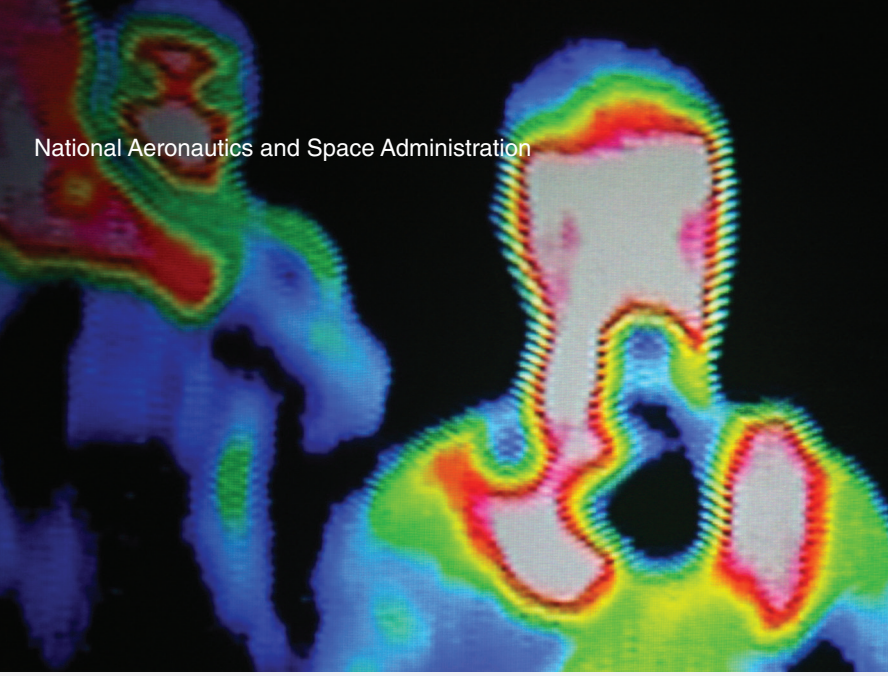

Information Technology and Software

Flash Infrared Thermography Software

Infrared (IR) contrast analysis and imaging augments and improves flash IR thermography

Researchers at NASA's Johnson Space Center (JSC) have developed novel techniques for post-processing of flash IR thermography data. These methods efficiently and cost-effectively provide valuable new information when conducting NDE of nonmetallic structural composites during their manufacture as well as over the lifetime of the deployed part. Based on a novel IR contrast approach, this suite of tools is compatible with commercial IR thermography products and provides enhanced imaging, as well as both quantitative and qualitative data analysis capabilities. The methodologies provide reliable detection and characterization of anomalies in composite structures made of nonmetallic materials, such as reinforced carbon-carbon and carbon-fiber-reinforced polymers. Characterization capabilities include determining depth, size, location, and boundaries of these flaws. Calibration techniques provide detailed, systematic analysis of flash thermography data comparable to that used in advanced pulse/echo ultrasonic testing, offering performance enhancements not currently available for NDE of composite materials.

BENEFITS

- Comprehensive—includes complementary contrast tools that provide enhanced quantitative and qualitative data about flaws
- Detailed—offers complementary and predictably accurate insights into defect shape, size, depth, and location
- Competitive—provides the most precise and detailed characterization of flaws and anomalies in nonmetallic composite structures and thin metallic materials
- Cost-effective—lowers the cost of implementation through compatibility with existing hardware systems and ability to augment single-sided IR data processing methods
- Accurate—provides reflection correction and signal processing to improve signal-to-noise ratio, improving flaw detection sensitivity
- Efficient—extracts and constructs images quickly and simply, saving operators the chore of manually sorting through stacks of images, enabling swifter and more accurate evaluation of thermographic data

technology solution

THE TECHNOLOGY

Originally used by NASA for NDE of the Space Shuttle Orbiter, JSC's suite of IR contrast methods and tools enhances mission-critical detection and evaluation of defects in nonmetallic composites using flash IR thermography. This helps ensure the performance, functionality, and safety of composite structures.

The standard flash IR thermography setup consists of a flashhood, a flash power supply/trigger unit, a flash duration controller, and electronics used to capture the data from the IR camera. It also includes a data display and software for post-processing of the data. The flashhood helps contain the flash and has one open side, while the other side has a window for the IR camera lens. The camera is mounted to the outside of the hood, and flash lamps direct the illumination toward the hood opening.

This setup houses the material being evaluated and directs a pulse of IR light onto it. The material's reflected thermal response generates an IR image. When a defect is present, heat flowing at the structure's front surface is impeded relative to the surrounding defect-free areas. Variations in the thermal diffusivity of the material manifest themselves as anomalies in the IR image of the test surface.

Although optimized for performance, critical components in aerospace structures can be difficult, if not impossible, to inspect adequately due to design complexity and/or the use of advanced materials. JSC's suite of software and tools offers a cost-effective and efficient way to provide more comprehensive, detailed, and accurate NDE detection and characterization of subsurface defects in nonmetallic composite materials having flat or curved surfaces.

Currently available commercial thermography software does not use image contrast or temperature contrast and therefore provides less accurate characterization of defects. Furthermore, because this software normalizes and calibrates data, it provides more stable measurements and greatly minimizes errors due to operator and camera variability.

The NASA developed software has a wide variety of applications. It could be used in IR camera manufacturing or in the nondestructive testing of aerospace structures.

APPLICATIONS

This suite of tools can be applied to NDE using flash IR thermography of any nonmetallic advanced structural composite, such as those used in myriad industries:

Aerospace – aircraft and fuselage structure, airfoils, turbine blades

Power generation – turbine blades, pipelines

Chemical and petrochemical – pipelines, fuel tanks

Marine – marine vehicle bodies, fuel tanks, pressure vessels

High-performace automotive – racecar bodies and structures

Construction – bridges

PUBLICATIONS

U.S. Patent 8,577,120

More Information

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NP-2014-08-1132-HQ

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MSC-24444-1, MSC-24506-1