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Electromagnetic Ultrasonic Guided Waves



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Preface

The use of electromagnetic ultrasonic waves has several distinct advantages, including operation without a coupling fluid, non-contact operation, higher temperature operation and flexibility to generate the shear horizontal waves. Since the 1970s, a number of researchers have carried out electromagnetic ultrasonic testing with increasing concern. The use of ultrasonic guided waves has received a great deal of attention for nondestructive testing for the advantages of guided wave techniques such as high testing speed and the detection sensitivity on both inner and outer surfaces. Many industrial problems in special conditions can be solved by a combination of the electromagnetic ultrasonic approach and the guided wave technique, such as the online detection of stress corrosion cracks in natural gas pipelines. However, the electromagnetic ultrasonic technique is involved with the coupling and conversion among electromagnetics and mechanics as well as the vibration and propagation of ultrasonic waves, which can make it more difficult to do quantitative research. The multi-modes nature and dispersive characteristics of ultrasonic guided waves, and the mode conversion of the interactions between guided waves and defects, make it the most complicated of uses of guided waves. Consequently, it can be very difficult to combine the electromagnetic ultrasonics with ultrasonic guided-waves for application. In recent years, tremendous progress has been made in the theory and application of electromagnetic ultrasonic guided waves.

This book illustrates the theory and the practical applications of the electromagnetic ultrasonic guided waves. The main parts of the book include: the energy transfer mechanism of electromagnetic ultrasonics as well as the design methods; the calculations and simulations of the electromagnetic ultrasonics based on Lorentz force and magnetostrictive mechanism; the propagation characteristics of ultrasonic guided waves; the mechanism of detection of defects by guided waves; the quantification and location of defects; and the applications of electromagnetic ultrasonic guided wave techniques.

The contents of this book are the summaries of the authors' latest eight years of investigations and practical application in the field of electromagnetic ultrasonic

guided waves. Most of them are involved in the dissertations of the graduate and Ph.D. students supervised by the authors, including Shen Wang, Kuansheng Hao, Yongsheng Zhang, Chaofeng Ye, Peng Li, Junjun Xin, Yun Tong et al. In the practical applications of related technology, significant support was provided by colleagues and engineers from related companies and institutes of Petrochina Co. and Sinopec. We express our sincere gratitude to them for helping to improve the technology in real practice.

Chapters 1 and 6 were written by Weibin Li, Chaps. 2 and 3 were written by Qing Wang, Chaps. 4 and 5 were written by Shen Wang, and Chap. 7 was written by Songling Huang.

Considering the rapid growth of online detection and the great advantages of the electromagnetic guided wave technique, we hope that this book will be used as a reference in electromagnetic guided wave nondestructive evaluation and testing by individuals at any level and by graduate students. It is also hoped that this book will expand and promote the use of electromagnetic guided waves at both the national and international levels.

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Contents

1	Electromagnetic Acoustic Transducer	1
1.1	Outline	1
1.2	Research Status of EMAT	2
1.2.1	Structure of EMAT	2
1.2.2	Energy Conversion Mechanism and Analytical Method of EMAT	6
1.3	Optimal Design of EMAT and Its New Configuration	10
1.3.1	Optimal Design of Meander Coil	10
1.3.2	Multibelt Coil Axisymmetric Guided Wave EMAT	23
1.3.3	SH Guided Wave EMAT Used in Non-ferromagnetic Material	35
1.3.4	Calculation of the Impedance Matching Capacitance of EMAT [5].	38
	References	42
2	Analytical Method of EMAT Based on Lorentz Force Mechanism	43
2.1	Multifield Coupling Equation of EMAT Based on Lorentz Force Mechanism.	43
2.1.1	Magnetic Field Equation of a Permanent Magnet	44
2.1.2	Dynamic Magnetic Field Equation of the Pulsed Eddy Current [1]	45
2.1.3	Motion Equation of Particle in the Specimen	47
2.1.4	Receiving Equation of Ultrasonic Signal	48
2.2	The Weak Form of the Coupling Field Equations	49
2.2.1	The Weak Form of Coupled Equations Under Two-Dimensional Cartesian Coordinates	49
2.2.2	The Weak Form of Coupled Equations in the Axisymmetric Coordinate System	52

