

Active Stiffness Control of Air-Mounted Systems

Air mounts, with their attractive attribute of being able to provide the most softness of all mounts of comparable size, have been gaining popularity and wide spread use. The drawback of soft mounting is excessive motion of the mounted machine in response to abrupt, impulse-like disturbances (such as starting up or shutting down an engine).

Being able to vary the stiffness of an air mount, in situ and in real-time, will provide the high vibration isolation, by making the mount soft, without the undesirable side-effect of in-effective shock isolation (large impulse response). DEICON's active stiffness control technology, can change the heave (vertical) stiffness of an air mount, in a matter of milli-seconds, turning it into a stiff mount when need be and back into a soft mount again. This very attractive feature is demonstrated experimentally using a 500 lb (240 Kg) machine mounted on a stiffness-controlled a) convoluted air mount. Figure 1 shows the frequency response functions of the isolated system with a pneumatic air-spring (a) and a convoluted air-spring (b) for 3 different stiffness control gains.

Clear from Figure 1, the decrease in the amplitude of vibration by increase in the resonant frequency is another

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

indication that the stiffness was changed; note that a low frequency response magnitude is an indication of high stiffness.

Depending on the value stiffness controller gains the air mount in the Computer Controlled Air Isolation System can exhibit various levels of stiffness/softness, nearly instantaneously. For example, the convoluted mount with the frequency response traces shown in Figure 1(b), underwent a factor of 4 (400%) change in stiffness providing a factor of 2 change in natural frequency (from 2.25 Hz to 4.5 Hz).

In addition to active stiffness control, DEICON's Computer Controlled Air Isolation System is equipped with active narrow-band damping control. This narrow-band active damping scheme is increased/decreased in conjunction with increase/decrease in stiffness to further enhance the shock isolation and vibration isolation capabilities of DEICON's Computer Controlled Air Isolation System, allowing for an ideal mounting design which avoids the common compromises commonly used in traditional isolation systems.

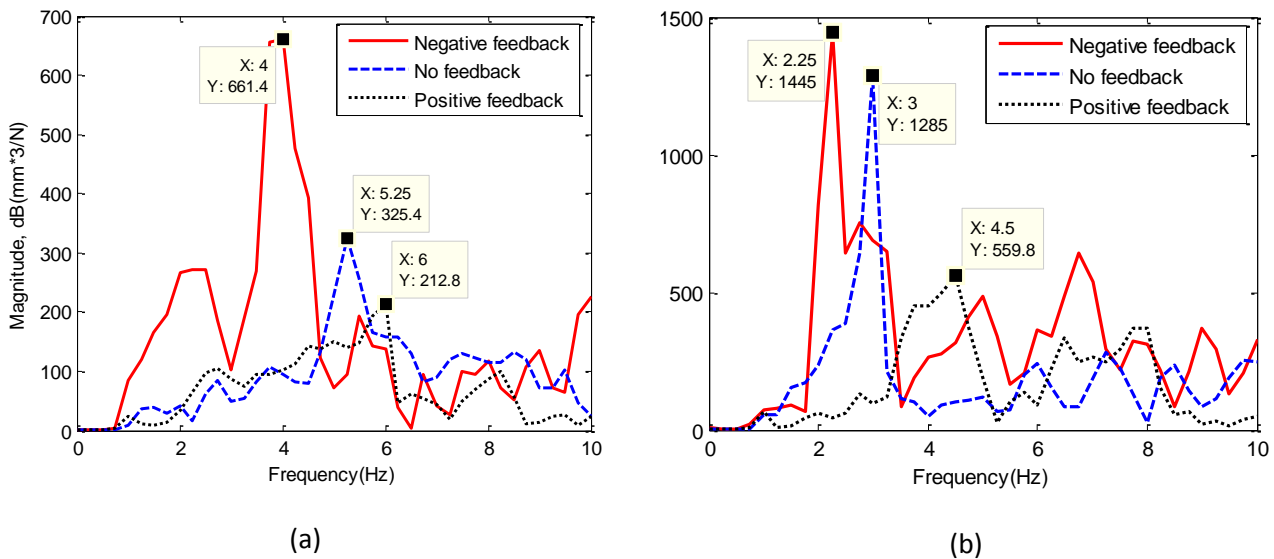


Figure 1 Frequency response of the pneumatic (a) and convoluted (b) air-mounted system with different stiffness controller feedback gains