

## Thick Section Composite Oblique Ultrasonics

### Problem:

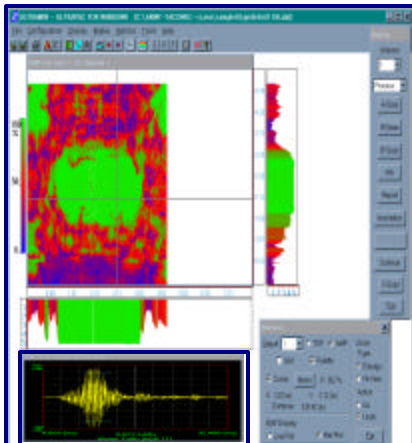
Multi-layer composite structural elements have many advantages over comparable metal designs. Among these are a very high stiffness to weight ratio, strength vs. weight and resistance to corrosion. However, in order to realize these benefits, the layers that make up the composite structure must be fully bonded to each other during the original manufacturing or any subsequent repair process.

To determine the quality (integrity) of a bonded structure, inspection techniques have been developed which include various forms of ultrasonic technology. However, due to the nature of the material – including the bonding process itself – these techniques require sophisticated or highly specialized test set-ups that are typically available only in large laboratories or production facilities – thus are usually not available in portable, field-oriented environments, particularly after the original manufacturing process or during subsequent repair or maintenance operations.

### Solution:

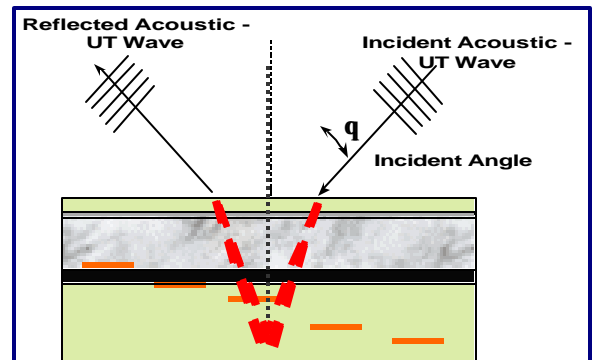
An oblique incidence angle, low frequency Guided Wave Acousto-Ultrasonic technique (named **Thick Section Composite Oblique UT – TSCOUT** – *as a function of its application*) has been demonstrated to be capable of penetrating through the different layers of thick section multi-layered composites and has been used to detect the presence of primary defects. These defects have included delaminations in the composite supporting layer, disbonds between embedded elastomer layers and ceramic tiles and also disbonds between elastomer layers and supporting composite layers.

The **TSCOUT** imaging technique has been configured as a low cost, portable inspection system designed primarily for the field inspection of complex, thick-section composite structures.



*Representative TSCOUT inspection (C-Scan image) showing delamination (green) in thick section composite.*

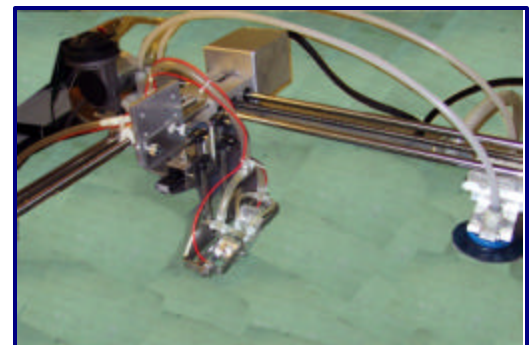
aircraft component inspection for military and commercial aircraft. The technology and scanning systems developed are particularly applicable where other technologies cannot be effectively utilized, such as thick section composites *from one side* in aircraft fuselage, wings and tail sections, helicopter composite rotor blades and Navy ship hull structures, FRP (high-pressure gas) bottles and multi-layer composite (e.g. de-icing) blankets.



*The TSCOUT uses oblique angle, pulse-echo, ultrasonic techniques to scan a thick-section composite with access from one side only.*

As implemented, the system's key features include: a multi-sensor probe (can be reduced to a single probe, for portability), a proprietary "Arbitrary Waveform Generator" (AWG) board, a multi-channel Digital Signal Processing (DiSP) board, a computer controlled portable scanning bridge (other scanners, including manual versions are available) and a Windows-based Ultrasonic data collection, analysis and reporting control program (UltraWin<sup>TM</sup>).

Applications for this field-oriented, portable inspection technology include many critical composite structures, such as



*View of portable scanning system with dual-sensor head inspecting composite panel.*