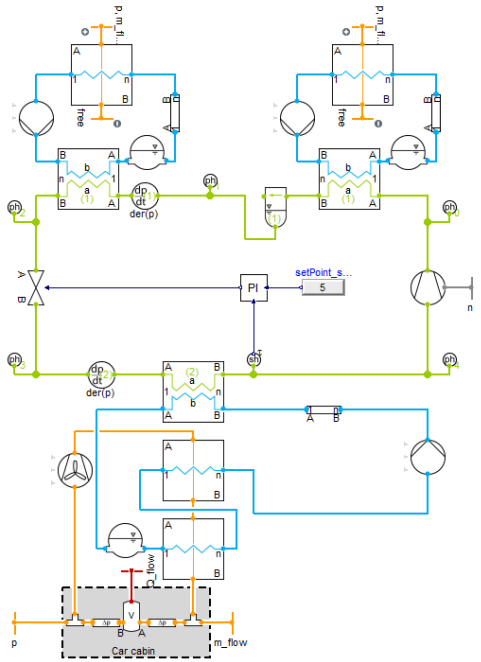
DYMOLA Model Troubleshooting

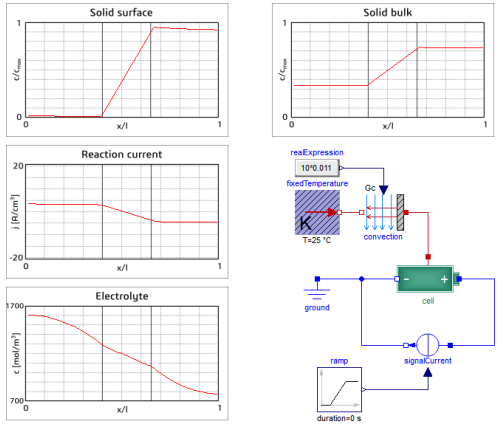
- Duration – One Hour
- Pre Requisites – Active DYMOLA user

- The Structure
  - One hour Web sessions
  - One to one interaction
  - User defined topics
  - Option to record session
  - Option of user defined examples

This course may be used to introduce new users or how to approach a new application. The user may choose to define a subject for which a deeper knowledge is required or, in the case of the user supplying the model, using the session to troubleshoot and better optimise that particular model.







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Model Optimization with Dymola

- Pre Requisites – Active DYMOLA user

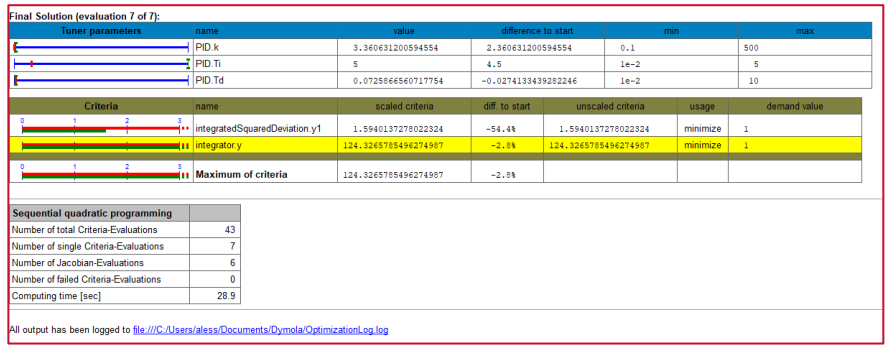
This course is created for active users of DYMOLA looking to learn how to perform optimization within Dymola itself without the need to use external optimizers and without the need for co-simulation or FMI

.

The course utilizes the Optimization library to perform:

- Single case optimization
- Multi-case optimization
- Single criteria optimization
- Multi-criteria optimization

We explore the use of the Optimization library to optimise both *control parameters* and also *geometrical parameters* to achieve the desired performance/response dynamics from the physical and control systems.



