

CHAPTER X

ACTIVE INFRARED THERMOGRAPHY TECHNIQUES FOR THE NONDESTRUCTIVE TESTING OF MATERIALS

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Active infrared thermography refers to the group of methods employed to inspect the integrity of materials or systems through the use of an external energy source and an infrared detector. The external stimulus can be of many forms such as warm or cold air, heat pulses, periodic thermal waves, or mechanical oscillations, e.g. ultrasounds. The way data is captured and processed, as well as the typical applications, differ according to the excitation source. This chapter presents a review of three of the most common active techniques in the field of thermography: pulsed thermography, lock-in thermography and vibrothermography.

1. Introduction

Infrared (IR) thermography is a nondestructive testing (NDT) technique, *i.e.* an inspection method for the examination of a part, material or system without impairing its future usefulness [1]. When compared with other classical NDT techniques such as C-Scan ultrasonics or X-Rays, data acquisition by infrared thermography is safe, nonintrusive and noncontact, allowing the detection of relatively shallow subsurface defects (a few millimeters in depth) under large surfaces (typically 30x30 cm² at once, although inspection of larger surfaces is possible) and in a fast manner (from a fraction of a second to a few minutes depending in the configuration, see below). Any object above the absolute zero temperature will emit IR radiation. Infrared radiation corresponds to the band of the electromagnetic

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Ultrasonic and Advanced Methods for Nondestructive Testing and Material Characterization Chi-hau Chen, 2007

Ultrasonic methods have been very popular in nondestructive testing and characterization of materials. This book deals with both industrial ultrasound and medical ultrasound. The advantages of ultrasound include flexibility, low cost, in-line operation, and providing data in both signal and image formats for further analysis. The book devotes 11 chapters to ultrasonic methods. However, ultrasonic methods can be much less effective with some applications. So the book also has 14 chapters catering to other or advanced methods for nondestructive testing or material characterization. Topics like structural health monitoring, Terahertz methods, X-ray, and thermography methods are presented. Besides different sensors for nondestructive testing, the book places much emphasis on signal, image processing, and pattern recognition of the signals acquired. **Integrated**

Imaging and Vision Techniques for Industrial Inspection Zheng Liu, Hiroyuki Ukida, Pradeep Ramuhalli, Kurt

Niel, 2015-09-24. This pioneering text reference presents a detailed focus on the use of machine vision techniques in industrial inspection applications. An internationally renowned selection of experts provide insights on a range of inspection tasks drawn from their cutting edge work in academia and industry covering practical issues of vision system integration for real world applications. Topics and features presents a comprehensive review of state of the art hardware and software tools for machine vision and the evolution of algorithms for industrial inspection includes in depth descriptions of advanced inspection methodologies and machine vision technologies for specific needs. Discusses the latest developments and future trends in imaging and vision techniques for industrial inspection tasks provides a focus on imaging and vision system integration implementation and optimization describes the pitfalls and barriers to developing successful inspection systems for smooth and efficient manufacturing process. *Spectroscopy of Polymer Nanocomposites* Sabu Thomas, Didier Rouxel, Deepalekshmi

Ponnamma, 2016-02-16. *Spectroscopy of Polymer Nanocomposites* covers all aspects of the spectroscopic characterization of polymer nanocomposites. More than 25 spectroscopy characterization techniques almost all used in materials science are treated in the book with discussion of their potentialities and limitations. By comparing the techniques with each other and presenting the techniques together with their specific application areas, the book provides scientists and engineers the information needed for solving specific problems and choosing the right technique for analyzing the material structure. From this, the dispersion structure of fillers, property relations, and filler-polymer interactions can be determined, and ultimately the right materials can be chosen for the right applications. Besides the techniques and structure-property relations aspects covered include phase segregation of filler particles, filler agglomeration and deagglomeration, filler dispersion, filler-polymer interactions, surfaces and interfaces. The book also examines recent developments as well as unresolved issues and new challenges in the characterization of surfaces and interfaces in polymer nanocomposites. This handpicked selection of topics and the combined expertise of contributors from industry, academia, government, and private research organizations across

the globe make this survey an outstanding reference source for anyone involved in the field of polymer nanocomposites in academia or industry Provides comprehensive coverage of spectroscopy techniques for analyzing polymer nanocomposites Enables researchers and engineers to choose the right technique and make better materials decisions in research and a range of industries Presents the fundamentals information on structure property relations and all other aspects relevant for understanding spectroscopic analyses of nanoreinforced polymers and their applications

Theory and Practice of Infrared Technology for Nondestructive Testing Xavier Maldague,2001-04-30 The book includes fundamental concepts of theory instrumentation and experimental practice as well as practical applications An important chapter setting the book apart from other publications describes the properties of materials and presents case studies from industry In addition a program called IRNDT accompanies the book and is available on the Wiley ftp site The program includes an image bank that can be used to test the principles covered in the book All chapters end with summaries problems and questions Authored by an acknowledged expert in the field Material draws on case studies to illustrate major points

Materials Evaluation,2003 **Thermosense XVII** Sharon A. Semanovich,1995 Diagnostic Imaging Technologies and Industrial Applications Jorma Lammasniemi,1999 *Optical Techniques for Industrial Inspection, 4-6 June 1986, Québec City, Canada* Society of Photo-optical Instrumentation Engineers,National Research Council Canada,Société inter-port de Québec,1986 *Thermosense ...* ,2003 Multispectral and Hyperspectral Image Acquisition and Processing Qingxi Tong,Yaoting Zhu,Zhenfu Zhu,2001 Photography by Infrared Henry Louis Gibson,1978 *Oceanic Abstracts* ,1993-06 **A Handbook of Information Technology** Bubu Bhuyan,2007 This handbook on information technology aims to bring together views of professors industry experts researchers and student learners from across all barriers to a common platform for the discussion and propagation of knowledge on the latest breakthroughs in the fields of information technology New Concepts in Craniomandibular and Chronic Pain Management Harold Gelb,1994 This book presents the views of clinicians and researchers in this field with a new look at the posture maintenance problem The material presented should aid in the understanding and effective treatment of the chronic pain patient Topics covered include principles and determinants of the process of body use diagnosis and treatment of muscle pain scoliosis evaluation and documentation with computerized infrared thermography and restoration of abnormal upper quarter posture

Government Reports Announcements & Index,1992 **Thermosense XIII** George S. Baird,1991 Session 1 Predictive Maintenance reports on the cumulative effects of years of work Session 2 Buildings and Structures reports on new developments in another long standing application Session 3 Products and Processes presents a variety of instrument performance criteria and applications in quality and process control Session 4 Materials reflects the fastest growth area and Session 5 Research reports on new developments *Transactions of the American Society of Civil Engineers* American Society of Civil Engineers,1998 Vols 29 30 include papers of the International Engineering Congress Chicago 1893 v 54 includes papers of the International

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