Hybrid Isolation of Structure Borne Sound

Modelling and analysis

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Introduction

An important source for interior sound problems in vehicles is structure borne sound caused by the engine. Normally the engine is connected with the structure by means of passive mounts (rubbers). However, these mounts still transmit structural vibrations through the vehicle and cause sound problems elsewhere. A possible solution can be found by applying both active and passive isolation, socalled hybrid isolation. A research project in cooperation with TNO focuses on hybrid isolation of the engine from the remaining part of the vehicle.

Objective

Development of accurate and fast numerical tools to model and analyse realistic hybrid isolation systems. These tools are necessary to create an effective mounting of the engine with a reduction of the interior noise.

Methods

To obtain optimal noise reduction, a solution is sought in hybrid isolation with mounts which are composed of passive elements and actuators. An example of a representative model of a hybrid isolation system is shown in Figure 1. Four parts can be distinguished: a source (engine), hybrid mounts, a receiver structure and an acoustic domain (cavity).

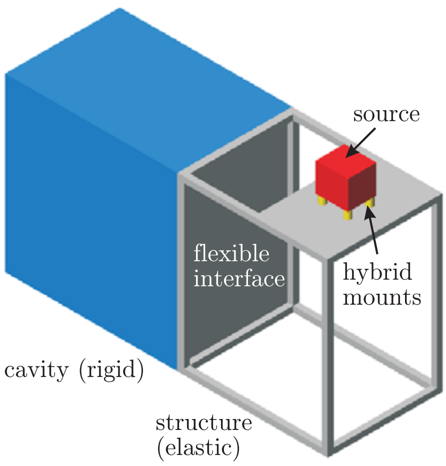

Figure 1 : Model of a hybrid isolation system.

Different steps can be distinguished for modelling the hybrid isolation system:

- Modal analysis of the structure and acoustic domain separately with the Finite Element Method.
- Determination of the harmonic response of both domains with modal superposition, see Figure 2.
- Choice of actuator locations and control strategy.
- Determination of the active response with optimal control theory.

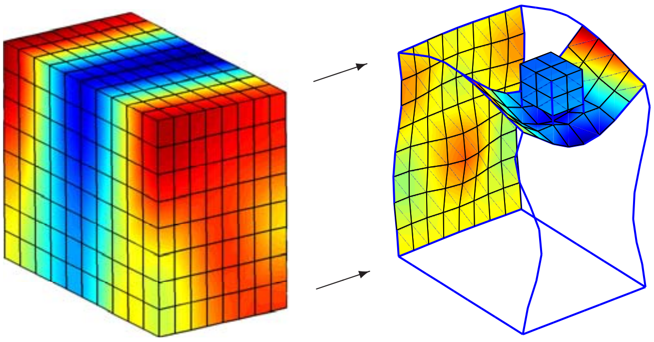

Figure 2 : Harmonic response of the cavity (excitated by the interface) and structure at 200 Hz.

Results

The results for the model described in Figure 1 are depicted by the acoustic pressure distribution in the cavity for the active and passive case, see Figure 3.

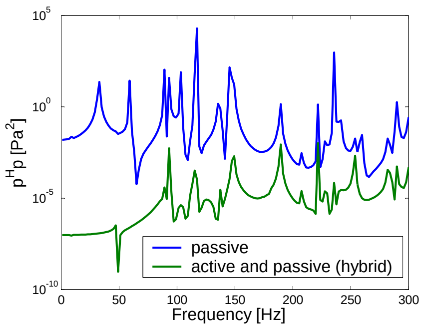

Figure 3 : Pressure response in the cavity for the active and passive case.

The additional actuation of the mounts causes a reduction of the interior sound in the cavity.

Further Research

- Further analysis and choice of an optimal control strategy.
- Experimental validation.
- Optimisation of the number and location of the actuators and sensors.