



TECHNOLOGY SOLUTION

Sensors

Infrasound Sensor Technology

An infrasound microphone enables remote detection of aircraft wake vortices, clear air turbulence, tornadoes, and seismic events

NASA Langley Research Center scientists have developed a microphone that detects infrasound, i.e., acoustic waves ranging from 20 Hz frequencies down to dc. Infrasound is emitted in a number of hazardous atmospheric phenomena, including aircraft wake vortices, clear air turbulence, and tornadoes. It is also emitted by seismic events, such as underground nuclear tests, digging of tunnels, etc. Infrasound propagates hundreds of miles and can penetrate walls, mountains and other obstacles without loss. The NASA infrasound sensor filters out wind noise that can interfere with detection, while using less power and much less space than currently available solutions. As a result, the NASA infrasound sensor can detect tornadoes and clear air turbulence hundreds of miles away; an array of 30 could cover the entire continental US. Aircraft wake vortices can be detected in real time by microphone arrays placed along an airport runway.

BENEFITS

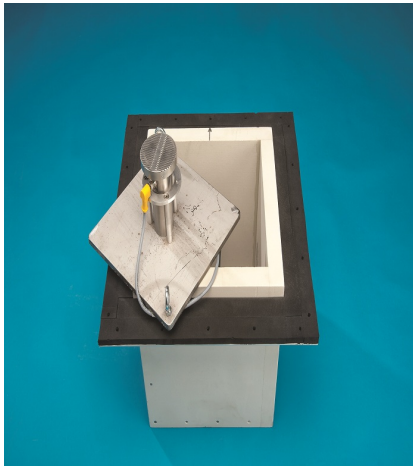
- Increases safety through allowing avoidance of wake vortices and clear air turbulence
- Increases airport efficiency by permitting more closely-timed takeoffs when no wake vortex is present
- Allows early detection of tornadoes from hundreds of miles away
- Enables detection of banned underground nuclear tests
- Facilitates detection of underground activity, e.g., tunnel digging
- Works in all weather conditions
- Can be deployed in a compact volume
- Consumes little power, roughly 35 mW



THE TECHNOLOGY

Large aircraft can generate air vortices in their wake, turbulence that can prove hazardous to aircraft that follow too closely. Because wake vortices are invisible, all takeoffs at busy airports are spaced several minutes apart. This separation gives the vortices time to dissipate, even though they only occur 10% of the time, with resulting loss of operational efficiency. Similarly, clear air turbulence is invisible and can also be hazardous to aircraft. By detecting such disturbances through their infrasound emissions, precautions can be taken to avoid them.

Other phenomena can be detected through infrasound, including tornadoes, helicopters on the other side of mountains, underground nuclear explosions and digging tunnels. Through the unique properties of infrasound, many of these can be detected from hundreds of miles away. NASA's infrasound sensor is a highly refined microphone that is capable of detecting acoustic waves from 20 Hz down to dc, the infrasound range. The design is robust and compact, eliminating the bulk and weight found in other technologies. Where most alternative methods are restricted to certain weather conditions and locations, the NASA sensor filters noise from wind and other sources, allowing its use under any weather or geographic conditions.



NASA's Infrasound sensor

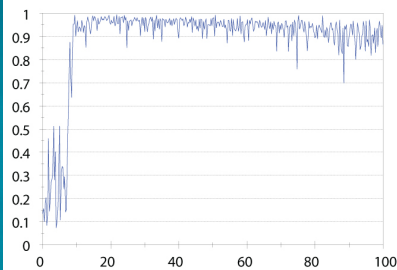


FIGURE 2 - Coherence, a measure of turbulence intensity, versus frequency, in the wake of a CRJ-700 aircraft

APPLICATIONS

The technology has several potential applications:

- Aviation detection of turbulence
 - Aircraft wake vortices
 - Clear air turbulence detection from hundreds of miles away
- Meteorology - tornado, severe thunderstorm detection
- Defense & Security sensing - previously undetectable or difficult to detect phenomena
 - Tunnel digging
 - Helicopters, movement of troops and other activity on the other side of mountains, hills
 - Detection of personnel inside buildings from outside
 - Banned underground nuclear tests

PUBLICATIONS

Patent No: 9,620,025