Acoustic Metamaterials and Wave Control Frontier Research In Computation And Mechanics Of Materials

Guangbin Ma

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This book is the first comprehensive review on acoustic metamaterials; novel materials which can be used to control the propagation of sound waves. This book is a survey of recent advances in the field of acoustic metamaterials, including theoretical and experimental studies. It is divided into two parts: the first part covers theoretical studies, while the second part focuses on experimental studies. The book is intended for researchers and engineers working in the field of acoustic metamaterials, as well as for students and educators interested in the topic.

Generalized Models and Non-classical Approaches in Complex Materials I

This comprehensive book presents all aspects of acoustic metamaterials and phononic crystals. It emphasizes on acoustic wave propagation phenomena at interfaces such as reflection, transmission, and refraction. The book provides a thorough discussion of the mechanisms leading to such reactive phenomena and includes the basic principles of non-destructive imaging, cloaking by surface water waves, flexural waves in thin plates, and other applications in medical imaging, materials science, and engineering.

Generalized Models and Non-classical Approaches in Complex Materials II

This book is dedicated to the memory of Gérard Maugin. It covers a wide range of subjects that were covered by this exceptional scientific leader. The book is divided into two parts: the first part covers theoretical studies, while the second part focuses on experimental studies. The book is intended for researchers and engineers working in the field of acoustic metamaterials, as well as for students and educators interested in the topic.


This book provides a comprehensive overview of the latest research and applications in machine learning. It covers a wide range of topics, including: Advances in Machine Learning; Applications of Machine Learning; and New Advances in Machine Learning. The book is intended for researchers and engineers working in the field of machine learning, as well as for students and educators interested in the topic.

Material Engineering and Manufacturing II

This book brings together contributions on a diverse range of topics, exploring the relationship between discrete and continuum mechanics as a tool to model new and complex materials. The book covers a wide range of topics, including: Advances in Material Engineering; Applications of Material Engineering; and New Advances in Material Engineering. The book is intended for researchers and engineers working in the field of material engineering, as well as for students and educators interested in the topic.

Functional Metamaterials and Metadevices

Functional Metamaterials and Metadevices: 2021 Edition

This book brings together contributions on a diverse range of topics, exploring the relationship between discrete and continuum mechanics as a tool to model new and complex materials. The book covers a wide range of topics, including: Advances in Functional Metamaterials; Applications of Functional Metamaterials; and New Advances in Functional Metamaterials. The book is intended for researchers and engineers working in the field of functional metamaterials, as well as for students and educators interested in the topic.
Discet and Continuum Models for Complex Metamaterials

To meet the demands of industry, scientists, and engineers for a systematic reference source, this book introduces, comprehensively and in a single voice, research and development progress in emerging metamaterials and derived fundamental wave devices. Coverage includes electromagnetic, optical, acoustic, thermal, and mechanical metamaterials and related multidisciplinary physics. Metamaterials are artificially engineered composite with designed properties beyond those attainable in nature and with applications in all aspects of materials science. From spatially tailored dielectric to tunable, dynamic materials properties and unique nonlinear behavior, metamaterial systems have demonstrated tremendous flexibility and functionality in electromagnetic, optical, acoustic, thermal, and mechanical engineering. Furthermore, the field of metamaterials has been enjoyed from the dawn of new era of various exotic wave phenomena, toward the design of practical devices, leading to the concepts of dynamically-reconfigurable metamaterials and functional micro/nanodevices. More and more wave front designs and engineering, as well as the extension to the fabrication of the devices, will be added to the book.

The Nonlinear Dynamic and Acoustics Of Ordered Granular Media

This book addresses theoretical and experimental methods for exploring microstructured metamaterials, with a special focus on wave dynamics, mechanical, and related physical properties. The authors are experts in computational and physical approaches to examine the microstructure properties in particular to the materials. These include: • Boundary value problems to reduced strain gradient elasticity for composite (or related) metamaterials. • Self-organization of materials in ferroelectrics thin films. • Combined models for surface layers of nanomaterials. • Computer simulation at the micro- and nanoscale. • Surfaces effects with anisotropic properties and imperfect temperature contact. • Holographic anisotropic metamaterials with uniaxial and coupled wave interfaces and special interface finite elements. • Other numerical and analytical methods for metamaterial applications. • Experimental and Applied Mechanics, Volume 6

This book is a useful extension to the notion of sound-wave topology, quality, coherence, and wave mixing, which constitute the emerging new science of sound. This volume includes a general introduction to the dynamics of sound propagation, a review of fundamental wave equations, and a detailed treatment of wave phenomena in various media. It discusses the propagation of sound in gases, liquids, and solids, as well as the general theory of wave motion. The book also covers the properties of waves and the behavior of waves in various media. The last two sections of the volume are devoted to the theory of sound in fluids and the theory of sound in solids.

