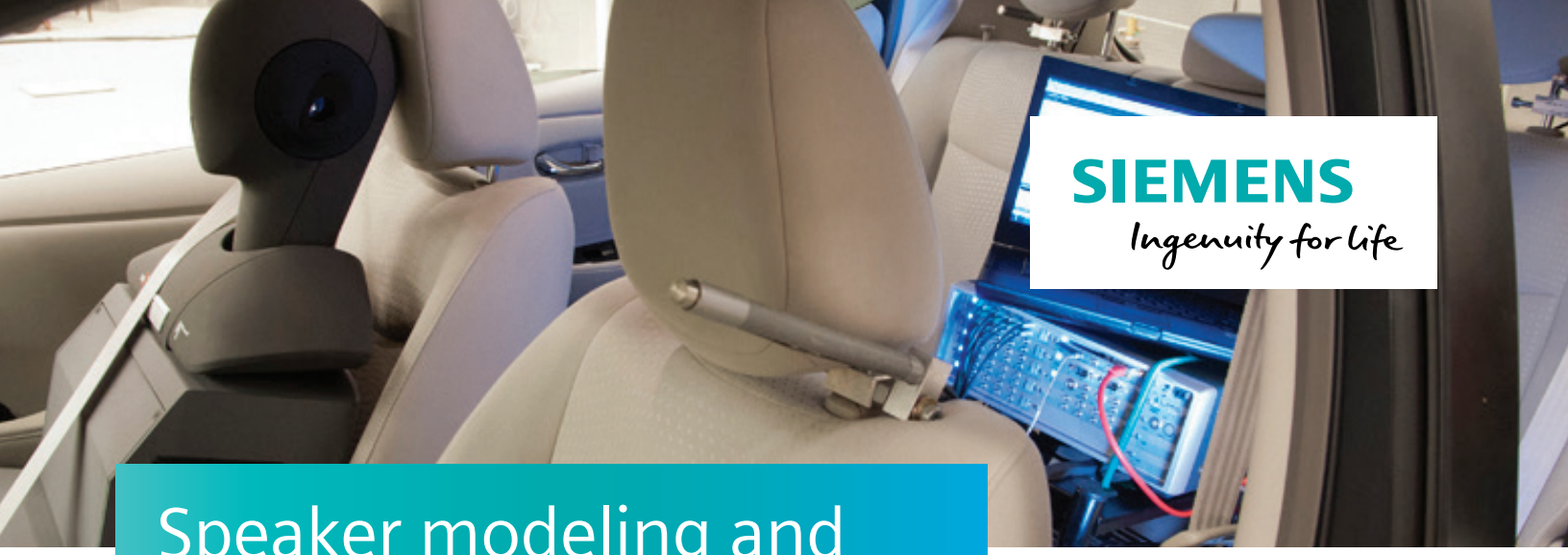

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Speaker modeling and car audio integration

LMS Engineering services optimize the performance of audio systems and eliminating door rattle

Benefits

- Optimize the location and integration of audio speakers upfront
- Build accurate speaker, door and full-vehicle cavity models
- Cover the full audio frequency range by combining different acoustic simulation methods (low frequency FEM and mid- to high-frequency ray tracing)
- Transfer speaker and car audio performance prediction technology to the customer
- Pinpoint the root causes of door rattle

Summary

LMS™ Engineering services optimize the configuration of car audio systems by combining advanced test and 3D acoustic simulation technologies. Covering the full audio frequency range, LMS Engineering experts provide simulation technology to optimize the location and integration of speakers in a vehicle body. Dedicated models also allow you to minimize the risk of door rattles.

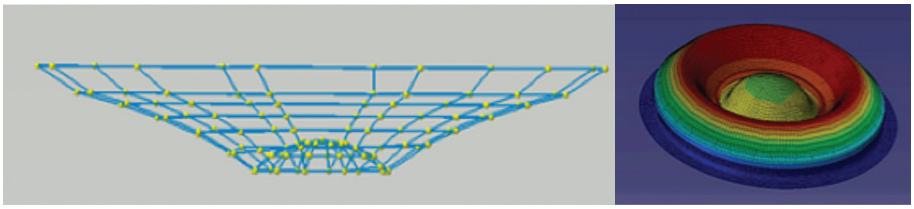
In an effort to avoid time-consuming and costly troubleshooting, automotive manufacturers need to front-load design decisions on all kinds of vehicle components, including those relating to audio systems. If the design of an audio system or its integration in the vehicle requires alterations late in the development process, it can be a complex and expensive undertaking.

Using a highly accurate 3D modeling approach makes it possible to front-load decisions related to the design of audio systems and their integration in the vehicle.

By virtually modeling speakers, related car panels and interior cavities, you can predict and evaluate vibro-acoustic performance, and if required, reduce door rattle issues.

Full vehicle ray-tracing model.

Speaker modeling and car audio integration



Speaker vibro-acoustic model.

A typical speaker modeling and car audio integration project is comprised of one or more of the following practices:

Speaker modeling
In the first stage, an accurate and detailed 3D speaker vibro-acoustic model is needed (finite element method/boundary element method) that can be built based on supplier data. To increase accuracy the latter can also be refined using speaker membrane displacement measurements. This model, which is comprised of testing and simulation, can be used to predict speaker performance and directivity, including (when needed) the effect of the vehicle (door, dashboard, etc.). It enables you to evaluate the overall car interior audio performance.

Speaker integration
In the second stage, the integration of the speaker in the car panels is considered. To this end, the flexible boundary conditions of the panels are studied, particularly at low frequency. Additionally, their excitation and sound radiation levels, as well as those of other components are examined, taking into account coupling between the internal cavities and the main vehicle cavity.

Rattle noise
To predict and eliminate rattle noise and vibration issues, experts investigate the vibro-acoustic door response under structural and/or acoustic excitation, implementing a dedicated rattle indicator. The input for the rattle indicator is based on a comparison of estimated gaps with respect to vibration levels, taking into account the uncertainty inherent in these parameters.

Car audio performance analysis
Car audio performance is assessed over a full audio frequency range using a combination of finite element (FE) simulation models for low frequencies, and ray tracing for mid to high frequencies. Overall evaluation takes place on the basis of a simulation of several quantities, such as sound pressure level (SPL), transfer functions, ray path, binaural impulse response and sound replay, which require an accurate model. LMS Engineering can provide technology transfer or improve the customer process by working on these areas.

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