



HYDRAULICS LIBRARY

Overview



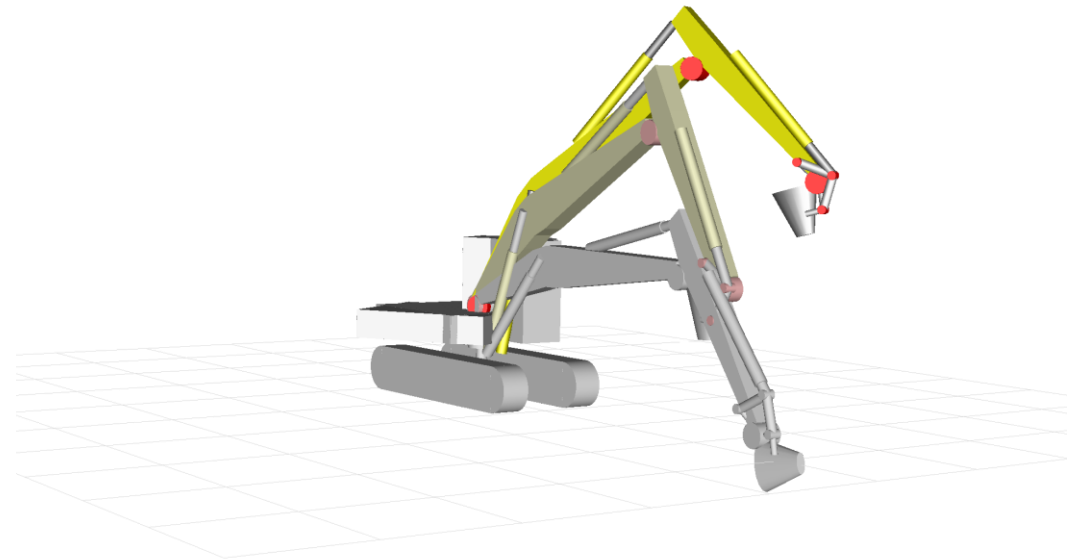
AGENDA

- 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





KEY BENEFITS

KEY BENEFITS

- 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



KEY CAPABILITIES

KEY CAPABILITIES

- 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.

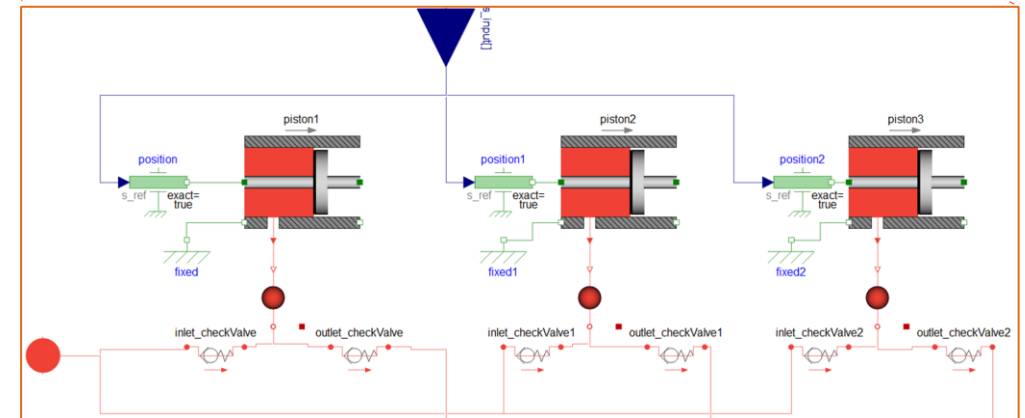
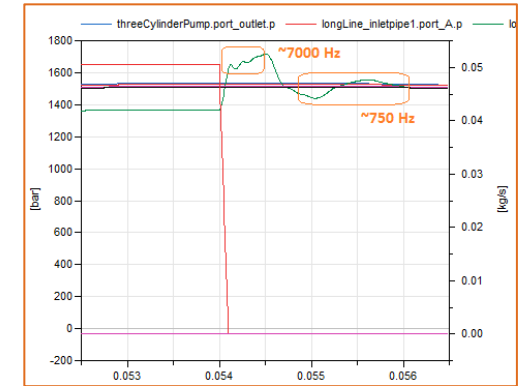
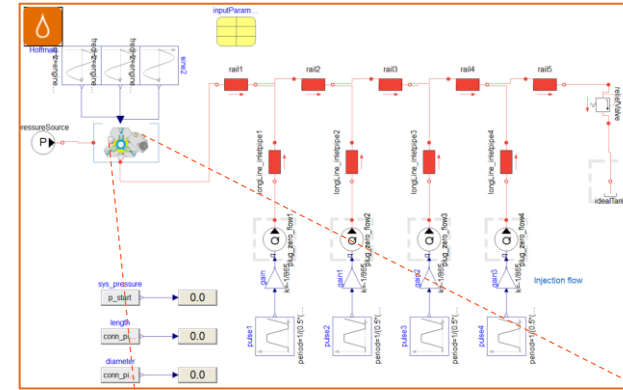




