National Aeronautics and Space Administration

NASA Langley's
Air Coupled Acoustic Thermography

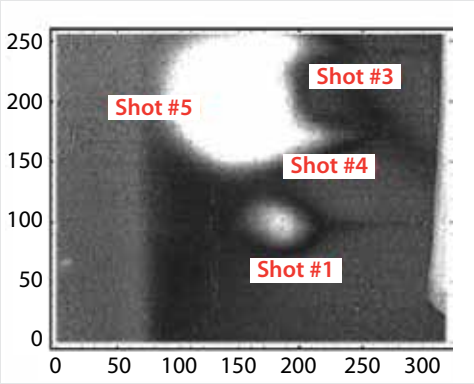
Nondestructive evaluation and inspection of honeycomb structures

NASA Langley researchers have developed a novel noncontact method to identify internal damage inside structures. Air Coupled Acoustic Thermography (ACAT) was originally developed for damage identification in honeycomb sandwich structures but can also be applied to other systems. ACAT uses pulsed acoustic waves to generate movement and vibrations in areas of honeycomb structures that exhibit weakness or stress. These vibrations generate temperature differentials that can be visualized via thermography and essentially allow more exact identification of damaged regions. ACAT provides several advantages over techniques used for similar purposes such as ultrasound or vibrothermography in that the excitation source does not need to be physically coupled to the substrate of interest. This advantage allows ACAT to detect damage in curved surfaces and mitigates the risk of damaging the substrate at the coupling point. ACAT has been demonstrated to accurately visualize internal core damage as well as damage nearer to the structure's skin.

Benefits

- Noncontact technique
- Ability to inspect and detect damage in curved and linear surfaces
- Defect or damage visible as heat
- Identification of defects not found via conventional flash thermography
- Inexpensive system requiring thermal imager and audio equipment
- Able to do large area inspections
- Ability to detect core and peripheral damage

partnership opportunity



Acoustic Thermography Image (magnitude image at 0.0625 Hz)

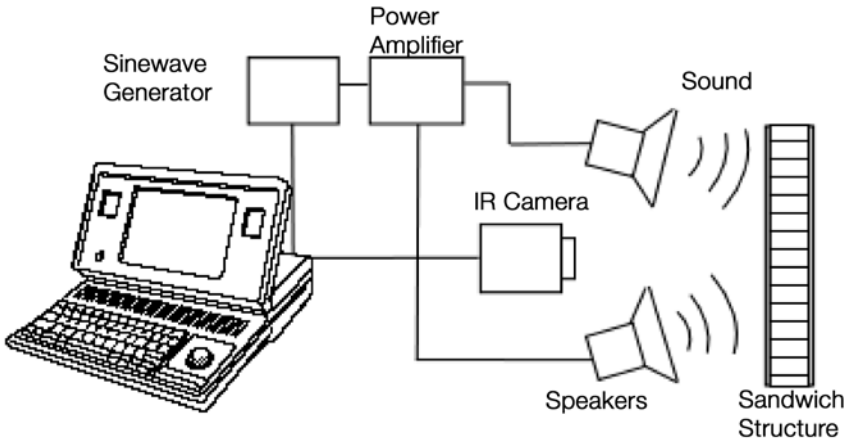
Applications

ACAT has shown definitive effectiveness identifying damage in honeycomb sandwich structures and has potential application in fields such as:

- Aviation inspection
- Composite repair inspection for boats and cars

The Technology

ACAT consists of an infrared camera, an image data capture system, an acoustic excitation source, and a chamber. The structure of interest is placed in a chamber to contain the sound and create a stable thermal environment. A loudspeaker is placed near to, but not in contact with, the structure, and it is then pulsed with acoustic energy for approximately 40–80 cycles. The majority of the acoustic excitation is reflected off the structure, and very little energy absorption is observed. However, weak or damaged areas vibrate and act like heat sources. These heat sources can then be visualized using an infrared camera. A typical inspection time takes 2–3 minutes. The data is processed pixel by pixel in the time domain using a fast Fourier transform algorithm to produce a magnitude of images as a function of frequency. ACAT can visualize core and near skin structure damage over wide areas without the need for a couplant. This permits ACAT to identify damage in curved and linear structures.



ACAT system block diagram for noncontact inspection of honeycomb structures

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

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