

Review

A Review of Recent Advances in Unidirectional Ultrasonic Guided Wave Techniques for Nondestructive Testing and Evaluation

Ali Abuassal ¹, Lei Kang ^{1,*} , Lucas Martinho ², Alan Kubrusly ² , Steve Dixon ³, Edward Smart ¹ , Hongjie Ma ¹ and David Sanders ¹

¹ School of Electrical and Mechanical Engineering, University of Portsmouth, Portsmouth PO1 3DJ, UK; ali.abuassal@port.ac.uk (A.A.); edward.smart@port.ac.uk (E.S.); hongjie.ma@port.ac.uk (H.M.); david.sanders@port.ac.uk (D.S.)

² Department of Electrical Engineering, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro 38097, Brazil; lucas.martinho@cpti.cetuc.puc-rio.br (L.M.); alan@cpti.cetuc.puc-rio.br (A.K.)

³ Department of Physics, University of Warwick, Warwick CV4 7AL, UK; s.m.dixon@warwick.ac.uk

* Correspondence: lei.kang@port.ac.uk

Abstract: Unidirectional ultrasonic guided waves (UGWs) play a crucial role in the nondestructive testing and evaluation (NDT&E) domains, offering unique advantages in detecting material defects, evaluating structural integrity, and improving the accuracy of thickness measurements. This review paper thoroughly studies the state of the art of unidirectional UGWs before presenting a comprehensive review of the foundational mathematical principles of unidirectional UGWs, focusing on the recent advancements in their methodologies and applications. This review introduces ultrasonic guided waves and their modes before looking at mode excitability and selectivity, signal excitation, and mechanisms used to generate and receive guided waves unidirectionally. This paper outlines the applications of unidirectional UGWs to reflect their effectiveness, for instance, in measuring thickness and in identifying defects such as cracks and corrosion in pipelines, etc. The paper also studies the challenges associated with unidirectional UGW generation and utilisation, such as multi-mode and side lobes. It includes a review of the literature to mitigate these challenges. Finally, this paper highlights promising future perspectives and develops directions for the technique. This review aims to create a useful resource for researchers and practitioners to comprehend unidirectional ultrasonic guided waves' capabilities, challenges, and prospects in NDT&E applications.

Keywords: ultrasonic guided waves (UGWs); unidirectional UGWs; nondestructive testing and evaluation (NDT&E)



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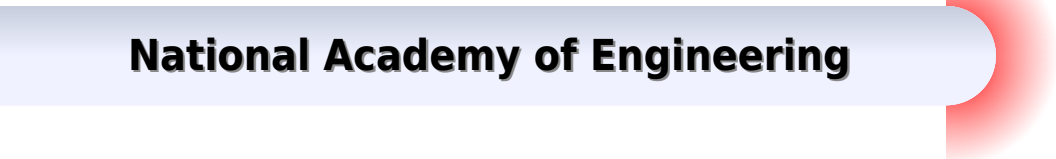
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1. Introduction

Ultrasonic guided waves (UGWs) are mechanical waves propagating along structures, such as pipes, plates, and rods, and are bound by the surfaces or boundaries along which they propagate. Their ability to travel long distances while maintaining sensitivity to defects makes them highly valuable for applications like nondestructive testing and evaluation (NDT&E), structural health monitoring (SHM), and industrial inspection. Guided waves offer advantages over bulk waves because they can propagate through complex geometries and reach areas that would otherwise be inaccessible [1–3]. UGWs propagate as distinct modes with dispersion relationships that depend on the material properties and waveguide geometry of the sample [4–9].

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Recent Advances In Nondestructive Evaluation Techniques For Material Science And Industries Proceedings:

