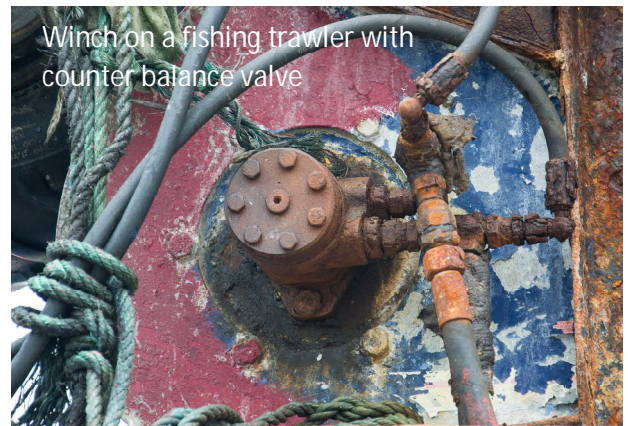


## Case Study for Mobile Applications

# Simulation of Counter Balance Valves with DSHplus

If cylinders or hydro-motors have to be secured against moving under load or their own weight usage of counter balance valves is a popular choice. Lifting devices like cranes and platforms, hydraulic bridges and industrial machinery all make use of counter balance valves. While they come in handy for the application, a valve has to be correctly chosen to operate in a stable manner. An accurate simulation model of the valve can help to verify stable operating conditions of the hydraulic system. Depending on the focus of the simulation there are different methods to model such kinds of valves. Two typical realisations are shown below.



## Option 1: Physical Model

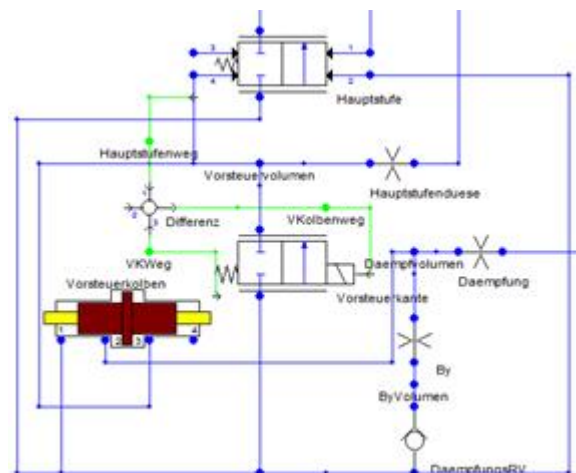
A discrete model of the valve's subcomponents is build using physical parameters. This type of modelling is useful for studying internal effects, but it requires detailed knowledge of the construction. For each manufacturer, dependent on construction even for different models of the same manufacturer, the component set-up of the simulation model has to be changed. Furthermore, accurate modeling produces small hydraulic volumes which lead to long simulation times. This approach is mostly suited for component development.

Pros:

- Simulation model can be used for component development.
- Component internal effects can be studied during the simulation run.

Cons:

- Detailed knowledge of the component's part dimensions is required.
- Component model set-up is manufacturer-specific.
- Possibly, due to small intermediate fluid volumes, a very slow simulation.



## Option 2: Measurement Based Model

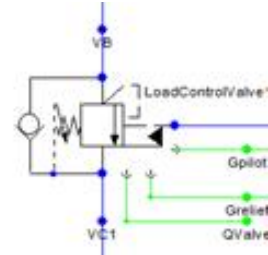
A measurement based component is manufacturer independent with regard to the model set-up. Simulation times will also be faster since there are a lot less components and small volumes involved. It is of course not possible to study any internal effects of the valve and parametrization requires measurement data for the whole range of operation of the modeled system. Due to its fast calculation speed this approach is best suited for system simulation.

Pros:

- A measurement based model will not slow down the system simulation.
- The model set-up is manufacture independent.

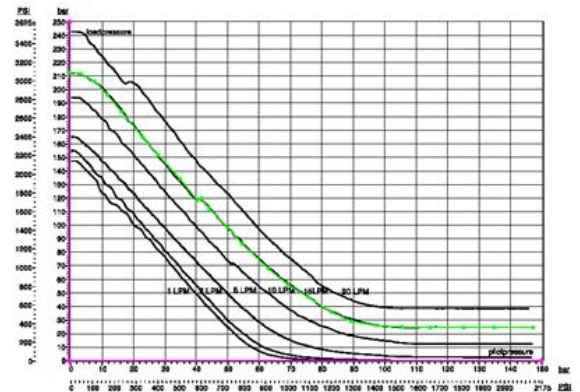
Cons:

- Measurements of the component's behavior are required.
- No conclusion about component internal effects.



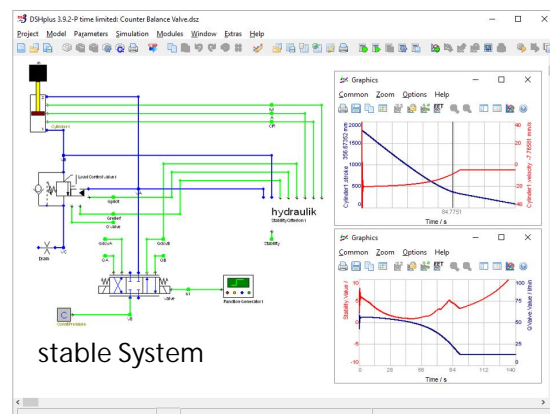
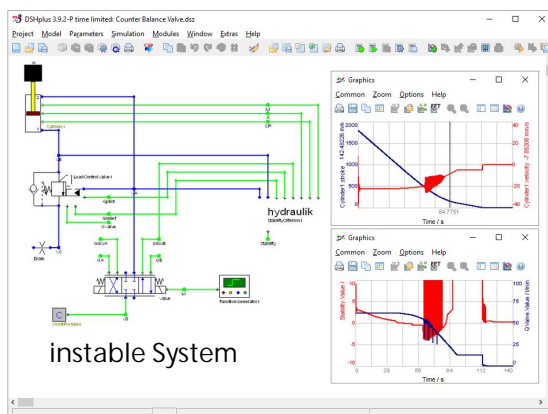
## Obtaining parameters from measurements

Measurements at different points of operation are combined into a 3D-look-up table, which is used in the compact model of the counter balance valve. In the component's parameter dialog the look-up table is chosen and simulation can start right away.



## Simulation using a counter balance valve model

At first simulation of the system's operational envelope will validate component dimensions etc. By variation of loads and pressures (e. g. due to environmental conditions) for different points of operation the counter balance valves can then be checked for stability.



## Solution Highlights

DSHplus is able to support the general engineering of mobile hydraulic systems with simulation models at typical system level detail as well as with high-fidelity physical models, which allow a comprehensive performance analysis and which also support simulation driven optimization techniques, to improve the system's performance.