

Active Feedback-Controlled Low-Frequency Sound Absorption in a Duct

In an experimental set up, the effectiveness of DEICON's active feedback-controlled sound absorption system in a duct is demonstrated. The set up consists of a duct 10 ft long with the cross-section of 1 by 1 ft. The duct is made up of 3 sections each about 3 ft long. One end of the duct is equipped with a speaker (noise speaker) that excites the system. The 5 ½ inch control speaker is installed at the middle of the third section close to the duct outlet. Figure 1 depicts the experimental set up used in this demonstration.

The microphone is located on the same section, making the active system, modular. Another microphone, located outside the duct, about 1 ft away from the duct outlet, is used to measure the effectiveness of the system. Note that the 2nd microphone is not part of the feedback system. In an experiment, the excitation (noise) speaker was driven by random noise. The active system was used to abate the low-frequency component of the noise.



Figure 1 The experimental duct

Figure 2 shows the frequency response functions mapping the voltage driving the noise speaker to the pressure measured at the duct outlet, with and without the active acoustic absorber. The active control system, which is designed to absorb low-frequency acoustic waves, is performing effectively. Clear from Figure 2, the low-frequency sound is absorbed. Note that the small speaker (5 ½ inch) does not provide enough effectiveness at very low frequencies resulting in somewhat lower effectiveness of the control system around the first resonant frequency, i.e., 38 Hz; larger control speaker would have been more effective. In addition to, low-frequency, broadband abatement noise abatement, DEICON's technology can add considerable amount of damping to the standing waves of the duct; enough damping to nearly flatten the first few peaks.

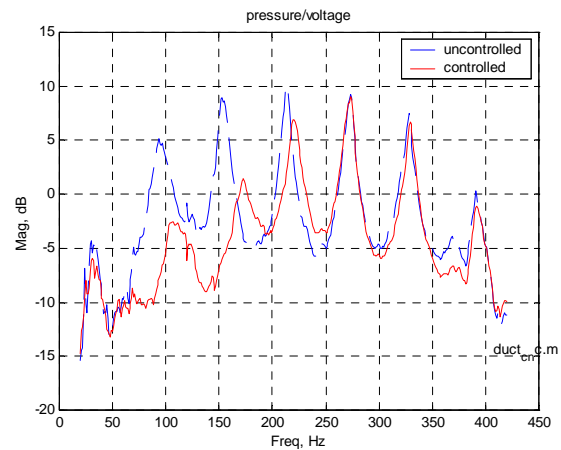


Figure 2 Frequency response functions of the duct with and without the electronic acoustic absorber

Lastly, we can also add zeros (anti-resonances) to the frequency response function of the duct at the frequencies corresponding to the fan's blade passage frequency and its harmonics. A different duct was used to demonstrate this capability. Figure 3 depicts the frequency response functions mapping the voltage driving the noise speaker to the pressure measured at the duct outlet, with and without active control. Figure 3 clearly indicates that the control system effectively attenuates the 260 Hz noise (the tuned frequency).

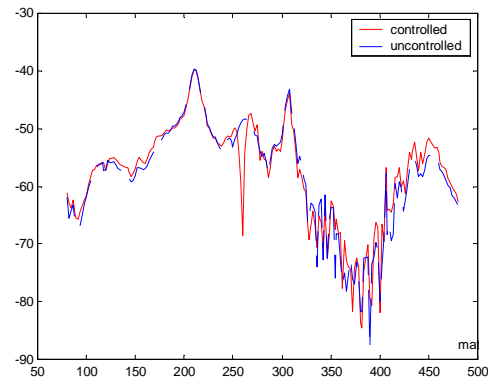


Figure 3 Frequency response functions with and without control