KEY APPLICATIONS

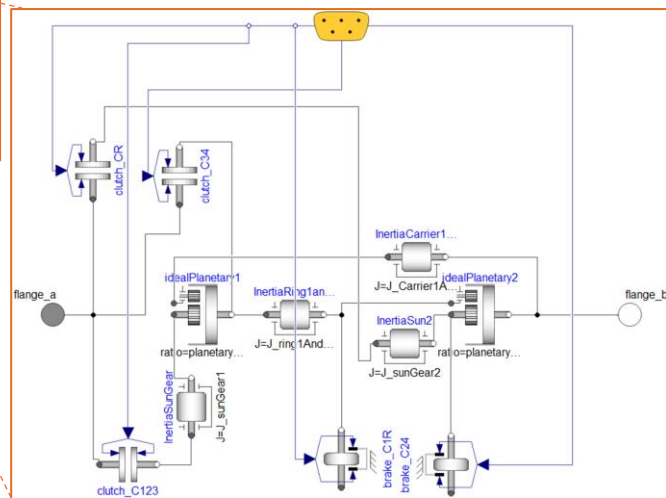
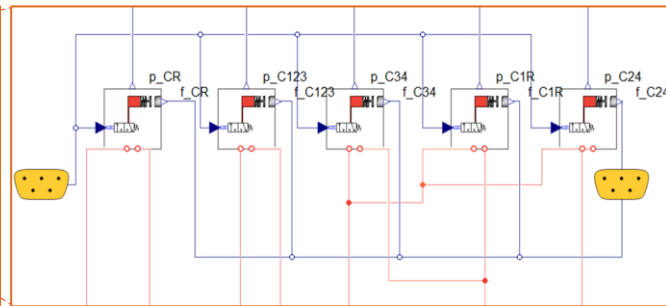
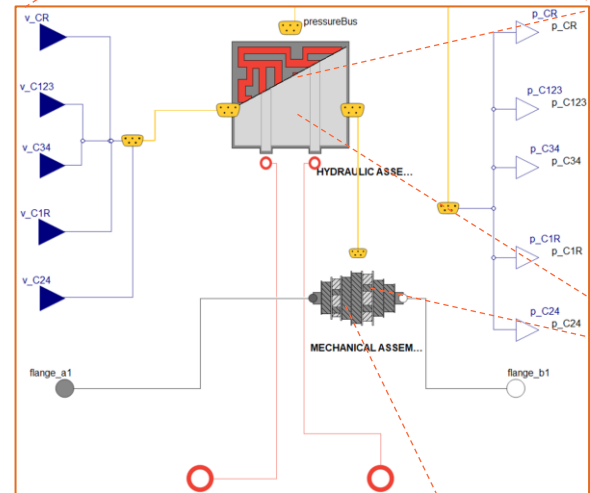
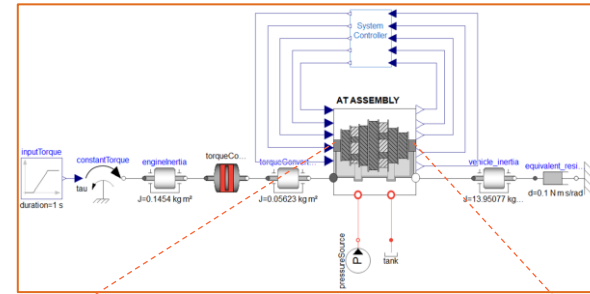
EXAMPLE: CRDI SYSTEM MODEL

