

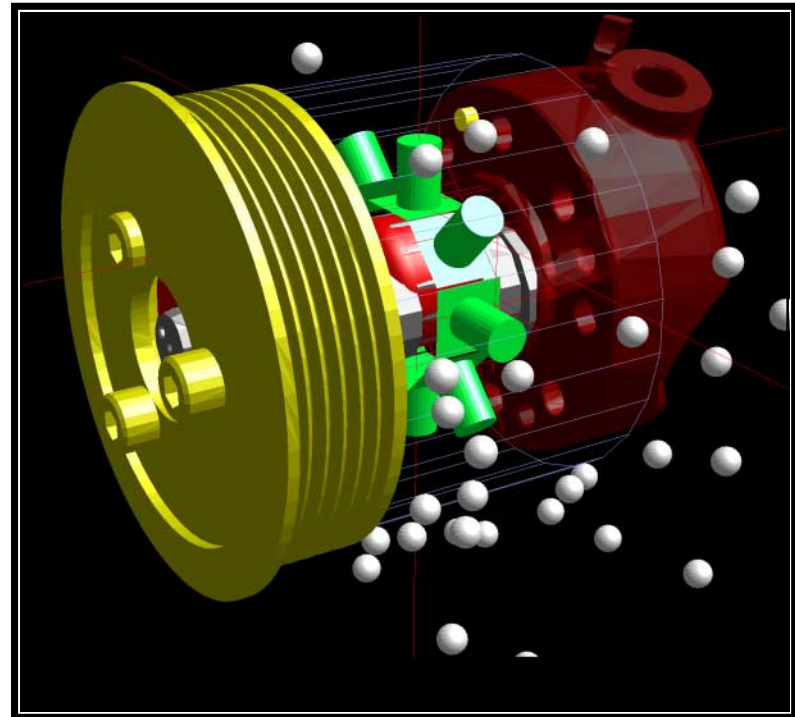


# Simulations up to 11000 rpm of a Radial 8 Piston Hydraulic Pump in SIMPACK

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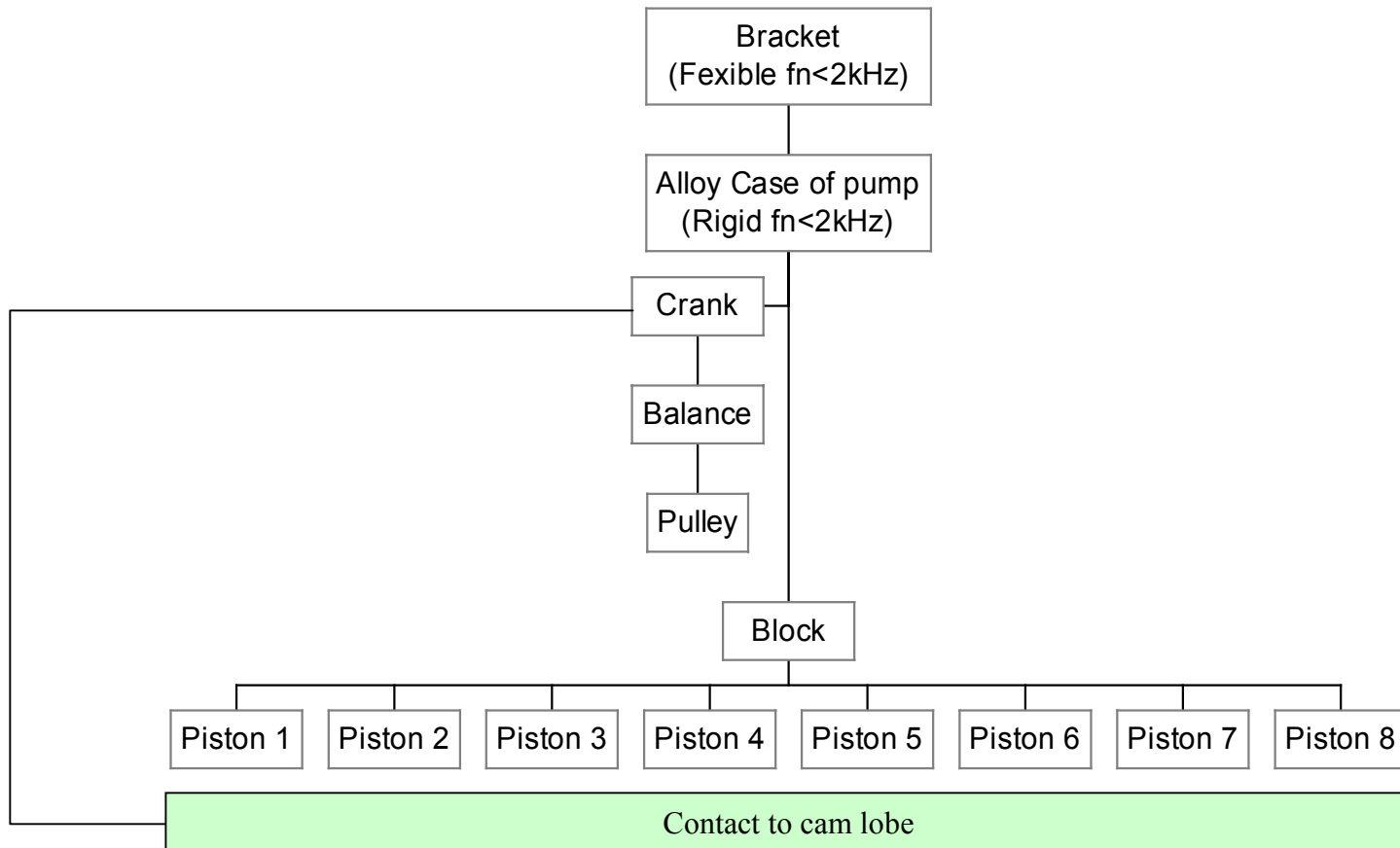
# Model Setup

- 8 pistons with full contact onto the driven cam.
- Piston pressure profile applied to each piston dependant on piston position in the bore from measured data.
- Flexible mounting bracket of the pump to capture bracket resonance's
- Piston to bore viscous / friction properties accounted for
- Runs up to 11000 rpm at a data output rate of 5 kHz





# Model Topology





# Model Solution

## Analysis requirements

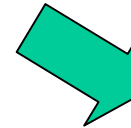
- Shaft Speed 11000 RPM
- Output  $f_{max}$  5 KHz for audio



