

Application

Handling Equipment

The efficiency of a pneumatic handling system is primarily determined by the transportation speed. The design of the drive components plays a main role for a proper function of the equipment in which unacceptable high loads can be prevented by choosing the adequate motion parameters.

During the design process, the adjustment effort for the throttle valves can be reduced, and the dynamic loads as acceleration, stopping forces and oscillation behavior can be investigated and minimized.

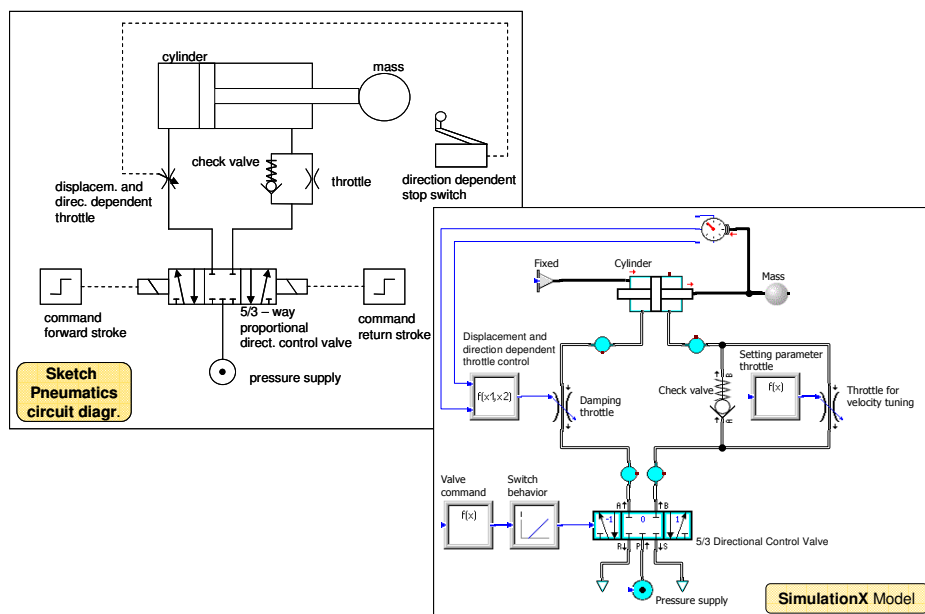
Model Structure

The simulation model below – based on a pneumatic circuit diagram on the left side – is set up in **SimulationX**.

The pneumatic cylinder is connected with a mass, which is including the mass of the piston rod and a horizontal mass load. To control the displacement of the piston rod of the pneumatic cylinder a 5/3 directional control valve is used. The model object of the directional control valve in **SimulationX** includes a lot of features to describe the flow characteristics by various resistance models, the switching behavior and the valve dynamics. The position of the rod is measured by a sensor block that tapes the mechanical state quantities at the mechanical connection. Throttle valves with various parameters are integrated to realize different velocities for the extension and the contraction process. The signal block “Displacement and direction dependent throttle valve” gets the information about the velocity and the displacement from the sensor block and calculates the hydraulic diameter of the damping throttle subject to the position and direction of the piston rod.

