CASE STUDY

IMPROVING PERCEIVED QUALITY AT CEVT

NEW BODY EVALUATION METHOD ENABLES SQUEAK & RATTLE PREVENTION

Background Information

Improving perceived quality and passenger comfort by minimizing buzz, squeak, and rattle (BSR) and eliminating unwanted noises in a car is a common challenge in vehicle development, especially as these issues are often detected late in the development phase. The new aspect to this challenge is the development of electrical vehicles (EV) that do not have a combustion engine covering up these small noises. The body structure of EVs significantly differs from traditional cars with a combustion engine, and with the body stiffness having a major impact on the squeak and rattle performance of a vehicle, carmakers today need new methods and technologies to evaluate earlier and improve the BSR performance of their products.

About the Customer

Headquartered in Göteborg, Sweden, China Euro Vehicle Technology AB (CEVT) is a subsidiary of Geely Holding Group, a global automotive group including brands such as Volvo Cars, Lotus, and others. Developing advanced automotive technology for all Geely automotive brands, CEVT is an innovation center for mobility solutions, focusing on vehicle architecture.

To facilitate and improve design choices early in the development phase, CEVT uses Altair solutions and multi-disciplinary optimization for a simulation-driven design approach allowing for rapid design iterations. Committed to redefining automotive engineering, CEVT is continuously striving to innovate and improve the architecture of their vehicle designs.

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Their Challenge

In a recent development project, CEVT engineers had to improve the BSR performance of a new electrical vehicle design. As the new topology of the EV car body including the stiff battery package makes the traditional torsional stiffness requirement much less relevant, CEVT needed BSR evaluation methodologies to improve the perceived performance of the new car architecture.

Understanding there is a strong correlation between distortions of body closure openings and the BSR performance, CEVT put special attention to the deformations of doors, tailgates, and sunroofs. Traditional methods such as stiffness tests in a static setting are not sufficient to evaluate the BSR performance of a dynamic event. With the goal to lower the risk for squeak and rattle, CEVT had to find a new methodology that offered an improved, enhanced approach to limit the distortion in the closure openings and improve the overall stiffness of the body early in the development. The CEVT engineers also had to ensure this new evaluation method would consider the complexity of both the body structure and the dynamic load on a complete vehicle.

Our Solution

The basic idea of the new evaluation method for the body in white (BIW) was to describe the dynamic body deformation including the distortion in all closure openings. As the CEVT engineers needed the absolute forces in a dynamic load case, their idea was to derive an equivalent static load (ESL) based on the dynamic diagonal distortion. In close cooperation with Altair the team designed a process to explore the new approach step by step.

CEVT used multi stethoscopes (MSS) – measuring the distortion in each closure opening of the body – and performed physical tests with two velocities and 12 accelerometers to identify body deformations. They compared the data of the test track measurements to the simulated distortion (correlation in time and frequency domain). When focusing on frequencies below 100 Hz, they observed a quasistatic body response (e.g. when driving on cobblestone road). This quasistatic response in relation with the opening distortion creates a so-called fingerprint that can be related to the two major body loads (drive line and suspension) – the opening distortion fingerprint (ODF).

A critical component for this evaluation is the "ODF detection tool," an all-in-one Altair Compose® application which makes the new method efficient and robust including all necessary options to identify the body fingerprint and correlate test and simulation. A key aspect was to integrate several independent scripts, whose execution needed to be performed sequentially in a rigid manner, into one consistent, more flexible, and automated process. This tool was developed in partnership with CEVT and is part of Altair Squeak and Rattle Director.

Results

Using the dynamic distortion in all closure body openings as correlation criteria helps to increase the understanding of the vehicle's structural architecture. The all-in-one app ODF detection tool enables CEVT to evaluate a new body design within minutes – instead of days – allowing for fast design iterations and educated decisions early in the development phase. Altair solutions and support enabled CEVT engineers to provide a new method that helps the Geely automotive brands to improve the overall BSR performance of new designs while achieving significant time and cost savings.

While focusing on perceived quality when developing this method, it turned out that the ODF approach can be also used as assessment tool within vehicle dynamics. Since the ODF can be clearly related to the loads coming from the drive line and the suspension, the new tool allows to analyze the load interaction with the body.

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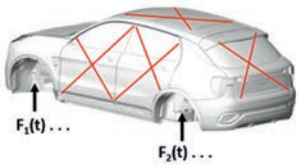

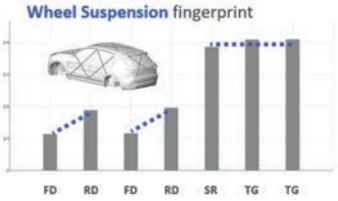

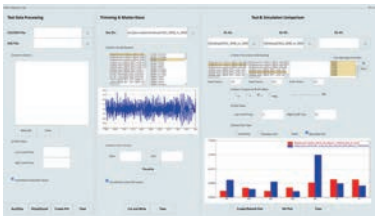

TOP: CEVT uses multi stethoscope (MSS) to measure the distortion in each closure opening of the body. **MIDDLE:** The opening distortion fingerprint (ODF) can be related to suspension and drive line forces. **BOTTOM:** The all-in-one app ODF detection tool enables CEVT to evaluate a new body design within minutes – instead of days.