Shock Mitigation and Wave Control Using Elastic Metamaterial Structures

This book provides a comprehensive and up-to-date treatment of practical applications of metamaterials, structural materials, and porous materials. It offers a wealth of new research developments and applications in the fields of materials engineering, nanotechnology, and mechanical engineering. The book presents a detailed introduction to the theory and practice of metamaterials, including their design, fabrication, and applications. It also discusses the fundamental principles of metamaterials, as well as their applications in various fields such as acoustics, optics, and mechanics. The book is intended for researchers, engineers, and students in a wide range of fields, including metamaterials, nanotechnology, and materials science.

Advanced Materials

The 3rd International Conference on Materials Engineering and Manufacturing (ICMEM 2013) and the 4th International Conference on Materials Engineering and Nanotechnology (ICMEN 2014) were dedicated to new research developments and applications in the fields of materials engineering, nanotechnology, and mechanical engineering. The book presents a detailed introduction to the theory and practice of metamaterials, including their design, fabrication, and applications. It also discusses the fundamental principles of metamaterials, as well as their applications in various fields such as acoustics, optics, and mechanics. The book is intended for researchers, engineers, and students in a wide range of fields, including metamaterials, nanotechnology, and materials science.

Acoustic Metamaterial Design and Applications

This book offers an essential introduction to the notions of sound wave topology, duality, coherence and wave-mixing, which constitute the emerging new science of sound. It includes general principles and specific examples that illustrate new and conventional notions of coherence, duality, and wave mixing. The book presents a detailed introduction to the theory and practice of metamaterials, including their design, fabrication, and applications. It also discusses the fundamental principles of metamaterials, as well as their applications in various fields such as acoustics, optics, and mechanics. The book is intended for researchers, engineers, and students in a wide range of fields, including metamaterials, nanotechnology, and materials science.
The absence of broadband sources, metamaterial parameters are non-unique, which allows for macroscopic descriptions that only include traditional parameters or traditional parameters and coupling factors. The additional coupling factors result in macroscopic momentum density and volume strain fields that are coupled due to being dependent on macroscopic acoustic particle velocity and pressure fields. This dissertation explores the analogy between bianisotropy in electromagnetism, electrodynamics, and acoustics and the consequences of neglecting their effects on the physical interpretation of acoustic metamaterial parameters. The analogies are used to provide a qualitative understanding of the origin of parameters, and a multiple scattering homogenization procedure is derived to demonstrate coupling due to asymmetry and nonlineal effects. Additionally, the restrictions of causality, passivity, and reciprocity on acoustic metamaterial parameters are derived, and it is demonstrated that macroscopic descriptions that neglect bianisotropy in micro-acoustic metamaterials do not in general satisfy these restrictions.

Theory and Design of Acoustic Metamaterials

Requiring no advanced knowledge of wave propagation, An Introduction to Metamaterials and Waves in Composites focuses on theoretical aspects of metamaterials, periodic composites, and layered composites. The book gives novice a platform from which they can start exploring the subject in more detail. After introducing concepts related to elasticity, acoustics, and electromagnetics, the book then discusses plane wave solutions to the equations that describe elastic, acoustic, and electromagnetic waves. It examines the existence of evanescent waves as well as scattering from curved interfaces, specifically spheres and cylinders. The author then covers electromechanical, acoustic, and electroacoustical metamaterials. Be it describing examples of transformations, aspects of acoustic cladding, and applications of phononic metamaterials to acoustic cladding. With a focus on periodic composites, the book uses the Bloch-Floquet theorem to find the effective behavior of composites in the quasistatic limit, presents the quasistatic equations of electrodynamics and electromagnetic waves, and investigates the effects of periodic composites on propagating waves in periodic structures. The final chapter discusses wave propagation in smoothly varying layered media, anisotropic periodic media, and quasistatic homogenization of laminates. This book provides a launch pad for research into elastic and acoustic metamaterials. Many of the ideas presented here will be realized experimentally—the book encourages readers to explore these ideas and bring them to technological maturity.

