HYDRAULICS LIBRARY

Overview

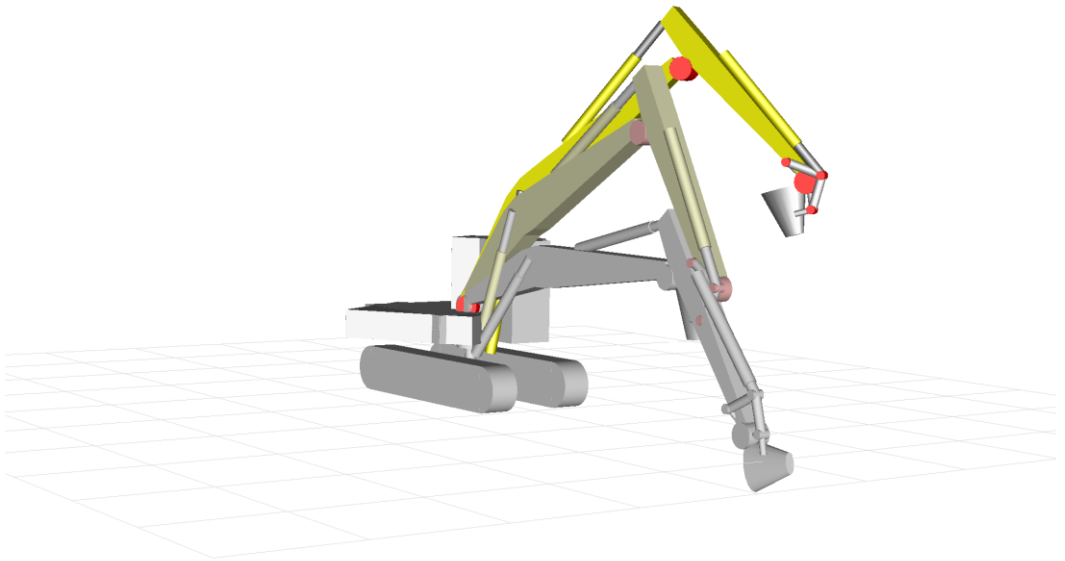
Modelon

AGENDA

- ❑ About Hydraulics Library
- ❑ Key Benefits
- ❑ Key Capabilities
- ❑ Key Applications
- ❑ Library Contents
- ❑ Modelon Compatibility
- ❑ Latest Release

ABOUT HYDRAULICS LIBRARY

- Modelica library for hydraulic systems
  - High pressure (up to several hundred bar)
  - Compressible flow
  - Optional ThermoHydraulics
- Components
  - Most models needed for fluid power applications available, both mobile and stationary
  - More can be built from basic building blocks
- Open Code means User is in Control
  - View, extend, modify models
  - Ideal for model sharing (encryption)
- Simulation of hydraulic systems for
  - Overall system dynamics
  - Verification of dimensioning
  - Testing of control strategies



Modelon

KEY BENEFITS

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- Easy-to-Use yet Powerful
  - Wide range of predefined components
  - New users get started quickly
  - No limitations for experienced users
- Unrivalled Flexibility
  - All components can be copied and modified
- Well suited for control design and validation
- True multi-engineering tool
  - Modeling of multi-domain systems, combine with multibody mechanics, control system etc.
  - Easy to integrate with other available libraries
- Visualization
  - Easily visualize system behaviour
  - Graphical workspace looks like a hydraulic scheme