SIMPACK

## Machine

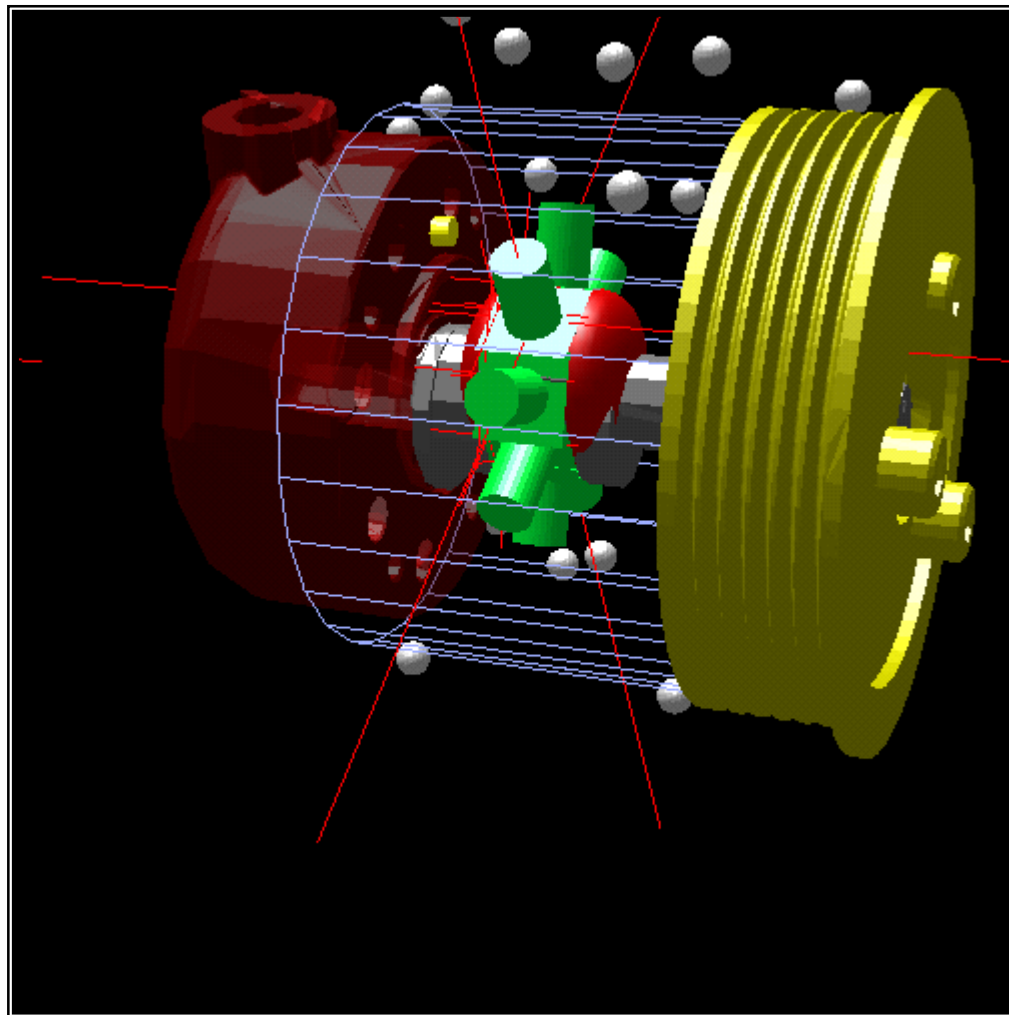
- Dell 530 workstation
- Twin 2.4 GHz XEON processors
- 4 Gb RAM
- 120 Gb SCSI DISCS