Recent Advances in Nondestructive Evaluation Techniques for Material Science and Industries Chiaki Miyasaka, 2004 **Practical Residual Stress Measurement Methods** Gary S. Schajer, 2013-08-01 An introductory and intermediate level handbook written in pragmatic style to explain residual stresses and to provide straightforward guidance about practical measurement methods Residual stresses play major roles in engineering structures with highly beneficial effects when designed well and catastrophic effects when ignored With ever increasing concern for product performance and reliability there is an urgent need for a renewed assessment of traditional and modern measurement techniques Success critically depends on being able to make the most practical and effective choice of measurement method for a given application Practical Residual Stress Measurement Methods provides the reader with the information needed to understand key residual stress concepts and to make informed technical decisions about optimal choice of measurement technique Each chapter written by invited specialists follows a focused and pragmatic format with subsections describing the measurement principle residual stress evaluation practical measurement procedures example applications references and further reading The chapter authors represent both international academia and industry Each of them brings to their writing substantial hands on experience and expertise in their chosen field Fully illustrated throughout the book provides a much needed practical approach to residual stress measurements The material presented is essential reading for industrial practitioners academic researchers and interested students Key features Presents an overview of the principal residual stress measurement methods both destructive and non destructive with coverage of new techniques and modern enhancements of established techniques Includes stand alone chapters each with its own figures tables and list of references and written by an invited team of international specialists Nondestructive Evaluation of Materials by Infrared Thermography Xavier P.V. Maldague, 2012-12-06 With national trade barriers falling causing the expansion of the competitive global market the question of quality control has become an essential issue for the 1990s The time where the promise was to replace a product if it does not work seems to have passed what is more important now is not so much a reduction in what is going wrong but an increase of what is going right the first time Feigenbaum 1990 This new trend is sometimes referred to as total quality Among the many advantages of this zero defect manufacturing policy we can enumerate Laurin 1990 superior marketability of wholly dependable products enormous gain in productivity elimination of waste full cost in replacing poor quality work and retrofitting rejected products from the field Although total quality is a relatively new and attractive concept for mass products such as cars consumer electronics and personal computers in many fields mainly aerospace and military it has been the rule for years because of security reasons **Advances in Manufacturing and Processing of Materials and Structures** Yoseph Bar-Cohen, 2018-09-03 Advances in Manufacturing and Processing of Materials and Structures cover the latest advances in materials and structures in manufacturing and processing including additive and subtractive processes It s

intended to provide a compiled resource that reviews details of the advances that have been made in recent years in manufacturing and processing of materials and structures A key development incorporated within this book is 3D printing which is being used to produce complex parts including composites with odd shape fibers as well as tissue and body organs This book has been tailored for engineers scientists and practitioners in different fields such as aerospace mechanical engineering materials science and biomedicine Biomimetic principles have also been integrated Features Provides the latest state of the art on different manufacturing processes including a biomimetics viewpoint Offers broad coverage of advances in materials and manufacturing Written by chapter authors who are world class researchers in their respective fields Provides in depth presentation of the latest 3D and 4D technologies related to various manufacturing disciplines Provides substantial references in each chapter to enhance further study

Advances in Signal Processing for Nondestructive Evaluation of Materials X.P. Maldague, 2012-12-06 Non Destructive Evaluation NDE is now playing an increasing role in our modern global economy in security sensitive industries for instance The complexity of the inspection task and either large or limited lot runs now require more operator assisted or fully automated signal processing This book deals with both fields of expertise NDE and signal processing On the signal processing side in the particular context of NDE applications the following topics are discussed sensor fusion signal knowledge representation artificial intelligence fuzzy logic computer vision integration of numeric and non numeric informations parallel decomposition noise processing and calibration of sensor devices as well as reliability of detection Some hardware considerations are introduced as well to discuss platforms on which processing is done On the NDE side applications include advances in holographic interferometry microwave resonance or shearography and also on more traditional NDE techniques such as ultrasonics infrared techniques X ray computed tomography Eddy currents Inverse problems are also discussed This book is required reading for those who already have some experience in one or both fields signal processing and or NDE

Review of Progress in Quantitative Nondestructive Evaluation Donald O. Thompson, Dale E. Chimenti, 2012-12-06 These Proceedings consisting of Parts A and B contain the edited versions of most of the papers presented at the annual Review of Progress in Quantitative Nondestructive Evaluation held at University of San Diego San Diego CA on July 27 to August 1 1997 The Review was organized by the Center for NDE at Iowa State University in cooperation with the Ames Laboratory of the USDOE the American Society of Nondestructive Testing the National Institute of Standards and Technology the Federal Aviation Administration and the National Science Foundation Industry/University Cooperative Research Centers This year's Review of Progress in QNDE was attended by approximately 370 participants from the US and many foreign countries who presented a total of approximately 350 papers As usual the meeting was divided into 36 sessions with four sessions running concurrently The Review covered all phases of NDE research and development from fundamental investigations to engineering applications and inspection systems and methods of inspection science from acoustics to x rays The Review continues to experience some fluctuations in size mostly under

pressure from a decrease in funding for NDE research at the US Federal level but increased participation from foreign laboratories has more than made up the difference The Review is ideally sized to permit a full scale overview of the latest developments in a collegial atmosphere that most participants favor The opening plenary session this year concentrated on advances in imaging technologies and methodologies that have been made in recent years Dr K **Critical Technologies Plan** ,1989 *Nuclear Science Abstracts* ,1970 *Annual Report - National Academy of Engineering* National Academy of Engineering,1971 *Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations for 1990* United States. Congress. House. Committee on Appropriations. Subcommittee on the Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies,1989 **Departments of Commerce, Justice, and State, the Judiciary, and related agencies appropriations for 1989** United States. Congress. House. Committee on Appropriations. Subcommittee on the Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies,1988

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In a digital era where connections and knowledge reign supreme, the enchanting power of language has become more apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is actually remarkable. This extraordinary book, aptly titled "**Recent Advances In Nondestructive Evaluation Techniques For Material Science And Industries Proceedings**," written by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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