Modelon

KEY CAPABILITIES

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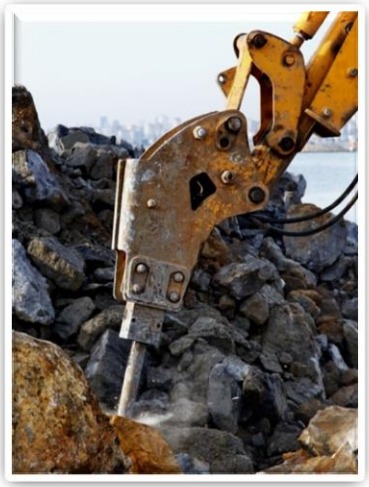
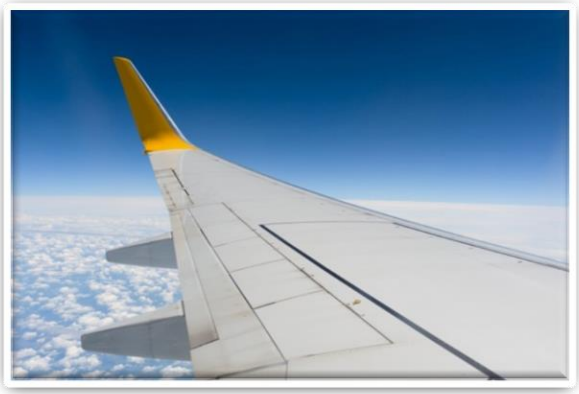
- Integration of hydraulic systems in wide range of multi-physics models
- Deployment
  - Co-simulation

- List of applications
  - Industrial Equipment:
    - Agricultural, drills, hammers, excavators etc.
  - Vehicles:
    - Brakes, dampers, gearboxes, power steering etc.
  - Aircrafts:
    - Actuators, landing gear etc.

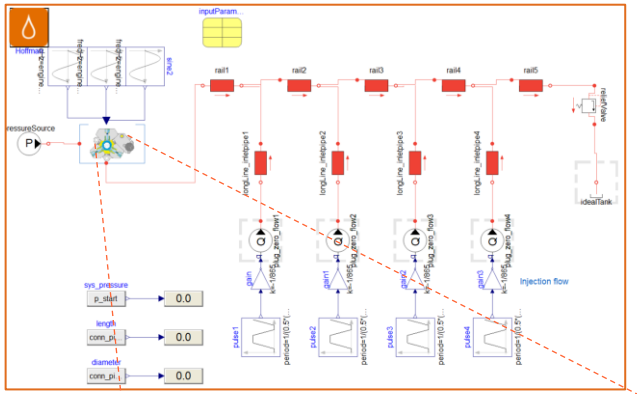


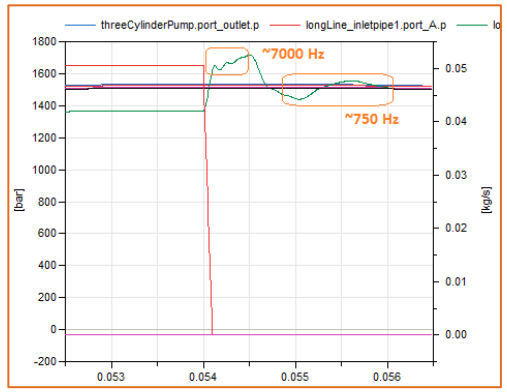


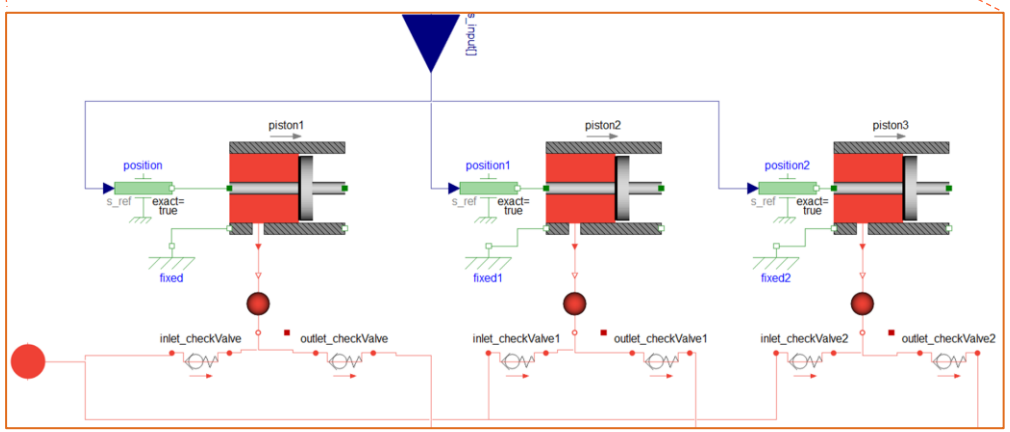
KEY APPLICATIONS

EXAMPLE: CRDI SYSTEM MODEL

- Common rail diesel injection pump model built from scratch using Elements models
- The long line models from the library are put to good use to capture high frequency phenomenon

