

which measures the thickness of liquid shim material applied to composite surfaces. Liquid shim, which is a low dielectric material, is applied to spar cap surfaces in order to maintain wing skin mold-line tolerances while reducing stresses at the location of fastener holes. For this application, the thickness of the shim material must be controlled within specific limits. Microwave reflection techniques provide an alternative nondestructive approach to liquid shim thickness measurements.

54380 *Edwards, J.; Zoughi, R.*

**Microwave sensitivity maximization of disbond characterization in conductor backed dielectric composites**

*Journal of Nondestructive Evaluation*, Vol. 12, No. 3, pp. 193-198 (Sep. 1993)

A swept frequency microwave nondestructive technique for detection of disbond in a dielectric composite backed by a conducting plate is discussed. The theoretical development is based on an incident plane wave illuminating such a medium, and then formulating the characteristics of the reflected wave. This way the effective reflection coefficient of the medium is found. The phase of this reflection coefficient changes in the presence of a disbonded medium. With the determination of an optimally sensitive frequency range using the theoretical model and the known properties of the composite dielectric material, it is shown that disbands on the order of a few microns can be accurately detected at relatively low microwave frequencies.

54123 *Borul'ko, V.F.; Vasil'ev, A.B.; Drobakhin, O.O.; D'yakonova, O.A.; Lebedeva, M.I.*

**RIMCh-03 measuring and computing complex for multifrequency radio-wave nondestructive inspection**

*Russian Journal of Nondestructive Testing*, Vol. 29, No. 4, pp. 290-294 (Dec. 1993)

A multifrequency measuring and calculating complex of the 8-mm range of electromagnetic waves with synthesis of time signal, making it possible to inspect the parameters of layers of layered dielectric structures differing in speed from measuring and calculating complexes of the indicated class, is described.

53873 *Basart, J.P.; Zhang, Z.*

**Experiments with double microwave apertures**

*Review of Progress in Quantitative Nondestructive Evaluation*, La Jolla, California (United States), 19-24 Jul. 1992. Vol. 12A, pp. 655-662. Edited by D.O. Thompson and D.E. Chimenti, Plenum Press (1993). ISBN 0-306-44483-6.

In NDE we are concerned with the linear resolution which we define as the product of the angular resolution and the range from the array phase center to the object of interest. For objects images in the far field of the array, the angular resolution is inversely proportional to the largest size of the array. We have conducted a series of experiments to study the practical and mathematical aspects of resolution when the object of interest is physically near the microwave apertures.

53654 *Smartt, H.B.; Johnson, J.A.; Einerson, C.J.*

**The role of intelligent systems in weld process control**

*Materials Evaluation*, Vol. 51, No. 10, pp. 1166-1173 (Oct. 1993)

Methods of incorporating intelligent systems, such as fuzzy expert systems and artificial neural networks, into control systems are discussed along with standard classical and modern control theory. The methods of intelligent systems such as neural networks and fuzzy systems are often means of generating an input-output mapping function. An example of an intelligent control system employs both fuzzy logic and a neural network to control heat input and mass input in gas metal arc welding (GMAW). Two cameras are used to measure the area of the joint to be filled and the temperature gradient in the solidified weld metal. This information is processed by a fuzzy logic system to determine the required mass to fill the joint and the heat input to the weld to maintain a specified cooling rate. This information is processed by a neural network which maps this to the welding parameters, travel speed and electrode speed. Hardware actuators on the weld machine then implement the required values.

53395 *Edward, J.*

**Microwave pulse-echo radar imaging for the nondestructive evaluation of civil structures**

*Dissertation Abstracts International*, Vol. 54, No. 1, p. 413-B (Jul. 1993) (DA 9314912)

We present an image reconstruction algorithm for impulse radar operating in monostatic pulse-echo mode. The algorithm is based upon holographic imaging techniques and uses coherent backward propagations of the received reflected wavefield to form a spatial image of the scattering interfaces within the region of interest. We apply the algorithm to both simulated and experimental data and demonstrate its usefulness in

nondestructively evaluating civil structures. The results exhibit resolution limits on the same order of magnitude as theoretical resolution limits.

