Technology FAQ

Comparing the OTS-1000 to Ultrasonic Testing (UT)

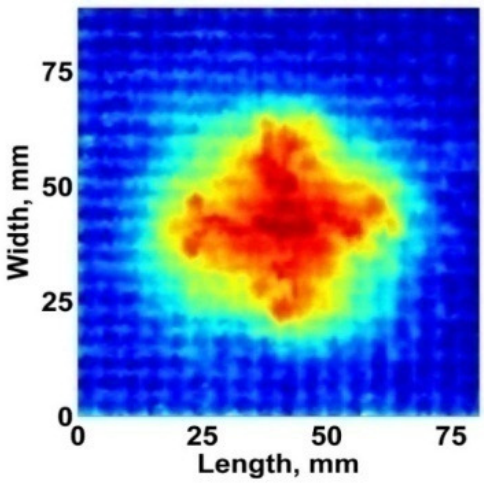
Overview

Optical Transmission Scanning (OTS) is based on transmission measurements made using ultraviolet (UV), visible (VIS) or near Infrared (NIR) light sources. OTS techniques originated in lab environments as an alternative to ultrasound testing (UT) for non-destructive testing (NDT) of fiberglass composites. The principles, validation, and comparison with conventional NDT techniques are published in several peer-reviewed publications.

Although OTS can be treated as radiography or through-transmission UT using the light instead of X-ray radiation or sound waves, respectively, it is less intrusive than radiography and less affected by UT air/material interfaces.

For flat composite samples, a two axis flat scanner system is simple and cost effective. Implementing OTS for more complex structures will involve more costly robotics, however the core technology is expected to produce the same high resolution measurements.

OTS is useful over a broad range of composite material and while it has many advantages over legacy technologies, it is limited in two areas by its core principles. The first limitation is that both sides of a sample must be available; one to the optical source and one to the sensor. Secondly, the sample must be semi-transparent to the source (not necessarily in the visible range).



Repeated impact damage to GFRP is shown to be distributed quasi-uniformly in the circumferential direction.

Basics of Ultrasonic Testing Systems

Ultrasonic Testing (UT) systems are widely used to detect flaws and dimensions in material and the small, hand held products are reasonably economical. Typical UT inspection systems include pulsers/receivers, transducers, and display devices. High voltage pulses drive the transducers to generate sound waves. The resultant sonic energy propagates through the materials and is received by UT detectors. Discontinuities (such as a crack) in the wave path appear as anomalies on display systems.

Features of UT based NDT systems include:

- Only single-sided sample access is needed (when the pulse-echo technique is used).
- Sensitivity to both surface and subsurface discontinuities.
- Determination of reflector position, size and shape of DUT.

Problems with Ultrasonic Systems

The relatively long sonic waves, compared to laser wavelengths, lack the high resolution characteristic of laser based or X-ray based analysis systems. Secondly, surfaces must be accessible to receive the sonic waves and normally closely coupled to the transducer using a gel or aqueous couplant. Additionally, skill and training means that only well qualified or experienced operators can perform NDT.

Gross defects such as cracks can be detected but more subtle issues, such as lack of homogeneity are

difficult to inspect. In particular, linear defects oriented parallel to the sound beam may go undetected. Finally, reference standards are required for both equipment calibration and the characterization of flaws.

Quick Review: Nine Advantages of OTS over Ultrasonic Systems for NDT.

1. **Contact:** UT requires a coupling material, such as gel or water. The OTS is non-contact and air-coupled and requires no couplants.
2. **Resolution:** A high resolution laser, provides at least 10× better lateral resolution, typically 100 µm versus 1-2 mm.
3. **Faster Scan Speed:** OTS can scan up to 200 mm/s.
4. **No Shadowing:** OTS can detect multiple internal cracks on top of each other that are invisible to UT.
5. **Air Voids and Gaps:** As little as 5% material porosity greatly reduces the depth of penetration for UT.
6. **Filler distribution:** OTS measures optical density and provides clearer pictures of quasi-isotropic material such as chopped fiber composites.
7. **Cost:** One can expect an OTS system to be less than 50% of the cost of an equivalent UT system.
8. **Epoxy Mixing Ratio and Composite Curing Quality:** The mixing ratio of epoxy resin as well as curing quality of composites can be estimated based on the characteristic line absorption.
9. **Coatings:** The high resolution OTS can analyze coatings as well as structures.

See the OTS-1000 at CAMX 2018
October 16-18
Kay Bailey Hutchinson Convention Center
Dallas, Texas

"We'll be in booth L-85"