Acoustic Metamaterials and Wave Control

Sononic phononic crystals termed acoustic/sound band gap media are elastic analogues of photonic crystals and have also recently received renewed attention in many acoustic applications. Photonic crystals have a periodic dielectric modulation with a spatial scale on the order of the optical wavelength. The design and optimization of photonic crystals can be utilized in many applications by combining factors related to the combinations of interacting materials, lattice symmetry, lattice constant, filling factor, shape of the scattering object, and thickness of a layered structure. Through the publications and discussions of the research on sonics/phononic crystals, researchers can obtain effective and valuable results and improve their future development in related fields. Devices based on periodic structures can be utilized in medical and physical applications and can also be designed for novel applications as described in the basis of this Special Issue.

Dynamical Processes in Generalized Continua and Structures

Power Flow: A practitioner's handbook for sound intensity is a guide for practitioners and research scientists in different areas of acoustical physics. In this book are outlined several fundamental aspects of sound intensity measurement and analysis, such as sound pressure level, sound intensity level, and sound power level. This book also provides a detailed overview of the measurement of sound intensity, including the theory and practice of sound intensity measurement, the measurement of sound power, and the measurement of sound intensity in complex environments. The book covers the following topics: sound intensity measurement, sound power measurement, sound quality, and sound intensity analysis. The book is divided into three parts: the first part discusses the fundamentals of sound intensity measurement, the second part discusses the practical aspects of sound intensity measurement, and the third part discusses the applications of sound intensity measurement.

Metamaterials

As an emerging interdisciplinary field, acoustic metamaterials have generated increasing interest due to various engineering applications, from noise and vibration alleviation to super-resolution imaging. The book starts with a simple one-in-one mass chain model to illustrate the concept of negative mass due to internal resonance and its impact on wave transmission. The practical transformation theory for controlling acoustic waves is explained. Postmodern acoustic metamaterials and related cladding design are also included. Finally, the book ends up with the sub-diffraction-limited acoustic imaging based on metamaterials. This comprehensive title gives a broad overview on different aspects of acoustic metamaterials with a balance of theoretical description and experimental realization. It is an ideal book for those working with micro and nanotechnology, MEMS (microelectromechanical systems), and acoustic devices. This book also presents an introduction to the fundamentals and properties of phononic crystals and covers simulation techniques for the analysis of phononic crystals. Discusses topics such as phononic crystals, phononic crystals in various applications, and three-dimensional phononic crystal structures. Illustrates how phononic crystal structures are being deployed in communication systems and energy systems.

Controlling Acoustic and Elastic Waves with Metamaterials

This book presents the most recent theoretical developments and numerical/experimental validations of new elastic and acoustic metamaterials that cannot be achieved with traditional materials. Many chapters explain the benefits of using metamaterials and how they can be used in practical applications. The book is divided into three parts: the first part discusses the fundamentals of metamaterials, the second part discusses the practical aspects of metamaterials, and the third part discusses the applications of metamaterials. The book is an ideal resource for researchers, engineers, and students interested in the field of metamaterials.

An Introduction to Metamaterials and Waves in Composites

Phononic and acoustic metamaterials are heterogeneous materials that enable manipulation of elastic waves. An important characteristic of these heterogeneous systems is their ability to tailor the propagation of elastic waves due to the existence of band gaps – frequency ranges of strong wave attenuation. In this Thesis, I report discoveries of three new types of band gaps: (i) Band gaps induced by geometric frustration in periodic photonic crystal structures; (ii) Band gaps induced by high connectivity in periodic bond lattices; and (iii) Topological band gaps in refractive phononic crystals that promote one-way edge waves. The investigations presented here led to novel light on the rich dynamic properties of phononic crystals and acoustic metamaterials, opening avenues for new strategies to control mechanical wave in elastic systems.

Bianisotropy in Passive Acoustic Metamaterials

Requiring no advanced knowledge of wave propagation, An Introduction to Metamaterials and Waves in Composites focuses on theoretical aspects of metamaterials, periodic composites, and layered composites. The book gives novice a platform from which they can start exploring the subject in more detail. After introducing concepts related to elasticity, acoustics, and electromagnetics, the book then discusses plane wave solutions to the equations that describe elastic, acoustic, and electromagnetic waves. It examines the existence of evanescent waves as well as scattering from curved interfaces, specifically spheres and cylinders. The author then covers electromechanical, acoustic, and electroacoustical metamaterials. Be it describing examples of transformations, aspects of acoustic cladding, and applications of phononic metamaterials to acoustic cladding. With a focus on periodic composites, the book uses the Bloch-Floquet theorem to find the effective behavior of composites in the quasistatic limit, presents the quasistatic equations of electrodynamics and electromagnetic waves, and investigates the effects of periodic composites on propagating waves in periodic structures. The final chapter discusses wave propagation in smoothly varying layered media, anisotropic periodic media, and quasistatic homogenization of laminates. This book provides a launch pad for research into elastic and acoustic metamaterials. Many of the ideas presented here will be realized experimentally—the book encourages readers to explore these ideas and bring them to technological maturity.

