

Optimization using Radioss & the N&V Director.

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▪ **November 2, 2009**

Optimization Concepts

- **There are two major ways to optimize a vehicle design especially for noise reduction.**
- **One way is to run the model and do a detail study at several high response points as to the body panels that may be causing the high response. Then to modify the panel and redo the analysis.**
- **This approach is available through the new N&V toolbox release that is available.**
- **A webinar is available for viewing with the details on how to get this self training course at the end of this presentation.**

Optimization Concepts

- **The second way is to create optimization parameters on all the major panels and tuning parameters and then determine the critical parameters through sensitivity.**
- **This presentations will show how the second approach can be used effectively to solve these type of problems using the Altair N&V Director.**

Direct Optimization

- In this approach, the full vehicle model is broken down into its individual components.
- Each component is processed through the N&V Director Renumbering tool. This module renumbers the model according to a given numbering scheme and to tag all the interface grids to the other components with recognizable names.
- The DESVAR options is also activated to automatically create DESVARS for all the plate thickness.
- Each component is then run in Radioss to create a superelement copy of the detail model.

Direct Optimization

- All the components are then brought together in the N&V Director Assembler and connected together with the appropriate connection type. (CBUSH, RBE2, HYDRO-MOUNT, ETC.)
- When the connections are being made in the Assembler, the option to automatically create DESVARS for each of the isolators is turned on.
- This allows all of the vehicle tuning parameters to be evaluated as to their effect on the response.
- The N&V Director Analyzer can then be used to select the appropriate type of analysis to be run along with the setup of the optimization deck. This includes the type of loading, the response points, the optimization directives along with the target curve.

Direct Optimization

- The first optimization run is done with all superelement components and only for one iteration. The resulting sensitivity Excel output is then filtered to determine the top 20 vehicle tuning components that affect the peaks over the desired frequency range. This job ran in 18 minutes.

P/T FULL VEHICLE ANALYSIS (ITERATION 0)

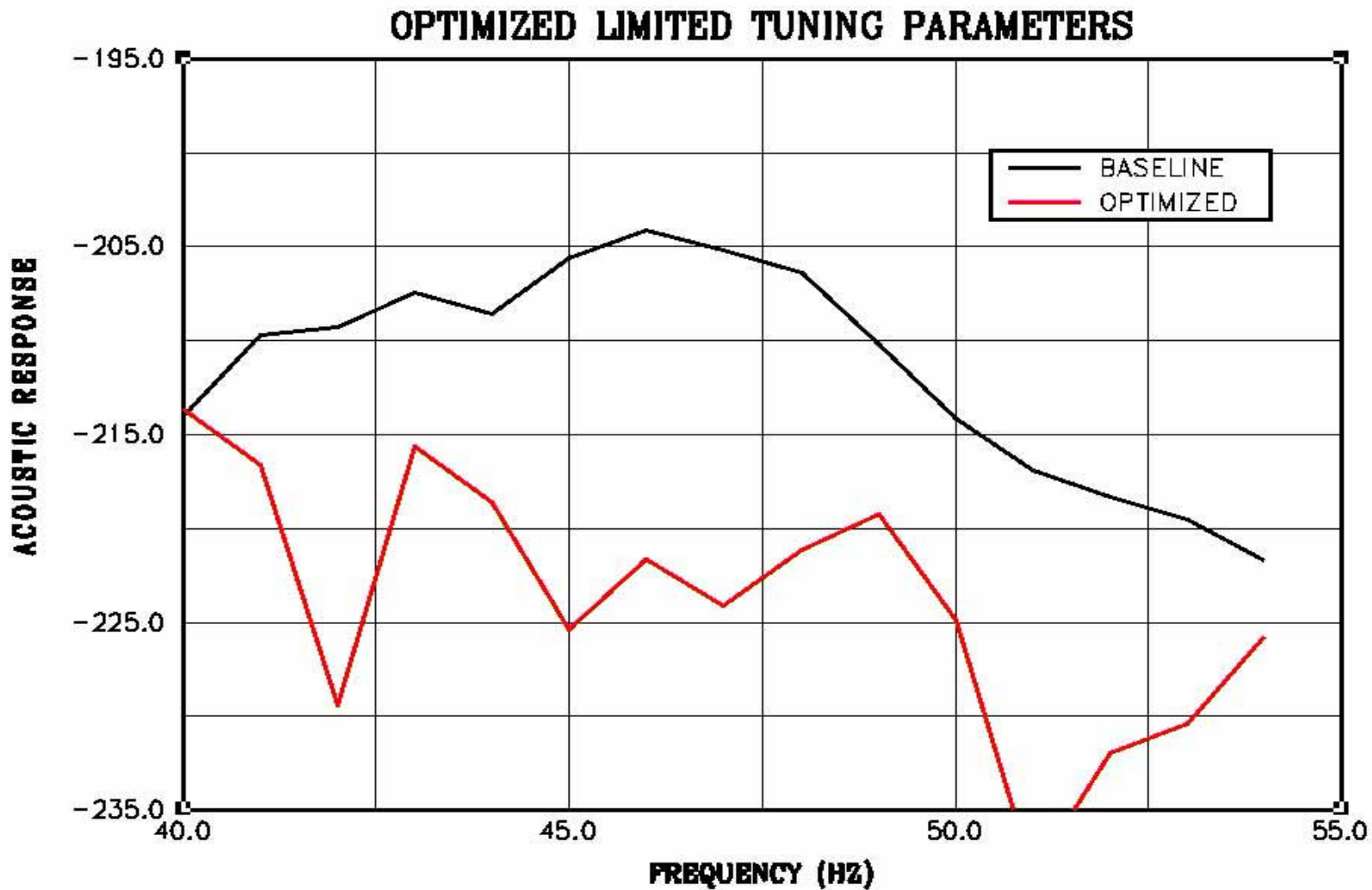
File PT_V2_OPT_OP8_ALL.dat submitted Mon Jan 26 20:39:03 EST 2009

