

## Improving Driver Experience by Eliminating Squeak & Rattle Noise



NEVS

### Key Highlights

#### Industry

Automotive

#### Challenge

Accurately simulate squeak and rattle noise in the interior of electric passenger cars.

#### Altair Solution

- S&R prevention using CAE
- Deployment and training for SnRD

#### Benefits

- Rapid identification of risk areas
- Accelerated development time
- Reduced need for prototypes

In the interior of a vehicle, unwanted noise is a problem that mostly affects trim parts such as the instrument panel, center console or door trims. When two parts are initially separated by a gap but rapidly come into contact with each other, a rattling noise is created. On the other hand, a squeak noise might be heard when two parts are initially in contact and a sufficiently large relative displacement is caused. When occupants in a vehicle experience squeak and rattle noise, the result is a feeling that the product has a general lack of overall quality. To avoid this negative perception, today's vehicle manufacturers are putting considerable efforts into ensuring that these problems do not occur.

Unfortunately, the traditional process of building a prototype, testing the material interaction and correcting problems as they occur is long winded and potentially expensive. The industry is therefore eager to better understand and predict these phenomena so interior noise can be reduced and ride quality can be improved.

National Electric Vehicle Sweden (NEVS) is an electric vehicle and technology developer formed from the experienced engineering teams of SAAB Automobile. The company's vision is to shape mobility for a more sustainable future through the development of mobility services that provide a more engaging electric vehicle (EV) experience. In cooperation with its Chinese shareholders, NEVS is establishing a production and R&D

# NEVS Success Story



**"We found Altair's Squeak and Rattle Director to be very useful in providing an early evaluation of potential squeak and rattle risks, determining material selection and improving awareness to engineering precautions."**

**Björn Rosvall**  
Lead Engineer Instrument Panel & Floor Console  
National Electric Vehicle Sweden AB

joint ventures in the Tianjin Binhai High-tech Zone in Tianjin, as well as a brand experience center in Beijing.

Thanks to the team's experience of developing vehicles in the Saab Automobile era, NEVS are highly knowledgeable regarding the use of simulation technologies to lead the design process. Interior development falls under the responsibility of the Interior Simulation Team where all

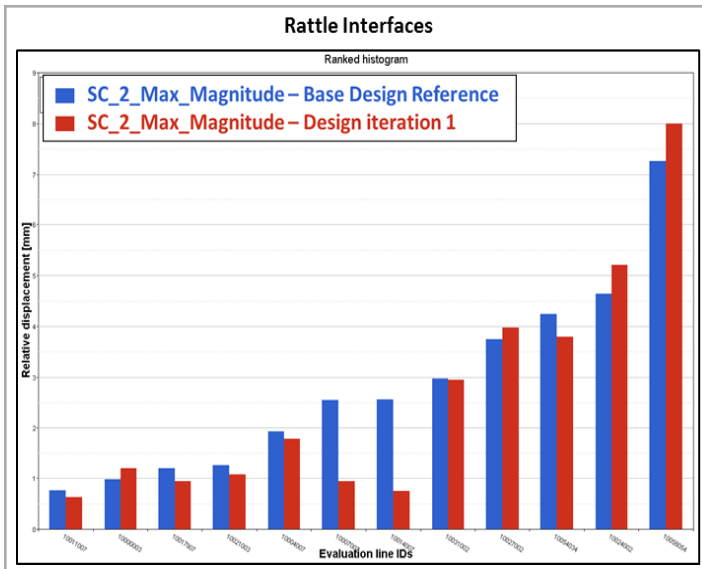
attributes are evaluated using finite element models for a range of investigations, but the team had not yet used simulation strategies to predict squeak and rattle issues.

## Implementing the Squeak & Rattle Director at NEVS

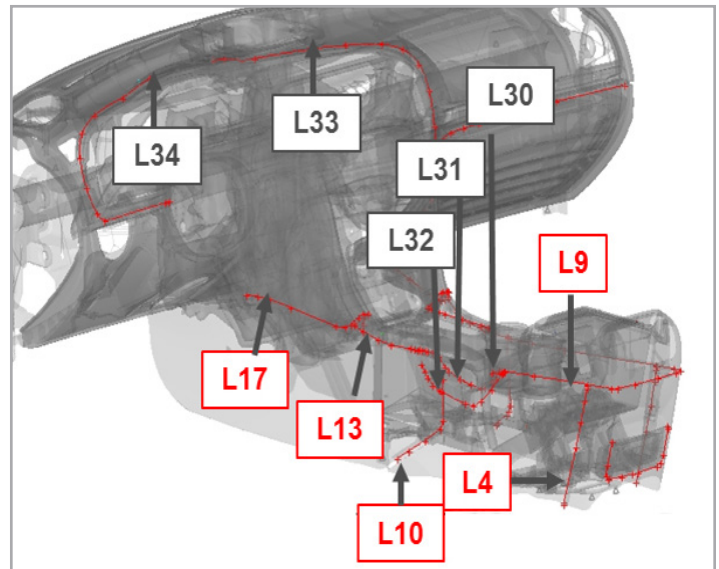
Due to a long-standing relationship with Altair and its HyperWorks suite of simulation solutions, NEVS approached Altair ProductDesign to see if the interior quality

issue could be tackled with simulation. To perform the project, Altair ProductDesign worked on site alongside NEVS Interior Simulation Team to implement Altair's Squeak and Rattle Director (SnRD).