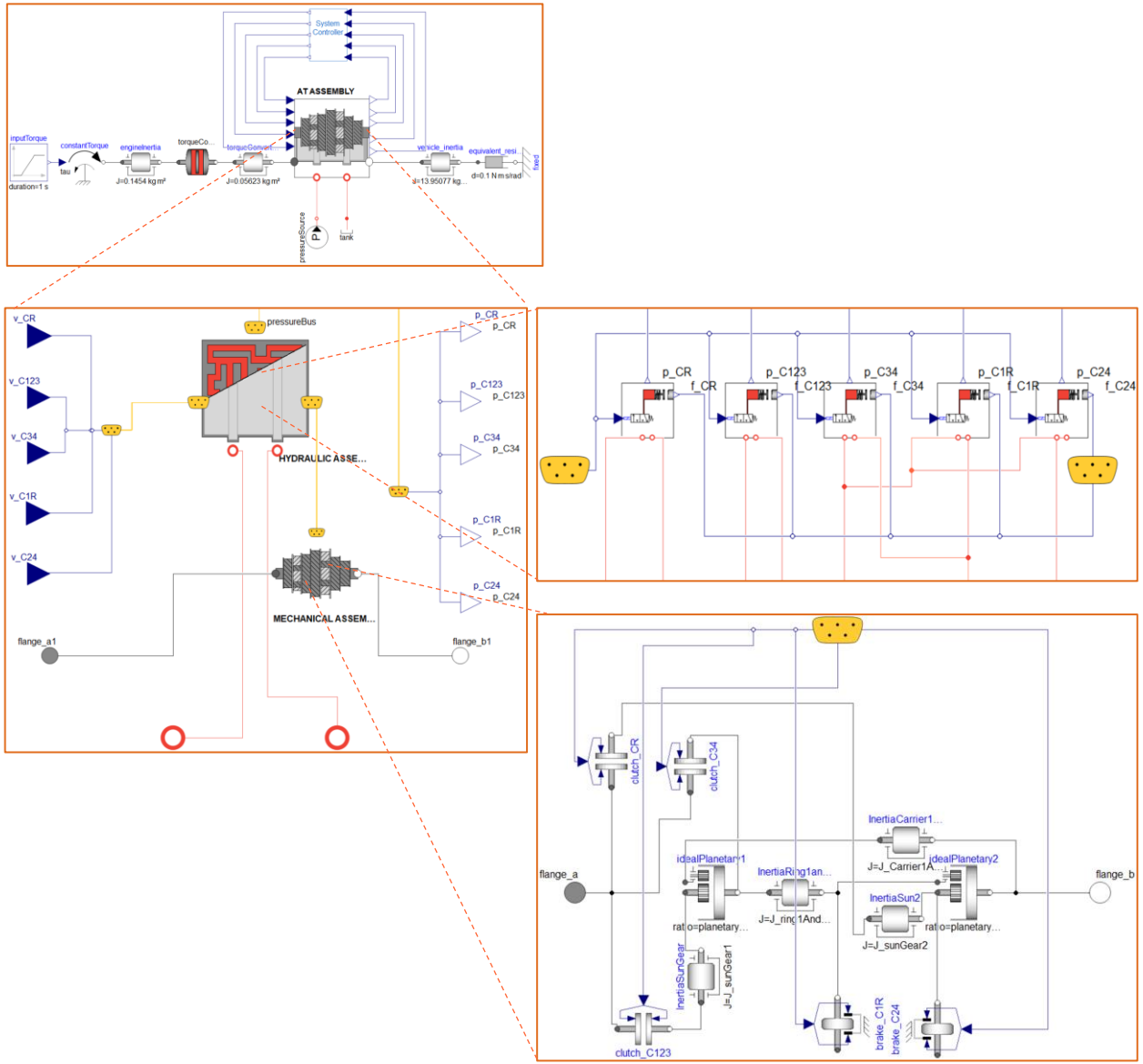






EXAMPLE: SHIFT SHOCK STUDY MODEL

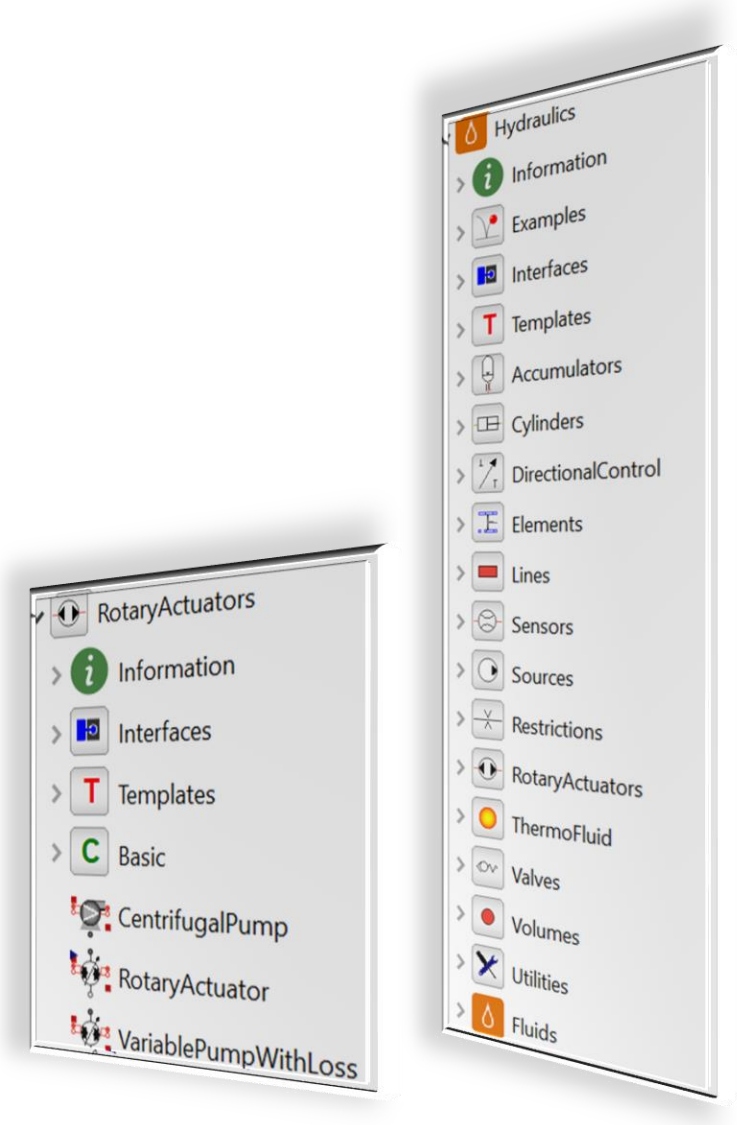
- Automatic transmission shift mechanism built using off-the-shelf library components as well as Elements models
- Shift shock phenomenon studied using the models



LIBRARY CONTENTS

LIBRARY CONTENTS

- Standard package order
  - Information
  - Examples
  - Interfaces
  - Templates
  - Components by type
- 2 Levels of components
  - Top level components for end user
  - Basic components are subcomponents, building blocks for new user-defined components



