Sensitivity analysis of a generic subsystem fixture for physical Squeak & Rattle prediction

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 attribute verification in early phases to meet shorter lead time with a reduced number of 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. Volvo Cars strategy of shifting the engineering activities to the early phases of the product development means every quality aspect needs to be evaluated upfront and without the need for complete vehicle prototypes. A practical approach to address this challenge is to use the subsystem level test rigs. However, having a proper fixture to mount the subsystem on the rig by securing the comparable boundary conditions and the system response is a necessity for a confident design judgement and verification. Thus, to have a robust fixture design for an instrument panel (IP) for the purpose of squeak and rattle evaluation, the fixture design parameters have to be analysed through computer simulations (CAE) and be verified by empirical results (experimental data). The analysis, design and manufacturing of such a fixture is the subject of this thesis work. The aim is to have a generic fixture that can be used for different IPs in different projects by adjusting some parameters in the fixture. 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) Identifying the parameters in an IP fixture that affect the system response (exhibited squeak and rattle sounds). Also, studying the system response sensitivity to variation among those parameters. 2) Designing and building a physical generic IP fixture to mount the IP on the subsystem shaker and do a validation analysis through empirical studies.

For this purpose, finite element models of available instrument panels and body-in-whites will be used. An FE model of a concept fixture will be developed for the parameter studies. For FE simulations the linear Nastran solver will be employed. Sensitivity analysis and physical fixture validation will be performed by doing physical experiments using the subsystem shaker rig.

Objective

The main objective of the work is:

- To design and use a generic fixture for physical testing of an instrument panel in subsystem test rig

To nail this the following research questions have to be answered:

- What are the important design parameters of an IP fixture in S&R verification
- What is the sensitivity of system response to parameter variation in IP fixture
- Design and build a generic subsystem fixture for instrument panel to be tested in subsystem shaker rig

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 fixture design, local and global stiffness impact on S&R generation and field studies on the previous in-house experiments
- Prepare the FE model of an IP (from existing models at VCC) and an FE representation of a concept fixture
- Identify parameter variation levels by performing benchmark studies (including the FE calculations) on available Body-in-White models (BIW)
- Perform a parameter study on the design parameters (like the local and global stiffness of the concept fixture) employing FE method
- Detail design of the fixture, including the suggested parameter adjustment mechanisms by support from VCC concept centre
- Build the generic IP fixture by support from VCC durability workshop
- Perform fixture validation by studying the modal behaviour and stiffness properties of the fixture
- Perform a physical sensitivity analysis, using the IP fixture, for Squeak and rattle sound verification
- Write a manual for parameter adjustment for the IP fixture
- Write the final report

Desired profile

- Passionate for cars, especially noise and vibration or strength and endurance
- Possessing knowledge of linear finite element analysis and structural dynamics
- Interest in experimental correlation work
- Previous experience of using finite element software packages like Ansa and FE solvers like MSC/NASTRAN is meritorious

Means

Office, workshop, test samples, computer, software and 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

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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=20125&company=C0000870892P&username=