## Solution Time

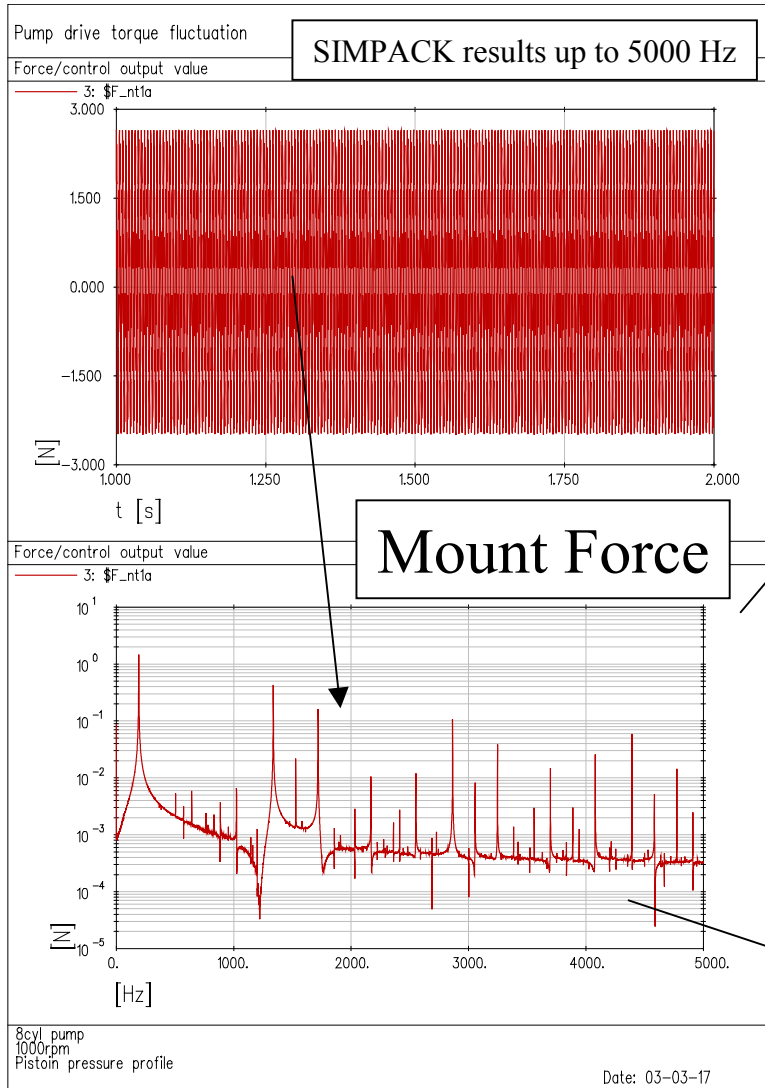
- 50 second run up  
= 120 minutes
- 10 seconds idle (1000 rpm)  
= 25 minutes