53131 *Bungey, J.H.; Millard, S.G.*

**Radar inspection of structures**

*Proceedings of the Institution of Civil Engineers (Structures & Buildings)*, Vol. 99, No. 2, pp. 173-186 (May 1993)

Investigation of the structural details and of the integrity of both concrete and masonry structures is described. Features of currently available equipment are described, with particular emphasis on the factors that influence reproducibility and interpretation of results, including the use of colour displays and computerized signal enhancement procedures. Advantages and limitations of the technique are examined critically, and areas for future study and development are identified.

52896 *Rudakov, V.N.; Ganibalov, A.A.; Kreps, G.R.*

**Nondestructive radiowave inspection utilising waveguide properties of components**

*Technical Diagnostics and Nondestructive Testing*, Vol. 4, No. 4, pp. 271-273 (1992)

The authors examine a method of nondestructive radio-wave inspection of structures made of non-metals and dielectric coatings or layers on metal. The method utilises the waveguide properties of the dielectric layers to detect defects of the heterogeneity or air hole type. Conditions are selected for effective detection of defects and an example of an automated inspection system using a microcomputer is described.

52891 *Ambrosio, G.; Massa, R.; Migliore, M.D.; Ciliberto, A.; Sabatino, C.*

**Microwave based and microwave aided non destructive test methods**

*Microwave Processing of Materials III*, San Francisco, California (United States), Apr. 27-May 1. 1992. pp. 497-502. Edited by R.L. Beatty, W.H. Sutton and M.F. Iskander. MRS. Vol. 269 (1992)

The reflection coefficient of Fiberglass/Kevlar slabs, including a layer of a different material was calculated as a function of permittivities, thicknesses, defect depth, and microwave frequency. Experimental tests were done with a single-frequency, amplitude and phase sensitive circuit, and with a swept-frequency amplitude only sensitive set-up. In this latter case a suitable processing of data allowed effective and fast defect detection. First experiments on microwave heating for thermographic NDT were also performed.

52890 *Bolomey, J.C.; Pichot, C.*

**Microwave imaging techniques for non-destructive testing of materials**

*Microwave Processing of Materials III*, San Francisco, California (United States), Apr. 27-May 1. 1992. pp. 479-489. Edited by R.L. Beatty, W.H. Sutton and M.F. Iskander. MRS. Vol. 269 (1992)

Recent technological advances for microwave multiport sensors lead us to look for efficient wavefront processing techniques in order to improve image quality, in terms of spatial resolution and contrast.

52621 *Kawabe, H.; Natsume, Y.; Higo, Y.; Nunomura, S.*

**Nondestructive evaluation of crazes and microcracks on polymers by the elastic-wave transfer function method**

*Journal of Materials Science*, Vol. 28, No. 12, pp. 3197-3204 (15 Jun. 1993)

The precise study of the relation between microdefects such as crazes or microcracks and the elastic-wave transfer function method (ETFuM) was conducted in acrylonitrile butadiene styrene and acetal homopolymer. The ETFuM is the method of comparing the input elastic wave and the output wave from the specimens, and separating and analysing only the information on the object condition in the specimen from the transfer function in the frequency domain. In order to investigate the formation of crazes or microcracks caused by tensile deformation, transmission electron microscopy and polarization microscopy was used. The variation of transfer function before/after annealing indicated the dependence on the nucleation and growth of crazes or microcracks.

52619 *Bakhtiari, S.; Ganchev, S.I.; Zoughi, R.*

**Microwave swept-frequency optimization for accurate thickness or dielectric property monitoring of conductor-backed composites**

*Materials Evaluation*, Vol. 51, No. 6, pp. 740-743, 748 (Jun. 1993)

A microwave swept-frequency approach is discussed for accurate measurement of thickness and dielectric properties of a conductor-backed dielectric composite. This technique illustrates the importance of frequency