- 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

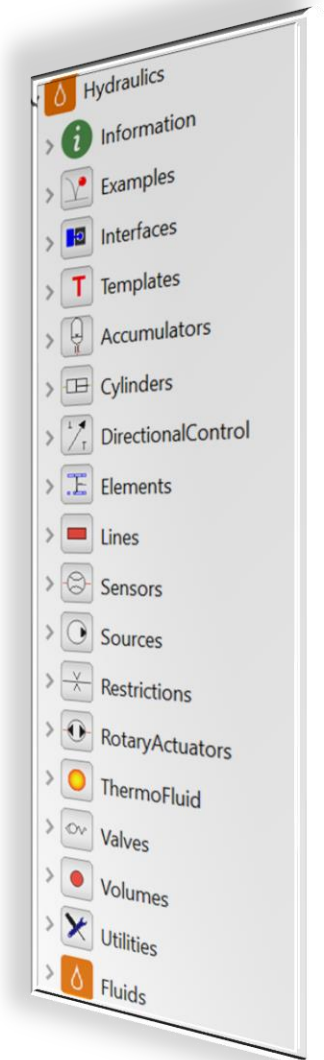
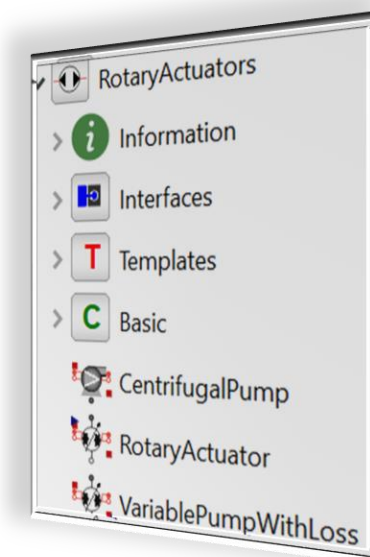




LIBRARY CONTENTS

LIBRARY CONTENTS

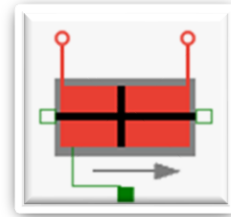
- Standard package order
 - Information
 - Examples
 - Interfaces
 - Templates
 - Components by type
- 2 Levels of components
 - Top level components for end user
 - Basic components are subcomponents, building blocks for new user-defined components



LIBRARY CONTENTS

Cylinders

- Single & Double acting, plunger



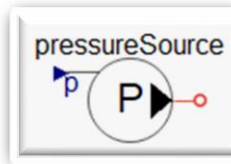
Lines

- Rigid, flexible, discretized



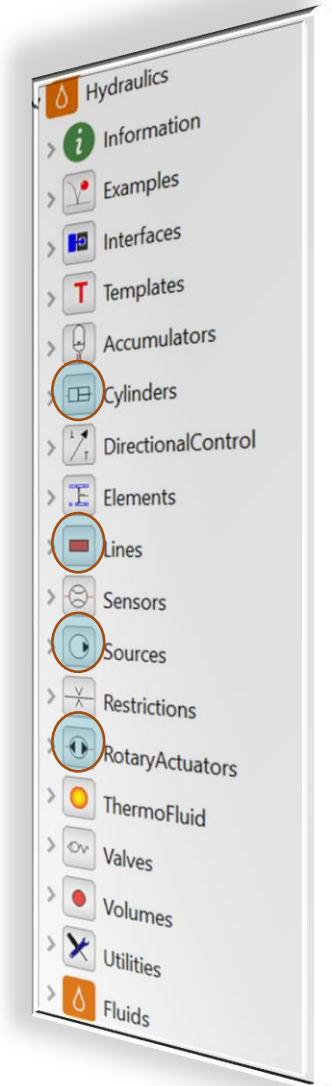
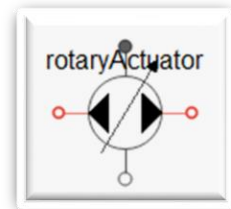
Sources

