Near-source sensor strategies for active isolation

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Introduction

Active isolation of engines (source) is a novel method for reducing interior noise in vehicles (receiver) at low frequencies and is still under development. Sensors can be placed at the receiver structure or near the source. The latter concept has two advantages: easier practical implementation and the possibility to define a global measure of the acoustic or vibrational response of the receiver structure. A numerical simulation tool was developed to analyze near-source sensor strategies.

Objective

Design and implement effective near-source sensor-strategies that lead to a global noise reduction of the receiver structure.

Methods

The different components of an active isolation system in a ship are depicted in Figure 1.

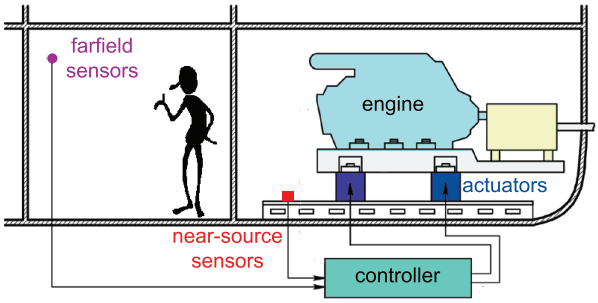

Figure 1 : Example of an active isolation system in a ship.

The goal is either reduction at the sensors in the accommodation (farfield sensors) or a global reduction of the receiver response with use of the near-source sensors. Two approaches can be used:

- Weighting of the near-source sensors with measured transfer functions between the near-source sensors and a set of well-chosen farfield sensors.
- Near-source sensor strategy that measures the transmitted power: the power input of the engine into the receiver structure.

Numerical models are used to investigate the feasibility, performance and practical applicability of different types of near-source sensor strategies. In Figure 2 a numerical model of a frame consisting of beams is depicted.

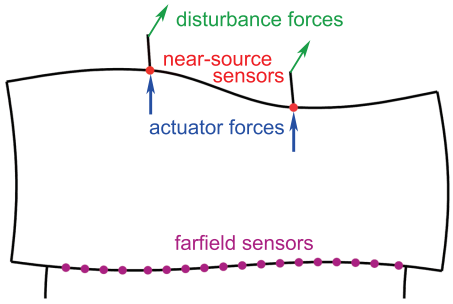

Figure 2 : Harmonic response of the example frame.

Results

The passive and active results of the example are presented in Figure 3 for a near-source sensor strategy based on minimization of velocity response of the far-field sensors (approach 1) and a near-source sensor strategy based on an estimation of the transmitted power (approach 2). In this example the total kinetic energy is considered as a global measure of the vibration of the receiver structure.

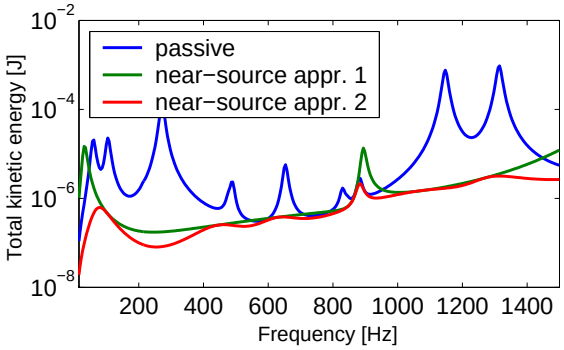

Figure 3 : Response of the frame for different sensor strategies.

The near-source sensor strategy based on minimization of the transmitted power yields a reduction of the total kinetic energy of the receiver structure which is even better than the reduction achieved with the farfield sensor strategy.

Further Research

- Sensitivity of the near-source sensor strategies to errors
- Practical implementation and experimental validation of near-source sensor strategies