Application: New Laser Technology Inspects Complex Aircraft Structures

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Non-destructive testing of aircraft is a multi-million dollar industry. Many of today’s aircraft are made of materials unknown to early aviation pioneers. These new materials require sophisticated inspection and repair procedures. Older inspection technologies are often incapable of testing and verifying the integrity of some composite structures. So aircraft operators, manufacturers, and government agencies have worked hard to find acceptable technologies to inspect the newer generation aircraft and ensure a level of safety for passengers and cargo flying in countries around the world.

One of the companies meeting the challenge of inspecting the newest generation of aircraft is iPhoton Solutions of Fort Worth, Texas. iPhoton has developed and delivered new technology for inspecting today’s high tech aircraft structures.

Figure 1. iPhoton’s Articulated Beam Delivery System includes a six-axis robot mounted on a linear rail. The system is capable of reaching the top of an airliner to check the fuselage and wings. Notice the test stand, which stimulates a composite aircraft fuselage.
iPhoton’s system checks the quality and size of the laser beams before inspecting aircraft parts. So we used the Spiricon Pyrocam III camera and BeamGage Professional beam profiling software to begin our evaluation. Knowing the accurate beam size and quality before they start helps ensure accurate measurements throughout the inspection process.

Here is a summary of iPhoton’s technology as it puts lasers to work inspecting aircraft.

**iPLUS**

iPhoton uses their iPLUS™, a laser-based ultrasonic technology, to inspect polymer-matrix composites. iPLUS incorporates a short-pulse CO₂ laser to generate ultrasound by thermal expansion in the composite. A second laser is coupled to an interferometer to detect the resulting pulse echo ultrasonic signals.

With iPLUS technology, the composite part is the source of the ultrasonic wave. Therefore, with angles of incidence as high as 45-degrees, the ultrasonic wave is launched inside the composite normal to the part surface. The ensuing ultrasonic signals are interpreted exactly like those obtained using conventional piezoelectric transducers.

iPLUS is designed for flexibility and can inspect a wide array of parts ranging from simple flat parts to the most complex within minutes. iPLUS is beneficial for highly complex parts such as double curvature fuselage structures, stringers, and tight-radius parts.
Figure 3. This BeamGage Pro image shows the interference fringes caused by reflections of two optical surfaces. We were able to correct this quickly.
Figures 4 and 5. Two examples of BeamGage images. The top image indicated there was a focus issue and the bottom indicated misalignment. Having a 12 mm square array was helpful with this large beam size. We were able to adjust focus and alignment based on the information provided in these images.

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