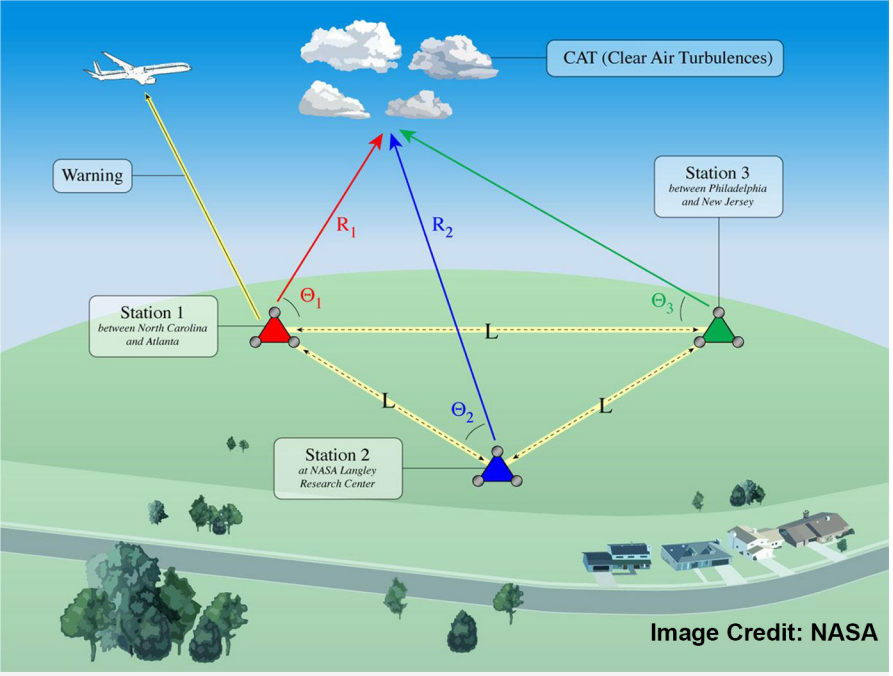


National Aeronautics and Space Administration

Information Technology and Software

Adaptive Algorithm and Software for Recognition of Ground-based, Airborne, Underground, and Underwater Low Frequency Events

Ground-based infrasonic array to track atmospheric turbulence

The innovative approach is to exploit modern signal processing methods. i.e. adaptive filtering, where the computer is trained on-line to recognize features of the low frequency events (on the ground, in air, underground, and underwater) to be detected. Modern instrument development techniques and computational capability has enabled the development of a vastly more powerful algorithm and detection techniques.

BENEFITS

- The technology has better demonstrated accuracy compared to comparable technology

APPLICATIONS

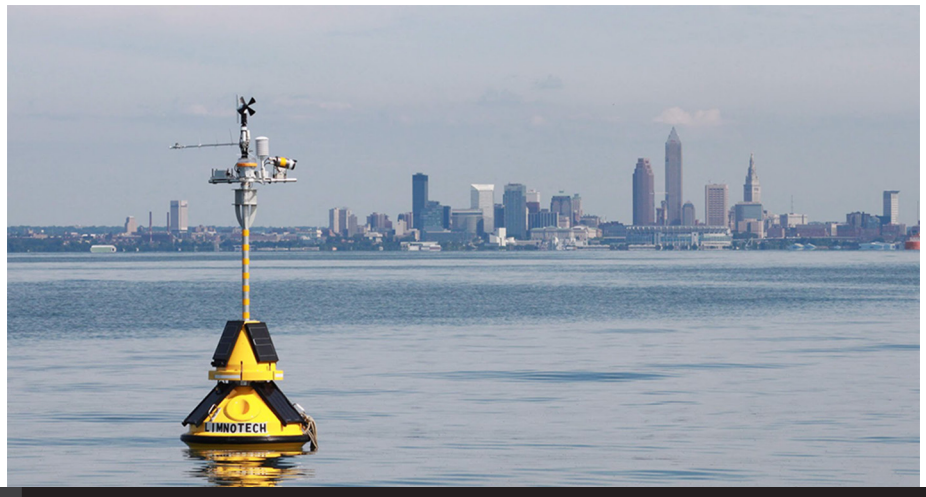
- Detecting and tracking atmospheric turbulence
- Detection of stealth submarines
- Detection of stealth submarines
- Detecting tsunamis
- Nuclear test ban detection

technology solution

THE TECHNOLOGY

Acoustical studies of atmospheric events like convective storms, shear-induced turbulence, acoustic gravity waves, microbursts, hurricanes, and clear air turbulence over the last forty-five years have established that these events are strong emitters of infrasound (sound at frequencies below 20 Hz). Over the years, NASA Langley has designed and developed a portable infrasonic detection system which can be used to make useful infrasound measurements at a location where it was not possible previously. The system comprises an electret condenser microphone, and a small, compact windscreen. The system has been modified to be used in the air, underground, as well as underwater (to determine man-made and precursor to tsunami). The system also features a data acquisition system that permits real-time detection, bearing, and signature of a low frequency source. However, to determine bearing of the received signals, the microphones are to be arranged as an equilateral triangle with a certain microphone spacing. The spacing depends upon location of the microphone array. For a ground-based array, the microphone spacing of 100 feet (30.48m) is desired to determine time delay for signals arriving at each microphone location. The microphone spacing depends upon speed of sound through the array medium. For underwater array, the spacing between microphones would be around 1500 feet. The data acquisition system provides data output in the infrasonic bandwidth which is then analyzed using an adaptive algorithm (least-mean-squares time-delay-estimation) using modern computational power to locate source by plotting source location hyperbolas on-line.

A smaller array size reduces the time resolution resulting in strong signal coherence. The innovation approach is to exploit modern signal processing methods, i.e. adaptive filtering, where computer is trained on-line to recognize features of the event to be detected. Modern computational capability permits the adaptive algorithm (least-mean-squares time-delay estimation or LMSTDE) which is vastly more powerful algorithm. This system has better resolution able to determine direction with arrived signals within five-degree accuracy.



PUBLICATIONS

Patent No: 10,802,107

More Information

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