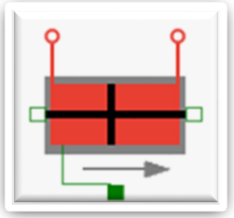
LIBRARY CONTENTS

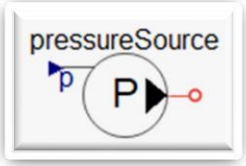
Cylinders
- Single & Double acting, plunger

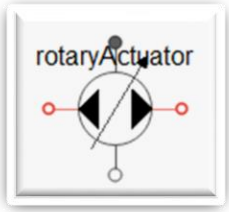
Lines
- Rigid, flexible, discretized

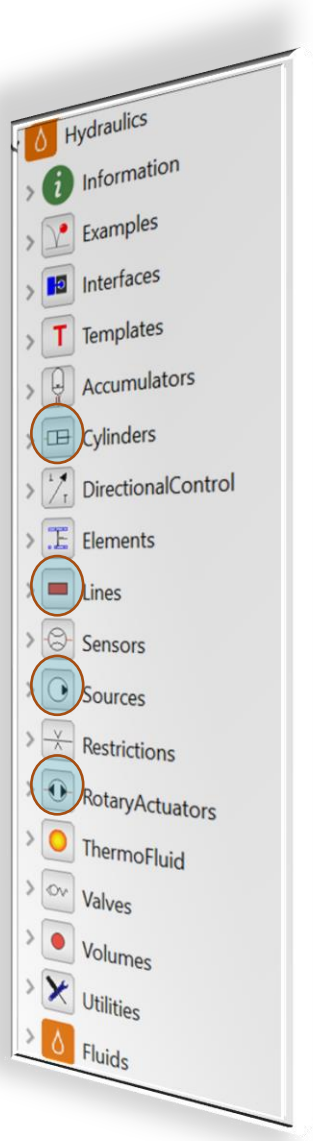
Sources
- Flow, pressure

Rotary Actuators
- Ideal, variable, lossy





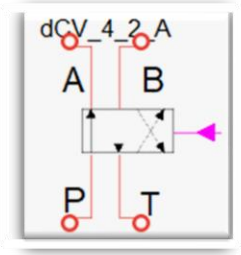




LIBRARY CONTENTS

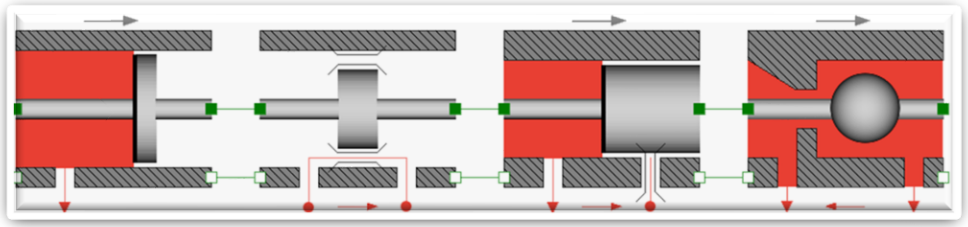
DirectionalControl

- For flow control
- First order spool dynamics



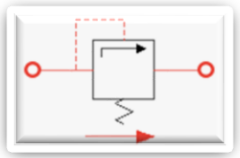
Elements

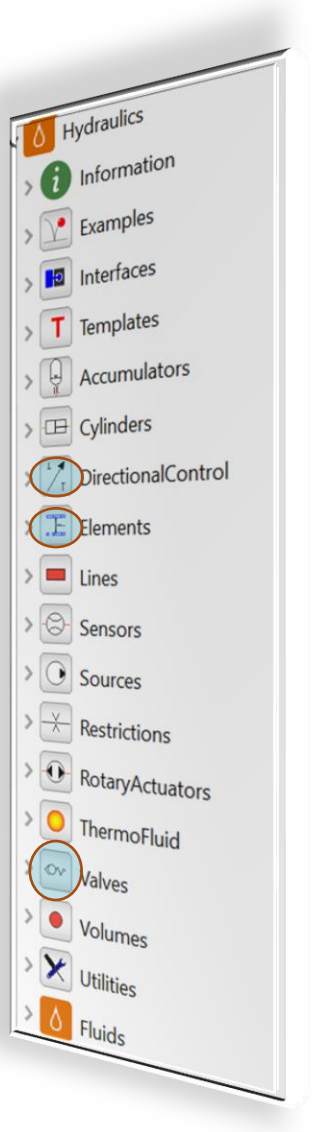
- Primitives for detailed component design