The SnRD is a comprehensive set of services and software automations that rapidly identify and analyze design alternatives to eliminate the root causes of squeak and rattle in assemblies. With customization from



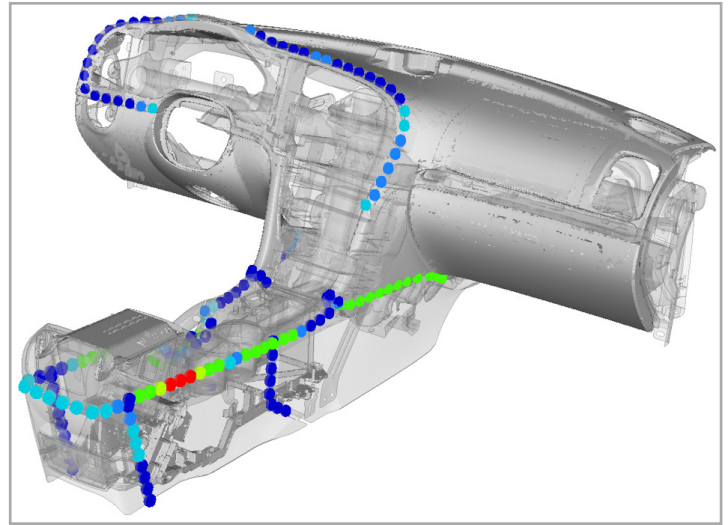
Design variants evaluation - SnRD Automatic Comparison for Rattle & Squeak Simulation Results



Interfaces from GD&T as an input for the Squeak & Rattle Director



Old generation Saab 9-3 cockpit module



SnRD visualization of S&R risk zones in new design cockpit

Altair ProductDesign, the solution provides a semi-automated approach to determine relative component displacements in the time domain that can lead to undesired noise in the interior of NEVS vehicle.

The first stage in the project was to build a base model that could be used for squeak and rattle (S&R) risk analysis as a reference for the existing performance of the initial design. Geometric dimensioning and tolerancing (GD&T) data was used to perform the initial evaluation stage along with worst case scenario and sine sweep loading conditions. The risk areas identified at this early stage were communicated back to the design team and a series of design recommendations could be proposed to the project team.

The model geometry was updated based on these suggestions, incorporating any new materials that were identified as potentially having a positive effect of S&R performance. New GD&T data was implemented in the model and a further risk analysis was performed with the results compared to the baseline model. Comparing the results of the initial design to the updated model allowed

the Altair ProductDesign team to perform root cause analysis to highlight the critical interfaces and connections within the interior structure.

Detailed investigations of the relative displacement profiles for dynamic behavior could be documented, enabling the team to identify critical frequencies and find the optimum balance between global and local stiffnesses.

Component level optimization studies were performed to guide the design team in discovering efficient methods of improving the stiffness of key structures. Finally, detailed reports were produced for NEVS' Interior Simulation Team to guide the refinement of the different component as well as dimensioning any problematic gaps. NEVS' electric vehicle focus created new problems for its Interior Simulation Team.

### **Accelerating the Development Process While Minimizing Cost**

Traditionally the sound of the combustion engine masks out a lot of the rattling and squeaking noises that reach the driver's ear, but this is not something that can be

continuously relied on due to the relative silence from an electrical powertrain. The SnRD has been able to help NEVS identify S&R risk zones without physical prototypes, and provide valuable inputs to eradicate those risk areas to arrive at a more robust design.

NEVS can now explore the effect of different deviations that could result from the manufactured parts through sensitivity studies such as the effect of different material properties, tolerance chains and different road loads. The required models are rapidly built and set up for analysis, with the results automatically post-processed, all while providing access to powerful and intelligent optimization technologies that identify improvements throughout the structure. The reduced requirement for prototype products has provided opportunities to save significant cost and time throughout the development program.

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## About Altair

Altair is focused on the development and broad application of simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. Privately held with more than 2,600 employees, Altair is headquartered in Troy, Michigan, USA and operates more than 45 offices throughout 20 countries. Today, Altair serves more than 5,000 corporate clients across broad industry segments.

[www.altair.com](http://www.altair.com)

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## About Altair ProductDesign

Altair ProductDesign is a global, multi-disciplinary product development consultancy of more than 800 designers, engineers, scientists, and creative thinkers. As a wholly owned subsidiary of Altair Engineering Inc., this organization is best known for its market leadership in combining its engineering expertise with computer aided engineering (CAE) technology to deliver innovation and automate processes. Altair ProductDesign utilizes proprietary simulation and optimization technologies (such as Altair HyperWorks) to help clients bring innovative, profitable products to market on a tighter, more efficient time-scale.

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## About HyperWorks

HyperWorks is an enterprise simulation solution for rapid design exploration and decision-making. As one of the most comprehensive, open-architecture CAE solutions in the industry, HyperWorks includes best-in-class modeling, analysis, visualization and data management solutions for linear, nonlinear, structural optimization, fluid-structure interaction, and multi-body dynamics applications.

[www.altairhyperworks.com](http://www.altairhyperworks.com)



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