Semi-active Air-suspended Tuned Mass Damper

Tuned mass dampers (TMDs) are tuned damping devices commonly used for dampening the vibration of a structure at a particular resonant frequency. TMDs come in various configurations. The commonality between all of them is their make-up which includes an inertia element (mass) suspended by an energy dissipating (damping) device and a restoring (resilient) element.

Contrary to traditional TMDs that use two individual elements, i.e., spring and a damper, to make up their suspension, DEICON's air suspended TMD uses only air springs (acting both as the resilient and dissipative elements) in its suspension. This results in fewer part counts, more reliability, and lower cost.

DEICON's *patented,* semi-actively controlled, 'air suspended tuned mass damper' (TMD) uses one/multiple air spring(s) *as both the restoring (resilient) and energy dissipating (damping) elements*.

Feedback control is used to adjust the stiffness and damping of the air spring(s). The schematic of a tuned mass damper installed on a structure is shown in Figure 1. These TMDs can readily be fine-tuned and re-tuned, via software, without changing any hardware.

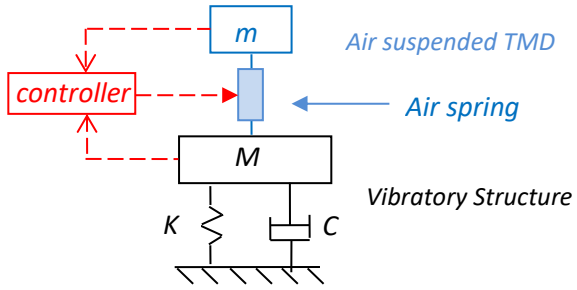

Figure 1 Schematic of air suspended adjustable tuned mass damper installed on a structure

Figure 2 shows images of a 1500 lb air suspended tuned mass damper with horizontal pendulum configuration, being tested to demonstrate the effectiveness of the semi-active control schemes in adjusting its damping and stiffness.

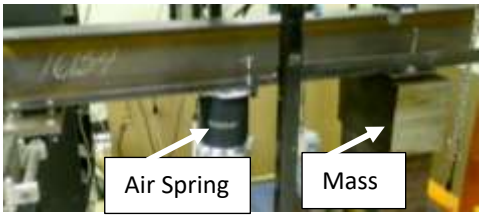

Figure 2 A horizontal (left) and a vertical (right) air-suspended pendulum TMDs

Figure 3 shows the impulse responses of the TMD mass with the semi-active damping control scheme off (blue trace) and on (red trace). The comparison of the two traces clearly shows the effectiveness of DEICON's semi-active damping technology. The extent of damping in the TMD can readily be changed via software.

Vibration energy in DEICON's air suspended TMDs is dissipated by releasing some compressed air from the air suspension, not via heat dissipation (as is in viscous dampers used in traditional TMDs). These TMDs are smaller in size and have temperature-independent damping attributes.

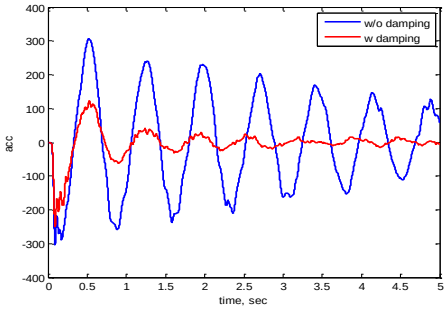

Figure 3 Accelearion responses of the TMD mass without and with damping control

The two traces in Figure 4 also show impulse responses of the TMD mass with the stiffness control off (blue trace) and on (red trace).

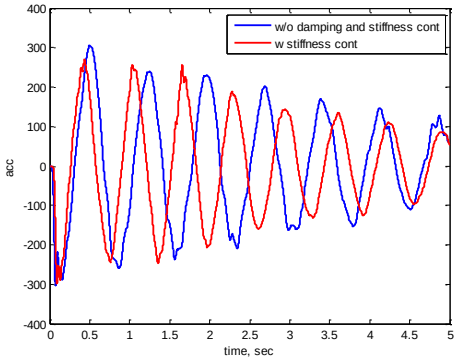

Figure 4 The acceleration responses of the TMD mass without and with stiffness control

Clear from Figure 4, the natural frequency of the air suspended tuned mass damper has inreased using the stiffness control strategy. In general this control scheme can increase the TMD stiffness 3-4 folds, resulting in change in tuning frequency by a factor of up to two.

As in damping, the extent of stiffness (and thus the tuning frequency) in DEICON's air suspended TMD can readily be changed via software. With this feature, these *TMDs are capable of self-tuning themselves*.

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