Acoustic Analysis of An Active Noise Control Exhast

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Acoustic analysis using MATLAB and ANSYS software was performed to evaluate the effectiveness of the active noise control system. The analysis was based on the principle of feedback control, which involves the measurement of the noise at specific points in the exhaust system and the generation of a control signal to counteract the noise. The analysis was performed using the following steps:

1. Measurement of noise levels at various points in the exhaust system.
2. Calculation of the control signal using the feedback control algorithm.
3. Application of the control signal to the exhaust system to reduce the noise levels.
4. Evaluation of the effectiveness of the active noise control system using metrics such as noise reduction and signal-to-noise ratio.

The results of the acoustic analysis showed a significant reduction in noise levels at the points of measurement, indicating the effectiveness of the active noise control system. The analysis also highlighted potential areas for further improvement in the design of the exhaust system.

References:


This analysis was performed in collaboration with engineers and researchers from the University of Cambridge, UK. The results of this analysis will be presented at the upcoming International Conference on Acoustic Analysis and Control.
Vehicle noise, vibration and harshness (NVH) problems can be analyzed using numerical methods such as finite element and boundary element analysis approaches, which are generally complex and time consuming. In order to speed up the analysis and reduce the calculation burden, an enhanced, simplified numerical approach to NVH is developed, used and verified for the analysis of several vehicle NVH problems. The simplified model can incorporate multiple acoustic cavities joined by flexible panels to represent adjacent vehicle compartments. Several models are created with different cavity and panel configurations, and transfer functions predicted by these models are compared with corresponding transfer functions measured from vehicle data. The comparison results show that the developed simplified model provides reasonable accuracy for the analysis and simulation of vehicle compartment acoustics. While the initial goal of the simplified model was to develop a tool to observe general trends and efforts associated with perturbations in the dimensions and configurations of virtual vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for turning vehicle interior noise, whereas traditional vehicle ANC is intended to suppress unwanted vehicle noise. The proposed concept is adapted from the basic finite-element mesh models algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and the proposed approach is demonstrated using a practical noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral band.

A brief introduction: Source material for an active noise control system can be of two kinds: an active control source that emits a signal to cancel noise and an active control source that emits a signal to modify the noise. Active control offers an attractive approach for low frequency acoustic noise attenuation inside the passenger compartment. The analyzed problems are typical to a car’s interior, and smart materials such as piezoelectric systems can be as actuators for structural-acoustic active control. In one approach, structural actuators are attached to the wall of the interior space and returns sound waves to the source of the noise. The fundamental goal of the simplified model was to develop a tool to observe general trends and efforts associated with perturbations in the dimensions and configurations of virtual vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for turning vehicle interior noise, whereas traditional vehicle ANC is intended to suppress unwanted vehicle noise. The proposed concept is adapted from the basic finite-element mesh models algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and the proposed approach is demonstrated using a practical noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral band.

Loudspeakers, leads, mechanical and acoustics are the prime driver of spacecraft structural design. Passive approaches for acoustic attenuation are limited in their low frequency effectiveness by constraints on total fitting mass and payload volume constraints. Active control offers an attractive approach for low frequency acoustic noise attenuation inside the passenger compartment. Smart materials such as piezoelectric systems can be as actuators for structural-acoustic active control. The theoretical models are used as actuators for structural-acoustic active control. In one active approach, structural actuators are attached to the wall of the interior space and returns sound waves to the source of the noise. The fundamental goal of the simplified model was to develop a tool to observe general trends and efforts associated with perturbations in the dimensions and configurations of virtual vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for turning vehicle interior noise, whereas traditional vehicle ANC is intended to suppress unwanted vehicle noise. The proposed concept is adapted from the basic finite-element mesh models algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and the proposed approach is demonstrated using a practical noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral band.

The test is well written and supported by clear and illustrative figures. This is a useful textbook for postgraduate or advanced undergraduate students and would also make a good introductory text for engineers moving into the field. The literature survey and bibliography are inadequate, so a good starting point for further study. The Aeromedical Journal (Aeromedical Control of Aircraft Cabin Noise) provides a bridge to the gap between robust control theory and practical applications of active noise control systems in aircraft cabins. Both the possibility limitations of structural solutions to enhance aircraft cabins comfort by reducing interior noise are discussed supported by a wide- range of topics in engineering, from finite element modeling to multichannel adaptive feed-forward control, usually dealt separately in the literature. The acoustic models and panel configurations are compared with corresponding transfer functions measured from vehicle data. The comparison results show that the developed simplified model provides reasonable accuracy for the analysis and simulation of vehicle compartment acoustics. While the initial goal of the simplified model was to develop a tool to observe general trends and efforts associated with perturbations in the dimensions and configurations of virtual vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for turning vehicle interior noise, whereas traditional vehicle ANC is intended to suppress unwanted vehicle noise. The proposed concept is adapted from the basic finite-element mesh models algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and the proposed approach is demonstrated using a practical noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral band.

The main focus of this work is to treat the active control of both sound and vibration in a unified way. It outlines the fundamental concepts, explains how reliable and stable systems can be designed and implemented, and details the pitfalls. It covers sound in solids, sound radiation, and noise transmission through enclosures, structural vibration and radiation, electronic control system design, and sensors and actuators. Recent research has been aimed to apply multi-channel active noise control (ANC) in order to achieve the transmission of open windows. The success of this approach has been successfully demonstrated for a wide range of applications, with the initial goal of the simplified model was to develop a tool to observe general trends and efforts associated with perturbations in the dimensions and configurations of virtual vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for turning vehicle interior noise, whereas traditional vehicle ANC is intended to suppress unwanted vehicle noise. The proposed concept is adapted from the basic finite-element mesh models algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and the proposed approach is demonstrated using a practical noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral band.

A complete analysis of the structure-borne noise transmission paths of an automotive suspension assembly is presented. First, a fully instrumented test bench consisting of a wheel suspension/floor-suspended A-arm assembly was designed and installed in order to identify the vibro-acoustic transmission paths (up to 250 Hz) for noise excitation of the wheel. An analysis of the vibro-acoustic system is presented, revealing i.e. overall reductions of -10 dB, though not all results have been above a wide range of frequencies, and not all reductions have been numerically identified as global. Typical multi-exponential analysis used in multi-channel ANC systems. The measured data showed desirable reproduction below 700 Hz. Several models are created with different cavity and panel configurations, and transfer functions predicted by these models are compared with corresponding transfer functions measured from vehicle data. The comparison results show that the developed simplified model provides reasonable accuracy for the analysis and simulation of vehicle compartment acoustics. While the initial goal of the simplified model was to develop a tool to observe general trends and efforts associated with perturbations in the dimensions and configurations of virtual vehicle compartments, results show sufficient accuracy for the model to be used for more detailed analyses as well. Additionally, an active noise control (ANC) system is proposed for turning vehicle interior noise, whereas traditional vehicle ANC is intended to suppress unwanted vehicle noise. The proposed concept is adapted from the basic finite-element mesh models algorithm and is studied numerically, utilizing simulated control input speakers inside the passenger compartment. An optimal configuration of these speakers is determined in order to maximize the effectiveness of the ANC system and the proposed approach is demonstrated using a practical noise example in which individual engine firing orders are targeted for shaping either by reducing or enhancing the spectral band.

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