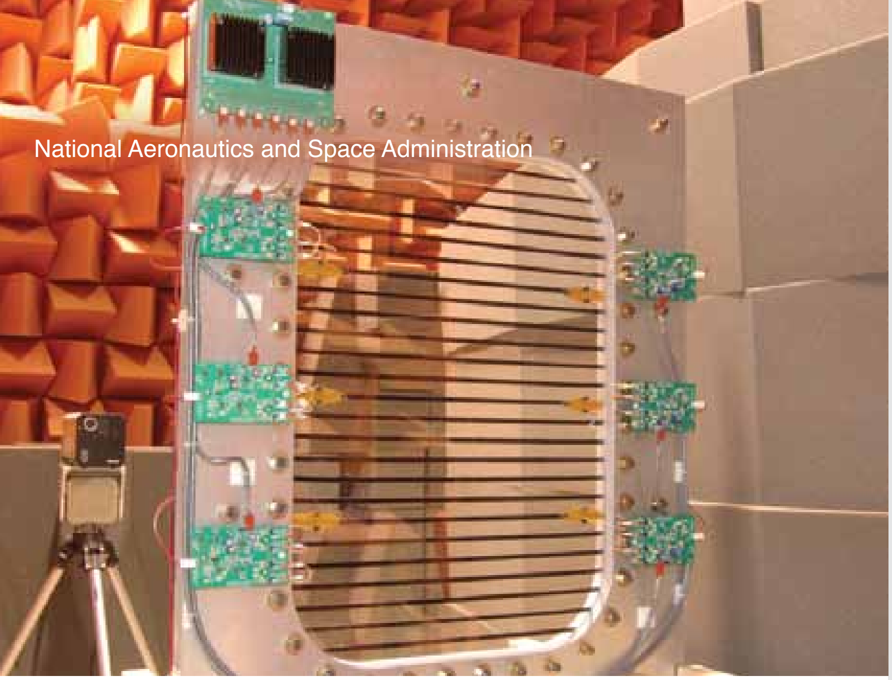


National Aeronautics and Space Administration

NASA Langley's

Compact Active Vibration Control System

Improved collocated point sensor and piezoelectric actuator array for reducing vibration in flexible structures

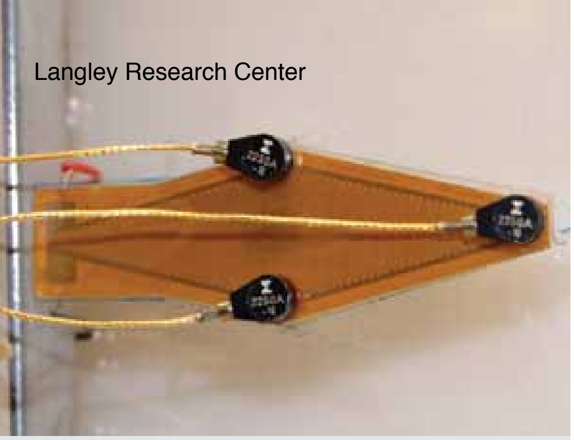
NASA Langley Research Center has developed a point sensor and piezoelectric actuator system to actively sense and reduce vibrations in flexible structures. Miniature accelerometers sense vibration and feed signals to control circuits that condition and amplify the signal. Interdigitated electrodes in the actuator apply an in-plane voltage differential across the piezoelectric material, causing compressive stress contrary to the vibration of the structure. This active damping system can reduce vibrations in aircraft windows, thereby reducing cabin noise, or help stabilize large, flexible space structures.

Benefits

- Compact, lightweight design (0.4 g actuator)
- Simple, 28V DC power electronics
- Effective operation over a broad frequency range (500 Hz–3,000 Hz)
- Improved actuator geometry and design offers precise coupling with vibrating structure and better control, especially at high frequencies
- Versatile sensor and actuator array can be located anywhere on the flexible structure

partnership opportunity

The Technology Gateway



The Technology

To achieve precise results over a broad frequency range, active vibration damping requires a collocated sensor and actuator pair properly coupled to the flexible structure. This technology's diamond-shaped actuator design incorporates 2–4 point sensors located at the actuator's corners. Taking the weighted sum of signals from four sensors allows the unit to function as a collocated transducer pair at higher frequencies than was possible with previous triangle-shaped actuators. Interdigitated electrodes apply a voltage differential in the in-plane direction, creating a highly directional actuator that can be shaped to couple with the response of the flexible structure. The size and placement of the actuator can be optimized to allow for a broad operating bandwidth or can be focused on a more narrow range of problem frequencies. When affixed to the sidewall or window of an aircraft, this system will sum and amplify the sensor response and will feed the signal back to the actuator. The actuator then generates a force that reduces the vibration, thus reducing cabin noise.

The system's compact, lightweight design features a Macro Fiber Composite actuator, made possible by a technology developed at NASA Langley and licensed to Smart Material Corporation in 2002. The system's compact design allows for the actuator to be mounted on a surface or incorporated within. Commercially available miniature accelerometers are used to sense vibration, and simple electronics provide signal conditioning, control logic, and power handling in compact circuits.

The technology portfolio includes U.S. patent 7,893,602, granted February 22, 2011.

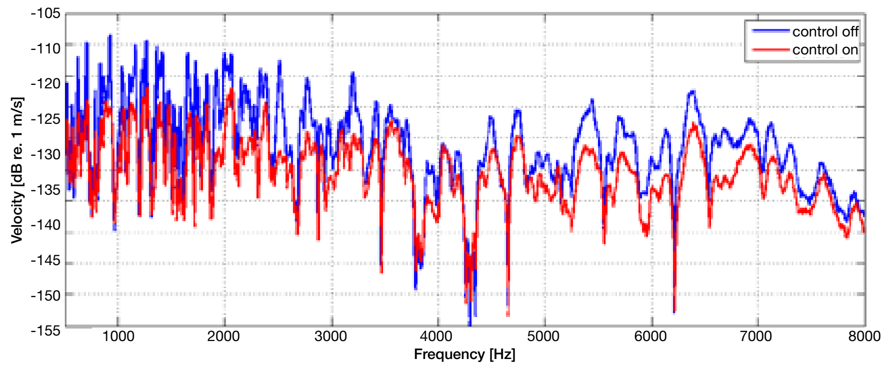


Figure 1. Velocity measurements at a single point on a Plexiglass panel with the control system powered off (blue curve) and on (red curve). Peak reduction was 15 dB, and integrated reduction from 500 HZ to 8,000 HZ was almost 6 dB.

Applications

- Aerospace—Reduce vibration and noise in commercial helicopters or airplanes
- Aerospace—Stabilize large, flexible space structures
- Manufacturing—Reduce noise radiation from vibrating panels
- Electronics—Stabilize optical components or other sensitive machinery

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

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