2.3	Finite Element Simulation of EMAT by COMSOL Multiphysics [2].	55
2.3.1	Simulation Procedure of EMAT by COMSOL Multiphysics	55
2.3.2	Example of the Numerical Simulation and Experimental Verification	57
2.4	Analytical Modeling and Calculation of EMAT with Spiral Coil [3]	67
2.4.1	Configurations of the EMAT with Spiral Coils	67
2.4.2	Frequency-Domain Solution	68
2.4.3	The Time-Domain Solutions	76
2.4.4	Results Comparison and Discussion	77
2.5	Analytical Modeling and Calculation of the Meander Coil EMAT [4].	81
2.5.1	Meander Coil EMAT Configuration and Calculation Model.	82
2.5.2	The Frequency-Domain Calculation of the Coil's Impedance and Magnetic Field	83
2.5.3	The Calculation of the Time-Domain Pulsed Magnetic Field.	92
2.5.4	Example and Comparison of Results	93
2.6	The Analytical Method of EMAT Under Impulse Voltage Excitation [5]	97
2.6.1	Calculating the Pulsed Current Using the Analytical Equation	97
2.6.2	Calculating the Pulsed Current Using the Field-Circuit Coupling Finite Element Method	98
2.6.3	The Coil's Current Calculation Examples Realized Using the Circuit-Field Coupled Finite Element Method.	101
	References	102
3	Analytical Method of EMAT Based on Magnetostrictive Mechanism	103
3.1	Magnetic and Magnetostrictive Property of Ferromagnetic Materials.	104
3.1.1	Magnetic Characteristics and Magnetic Permeability of Ferromagnetic Materials	104
3.1.2	Magnetostrictive Property of the Ferromagnetic Material	105
3.2	Finite Element Method of EMAT Based on the Magnetostrictive Mechanism [1]	108
3.2.1	Basic Physical Equations.	108

3.2.2	Calculations of Magnetostrictive Force and Magnetostrictive Current Density in the Two-Dimensional Cartesian Coordinate System	111
3.2.3	Calculation of the Magnetostrictive Force and Magnetostrictive Current Density in the Axisymmetric Coordinates	114
3.2.4	Determination of the Piezomagnetic Coefficient	116
3.2.5	Numerical Simulation of EMAT Based on Magnetostrictive Mechanism	122
3.3	Analytical Modeling and Calculation of SH Guided Waves by EMAT [2]	132
3.4	Analytical Modeling and Calculation of an Axial Guided Wave in a Pipe by EMAT	137
3.4.1	The Magnetic Vector Potential of the δ Coil	138
3.4.2	Magnetic Vector Potential of the Coil with the Rectangular Cross Section.	141
3.4.3	The Impedance, Eddy Current, and Magnetic Induction Intensity of the Coil	143
3.4.4	One-Layer Conductor	144
3.4.5	Magnetic Elasticity of the Axial Guided Wave EMAT in Pipe.	148
3.4.6	Calculation of the Pulsed Magnetic Field of the T -Mode Guided Wave.	149
	References	151
4	The Propagation Characteristics of Ultrasonic Guided Waves in Plate and Pipe.	153
4.1	Dispersion and Wave Structures of the Lamb Waves in the Plate	153
4.1.1	The Dispersion Characteristics of the Lamb Waves in the Plate	154
4.1.2	The Wave Structures of the Lamb Waves in the Plate	155
4.2	The Characteristics of Dispersion and Wave Structures of SH Guided Waves in the Plate	159
4.2.1	Dispersion of SH Guided Waves in the Plate.	159
4.2.2	Wave Structure of SH Guided Waves in the Plate	159
4.3	Dispersion and Wave Structure of Circumferential Lamb Waves in Pipe [1]	161
4.3.1	Dispersion Equations and Their Solution of Circumferential Lamb Waves in Pipe	161
4.3.2	Wave Structure of Circumferential Lamb Waves in the Pipe	168