					UPDATING - EQATN
	New	Reference	Lower	Upper	Global
CRFMUpL1	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-2.37E+02
CRFMUpL2	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-9.60E+02
CRFMUpL3	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-9.75E+02
CRFMUpL4	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-5.15E-02
CRFMUpL5	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-4.34E-01
CRFMUpL6	1.00E+00	1.00E+00	2.00E-01	2.00E+00	1.32E-02
HdLatcC1	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-1.04E+01
HdLatcC2	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-5.00E+01
HdLatcC3	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-2.08E+00
HdFrSnL1	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-8.02E+02
HdFrSnL2	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-3.16E+01
HdFrSnL3	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-2.72E+02
CrMt01L1	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-9.03E+02
CrMt01L2	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-1.00E+02
CrMt01L3	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-4.18E+04
CrMt01L4	1.00E+00	1.00E+00	2.00E-01	2.00E+00	-1.16E+02

Direct Optimization

- **If the modal tire model is being used, it is critical to also include DESVARS for all the modal tire modal mass, stiffness and damping with this run. This run included around 1000 DESVARS. 780 were the tire modal DESVARS**
- **The DESVAR set is then reduced to these top 20 DESVARS.**
- **This optimization file is run until the optimization criteria is satisfied.**

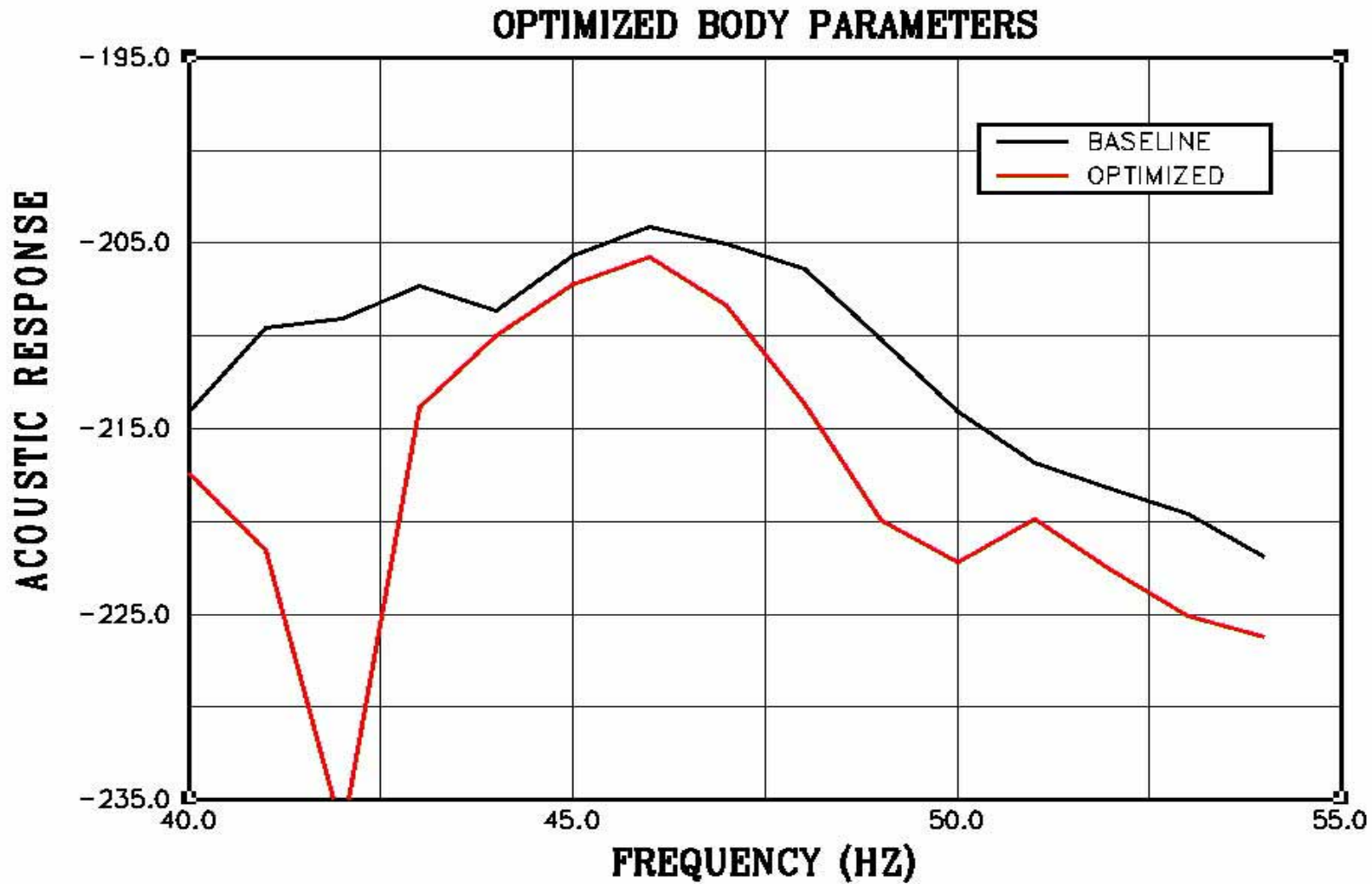
Direct Optimization



Direct Optimization

- **The next step is to run the full vehicle model for one iteration with just the component DESVARS. In this example, there were over 900 DESVARS. The model contained around 12 million degrees of freedom. The job ran in 5 hours.**
- **The resulting Excel sensitivity file from Radioss is again filtered to determine the top 20 sensitivities.**
- **The model is now run with the DESVAR set limited to these top component sensitivities and the superelement versions of all the components that do not have DESVARS sensitivities are include.**
- **Here is an example of the output from this type of run.**

