

Mathematical Modelling of Ultrasonic Non-Destructive Evaluation†

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Abstract. High-frequency asymptotics have been used at our Centre to develop codes for modelling pulse propagation and scattering in the near-field of the ultrasonic transducers used in NDE (Non-Destructive Evaluation), particularly of walls of nuclear reactors. The codes are hundreds of times faster than the direct numerical codes but no less accurate.

1. Introduction

Our Centre specialises in mathematical modelling of NDE based on high-frequency asymptotics. We have been the first^{1–3} to produce the complete asymptotic description of the time-harmonic near field of a circular compressional transducer which is directly coupled to isotropic solid, both its geometrical regions and boundary layers in between the geometrical regions (see Fig. 1). Pulse propagation, rectangular transducers and transducers of complex apodisation have been also modelled using this approach^{4–6}. The crux of the method is approximation of integrals containing an exponential factor, such that when observation point moves across the near field, the factor undergoes many oscillations while the amplitudes varies slowly. The main contributions to the integrals of this type come from the critical points: singularities of the amplitude, PSP (the stationary points

† Due to space limitation this article was omitted from the previous special issue on McNabb Symposium.

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Mathematical Modelling In Non Destructive Testing

**Abul Hasan Siddiqi, Pammy
Manchanda, Rashmi Bhardwaj**



Mathematical Modelling In Non Destructive Testing:

Mathematical Modelling in Non-destructive Testing Michael Blakemore, George A. Georgiou, 1988 Very Good No Highlights or Markup all pages are intact

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Mathematical Models, Methods and Applications Abul Hasan Siddiqi, Pammy Manchanda, Rashmi Bhardwaj, 2015-12-14 The present volume contains invited talks of 11th biennial conference on Emerging Mathematical Methods Models and Algorithms for Science and Technology The main message of the book is that mathematics has a great potential to analyse and understand the challenging problems of nanotechnology biotechnology medical science oil industry and financial technology The book highlights all the features and main theme discussed in the conference All contributing authors are eminent academicians scientists researchers and scholars in their respective fields hailing from around the world

Mathematical Modelling of Weld Phenomena: No. 5 H. Cerjak, 2024-12-20 Contains the papers presented at the fourth International Seminar Numerical Analysis of Weldability held in September 1997 at Schloss Seggau near Graz Austria

Overview of Mathematical Modeling in Nondestructive Evaluation (NDE) John C. Aldrin, 2001-11 This report presents a broad overview of mathematical modeling in nondestructive evaluation NDE The primary emphasis is to expand the review of NDE modeling literature covered by previous general works To provide a starting point for researchers and engineers the discussions and references include multiple modeling approaches analytical asymptotic and numerical for a variety of NDE techniques A second emphasis for this report is to present the pertinent modeling software packages for a variety of NDE techniques Overviews of modeling for four NDE techniques ultrasonic testing eddy current testing radiography and thermography are presented In order to present the broad subject of NDE modeling for this report the discussions of modeling research and software packages are limited in scope however numerous references are provided in each section for further study by the reader Given the inherent depth and importance of the field special emphasis is given to ultrasonic NDE Discussions are presented on the generation of ultrasound wave propagation in elastic solids scattering from cracks and waves in guides and at interfaces

British Journal of Non-destructive Testing, 1994

Handbook of Mathematical Models and Algorithms in Computer Vision and Imaging Ke Chen, Carola-Bibiane Schönlieb, Xue-Cheng Tai, Laurent Younes, 2023-02-24 This handbook gathers together the state of the art on mathematical models and algorithms for imaging and vision Its emphasis lies on rigorous mathematical methods which represent the optimal solutions to a class of imaging and vision problems and on effective algorithms which are necessary for the methods to be translated to practical use in various applications Viewing discrete images as data sampled from functional surfaces enables the use of advanced tools from calculus functions and calculus of variations and nonlinear optimization and provides the basis of high resolution imaging through geometry and variational models Besides optimization naturally connects traditional model driven

approaches to the emerging data driven approaches of machine and deep learning No other framework can provide comparable accuracy and precision to imaging and vision Written by leading researchers in imaging and vision the chapters in this handbook all start with gentle introductions which make this work accessible to graduate students For newcomers to the field the book provides a comprehensive and fast track introduction to the content to save time and get on with tackling new and emerging challenges For researchers exposure to the state of the art of research works leads to an overall view of the entire field so as to guide new research directions and avoid pitfalls in moving the field forward and looking into the next decades of imaging and information services This work can greatly benefit graduate students researchers and practitioners in imaging and vision applied mathematicians medical imagers engineers and computer scientists

