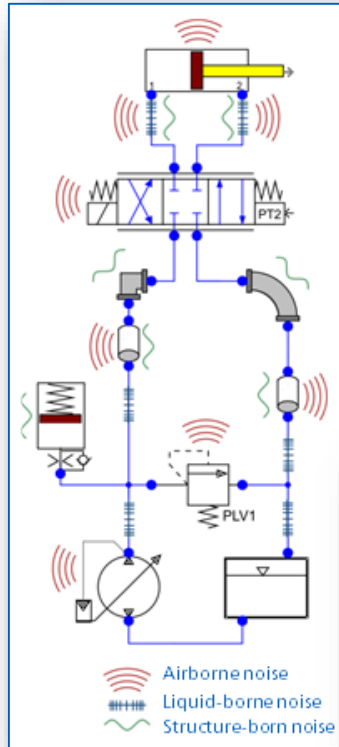


# Reducing noise emissions in piping systems with DSHplus and HyperStudy

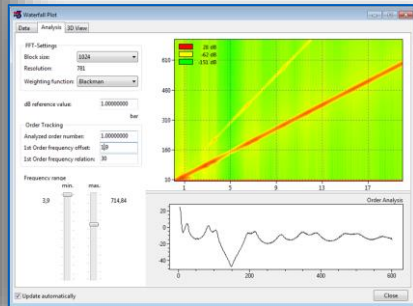
Optimizing piping systems with system level design by FLUIDON

# Pressure Oscillation Analysis

## Application for piping systems



Close up of a high pressure fuel rail



## Challenge

- Reduce pressure and flow ripples in fluid power systems
- Eliminate unwanted noise emissions

## Solution

- Align the damper design onto the required resonant frequency
- Calculate the dynamic response of remaining network
- Determine the position of the damper with maximum pressure fluctuation

## Results

- Rapid analysis of acoustic behavior of arbitrary pipe (and hose) networks
- Solve pressure oscillation problems

# DSHplus and HyperStudy

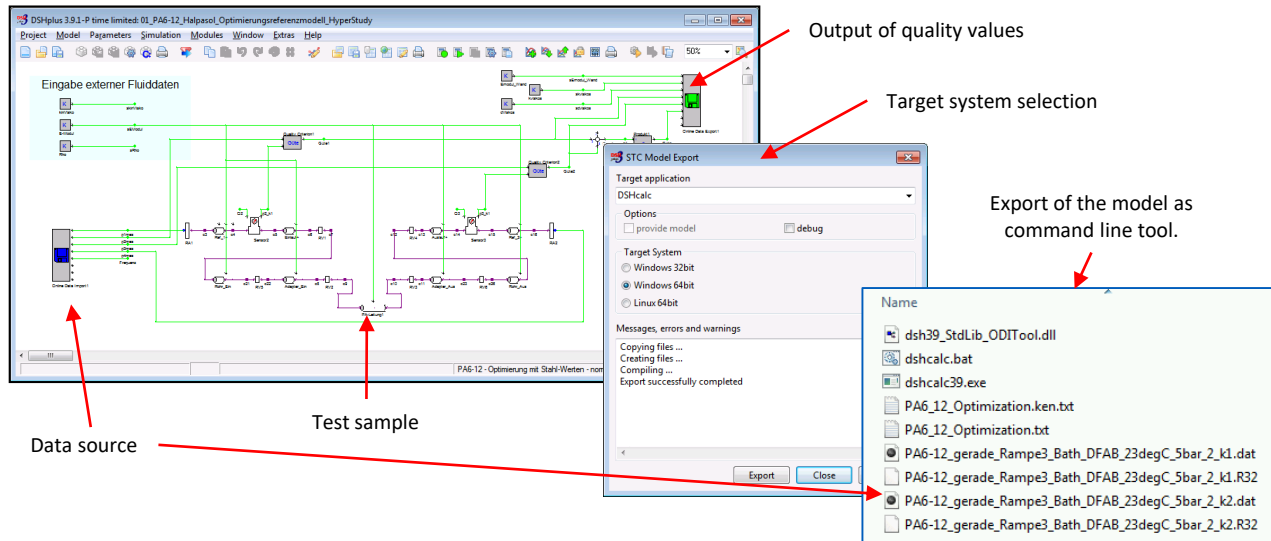
## Background for Application Scenarios

- In hydraulic and pneumatic system simulation the simulation models typically consist of numerous component models, that are connected according to a given engineering layout (circuit diagram).
- Accompanied by suitable control structures and mechanical load elements, such models enable a detailed virtual investigation of the system's dynamic performance.
- HyperStudy as a multi-disciplinary design exploration, study and optimization software is able to support the 1D system simulation through the entire design phase of the fluid power system.
- Possible applications are the evaluation of design alternatives for systems and components, such as the sizing of the Helmholtz-resonators, robustness and sensitivity analyses, as well as controller parameter optimizations.
- But also a parameter identification for empirically modeled effects can be done with programs like HyperStudy.
- The following example presents how such a parameter identification is performed for the visco-elastic wall-behavior of plastic tubes or flexible hose line.

# DSHplus and HyperStudy

## Background and DSHplus model set-up

- Pressure signals containing the desired visco-elastic material behaviour are used as the starting point for parameter identification.
- A DSHplus model is using some signals as excitation source and other signals as reference signals.



