



Sensors

## Low Frequency Portable Acoustic Measurement System

*A system to detect and locate atmospheric clear air turbulence and severe weather*

NASA's Langley Research Center has developed a system to detect and locate atmospheric clear air turbulence (CAT) by means of a ground-based infrasonic array to serve as an early warning system for aircraft. This system could augment existing systems such as pilot reports (PIREPs), airborne lidar, and airborne radar. The NASA system offers a benefit based on the fact that the existing electromagnetic methods lack targets at 30,000-40,000 ft and will not detect CAT. Because CAT and severe storms emit infrasound that propagates over vast distances through the Earth's atmosphere, the Langley system offers an excellent early warning opportunity. The system has been able to detect known events - such as detection of the launch of the Space Shuttle in Florida all the way from Virginia. It also has correlated data with NOAA's PIREPs information.

### BENEFITS

- Robust - hardware proven in various weather conditions, and successful wind screening
- Portable - including detector array and field calibration
- Proven - known events detected as well as correlation with pilot-reported data via PIREPs

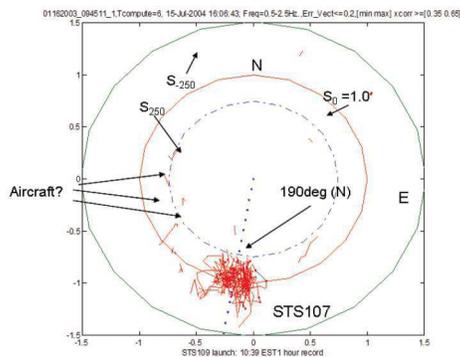
technology solution

## THE TECHNOLOGY

Langley has developed various technologies to enable the portable detection system, including:

- 3-inch electret condenser microphone - unprecedented sensitivity of -45 dB/Hz
- compact nonporous windscreen - suitable for replacing spatially demanding soaker hoses in current use
- infrasonic calibrator for field use - piston phone with a test signal of 110 dB at 14Hz.
- laboratory calibration apparatus - to very low frequencies
- vacuum isolation vessel - sufficiently anechoic to permit measurement of background noise in microphones at frequencies down to a few Hz
- mobile source for reference - a Helmholtz resonator that provides pure tone at 19 Hz

The NASA system uses a three-element array in the field to locate sources of infrasound and their direction. This information has been correlated with PIREPs available in real time via the Internet, with 10 examples of good correlation.



NASA system detected STS107 Columbia launch at Cape Canaveral, Fl., on June 16, 2003, from sensors at NASA Langley in Hampton, VA.

## APPLICATIONS

The technology has several potential applications:

- Detection and location of clear air turbulence for aircraft
- Severe weather monitoring, including tornado chasing via portable
- infrasound array
- Remote motion detection - microphone technology
- Mine communications - infrasound travels through solid barriers

## PUBLICATIONS

Patent No: 8,401,217; 8,671,763

Patent Pending

National Aeronautics and Space Administration

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