Implementation of Active Noise Control on the air intake of a truck
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Abstract

Noise control using passive solutions like damping layers, rubber bushings and absorption materials are well established and successful methods, but show limits in the low frequency range. An alternative to passive measures is the implementation of active noise control, first presented by Paul Leg in 1934. Advances in appropriate low latency processing units required for active control over the last years and the possibility of high-level programming have lowered the implementation costs for realizing an active noise control system. On a truck, the air intake system is connected to the rear wall of the cabin and the pressure pulsations inside the intake system produce air borne noise in the cabin from the duct mouth and the duct wall. Structure borne noise is transferred via the connections with the rear wall. The cabin noise is today optimized with passive measures.

This master's thesis is about the feasibility assessment and the implementation of active noise control in the air intake system of a truck to optimize the cabin noise in the frequency range 20 Hz to 350 Hz. To do so, the air intake system from a truck is mounted on a aluminum rig to serve as experimental setup. A single channel feed-forward NBFXLMS controller is proposed for the implementation. The controller is implemented using a block-based LMS algorithm making the controller versatile for possible future implementations both in time and frequency domain. Offline and adaptive implementations are compared with measurements and virtual simulations in Simulink. An investigation on the control loudspeaker limitations shows that the loudspeaker used in the project cannot produce the sound pressure levels required in the test conditions due to maximum consumed power and maximum excursion limits. Due to the control loudspeaker limitations, final measurements were carried out at lower sound pressure levels were the control loudspeaker operates within it's operating limits.The results show that an active control system is technically possible to implement.

Obtained reduction for air borne sound at the inlet mouth is up to 15dB SPL and $35\,\mathrm{m \cdot s^{-2}}$ for structure borne vibrations transmitted to the aluminum rig in the frequency range of interest at several truck driving conditions. To be able to control the actual sound pressure levels in the air intake system a new control loudspeaker study is suggested.

Keywords: ANC, active noise control, FXLMS, NBFXLMS, air intake, adaptive.