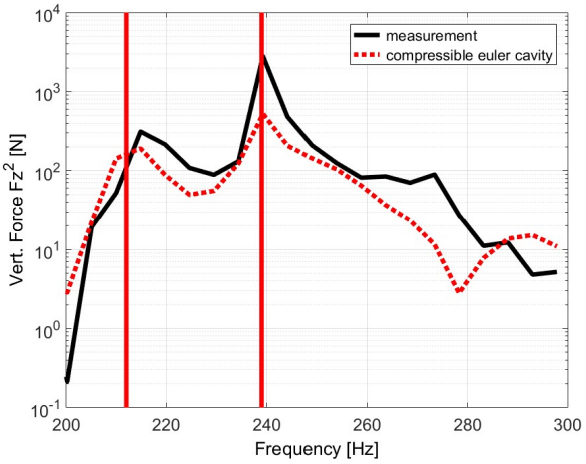
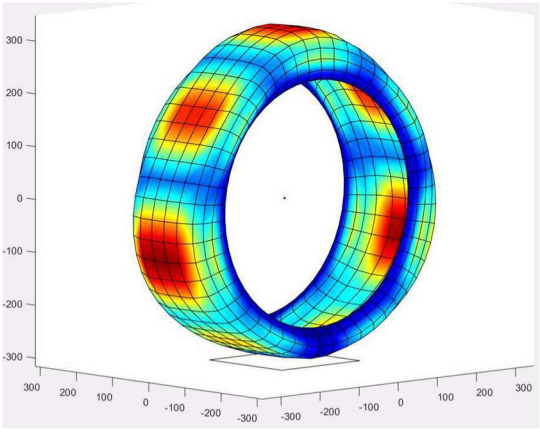
Job category	Students & Graduates
Form of employment	-
Location	Gothenburg
Country	Sweden

Thesis Work:

CDTire models for road noise CAE predictions





Background

The noise and vibration which occurs in a vehicle when driving over different road surfaces is a major factor in how the customer perceives the quality of the vehicle. This is therefore one of the most important load cases used during the development process of a new car.

The road noise and vibration levels are highly dependent on the interaction between the tire, rim, wheel suspension and car body. Traditionally, tire models have only been accurate enough for NVH (Noise, Vibration and Harshness) predictions below 200 Hz, and have not been able to accurately predict tire cavity noise which is the noise generated by the vibrations caused by the resonance of the enclosed air volume in the tire. However, in recent years tire models detailed enough for

accurate CAE predictions of the whole frequency band of structure-borne road noise have emerged, one of the most prominent being CD Tire developed by Fraunhofer ITWM.

Due to the historical lack of sufficiently accurate tire models, traditional CAE methods for road noise analysis are based on excitation using measured spindle loads. In this thesis CD Tire models of production tires will be implemented in the Volvo complete vehicle simulation environment, and subsequently used for direct excitation and prediction of interior vehicle road noise with a focus on tire cavity noise. Cavity noise is the chosen focus of the thesis for two reasons: firstly, it is very important for the customer perception due to the tonality of the noise; secondly, tire cavity noise is highly sensitive to damping and very challenging to predict accurately using FE models of tires.

The thesis will include measurements and CAE analysis of spindle loads and interior noise levels for the same production tires on a current production XC90 vehicle, and comparisons between measurement results and CAE results using both CD Tire and spindle loads. Using the newly implemented CAE capabiltiy, the thesis work will also include transfer path analysis of tire cavity noise, and developing proposals for improving the vehicle's interior cavity noise.

The complete vehicle models at Volvo are based on FE models of all chassis components and the car body, which are reduced to Craig-Bampton type superelements used in the calculations.

This project is run in cooperation between Fraunhofer-Chalmers Centre for Industrial Mathematics (FCC) and Volvo Car Group.

Scope

The project will include:

- Literature study of FE modelling of tires for NVH applications, tire cavity noise phenomena and countermeasures, CAE procedures for road noise prediction
- Implementation of CD Tire models and load cases into existing CAE environment i.e. Altair NVH Director complete vehicle finite element software
- Assisting/leading (depending on interest) in spindle load measurements on current production XC90 vehicle on test track roads
- Spindle load CAE analysis based on measured loads
- Comparing CAE results using CD Tire as well as spindle loads to obtained measurement results (wheel suspension vibration levels as well as interior sound pressure levels)
- Performing transfer path analysis of cavity noise and identifying potential countermeasures to improve vehicle interior cavity noise levels

Profile

Required: Students from Master program in Applied Mechanics, Sound and Vibration or Automotive Engineering. Good knowledge in FEM, structural dynamics, noise and vibrations. Self standing, curious and fast learner. Driving license.

Application

A brief cover letter, CV and academic record are required for application

Duration

- The thesis project will start January 2022 and continue 20 weeks.
- 1-2 students. This diploma work gives 30 points/student. The thesis project is located at Volvo Car Corporation in Gothenburg.

Contact

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Last application date **2021-10-30**

References

Uhlar, Stefan ,Heyder, Florian & König, Thomas (2019), Assessment of two physical tyre models in relation to their NVH performance up to 300 Hz, Vehicle System Dynamics.
O'Boy, Dan & Walsh, Stephen (2016), Automotive tyre cavity noise modelling and reduction, Conference: Proceedings of Internoise.
Gallrein, A., Baecker, M., and Guan, J. (2018), Simulation of Dynamic Gas Cavity Effects of a Tire under Operational Conditions, SAE Technical Paper 2018-01-0682, 2018, https://doi.org/10.4271/2018-01-0682.