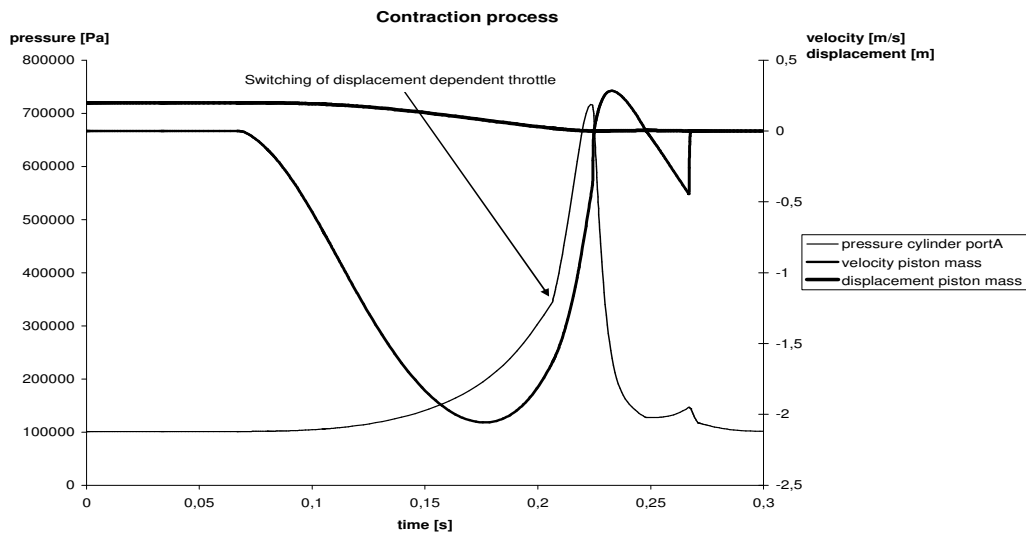
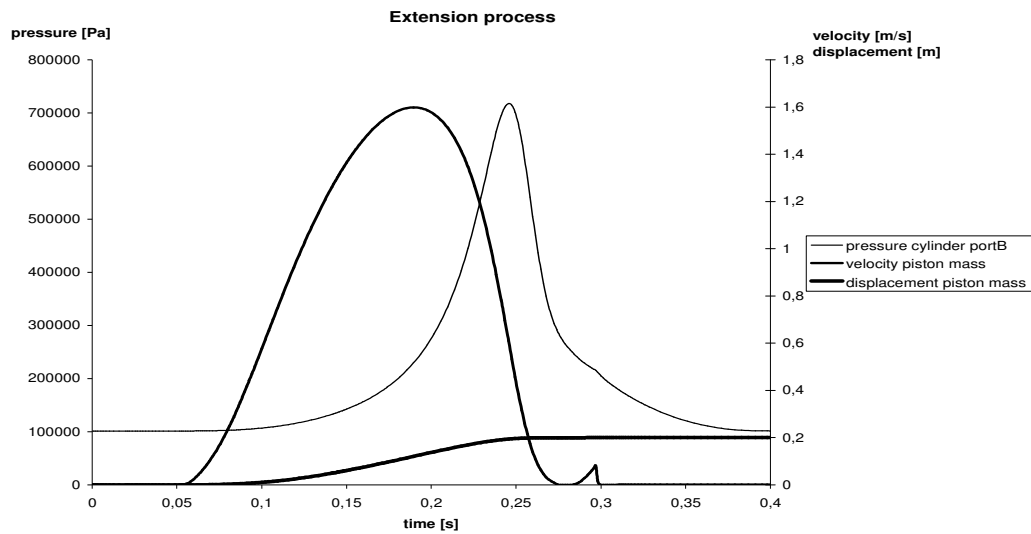
All the model objects are found in the SimulationX libraries Pneumatics, Mechanics, and Control Blocks.

- *Physical based modeling and simulation of electro-pneumtical and mechanical components and systems*
- *Pneumatic drive dimensioning and selection of components*
- *Device-oriented modeling*
- *Graphic model editor analogous to circuit diagram*
- *Coupled problems (mechanics, pneumatics, control and measuring system ...)*



The simulation of the extension and contraction process is carried out separately. The desired result quantities for the evaluation of the drive system are selected and can be observed during the simulation.

Simulation Results



As an example, the time-dependent result curves for the piston velocity, displacement and cylinder chamber pressures are shown above. The effect of different switching operations can be evaluated by comparing the pressure curves of both processes. Due to the increase of the throttle resistance at a certain position during cylinder contraction, it is possible to slow down from higher speeds. The displacement time is reduced.

The system modeling concept of SimulationX

The concept of **SimulationX** enables the user to create models of pneumatic drive systems on a device-oriented level with interactive graphics. Components with pneumatic, mechanical, and control-engineering features can be combined within one simulation model for investigating various interaction mechanisms between different components and/or physical domains. By modifying the system structure and the system parameters, alternative solutions can be compared and evaluated. In the current application, valuable and reliable conclusions about the system performance can be obtained by varying the

- *resistance characteristics of the pneumatic throttle valves*
- *geometric data of the cylinder*

These conclusions may support you to decide which components are to be selected in the design process yet.