Advances in Mechanics: Theoretical, Computational and Interdisciplinary Issues

Acoustic/Elastic metamaterials have attracted increased attention in recent times. Metamaterials are defined as special materials that exhibit unusual properties not normally found in natural materials. These unusual properties are derived from the specially designed microstructures rather than the chemical composition of the material. Based on the concept of locally resonant metamaterials, these materials are applied in many applications such as impact wave attenuation, anti-wave and wave control and manipulation due to their flexibility and tailorability properties. For various needed applications, we present the development of a dissipative elastic metamaterial with multiple Macfarlane resonators for dynamic load mitigation. Besides the wave attenuation of dynamic loads, we also investigate the asymmetric transmission of elastic waves which has recently been realized by linear structures. We design and propose different diamatic and triangular elastic metamaterials to obtain large asymptotic elastic wave transmission in multiple low-frequency bands. All these designs are achieved through the design of one-dimensional structures with different directions of transmission. All proposed models in this research are analytically investigated and numerically verified by both analytical and continuous models. Also, the dynamic response of the proposed models are explored and analyzed in time and frequency domains. The effect of damping on the proposed models is also investigated for more practical applications. Lastly, the book concludes with a broad overview of the field, giving a broad overview of acoustic metamaterials and their uses. The book is divided into three parts, covering the state-of-the-art, the fundamentals, and the real-world applications of acoustic metamaterials.

Paper Microfluidics

This book presents the latest developments and applications of microchirpionics and nanomechanics. It particularly focuses on recent applications and impact areas of microchirpionics that have not been discussed in traditional microchirpionics and nanomechanics books on metamaterials, microchirpionics of ferroelectric/piezoelectric, electromagnetic materials, microchirpionics of interface, size effects and strain gradient theories, computational and experimental nanomechanics, multiscale simulations and theories, soft matter composite, and computational homogenization theory. This book covers analytical, experimental, as well as computational and numerical approaches in depth. Page 3/4
Acoustic Metamaterials and Phononic Crystals

This book deals with the subject of optical and electronic negative refraction (NR) and negative index materials (NIM). Diverse approaches for achieving NR and NIM are covered, such as using photonic crystals, phononic crystals, splitting resonators (SRRs) and continuous media, focusing of waves, guided-wave behavior, and nonlinear effects. It is perhaps the most comprehensive book on the new class of negative refraction materials, covering all aspects of negative refraction and negative index materials.

Waves in Gradient Metamaterials

This book presents selected peer-reviewed contributions from the 2017 International Conference on “Physics and Mechanics of New Materials and Their Applications”. PHEMM 2017 (Jodhpur, India, 14-16 October, 2017), which is devoted to processing techniques, physics, mechanics, and applications of advanced materials. The book focuses on a wide spectrum of nanostructures, ferroelectric crystals, materials and composites as well as promising materials with special properties. It presents nanotechnology approaches, modern environmentally friendly piezoelectric and ferroelectric devices, and recent advancements in the field of phononics and phononic crystals. This book will be a tremendous up-to-date resource for researchers working in the field globally.

An Introduction to Metamaterials and Waves in Composites

Metamaterials have attracted enormous interest from both physics and engineering communities in the past 20 years, owing to their powerful ability in manipulating electromagnetic waves. However, the functionalities of traditional metamaterials are fixed at the time of fabrication. To control the EM waves dynamically, active components are introduced to the metamaterials to achieve the desired functionalities. This book presents an overview of the recent advances in the field of metamaterials, including their basic concepts, fabrication techniques, and potential applications.

