



## TECHNOLOGY SOLUTION

### Sensors



# In Situ Performance Monitoring of Piezoelectric Sensors and Accelerometers

Tests and Identifies Degraded Sensors Without Having to Remove Them

An in situ measurement system for monitoring the performance of piezoelectric sensors, particularly accelerometers, was developed. With this technology, characteristics such as resonant frequency, response, cable status, connectivity, bonding and linear range, can be determined. Sensors can be tested in a very wide frequency range, extending to 200 MHz and beyond, without removing them from their mounted locations, and without requiring specially constructed transducers or special wiring. Assessments can be performed in situ, and can be conducted with hand held test equipment or integrated into instrumentation systems. With this monitoring system, degraded sensor performance can be quickly and economically identified with a handheld unit or integrated directly into test equipment.

### BENEFITS

- Simplified Testing: Allows testing of piezoelectric sensors without requiring physical contact
- Reduced Re-Calibration Costs: Does not require removing mounted sensor or sending to a calibration lab
- Increased Testing Parameter Range: Provides both normal and as-mounted resonant frequencies
- Improved Accuracy: Provides entire frequency response over the range of the device (unlike commonly used shaker tables)
- Identifies In Situ Problems: Can identify degraded sensor bonds, faulty cabling and sensor damage



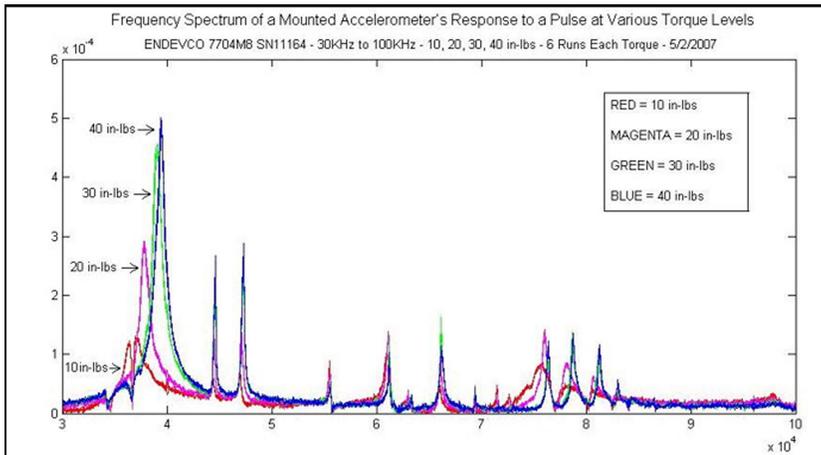
## THE TECHNOLOGY

On occasion, anomalies may appear in the highly dynamic test data obtained during rocket engine tests, which are investigated and corrective action may be mandated before subsequent testing. Also, it is often unclear if anomalies in recorded signals are due to differences between the Low and High Speed Data Acquisitions Systems, difference between the transducers, a failed transducer, or if everything is working correctly and the system were actually accurately recording real events.

Commercial test equipment suitable for testing piezoelectric sensors is expensive and requires that the sensor be removed from the test article for evaluation. With the monitoring system developed, degraded sensor performance can be quickly and economically identified.

This system can evaluate installed piezoelectric sensors, without requiring physical contact with or removing them from their mounted locations. Tests are conducted through cabling. Since it is not necessary to remove the device, data that reflect the devices specific physical configuration (such as as-mounted resonant frequency) are retained, and devices that are physically inaccessible can still be tested. The testing system is not limited to identifying degraded performance in the sensors piezoelectric elements; it can detect changes within the entire sensor, and sensor housing.

The system can be made portable, in a battery powered sealed box, for testing in the field. Since physical contact with the sensor is not necessary, therefore, monitoring can be done as far away as 250 feet, or longer if certain provisions are made.



Frequency response of accelerometer, without removing it from its mounted location, using the in situ performance monitoring system.

## APPLICATIONS

The technology has several potential applications:

- Accelerometers
- Automotive sensors
- Structural sensors
- Sensors for manufacturing equipment
- Any application where vibration is monitored
- Any piezoelectric sensor
- Applicable in Nondestructive Testing (NDT)

## PUBLICATIONS

Patent No: 8,401,820

Jensen, Scott. "In Situ Health Monitoring of Piezoelectric Sensors." TechConnect World Innovation Conference & Expo, June 17, 2015, Washington, DC.

Jensen, Scott. "In Situ Performance Monitoring of Piezoelectric Sensors and Accelerometers." NOBIC (New Orleans BioInnovation Center) Technology Showcase, Innovation Louisiana 2015 Conference, November 18, 2015 New Orleans, LA.

[technology.nasa.gov](http://technology.nasa.gov)

**More Information**  
National Aeronautics and Space Administration  
**Agency Licensing Concierge**  
**Stennis Space Center**  
EA03/Office of Technology Development  
Stennis Space Center, MS 39529  
202-358-7432  
Agency-Patent-Licensing@mail.nasa.gov  
**www.nasa.gov**  
NP-2014-08-1151-HQ

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.

SSC-00327, SSC-TOPS-1