Valves

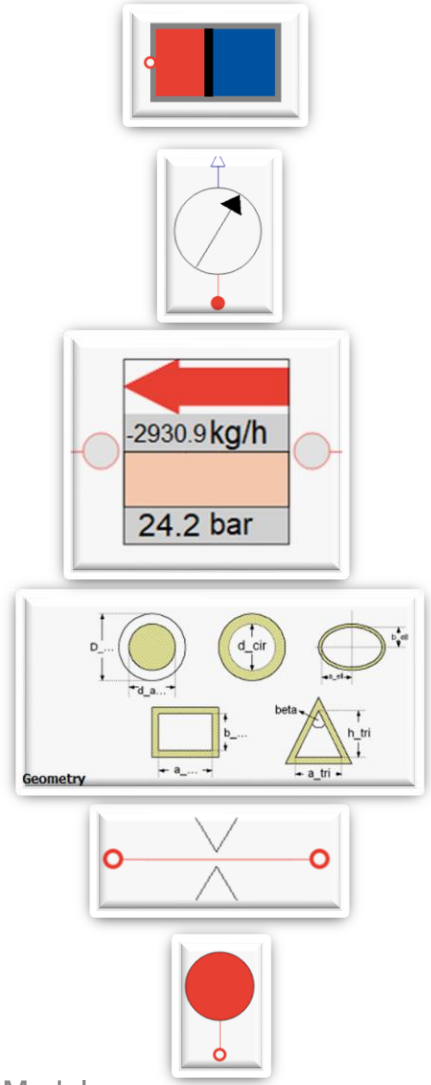
- Pressure and flow actuated

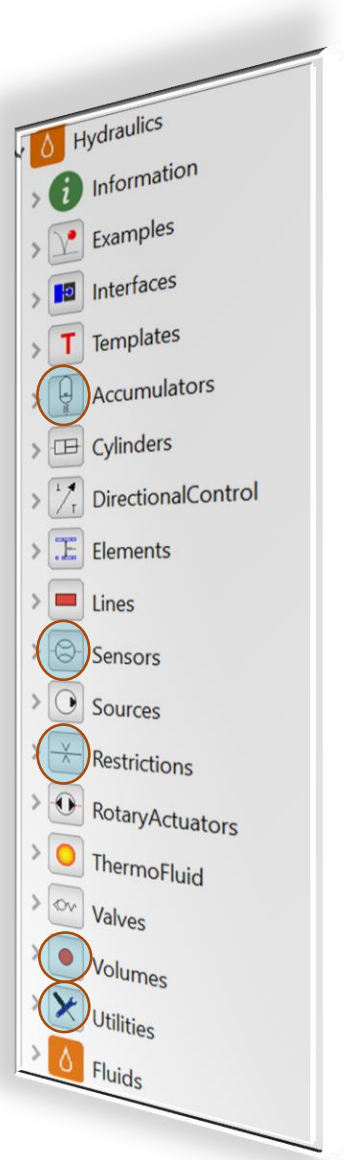




LIBRARY CONTENTS

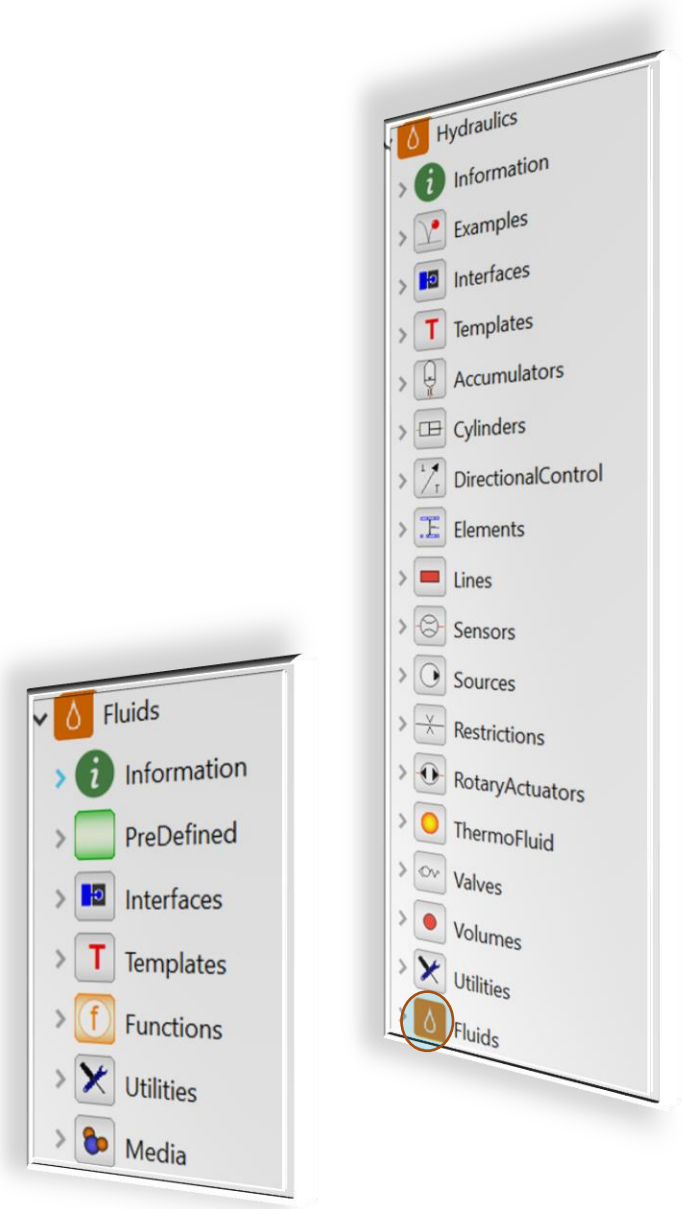
- Accumulators
- Sensors and Utilities.Visualizers
  - Flow, pressure and temperature
  - Non-ideal sensors
- Restrictions
  - Laminar/Turbulent
  - Cavitational effects
    - Geometry based fittings
- Volumes
  - Closed, open, chamber





LIBRARY CONTENTS

- Fluids
  - Pre-defined table based
  - ThermoHydraulics
  - Equation based
    - Constant properties
    - With unresolved air
      - Nykaenen,
      - Gibson,
      - Hoffman
  - Coefficient based jet fuels