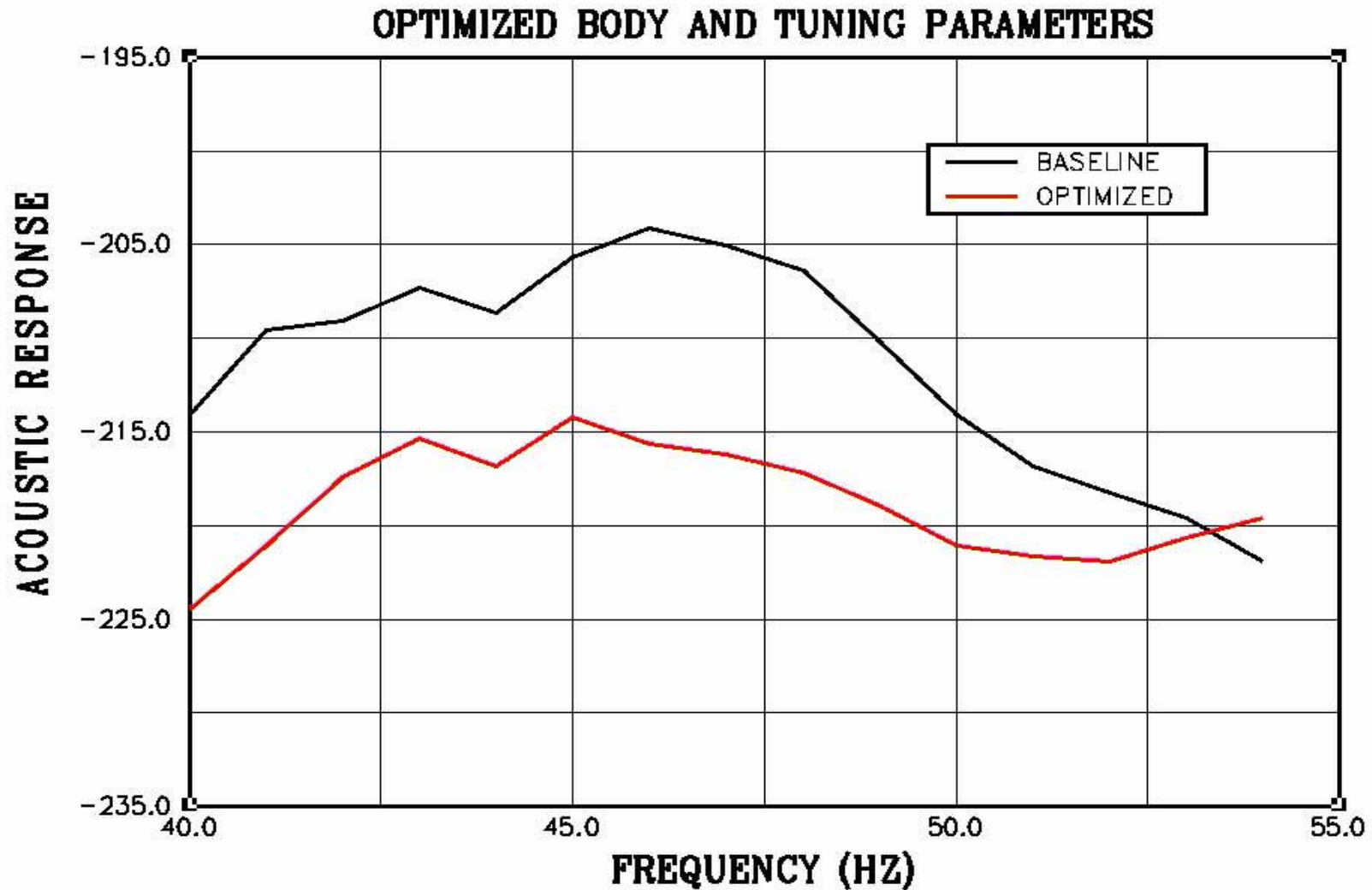
Direct Optimization



Direct Optimization

- **The final run is to combine the top sensitivities from both evaluations. (80 hours)**
- **The sensitivities levels of each run are compared to see if additional sensitivities from each application should be included.**
- **Again superelements are used for all components that do not have sensitivities in the top 40 values.**

Direct Optimization



Direct Optimization

- **With this approach, the analysts can not only look at the operating deformed shape to understand the problem, but the top sensitivities also add to that understanding.**
- **With the first approach, most of the effort was in working on changing the body, while the critical issues were not in the body structure.**
- **In this example, the tire modes and the lower control ride bushings were very critical.**
- **Also the McPherson strut fore-aft bushing rate was identified as the major input into the body.**

Summary

- **The direct optimization approach with sensitivity tuning can be very effective in fixing N&V problems.**
- **Altair's N&V Director makes this approach very easy to use in setting up all the DESVARS for all the components and the turning items. Over 1900 DESVARS were evaluated in this example**