- Flow, pressure



Rotary Actuators

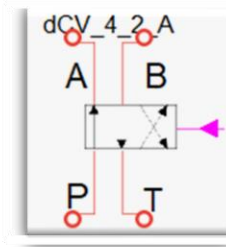
- Ideal, variable, lossy



LIBRARY CONTENTS

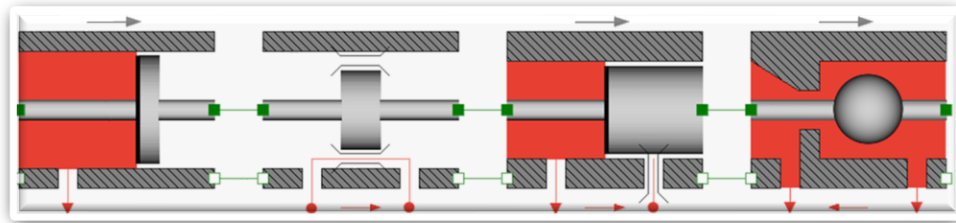
DirectionalControl

- For flow control
- First order spool dynamics



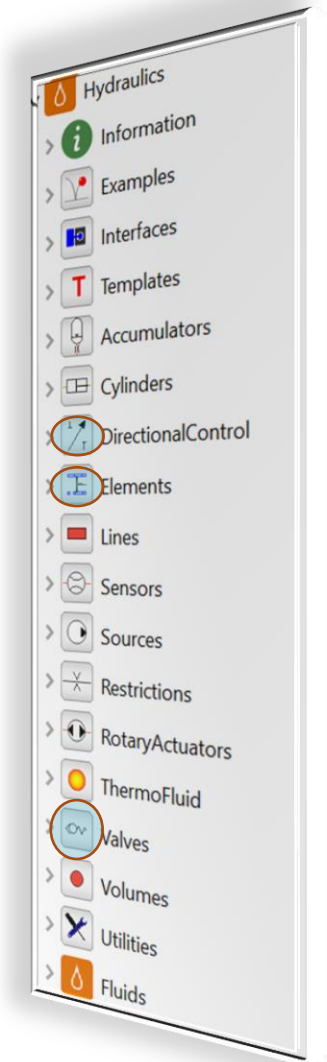
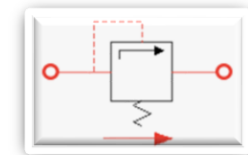
Elements

- Primitives for detailed component design



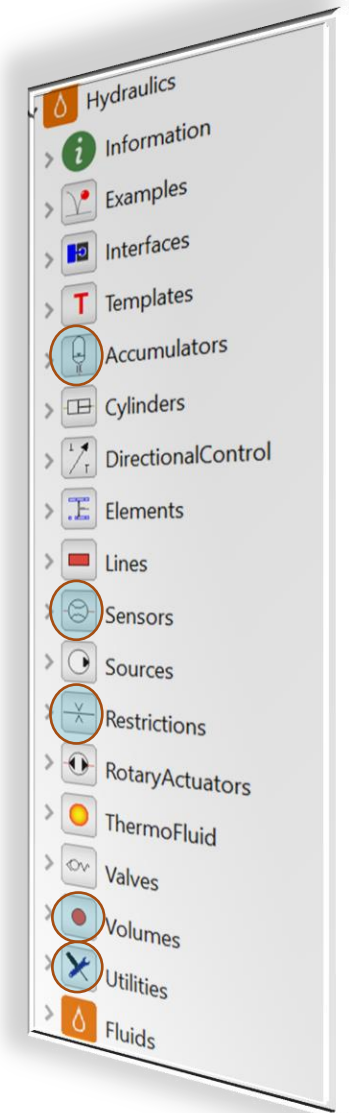
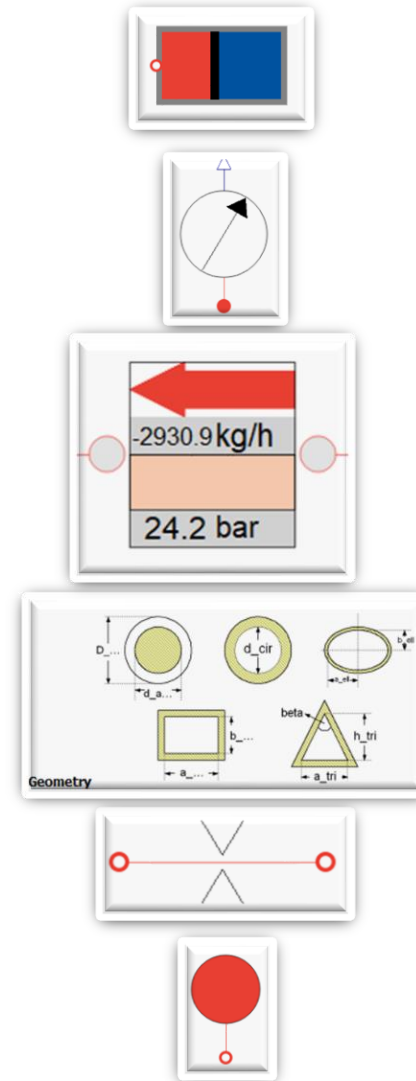
Valves

