Applus IDIADA

Simulates vehicle squeaks and rattles with SIMULIA solutions

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Inés Lama
Project Manager
Design Engineering
IDIADA

Challenge

As vehicles have become quieter, drivers have become more aware of interior squeaks and rattles (S&R) impacting warranties and customer satisfaction for automotive manufacturers and dealerships.

Solution

IDIADA engineers use SIMULIA's Abaqus Unified FEA from Dassault Systèmes to pinpoint where S&R can occur.

Benefits

IDIADA is developing increasingly sophisticated realistic simulation models that will help its automotive customers mitigate S&R issues in the earliest stages of design, saving time and expense in product development and marketing.

DASSAULT SYSTEMES

Applus IDIADA

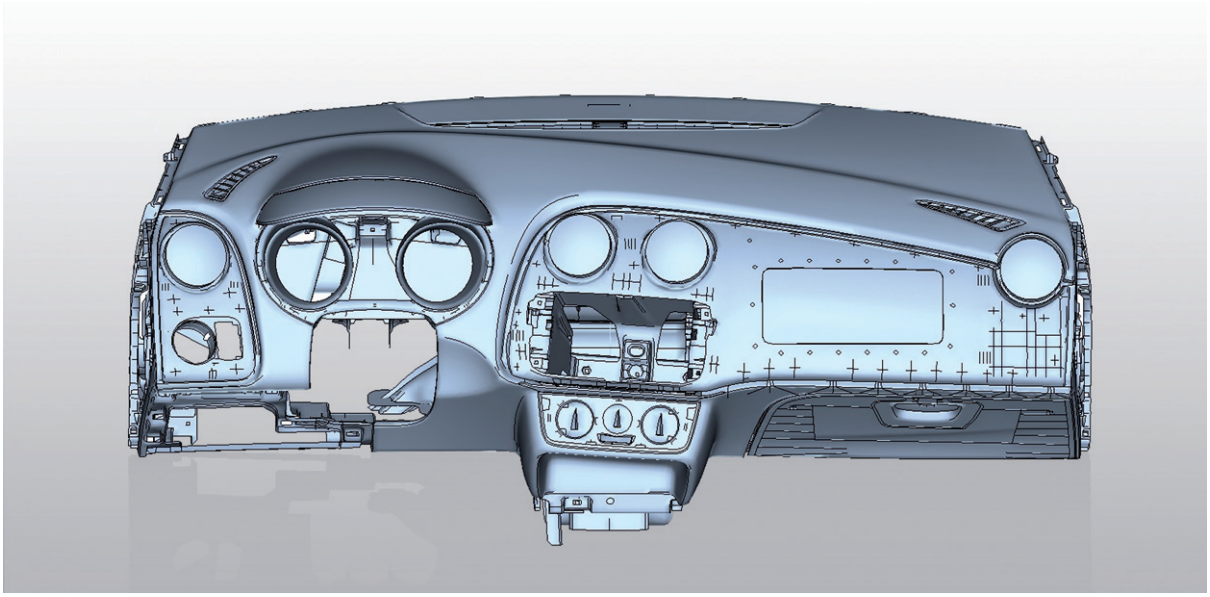
Applus IDIADA, headquartered in Barcelona, Spain, supports automotive manufacturers with design, engineering, testing and homologation services. Winner of the 2010 "Automotive Testing Company of the Year" award from Automotive Testing Technology International magazine, IDIADA has branches throughout Europe, Asia and South America.

Silencing squeaks and rattles with realistic simulation

Squeaks and rattles (S&R) are unidentifiable, repetitive, distracting sounds coming from somewhere inside an automobile, such as the interior trim, that can be annoying especially when the source cannot be found. Both noises are usually due to inconsistent assembly tolerances or lack of stiffness. Whereas great progress has been made in other areas of noise and vibration (N&V), the fact that modern automobiles run more quietly than ever has made lingering S&R issues even more apparent.

"Squeak and rattles have become of greater concern for us in recent years as more auto manufacturers come to us with these problems," says Inés Lama, project manager, design engineering, for IDIADA. "Our customers are asking us if it's possible to use simulation to identify the potential for squeak and rattle earlier in their design processes, rather than later when it is more costly and time consuming to solve." She and her team have been using Abaqus Unified Finite Element Analysis (FEA) from Dassault Systèmes' realistic simulation brand SIMULIA for years. "Since we'd already been using Abaqus in vehicle cockpit design and testing for thermal, impact and normal modal analyses, it made a lot of sense to simply develop a new load case for squeak and rattle inside Abaqus," she says.

Classic automotive N&V analyses (of the effects of a car engine running, or tires rolling) use modal theory to predict at what frequencies certain parts of the vehicle will begin to vibrate. "Modal theory is based on the hypothesis of linearity, without contact," says Lama. "But an S&R event, although it happens within a frequency-dependent N&V-type setting, is also very nonlinear—the parts producing the squeaks and rattles are interacting with each other in three dimensions. A standard, eigenmode-based, N&V method alone can't model, or predict, the contact that will result in a rattle."



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The engineers needed to come up with a simulation that would accommodate both frequency (N&V) and contact (S&R) behavior. "The unique connector element in Abaqus was particularly useful for us with this challenge," said Lama. IDIADA engineers realized that the connector could be used as a "virtual sensor" for the detection of contact. Placing connector elements in the gaps between nodes in the FEA model of the instrument panel allowed for the measurement of the independent behavior of the model in three different directions.

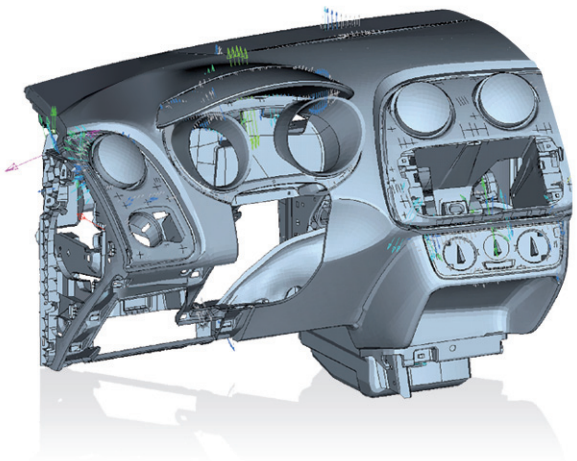
Blame it on the ducts

By adding more geometric details to their models, including simulation of the masses of the radiators in the heating, ventilation, and air conditioning (HVAC) system, and fine-tuning the stiffness of different connection points, the engineers were then able to pinpoint three areas in the dashboard that most influenced the results - two connections of the HVAC duct and the connection of the HVAC duct leading to the central diffuser.

Going even deeper with S&R analysis

The first simulations of these three areas detected rattles with good correlation although, interestingly, the simulations detected many more rattling issues than real-world tests. "In the future, we will be working on rattle-detection criteria improvement to differentiate between rattles that can be heard and those that can't," says Lama. "We will also continue to refine our analyses to include those zones in the vehicle cockpit where there can be more problems with tolerances."

SIMULIA



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Images courtesy of SEAT.

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