Improving the Effectiveness and Reliability of Non-Destructive Testing W.E. Gardner,2013-10-22 This book is concerned with the two most important aspects of the use of non destructive testing Firstly the effectiveness of procedures to detect and size the defects present irrespective of the geometry materials involved or environment Secondly the reliability of instrumentation and personnel to perform the specified procedures Validation and certification techniques required for the justification of safe operation of a plant are also discussed Experts in industries where safety and defect detection are of paramount importance have made valuable contributions drawn from their experience to make this book essential reading for anyone responsible for safety of plant operation Illustrated throughout the book is also of interest to mechanical and structural engineers researchers and inspectors as well as being a useful reference tool for graduate students

Ultrasonic NDT in defect detection Håkan Wirdelius,1995 Barkhausen Noise for Non-destructive Testing and Materials Characterization in Low Carbon Steels Tu Le Manh,Jose Alberto Perez Benitez,Jose Hiram Espina Hernandez,Jose Manuel Hallen,2020-06-11

Barkhausen Noise for Nondestructive Testing and Materials Characterization in Low Carbon Steels presents a balanced approach reviewing the disadvantages and advantages of using this technique and its comparison over other magnetic testing techniques In addition the book looks towards future applications of this technique in particular its industrial applications as a method for pipeline inspection current advantages and barriers to implementation The book is suitable for materials scientists researchers and engineers and may be applicable for those working in metallurgical plants Not only does the book discuss fundamentals it reviews recent discoveries such as the correlation between magnetocrystalline energy and Barkhausen noise the modeling of this relationship and the application of this technique in the characterization of magnetic materials Provides detailed explanation for the stochastic and deterministic characteristics of Barkhausen noise Discusses principles of applying Barkhausen noise as a non destructive method and magnetic material characterization method Reviews the advantages and disadvantages of this non destructive testing technique and compares it to other competitive techniques

Applied Mathematics in Industry Yasmin Águeda Ríos Solís,Giovana Ortigoza Álvarez,Ivete Sánchez Bravo,2026-01-01 This book comes from a mini symposium held at the ICIAM 2023 congress coordinated by Giovana Ortigoza lvarez a

mathematician in Industry Openpay by BBVA Ivete Sanchez Bravo a computational mathematician in Academia focusing on industrial applications Centro de Investigaci n en Matem ticas and Yasm n Ros Sol s a mathematician in Academia Tecnologico de Monterrey The authors then took on the challenge of editing this book Compiling these success stories was not only intellectually rewarding but also immensely enjoyable The chapters within this book highlight the diverse applications of applied mathematics ranging from healthcare and aviation to ecological restoration and logistics Notable contributions include software solutions for temperature distribution Bayesian approaches for quality control and successful industrial problem solving workshops This book also covers green logistics Industry 4 0 developments and urban transportation planning

Non-destructive Testing J. M. Farley, R. W. Nichols, 1988 **Impact of Non-destructive Testing, NDT-89** C. Brook, P. D. Hanstead, 1990 The 28th British Conference on NDT the annual conference of The British Institute of Non Destructive Testing was held in Sheffield UK 18 21 September 1989 Its theme was the impact of NDT and it provided a valuable opportunity for participants to learn of the current developments in the field The formal presentations are recorded in this volume all of the major methods of NDT are detailed with an emphasis on ultrasonics Other topics covered in papers include radiography electronic imaging crack depth measurement concrete and NDT in aircraft The papers combine to present a comprehensive account of the latest literature in the field with an excellent representation of the conference s research sessions Overall the book serves as a valuable record of the conference and provides an insight into recent literary contributions for non attendees

NON DESTRUCTIVE TESTING Danny van Hemelrijck, Athanassios Anastassopoulos, 1996-01-01 Focusing on visual and optical inspection ultrasonics acoustic emission dynamic techniques X ray radiography material characterization industrial applications and qualification programmes this book is intended for engineers and researchers as well as teachers and graduate students

The Bulletin of Mathematics Books , 1992

Elastic Waves and Ultrasonic Nondestructive Evaluation Subhendu K. Datta, J. D. Achenbach, Y. Rajapakse, 1990 During the last decade the emergence of ultrasonic techniques for nondestructive evaluation of materials has provided a strong impetus for the study of propagation and diffraction of elastic waves Elastic wave propagation studies have led to quantitative techniques for evaluation and service life prediction of structures The IUTAM Symposium provided an opportunity for researchers active in the interdisciplinary field of QNDE to assess progress and delineate areas of future research Leading researchers presented state of the art lectures focusing attention on an important technological area in which wave propagation studies have made and will continue to make important contributions toward advancing the technology The volume provides a comprehensive overview on the current state of analytical numerical and experimental techniques as well as outlining future research needs It provides evidence of important advances that have been made in the detailed analysis and experimental verification of ultrasonic scattering by single and multiple defects in isotropic medium

Metals Abstracts , 1997 Technological Forecasting William J. Pananos, 1973 *Nuclear Energy* , 1989 *An*

Introductory Guide to EC Competition Law and Practice Valentine Korah, 1994

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