

# Loudspeaker Simulations in a Car Cabin

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## Abstract

COMSOL® Acoustics Module and LiveLink™ for MATLAB® were used to simulate the pressure generated by a loudspeaker in a car cabin. For this study, Mercedes Benz ML car was used. A 5.5 inch woofer was mounted on a rigid enclosure located around the driver seat. To validate the simulation results, a comparison between simulated and measured pressures was performed below 1 kHz. For this comparison, the pressure was simulated and measured on a 6 microphone arrays located at the 4 seat positions. For each microphone array, the averaged pressure was used for the comparison.

For the car cabin geometry, a manual 3D scan was used to get the interior car geometry. For the car interior, we assume that the car cabin is fully sealed which is not the case in reality. The LiveLink™ for MATLAB® was used to define the speaker acceleration in the COMSOL model. The speaker acceleration is based on a Lumped Parameter Model where the volume of the speaker enclosure can be defined. In the COMSOL model, the speaker is modeled as a rigid flat piston.

All boundary wall conditions were defined with a frequency-dependent absorption coefficient. Starting with the absorption coefficient described in the literature, one major activity was to optimize the absorption coefficients to get the best correlation between the measured and the simulated pressures.

The pressure comparison shows a very good correlation between the simulated and measured data. Around 62% of the predicted frequency bins show a measured/predicted pressure difference less than +/- 3 dB.

## Reference

Acoustic absorbers and diffusers, Theory, design and applications, Trevor J. Cox and Peter d'Antonio, Second Edition, Spon Press

# Figures used in the abstract

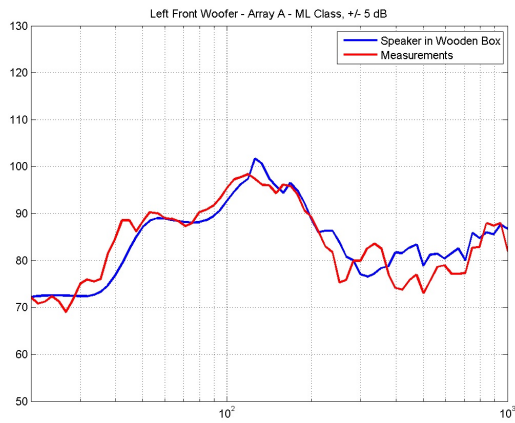


Figure 1

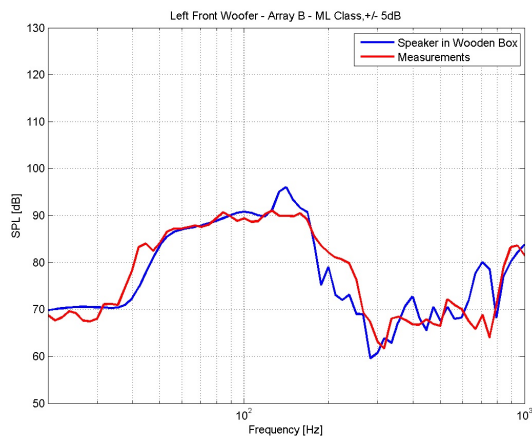
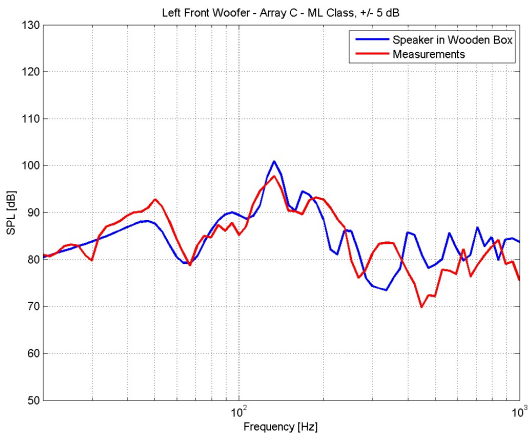
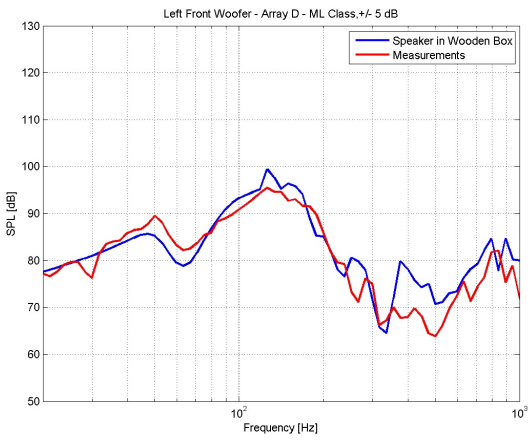


Figure 2



**Figure 3**



**Figure 4**