Hybrid Isolation of Structure Borne Sound

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Introduction

Vibration and interior noise problems in vehicles become more important due to the tendency to design lighter vehicles and the demand of more comfort. An important noise source is the engine, which causes vibrations that are transmitted through the whole structure. For this reason a research project has been started in cooperation with TNO on the isolation of vibrating engines from the receiving structure.

Objective

Reduction of the noise level in compartments of vehicles (eg. ships or trains) by means of effective mounting of the engine.

Methods

To obtain optimal noise reduction, a solution is sought in a combination of passive and active isolation. The engine mounts are composed of passive elements and actuators, the so-called hybrid mounts. An example of a hybrid isolation system for a ship is shown in Figure 1.

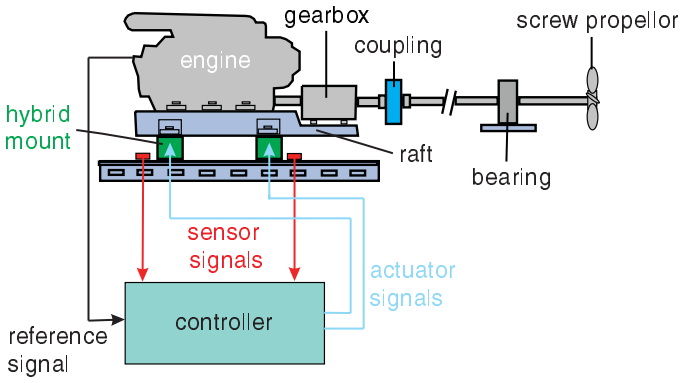

Figure 1 : Hybrid isolation of a ship engine (TNO)

The control problem is tackled by using a feedforward strategy with the rotational speed of the engine as reference signal.
To investigate the behaviour of the hybrid isolation system, an analytical model is studied (Figure 2). The main goal is to reduce the sound radiated by the plate in an effective way. The model is used to calculate the effect of different control strategies on the sound radiation of the plate.

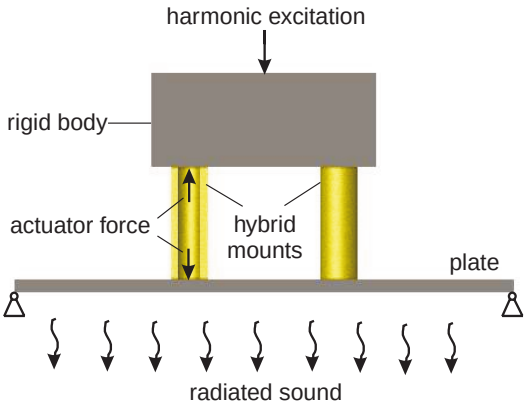

Figure 2 : Model of a hybrid isolation structure

Results

The effectiveness of the hybrid mounts can be determined by calculating the radiated sound power.

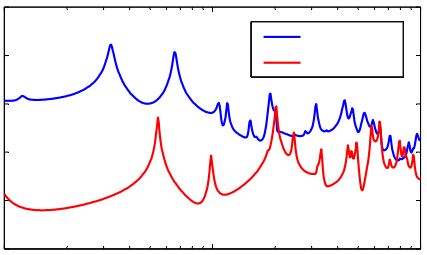

Figure 3 : Radiated sound power for the active and passive case

The additional actuation of the mounts causes a broadband reduction of the sound radiation.

Further Research

- Choice of an optimal control strategy.
- Experimental validation of the analytical model.
- Modelling of more realistic supporting structures.
- Optimisation of the number and location of the mounts and sensors.

References

1. Fuller, C.R., Eliot, S.J., Nelson, P.A. (1996) Active Control of Vibration, Academic Press.