Multidisciplinary optimisation of geometric variation analysis and modal behaviour for Squeak & Rattle prevention

Background

At Volvo Car's Research & Development, you will be a contributor to the next generation of outstanding premium cars from Volvo, together with other engineers around the world by creating innovative human-centric car technology that makes life less complicated and more enjoyable for people.

Solidity, as an important attribute within Craftsmanship and Durability Centre, is responsible for Squeak & Rattle sounds (S&R) and solid feeling in the car. Our main scope is setting requirements and verification of S&R problems from early phases to after production launch. One of our major challenges is to improve our competence for using robust design concepts in early phases to meet shorter lead time by avoiding the late phase changes and reducing the need for physical complete vehicle prototypes. And of course, the absence of S&R is a must for premium cars.

Scope

Squeak & Rattle are nonstationary sounds that occur when adjacent parts come into contact, either impacting or sliding. A car with the in-cabin S&R problems is considered quality deficient. And with the current emphasis on electrification, the nonstationary annoying noises in the car cabin will further draw the attention of passengers.

One of the main sources for the generation of S&R in the car cabin is geometric variations. This can result from manufacturing tolerances or other variation sources like temperature or aging. As far as the geometric variation as a result of manufacturing tolerances is concerned, established approaches are available to minimise the effect of production variation by choosing optimum attachment points in assemblies and adjusting the tolerance levels for a robust design. However, changing the attachment scheme in an assembly, by moving the attachment points, will have side effects on other attributes of the product. The modal behaviour of the assembly is among the most influenced attributes by changing the attachment points. In development phases, the standard practice is to perform a decoupled design optimisation for the location of attachment points to have a geometrically robust design and modal response. The main aim of this research is to combine the design optimisation for modal response and geometric variation optimisation for S&R prevention.

This thesis work is part of and contributes to a larger project with the aim of improving methods and tools for squeak and rattle prediction in product development.

Method

The project comprises of two major focus areas: 1) geometry variation analysis using the RD&T software and optimising the attachment points with the aim of controlling the displacement levels at selected interfaces vulnerable for generating S&R. 2) attachment point optimisation in an assembly to optimise the modal behaviour of the assembly to reduce the risk of dynamic S&R.

The main goal is to perform a multidisciplinary optimisation by defining the objective function in a way to satisfy the modal and geometric variation criteria. The assemblies to perform the studies on will be chosen based on a field study on the previous projects at the company and the simplified geometries can be used for the explorative part of the work.

Objective

The main objective of the work is:

- To perform a multi-disciplinary optimisation of the attachment points of selected assemblies in a car cabin to improve geometric variation and modal behaviour of the assemblies for Squeak and Rattle sound prevention.

By this, the following research questions have to be answered:

- With the aim of S&R prevention by geometric variation and modal analyses, how different the results of a decoupled or multidisciplinary optimisation are?
- For different geometries (and assemblies), how the above difference vary? Can the findings be clustered for different types of geometries and attachment schemes?

Project Outline

The exact outline of tasks in the project will be decided together with the master students upon the beginning of the thesis work.

- A Literature review of previous studies on attachment point optimisation for geometry assurance, modal optimisation for S&R prevention and multidisciplinary optimisation approaches.
- Identify assemblies in the car cabin through a field study and benchmark on the previous projects in the company.
- Prepare simplified geometries and finite element models (including the attachment schemes) representing the selected assemblies
- Perform geometric variation by attachment location optimisation in RD&T software
- Perform modal response optimisation to minimise the S&R risk in identified interfaces (based on benchmark and field interviews in the company) using MSC/Nastran and Matlab
- Perform a multidisciplinary optimisation incorporating the above two design objectives.
- Verify the findings for the detailed models of some of the selected assemblies
- Write a manual for the multi-disciplinary setup developed during the project
- Write the final report

Desired profile

- Passionate for cars, especially noise and vibration or strength and endurance
- Possessing knowledge of geometric variation analysis
- Understanding linear finite element and modal analyses
- Previous experience in geometry assurance analysis in RD&T software is meritorious
- Previous experience in using FE packages like Ansa and MSC/NASTRAN is meritorious

Means

Office, workshop, computer, software and main models will be arranged by Volvo Cars or university.

Duration

- The work is planned for 20 weeks, 30 credits
- Estimated start date; 2018-01-21 (or according to agreement)
- The project is suited for two students (it amounts for 30 ECTS credits for each student).

Contact

Mohsen Bayani, mohsen.bayani@volvocars.com, tel +46 729707561

Application

If you are interested, please apply no later than 31st November 2018, by sending the following documents within your application:

- CV and a Cover letter highlighting your skills and knowledge required to perform this task
- Grades, especially for related courses at university

Application link:

https://career5.successfactors.eu/sfcareer/jobreqcareer?jobId=20126&company=C0000870892P&username=