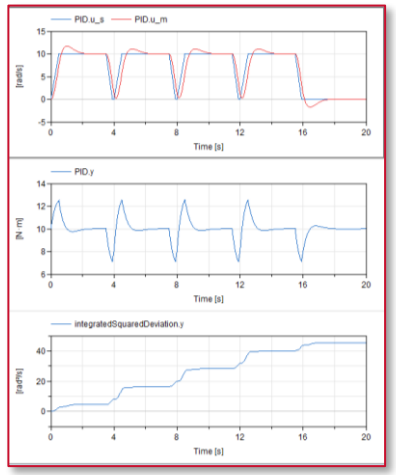
Final Solution (evaluation 7 of 7):

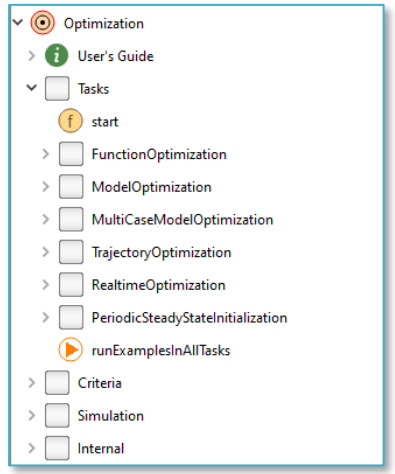
Tuner parameters	name	value	difference to start	min	max
	PID.k	3.360631200594554	2.360631200594554	0.1	500
	PID.Ti	5	4.5	1e-2	5
	PID.Td	0.0725866560717754	-0.0274133439282246	1e-2	10

Criteria	name	scaled criteria	diff. to start	unscaled criteria	usage	demand value
	integratedSquaredDeviation.y1	1.5940137278022324	-54.4%	1.5940137278022324	minimize	1
	integrator.y	124.3265785496274987	-2.8%	124.3265785496274987	minimize	1
	Maximum of criteria	124.3265785496274987	-2.8%			

Sequential quadratic programming	
Number of total Criteria-Evaluations	43
Number of single Criteria-Evaluations	7
Number of Jacobian-Evaluations	6
Number of failed Criteria-Evaluations	0
Computing time [sec]	28.9

All output has been logged to file:///C:/Users/aless/Documents/Dymola/OptimizationLog.log





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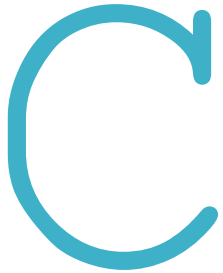
Interfacing with/to Modelica

- Duration – 8 hours
- Pre Requisites – Active DYMOLA user



- Using external C-code in Modelica model
- Calling C functions from a DYMOLA function
- Mapping of variables and records in DYMOLA to C code
- Creating Modelica External Objects
- Overview and example
- Debugging by stepping through dymosim.exe
- Building dymosim.exe with debug information
- Stepping through dsmodel.c and external C code
- Scripting within DYMOLA and utilising the DYMOLA - Python Interface.
- Using the DYMOLA library included in the DYMOLA install to call commands, functions and run simulations using Python.
- Extracting the desired results and perform post processing and plotting.

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Introduction to FMI

- Duration – 2 hours
- Pre Requisites – Active DYMOLA user

- Introduction to Model Exchange and Co-Simulation
- Exporting models from Dymola as FMU
  - Setting up FMU export options
  - Setting up inline solver
- Importing FMU into Dymola
- Claytex FMU starter kit

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Interfacing with FMI4Cpp

- Duration – 2 hours
- Pre Requisites – Active DYMOLA user, basic C++ knowledge

- Interface with FMI with C++ using FMI4Cpp
- Installation of FMI4Cpp
- Create a generic FMI4Cpp CoSimulation and Model Exchange examples
  - Introduction to the modelDescription.xml file
  - Initialise parameters at initialisation
  - Set inputs
  - Simulate
  - Record outputs

```
void simulate_SimpleVehicle_ModelExchange() {
    auto fmuFile = "RigidSuspensionsLinearTyres.fmu";
    double start_time = 0.0;
    double threshold = 2.0;
    double stop_time = 12;
    double step_size = 1e-3;
    double time = start_time;
    fmi2Boolean status = true;
```