# DSHplus and HyperStudy

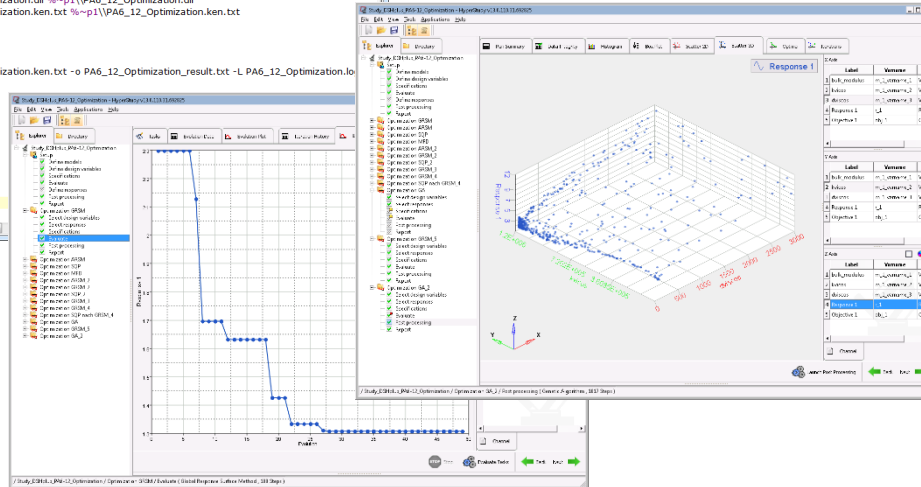
## DSHplus-Solver set-up in HyperStudy

- DSHplus exports model parameter and look-up tables as ASCII-text files. An integration into HyperStudy is therefore easily achieved.
- The dshcalc.bat file is used to set-up the solver in HyperStudy.

```
dshcalc_hyperstudy.bat - SciTE
File Edit Search View Tools Options Language Buffers Help
1 dshcalc_hyperstudy.bat
2
3 rem -- copy required files to HyperStudy directory
4 copy D:\Anwender\Bm\DSHplus39_Altair_32bit\dsh39_DataKon.dll %~p1\dsh39_DataKon.dll
5 copy D:\Anwender\Bm\DSHplus39_Altair_32bit\dsh39_Stdlub_ODITool.dll %~p1\dsh39_Stdlub_ODITool.dll
6 copy D:\Anwender\Bm\DSHplus39_Altair_32bit\dshcalc39.exe %~p1\dshcalc39.exe
7 copy D:\Anwender\Bm\DSHplus39_Altair_32bit\PA6_12_Optimization.dll %~p1\PA6_12_Optimization.dll
8 copy D:\Anwender\Bm\DSHplus39_Altair_32bit\PA6_12_Optimization.ken.txt %~p1\PA6_12_Optimization.ken.txt
9
10 rem -----
11
12 rem -- call dshcalc from hyperstudy
13 dshcalc39 -m PA6_12_Optimization.dll -p %~f1 -l PA6_12_Optimization.ken.txt -L PA6_12_Optimization.lo
14
15 rem -----
16
17 rem -- delete files in HyperStudy directory
18 del dsh39_DataKon.dll
19 del dsh39_Stdlub_ODITool.dll
20 del dshcalc39.exe
21 del PA6_12_Optimization.dll
22 del PA6_12_Optimization.ken.txt
23
24 rem -----
```

DSHplus files are copied into HyperStudy folders to allow multi core analyses.

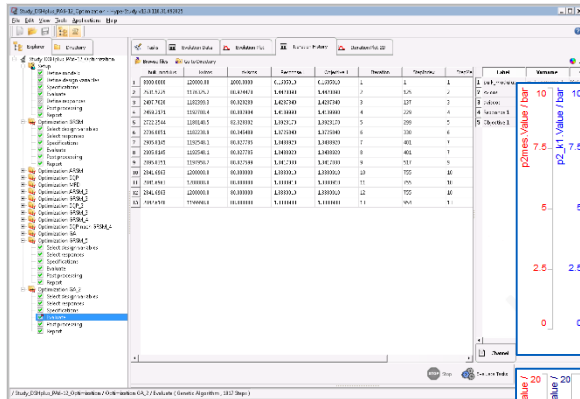
Development of the objective function of a GRSM analysis.



# DSHplus and HyperStudy

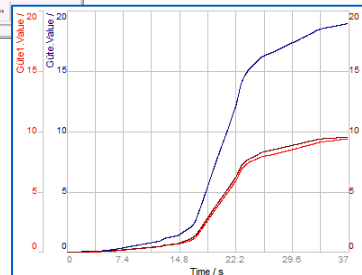
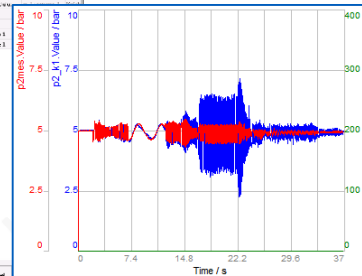
## DSHplus-Solver set-up in HyperStudy

- The optimization is started with steel values for the pipe's wall model.
- HyperStudy parameters are used for the validation simulation.

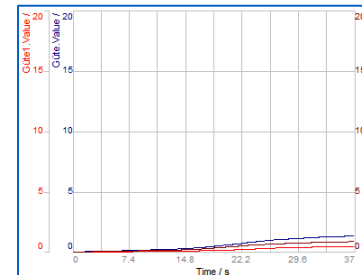
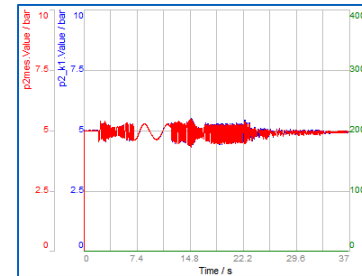


Iteration history of the HyperStudy optimization

Results of the initial simulation.  
The poor performance of the original parameters is clearly visible.



Optimized parameters give very good results.



For more information [support@fluidon.com](mailto:support@fluidon.com)!