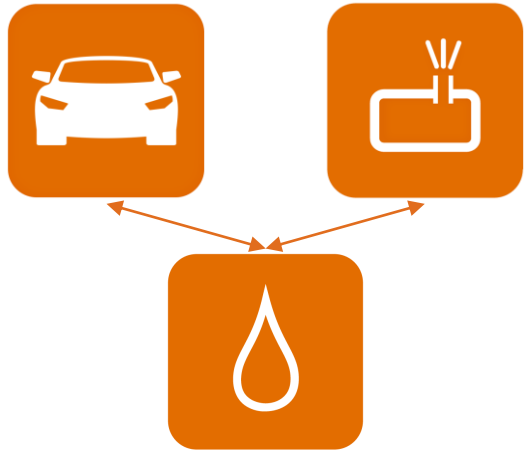


MORE LIBRARY VIEWS

MODELON COMPATIBILITY

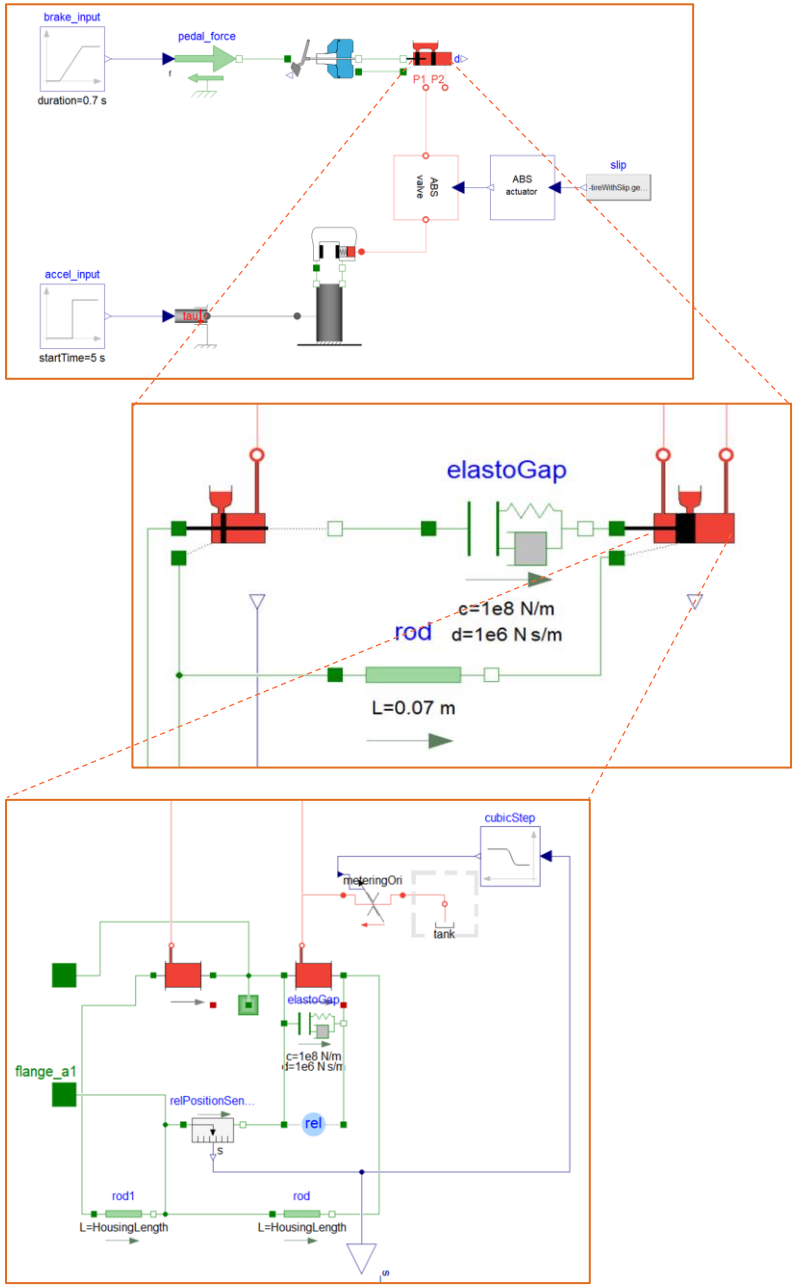
RECOMMENDED MODELON LIBRARY COMPATIBILITY

- Hydraulics Library can be combined with other Modelon libraries to solve specific engineering design tasks.
- Interesting libraries for integrating hydraulic solutions include the
  - Vehicle Dynamics Library
  - Pneumatics Library
- These libraries can also be used as a stand-alone solution.



EXAMPLE: ABS SYSTEM MODELS

- Anti-lock braking system involving the master cylinder and caliper models
- Off-the-shelf component models from library used to build the master cylinder circuit and caliper models



LATEST RELEASE

RELEASE: 2021.2

New Features

- Added a utility - and associated examples - to plot fluid properties
- The Elements package now uses a modular structure to select the fidelity of the modeled physical effects as well as to define the geometric parametrization

Enhancements

- Complete review of all experiment-annotations
- Harmonized code layer of ZeroVolume and Volume
- Moved reverse parameter in Elements to the General tab so it becomes more accessible