

UT Imaging Application: Complex Contour Fan Blade Bondline

Application Background

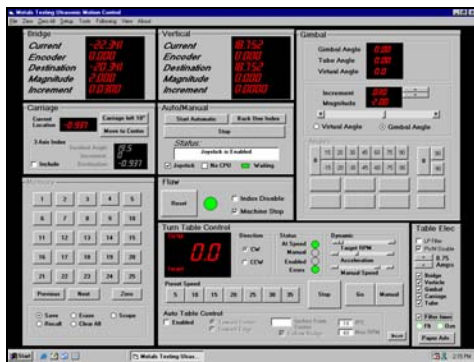
In the interest of weight reduction, internals of advanced aircraft blades are machined out. This is accomplished by manufacturing the blade in parts, followed by bonding the pieces together to form a single blade. Due to this sequence of manufacture, testing of the resultant bondline is critical to the integrity of the blade.

Material bondlines are routinely inspected by ultrasonics (UT). Advanced fan blades (AFB), however, provide a unique inspection challenge due to complex geometries. While the internal bondline is flat, the outer surface is a typical airfoil shape that varies in all directions. The net result is that the bondline can only be successfully inspected by a UT system capable of complex contour following.



Advanced fan blade in immersion tank - note the beginning of complex geometry at the blade's root stock

Such a system was created at Metals Testing Company (MTC) through the combination of an advanced Westinghouse IntraSpect™ C-Scan data acquisition system, and an internally developed motion control subsystem.



MTC's Motion Control User Interface Display

The MTC motion control system is capable of following the outer shape of the AFB in a manner to create a resultant zero degree UT beam at the flat internal bondline.

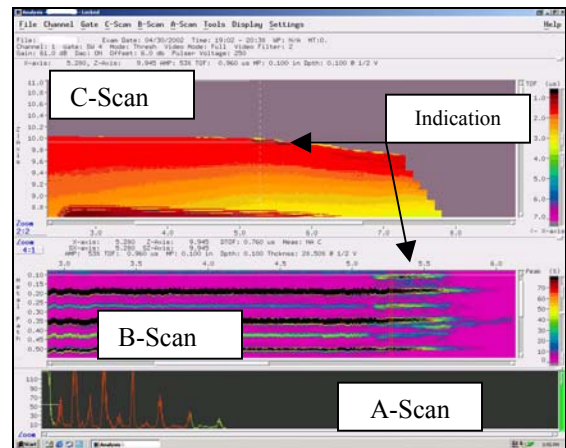
Inspection Results

The MTC system is routinely used to inspect both commercial and military advanced fan blades. The inspections can be done in two ways: collecting only Amplitude and Time-of-Flight (TOF), or collecting full RF waveforms. The latter allows significant post processing data analysis to be performed at any future time.



Example of advanced fan blade bondline C-Scan (i.e., top view)

The above image is a time-of-flight (TOF) thickness C-Scan that clearly shows some of the geometry of the AFB near its machined out areas. From the same data file, an amplitude based C-Scan image can also be viewed.



Example of an indication via RF data

When RF data is collected, additional information is available to further evaluate any indications that may arise. The above image provides a B-Scan cross sectional view of an indication detected in the zoomed C-Scan. The raw RF waveform is shown on the bottom of the image and is referred to as the A-Scan view. The indication and its multiple echoes are clearly seen in the B-Scan.

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