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Interfacing with FMPy

- Duration – 2 hours
- Pre Requisites – Active DYMOLA user

- Interface with FMI with Python using FMPy
- Installation and setup of FMPy
- Create a generic FMIPy CoSimulation and Model Exchange examples
  - Introduction to the modelDescription.xml file
  - Initialise parameters at initialisation
  - Set inputs
  - Simulate
  - Record outputs

```
def simulate_SimpleVehicle_ModelExchange(show_plot=True):

    # define the model name and simulation parameters
    fmu_filename = 'LeanAsphaltLake.fmu'

    # read the model description file
    model_description = fmpy.read_model_description(fmu_filename)
```

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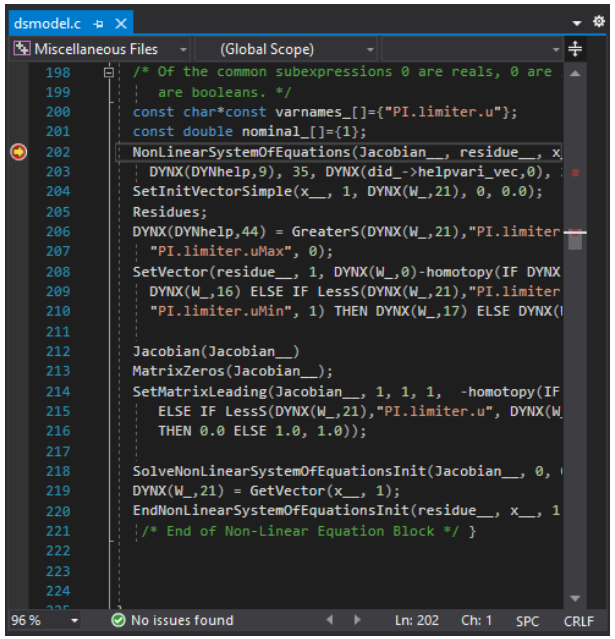
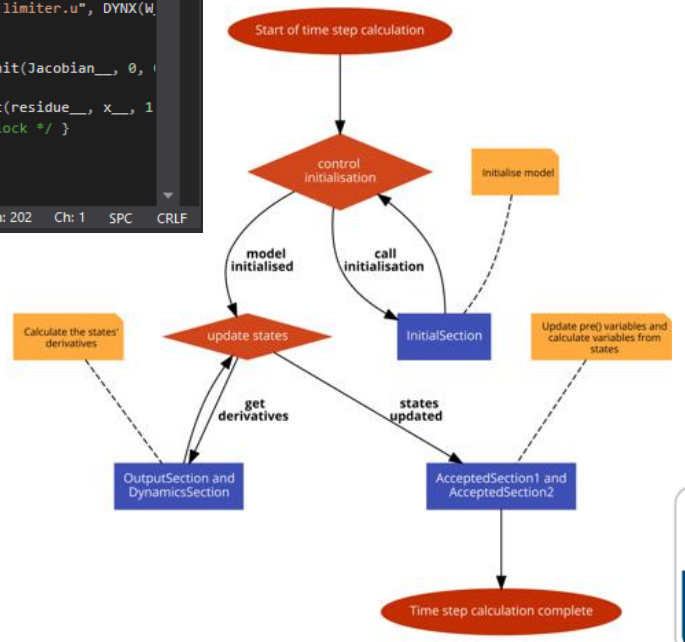
FMI Debugging

- Duration – 2 hours
- Pre Requisites – Active DYMOLA user

- Compilation process described
- Debug dymosim.exe
  - Build dymosim.exe
  - Step through dymosim.exe
  - Step through external C/C++ functions
- dsmodel.c described:
  - Layout
  - Variables
- General FMU debugging options
- Step through FMU code
  - Build debug FMU
  - Step into debug FMU
    - From Dymola
    - Using FMI4Cpp
    - Using FMPy





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