# Model Animation





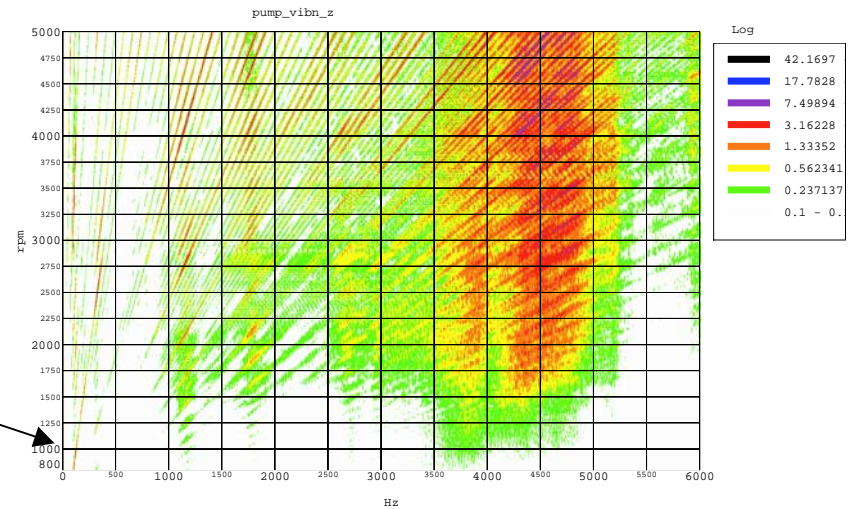
# Model Results



Generate wave file with MATLAB







Vertical Vibration on Pump Bracket

Measured results





# Audio results

	<b>1000 rpm No Load</b>	<b>1000 rpm No load No Fluid</b>	<b>Run up</b>
<b>Simulated</b>	Sim_1000_noload.wav 	Sim_1000_noload_nofluid.wav 	Sim_runup.wav 
<b>Measured</b>	Meas_1000_noload.wav 	Meas_1000_no_fluid.wav 	Meas_runup.wav 



# Conclusions

- Reasonable correlation of audio quality up to given frequency output.
- Measured data contains higher frequency content that is not yet captured by the model.
- Force data generated from SIMPACK will be used to generate drivers ear noise based on NTF's taken from measured vehicles.



# Next Steps

- Implement valve mechanism to introduce the higher frequency content from the pump
- Mounting bracket optimisation to reduce the drivers ear noise levels.
- Write a user routine to accurately apply the piston pressure for a variety of system pressures and running speeds.