- Pressure and flow actuated



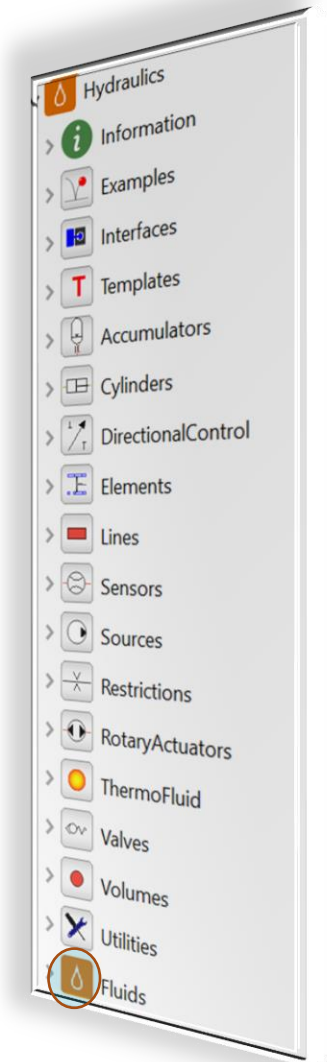
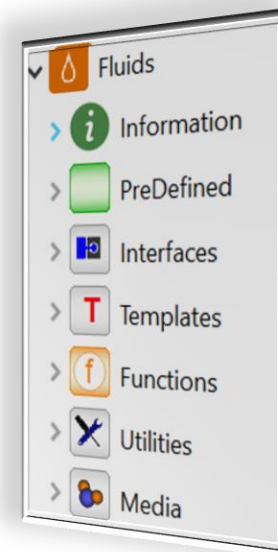
LIBRARY CONTENTS

- Accumulators
- Sensors and Utilities. Visualizers
 - Flow, pressure and temperature
 - Non-ideal sensors
- Restrictions
 - Laminar/Turbulent
 - Cavitation 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

- ▼ Accumulators
 - Information
 - > Templates
 - SpringAccumulator
 - PistonGasAccumulator
 - AccumulatorSimple
 - AccumulatorDetailed
- ▼ Cylinders
 - Information
 - > Interfaces
 - > Templates
 - PlungerCylinder
 - SingleActingCylinder
 - DifferentialCylinder
 - DoubleActingDualRod

- ▼ DirectionalControl
 - > Information
 - > PreDefined
 - > Examples
 - > Interfaces
 - > Templates
 - > Actuators
 - > Basic
 - DCV_3_2_PAB
 - DCV_3_2_PAT
 - DCV_4_2_A
 - DCV_4_2_X
 - DCV_4_3_A
 - DCV_4_3_B
 - DCV_4_3_C
 - DCV_4_3_X

- ▼ Elements
 - > Information
 - > Examples
 - ▼ Base
 - > Interfaces
 - > Templates
 - > Functions
 - > FluidProperties
 - > FlowCharacteristics
 - > Geometry
 - ZeroVolume
 - Volume
 - Leakage
 - Piston
 - PoppetLift
 - PoppetLiftCone
 - PoppetLiftConicalSharpEdge
 - SpoolValve
 - MassWithStopAndFriction
 - MassInMass

- ▼ Lines
 - > Information
 - > Examples
 - > Interfaces
 - > Templates
 - > Basic
 - Inductance
 - InductanceHole
 - Line
 - LongLineTLM
 - LongLine
 - ▼ RotaryActuators
 - > Information
 - > Interfaces
 - > Templates
 - > Basic
 - CentrifugalPump
 - RotaryActuator
 - VariablePumpWithLoss