Acoustic Waves in Periodic Structures, Metamaterials, and Porous Media

Acoustic Metamaterials and Phononic Crystals

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Physics of Negative Refraction and Negative Index Materials

The explosion of interest in metamaterials is due to the dramatically increased manipulation ability over light as well as sound waves. This material research was stimulated by the opportunity to develop an artificial media with negative refraction index and the application in superlens which allows super-resolution imaging. High-resolution acoustic imaging techniques are the essential tool for non-destructive testing and medical screening. However, the spatial resolution of the conventional acoustic imaging methods is restricted by the incident wavelength of ultrasound. This is due to the locally failing transversal fields which carry the subwavelength features of objects. By focusing the propagating waves and inverting the transverse field, a flat lens with negative-index can potentially overcome the diffraction limit. We present the first experimental demonstration of focusing ultrasound waves through a flat acoustic metamaterial lens composed of a planar network of subwavelength Helmholtz resonators. We showed a thick focus of self-wavelength in width at 68.5 KHz by imaging a point source. This result is in excellent agreement with the numerical simulation to transmission line model in which we derived the acoustic space and density are opposite to different frequencies. The metamaterial lens also displays variable focal length at different frequencies. The experiment shows the promise of designing compact and lightweight ultrasound imaging elements. Moreover, the concept of metamaterial extends far beyond negative refraction, rather giving enormous choice of material parameters for different applications. One of the most interesting examples these years is the invisible cloak. Such a device is proposed to render the hidden object undetectable under the flow of light or sound. By guiding and controlling the wave path through an engineered space surrounding the object. However, the cloak designed by transmission optics usually calls for a highly anisotropic metamaterial, which makes the experimental studies remains challenging. We present here the first practical realization of a low-loss and broadband acoustic cloak for underwaer sound. The metamaterial cloak is constructed with a network of acoustic circuit elements, namely serial inductors and shunt capacitors. Our experiment clearly shows that the acoustic cloak can effectively bend the ultrasound waves around the hidden object, with reduced scattering and shadow. Due to the non-resonant nature of the building elements, this low loss (~6dB/m) cylindrical cloak exhibits excellent invisibility over a broad frequency range from 52 to 64 kHz in the experiments. The low visibility of the cloaked object for underwater ultrasound shot a light on the fundamental understanding of manipulation, storage and control of acoustic waves. Furthermore, our experimental studies indicate that this design approach should be scalable to different acoustic frequencies and offers the possibility for a variety of devices based on coordinate transformation.

ADVANCES IN APPLIED NONLINEAR DYNAMICS, VIBRATION AND CONTROL 2021

This book presents a collection of chapters on the current problems of the theory of dynamical processes in generalized continua and structures, and has been compiled to commemorate the 70th birthday of Prof. Dmitry Indenbom – a leading specialist in the field of dynamical processes in solids, fluids and structures. It discusses various applications related to Prof. Indenbom’s contributions, including various discrete and continuous dynamic models of structures and media, as well as a number of discrete and continuous dynamic models of structures and media, as well as a number of different techniques for analyzing and controlling them.

Metamaterials and Wave Control

This book provides an overview of the recent advances in the field of paper microfluidics, whose enormous introduction has stimulated considerable attention to the development of rapid, cost-effective and simplified point-of-care diagnostic systems. The book is divided into three parts viz., theoretical background of paper microfluidics, fabrication techniques for paper-based devices, and broad applications. Each chapter of the book is self-contained and focuses on a specific topic and its relation to paper microfluidics and starts with a brief description of the topic’s background, essential definitions, and a short story of the recent progress in the relevant field. The book also covers the future outlook, remaining challenges, and emerging opportunities. This book shall be a tremendous up-to-date resource for researchers working in the area globally.

Phononic Crystals

This book highlights the acoustic metamaterials’ capability to manipulate the direction of sound propagation in solids which in turn control the scattering, diffraction and refraction, the three basic mechanisms of sound propagation in solids. This gives rise to several novel theories and applications and hence the name new acoustics. As an introduction, the book mentions that geometry of acoustic fields is the theoretical framework of acoustic metamaterials. This is then followed by describing that acoustic metamaterials began with locally resonant sonic materials which adhered to the concept of negative acoustic parameters such as mass density and bulk modulus. This complex with form invariance of the acoustic equation of motion which again exemplifies the symmetry property of acoustic fields.

Acoustic Metamaterials and Phononic Crystals

This book presents selected peer-reviewed contributions from the 2017 International Conference on “Physics and Mechanics of New Materials and Their Applications”. PHEMM 2017 (Jodhpur, India, 14-16 October, 2017), which is devoted to processing techniques, physics, mechanics, and applications of advanced materials. The book focuses on a wide spectrum of nanostructures, ferroelectric crystals, materials and composites as well as promising materials with special properties. It presents nanotechnology approaches, modern environmentally friendly piezoelectric and ferroelectric devices, and recent advancements in the field of phononics and phononic crystals. This book will be a tremendous up-to-date resource for researchers working in the field globally.