National Aeronautics and Space Administration

Sensors

Lightweight Low-Profile Transducer

Capable of generating a transverse point load or measuring transverse velocity

NASA's Langley Research Center researchers have developed a novel transducer design capable of generating a transverse point load and measuring transverse velocity. The technology was developed to work in conjunction with an accelerometer to eliminate sound propagation through aerospace vehicles, specifically airplane and helicopter windows. Studies on aircraft acoustics have shown that a dominant source of interior noise is from sound radiation from the windows. External sources include turbulent boundary layer, rotor, and engine noise. The transducer works by generating a point source interference pattern along the edges of the window, thereby canceling out the ambient sound wave radiated from the window. The transducer can be readily incorporated into existing technologies for improved performance.
NASA is seeking market insights on commercialization of the lightweight low-profile transducer, and welcomes interest from potential producers, users, and licensees.

BENEFITS

- Provides a lightweight and compact design
- Can be surface mounted or embedded
- Applies a point force
- Can act as a velocity source sensor
- Enables quieter aircraft

APPLICATIONS

- Commercial and military aircraft
  - -- Airplanes
  - -- Helicopters
- Industrial/manufacturing spaces
- Office buildings
- Additional applications include:
  - -- Acoustic speaker
  - -- Point velocity sensor

technology solution

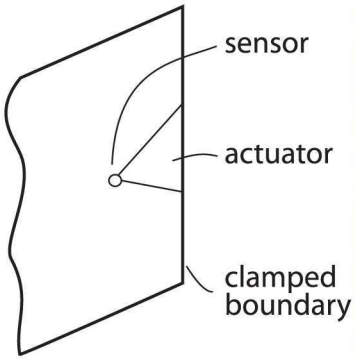
THE TECHNOLOGY

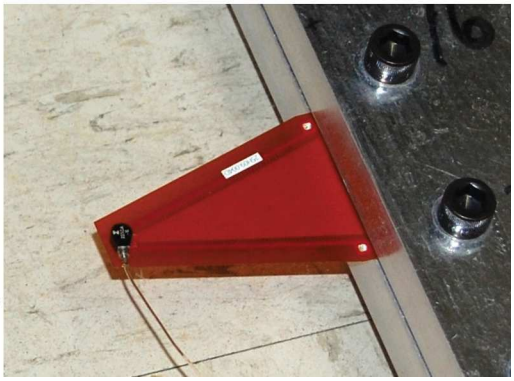
Acoustic disturbances in an airplane can be a major annoyance. Various techniques have been applied to successfully reduce noise transmission through the fuselage. However, the windows continue to be an effective pathway for the propagation of external noise into the vehicle.

Piezoelectric transducers have been developed that work in conjunction with an accelerometer to cancel window noise. Accelerometers measure the structural response at a single point whereas current piezoelectric transducers apply force over an area. The mismatch between the transducers results in reduced performance and efficacy. NASA has solved this problem with the low-profile transducer, which incorporates a thin-layer, triangularly shaped piezoelectric material with interlaced integrated electrodes.

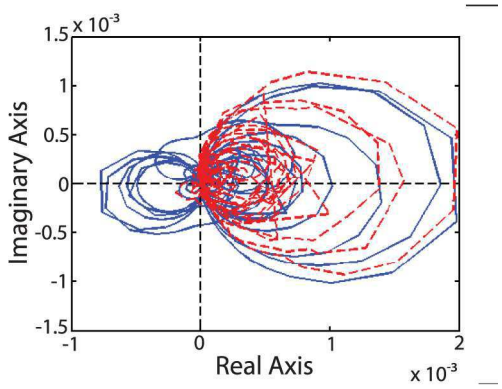
When used as a surface-mounted or embedded actuator, the integrated electrodes apply an electric field in a set planer direction. This produces a transverse point force at the tip of the actuator. The point force created can be matched more precisely with the accelerometer readings, thereby producing improved sound cancellation capabilities. The design allows for a compact dissipative vibration control system that can be embedded or mounted along the perimeter of a panel.

The device can also be used as a transverse velocity sensor. When used as a sensor, the electrodes collect the electricity generated in the piezoelectric material. The charge output is proportional to the motion of the tip of the device.





The diagrams show: (a) a triangular actuator and point sensor pair; and (b) a triangularly shaped actuator with an interdigitated electrode pattern mounted on a clamped Plexiglas plate.



Nyquist plots of the open-loop frequency response function for the sensor-actuator transfer function from 2.5 Hz to 3 kHz

PUBLICATIONS

Patent No: 7,893,602

More Information

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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