Active Damping of Air-Mounted Systems

Compared to elastomeric (rubber) and coil spring mounts, air mounts with their very low stiffness, provide the highest degree of low-frequency vibration.

Lack of damping in air mounts, although lowers the noise and vibration transmission of the mounted machine, will deteriorate its shock isolation attributes. This is mainly due to the creation of a highly underdamped, low-frequency resonance in the mounted system as shown in Figures 1 (a) depicting the transmissibility (transmitted force/perturbation force) of a mounted system for varying broadband damping in the mount. The reason practitioners do not embrace the obvious solution to alleviate the resonance problem, i.e., adding broadband damping, is that such damping deteriorates the high-frequency vibration isolation effectiveness of the mount resulting in transmission of noise.

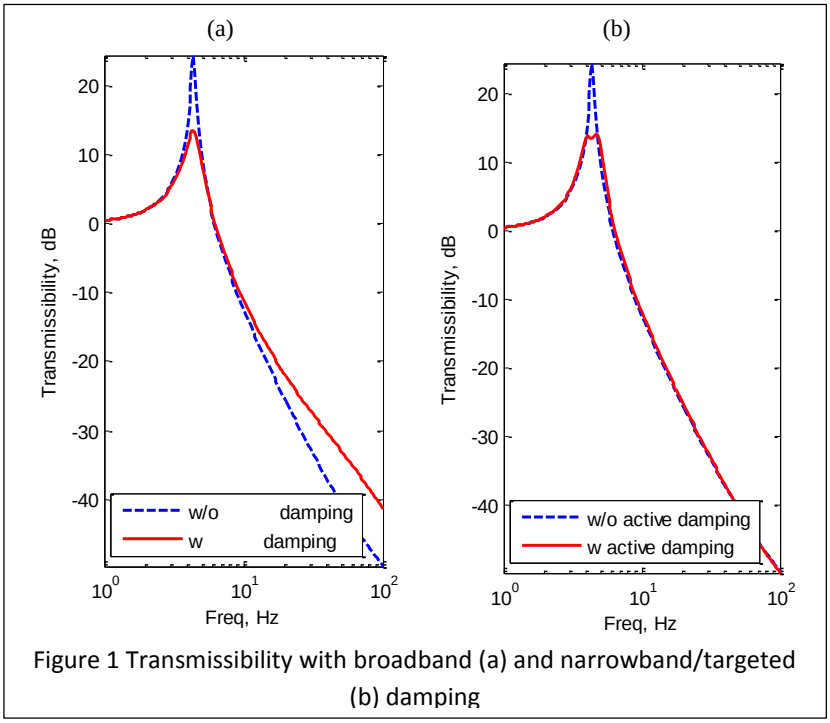

Figure 1 Transmissibility with broadband (a) and narrowband/targeted (b) damping

Clear from Figure 1(a), lower damping does not affect the transmission of force from the vibrating mass (e.g. diesel generator) to the base nor the transmission of the base vibration to the isolated machine (mass) at very low frequencies, increases them around the resonant frequency, and lowers these transmissions at high frequencies. This is why in most isolation applications the mount is selected to be highly underdamped. Of course, shock excitation common in vehicular, such as marine, applications will set off the resonance of the mounted system causing the mass to bounce.

Active damping, targeting the resonant frequency only, remedies the resonance problem enhancing the shock isolation attribute of the mount without damaging the high-frequency vibration and noise isolation attributes of the mount. Figure 1(b) depicting the transmissibility of an actively damped mount clearly shows the treatment of the resonance without increasing the transmissibility at high frequencies.

DEICON's *active damping technology for air isolation systems* effectively addresses the shortcoming of underdamped resonance leading to undesirable shock isolation, while maintaining the desirable vibration and noise isolation efficiency attributes of the air mount. The added benefits of active damping are the ease of adjustability, adaptability, and no space and weight penalty (no need for bulky and massive components commonly used in passive damping, such as mass or auxiliary air reservoirs).

Considering that air mounts in most isolation applications (including DEICON's Computer Controlled Air Isolation System) are either under pressure or height regulation, the proposed active system is readily realizable with minor modifications to the existing regulating valve(s).

Figure 2 shows the experimentally measured acceleration of a 500 lb (240 Kg) mass mounted on an uncontrolled and controlled air mount. Clear from this figure, active damping introduces an appreciable amount of damping into the system. Comparison of the two traces in Figure 2 indicates the increase in damping form 2.5% to 21%, i.e. in excess of 8 fold increase.

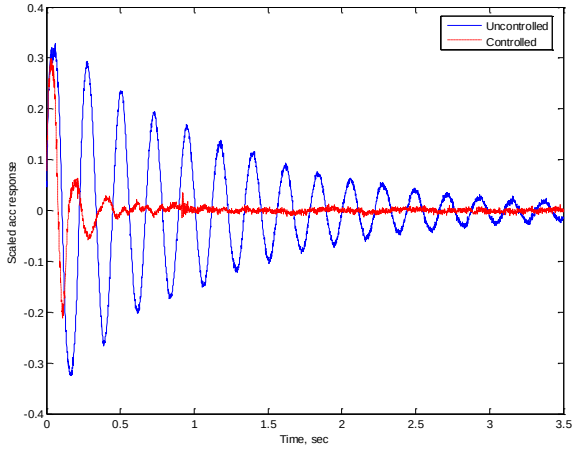

Figure 1 Transmissibility with broadband (a) and actively targeted (b) damping