- 4.4 Dispersion and Wave Structure of Circumferential SH Guided Waves in the Pipe [2] 171
 - 4.4.1 The Dispersive Equations and Solutions of the Circumferential SH Guided Waves in the Pipe 171
 - 4.4.2 Wave Structure of Circumferential SH Guided Waves in the Pipe 177
- 4.5 Comparison of the Propagation Characteristics Between Guided Waves in the Plate and Circumferential Guided Waves in the Pipe 180
- References 181
- 5 Simulation of Interactions Between Guided Waves and the Defects by Boundary Element Method 183**
 - 5.1 Hybrid BEM Model of the External Defects in a Plate 184
 - 5.2 Elastodynamic Integration Equation and Its Fundamental Solution 184
 - 5.3 Boundary Integration Equation and Its Discretized Numerical Solution 186
 - 5.3.1 The Solution of the Elements in Matrix G 189
 - 5.3.2 The Solution of the Elements in Matrix \hat{H} 192
 - 5.4 Construction of the Boundary Condition Based on Mode Expansion 193
 - 5.5 Structure of the BEM Program 202
 - 5.6 Factors of Computational Accuracy 205
 - 5.6.1 Sweeping of the Model Length 205
 - 5.6.2 Sweeping of the Boundary Elements Size 209
 - 5.7 Calculation of the Reflections at the End of the Plate 211
 - 5.8 Simulation of the External Defect in the Plate [1] 214
 - 5.8.1 Sweeping of the Crack Depth on the External Surface of the Plate 214
 - 5.8.2 Sweeping of the Crack Width on the External Surface of the Plate 217
 - 5.8.3 Sweeping of the Frequency Thickness Product in the Plate with External Defect 218
 - 5.9 Model and Numerical Simulation of Internal Defect in the Plate 219
 - 5.9.1 Internal Crack's Height in the Plate 222
 - 5.9.2 Internal Crack's Width in the Plate. 223
 - 5.9.3 Frequency Thickness Product of Internal Crack in the Plate 225
 - 5.9.4 Internal Crack's Movement Along the Vertical Direction. 227

- 5.10 Quantitative Crack Detection by Electromagnetic Ultrasonic Guided Waves 228
- References 235
- 6 Finite Element Simulation of Ultrasonic Guided Waves 237**
 - 6.1 The Explicit Integration Finite Element Method 237
 - 6.2 Finite Element Simulation of the Lamb Wave in the Plate [1] 238
 - 6.2.1 Establishment of the Lamb Wave Equation in the Elastic Plate 238
 - 6.2.2 Finite Element Simulation of the Lamb Wave in the Plate 240
 - 6.2.3 Example of Lamb Wave Simulation in the Plate 244
 - 6.3 Finite Element Simulation of the Circumferential Lamb Wave in Pipe [2] 248
 - 6.3.1 Establishment of the Dispersion Equation of Circumferential Lamb Waves. 248
 - 6.3.2 Finite Element Simulation of the Circumferential Lamb Wave in the Pipe 252
 - 6.3.3 Simulation of the Circumferential Lamb Wave in the Pipe 253
 - 6.4 Finite Element Simulation of the *L*-Type Guided Wave Along the Axial Direction of the Pipeline 262
 - 6.5 Finite Element Simulation of the *T*-type Guided Wave Along the Axial Direction in the Pipeline 267
 - References 270
- 7 Applications of the Electromagnetic Ultrasonic Guided Wave Technique 271**
 - 7.1 Thickness Measurement by Electromagnetic Ultrasonics 271
 - 7.1.1 Principle of the Thickness Measurement by Electromagnetic Ultrasonics 271
 - 7.1.2 Setup of the Electromagnetic Ultrasonic Thickness Measurement [1] 272
 - 7.1.3 Hardware of the Electromagnetic Ultrasonic Thickness Measurement [2]. 273
 - 7.1.4 Analysis and Processing of the Echo Signal in the Electromagnetic Ultrasonic Thickness Measurement [3] 275
 - 7.2 Electromagnetic Ultrasonic Guided Wave Test Along the Axial Direction of the Pipeline 279
 - 7.2.1 Electromagnetic Ultrasonic Transducers 279
 - 7.2.2 Electromagnetic Ultrasonic Excitation Source and the Filter Amplifier [4] 282

- 7.2.3 Experiment of the Electromagnetic Ultrasonic Guided Wave Test and the Factors. 284
- 7.3 Electromagnetic Ultrasonic Guided Wave Detection for Cracks in the Natural Gas Pipeline [5–7] 296
 - 7.3.1 The Main Structure of the Detector 296
 - 7.3.2 Relative Detection Experiment. 300
- References 300