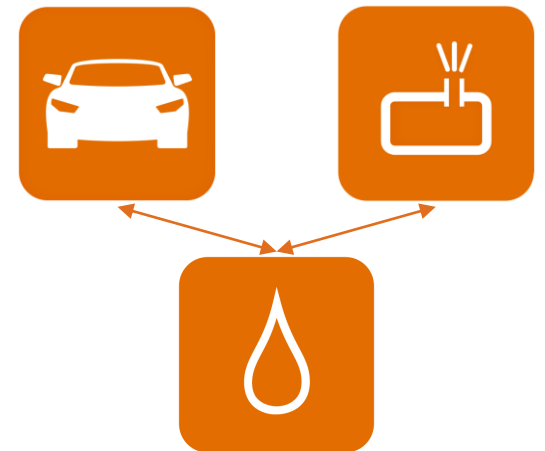
- ▼ Restrictions
 - > Information
 - ▼ Fittings
 - > Basic
 - BendCurve
 - BendEdge
 - Channel
 - SingleEdge
 - ThickEdge
 - StraightPipe
 - > Basic
 - Laminar
 - LaminarNominalPoint
 - Turbulent
 - TurbulentMultiple
 - Transition
 - TransitionMeter
 - TransitionPolynomial
 - TransitionPolynomialMeter
 - TransitionCavitation



MODELON COMPATIBILITY

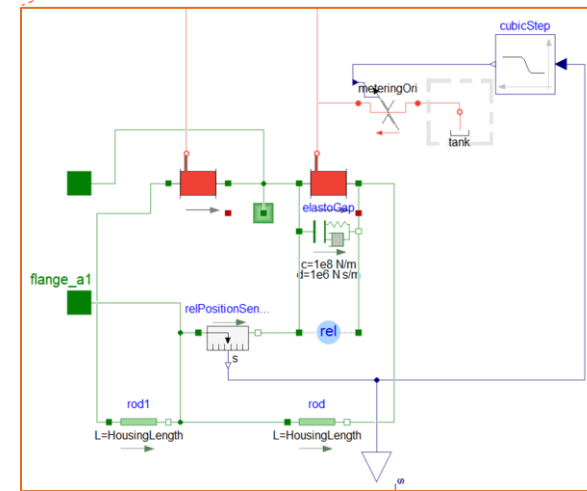
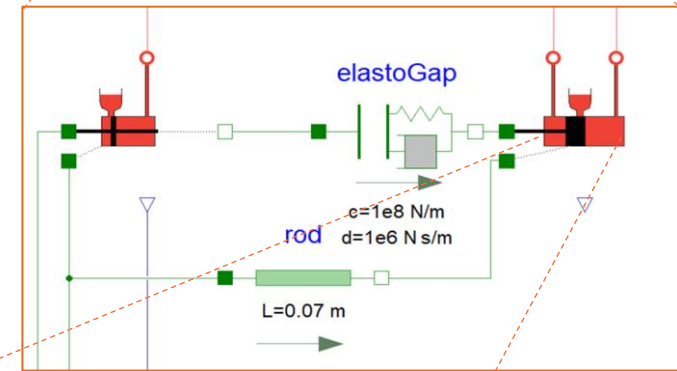
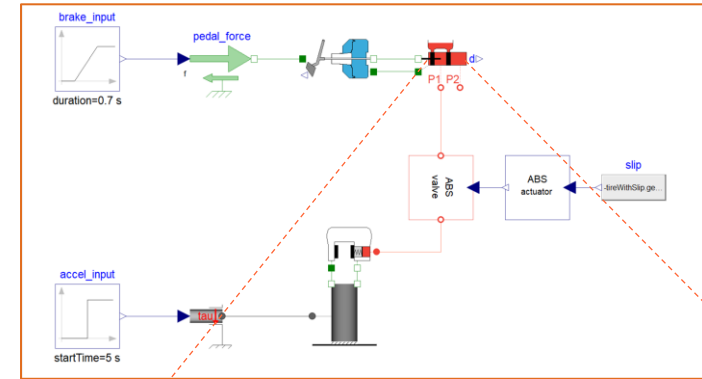
RECOMMENDED MODELON LIBRARY COMPATIBILITY

- 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



The background image is a dark, semi-transparent composite. On the left, a person is seen from the side, focused on a laptop. On the right, a large, detailed jet engine turbine is visible. The overall tone is professional and technical.

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

