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A Review on Recent Trends in Non Destructive Testing Applications

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Abstract : *The field of NDT is a very large and interdisciplinary field that plays a critical role in inspection of crucial component. These test may fail due to either the fault in the equipment used, the miss application of the methods or the However, these techniques generally require considerable operator skill and interpreting test results. This paper presents the reviews of different works in the area of NDT and tries to find out recent and trends available in industries and other fields in order to minimize the total equipment cost, minimize damages and maximize the safety of machines, structures and materials.*

Keyword – *NDT, Recent Trends in inspection, Multidisciplinary field*

I. INTRODUCTION

Non-destructive testing techniques typically use a probing energy form to determine material properties or to indicate the presence of material discontinuities (surface, internal or concealed).” The application of physical principles for detecting in homogeneities in materials without impairing the usefulness of the materials has brought into being a technique known as “non-destructive testing”. Actually, the methods and techniques used in NDT measure physical properties or non-uniformity in physical properties of materials as well. Variations or non uniformities in physical properties may or may not affect the usefulness of a material, depending upon the particular application under consideration. Non destructive testing is the testing of materials, for surface or internal flaws or metallurgical condition, without interfering in any way with the integrity of the material or its suitability for service.

The common NDT methods are:

1. Visual and optical Testing
2. Ultrasonic Testing
3. Electromagnetic Testing
4. Thermographic Testing
5. Radiographic Testing
6. Liquid Penetrant Testing
7. Magnetic particle Testing
8. Acoustic Emission testing
9. Magnetic Resonance Imaging Testing
10. Near-Infrared Spectroscopy
11. Optical Microscope Testing

II. OBJECTIVES

1. Providing better quality of products.
2. Reducing costs and increasing production.
3. Detection of unwanted failures in the very beginning phase.
4. Providing the ability to inspect the equipments in operational state.
5. Reaching to higher levels of reliability.
6. Gaining consumer satisfaction.
7. Avoiding or reducing downtime and wastage of material.
8. Thickness measurements.
9. Evaluation of surface characteristics.

III. LITERATURE SURVEY

M.D. Beard et al [1] are aimed at the development of a portable non-destructive testing instrument for evaluating the condition of rock bolts. In applications such as coal mine roof reinforcement, the opportunities for rock bolt inspection are currently limited to destructive techniques such as the pull-out test.

Carosena Meola et al [2] study was focused on the aid provided by lock-in thermography for non-destructive evaluation of aerospace materials and structures. The experimental analysis was performed by testing several specimens, which were made of different materials employed in the fabrication of aircraft (composites, hybrid composites, sandwiches, metals) and which included the most commonly encountered kinds of damage (delamination, impact damage, fatigue failure.

The optimum elements of the suitably defined matrices of the magnetic variables, based on the measurement of families of minor hysteresis loops, are more sensitive than any of the traditional parameters obtained from the saturation-to-saturation loop [4]. In order to get the optimum elements, the samples do not have to be measured up to their saturation value, but to a pre-determined lower magnetization value onl The development of non-destructive techniques (NDT) techniques for the in-service inspection of railroad wheels and gauge corners was the main activity of the NDT division.

Firstly the inspection of the wheels rim and disk should be carried out without dismantling the wheels and using ultrasonic techniques [5]. On the other hand, the inspection of the railroad track surface at a train speed of about 70 km/h should be guaranteed using eddy current techniques.

Thermal non-destructive testing (NDT) is commonly used for assessing aircraft composites. In this work, certain applications of transient thermal NDT relating to the assessment of aircraft composites are presented by N.P. Avdelid et al [6]. Real-time monitoring of all features was obtained using pulsed thermography. However, in the composite repairs cases thermal modelling and pulsed-phase thermography were also used with the intention of providing supplementary results.

Pulsed eddy current techniques, which are believed to be potentially rich of information, are also sensitive to the effect. Gui Yun Tian et al[7] gives an approach using normalisation and two reference signals to reduce the lift-off problem with pulsed eddy current techniques is proposed. The technique can also be applied for measurement of metal thickness beneath non-conductive coatings, microstructure, strain/stress measurement, where the output is sensitive to the lift-off effect.

C. Hakan Gur et al. [8] investigate the effect of quenching and tempering on sound velocity of steels, and to contribute to the non destructive control and optimisation of the quenching/tempering systems. Microstructures of the samples were characterised by metallographic examinations and hardness measurements. The reference values were obtained for as-quenched and tempered structures by measuring sound velocities for both longitudinal and transversal waves.

Impulse-thermography is well suited for the detection of voids and honeycombing in concrete up to concrete covers of 10 cm and more [9]. For quantitative analysis, a computer program for numerical simulation of the heating up and cooling down processes was developed based on Finite Differences. With this program parameter studies have been performed for investigating the influence of environmental conditions, material parameters and geometry on the thermal behaviour.

Yi-mei Mao et al [10] gives a detection technique for locating and determining the extent of defects and cracks in oil pipelines based on Hilbert-Huang time-frequency analysis is proposed. The ultrasonic signals reflected from defect-free pipelines and from pipelines with defects were processed using Hilbert-Huang transform, a recently developed signal processing technique based on direct extraction of the energy associated with the intrinsic time scales in the signal.

A non-destructive method is described by Gary S. Schajer et al [11] to estimate fibber (grain) direction, moisture density, and dry density of an orthotropic material such as wood, from measurements of the complex attenuation of microwaves transmitted through the material. The complex attenuation in an orthotropic material has a tensor character, similar to other tensor quantities such as stress and strain.

Allen G. Davis et al [12] describes the use of non-destructive testing to examine the efficiency of tunnel lining grouting programmes, with particular emphasis on results obtained by the impulse response and impulse radar methods.

K. Kosmas et al [13] presents a laboratory developed Hall sensor for non-destructive testing of ferromagnetic surfaces, based on magnetic anomaly detection phenomena. The principle of operation is based on the detection of the magnetic flux leakage in the dimensional boundaries of a gap.

Bruce W. et al [14] bring together the most relevant published work on arrays for non-destructive evaluation applications, comment on the state-of the art and discuss future directions. There is also a significant body of published literature referring to use of arrays in the medical and sonar fields and the most relevant papers from these related areas are also reviewed.

Impulse-thermography is an active method for quantitative investigations of the near surface region of various structures [15]. It has recently been applied and optimised to applications in civil engineering. By using either an internal or external heat source, parts of the structure under investigation are heated up and the transient heat flux is observed by recording the temperature change at the surface as a function of time.

IV. CONCLUSION

The ultrasonic inspection can be considered an effective method of checking the common defects and damages in composites.

1. AET as a NDT tool will make an important contribution to increased security for pressure vessels and better protection against environmental pollution.
2. Pulse thermography is easy and fast to use for information about the state of the art treasures, but data may be affected by non-uniform heating and local variation of thermal emission.
3. NDT is essential in the inspection of alteration, repair and new construction in construction industry and Spectral analysis of surface waves (SASW) in concrete structures is widely used.
4. In the composite repairs cases thermal modelling and pulsed-phase thermography werealso used, whilst in the case of through skin imaging thermal modelling was also used in order to demonstrate the importance of thermal contact resistance between two surfaces (skin and strut).
5. Lock in Thermography is a more powerful technique to detect impact damage and that transient thermography is more suitable for detecting inclusions.

A detection technique for locating and determining the extent of defects and cracks in oil pipelines based on Hilbert-Huang time-frequency analysis is proposed.

V. REFERENCES

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