

Mathematics And Music Composition Perception And Performance

This book constitutes the thoroughly refereed proceedings of the 7th International Conference on Mathematics and Computation in Music, MCM 2019, held in Madrid, Spain, in June 2019. The 22 full papers and 10 short papers presented were carefully reviewed and selected from 48 submissions. The papers feature research that combines mathematics or computation with music theory, music analysis, composition, and performance. They are organized in topical sections on algebraic and other abstract mathematical approaches to understanding musical objects; remanaging Riemann: mathematical music theory as “experimental philosophy”?; octave division; computer-based approaches to composition and score structuring; models for music cognition and beat tracking; pedagogy of mathematical music theory. The chapter “Distant Neighbors and Interscalar Contiguities” is available open access under a Creative Commons Attribution 4.0 International License via link.springer.com.

Musicians imagine music by means of functional models which determine certain aspects of the music while leaving others open. This gap between image and the experience it models offers a source of compositional creativity; different musical

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cultures embody different ways of imagining sound as music. Drawing on psychological and philosophical materials as well as the analysis of specific musical examples, Cook here defines the difference between music theory and aesthetic criticism, and affirms the importance of the ordinary listener in musical culture.

This book presents the latest computational models of rhythm and meter that are based on number theory, combinatorics and pattern matching. Two computational models of rhythm and meter are evaluated: The first one explores a relatively new field in Mathematics, namely Combinatorics on Words, specifically Christoffel Words and the Burrows-Wheeler Transform, together with integer partitions. The second model uses filtered Farey Sequences in combination with specific weights that are assigned to inter-onset ratios. This work is assessed within the context of the current state of the art of tempo tracking and computational music transcription. Furthermore, the author discusses various representations of musical rhythm, which lead to the development of a new shorthand notation that will be useful for musicologists and composers. Computational Models of Rhythm and Meter also contains numerous investigations into the timing structures of human rhythm and metre perception carried out within the last decade. Our solution to the transcription problem has

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been tested using a wide range of musical styles, and in particular using two recordings of J.S. Bach's Goldberg Variations by Glenn Gould. The technology is capable of modelling musical rhythm and meter by using Farey Sequences, and by detecting duration classes in a windowed analysis, which also detects the underlying tempo. The outcomes represent human performances of music as accurate as possible within Western score notation.

Following her distinguished earlier career as a concert pianist and later as a music theorist, Jeanne Bamberger conducted countless case studies analysing musical development and creativity the results of which were published in important scientific journals. Discovering musical mind draws together in one source these classic studies, offering the chance to revisit and reconsider some of her conclusions. Reviewing the data in light of current theories of cognitive development, she discusses how some of the conclusions she drew stand up to scrutiny, whilst in other cases, anomalies turn out to have greater significance than expected. The book is a collection of Bamberger's papers from 1975 to 2011. It includes her first study of Beethoven's original fingerings, her beginning work with children's invented notations, close observations and analysis of children in the Laboratory for Making Things, studies of musically gifted children, and the emergent musical development of students in elementary-secondary

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school and university undergraduate and graduate studies. The observations and research lead to the development of an interactive, computer-based music environment that uses her pragmatic theory of musical development as the basis for a project-oriented program for teaching and learning. Unlike other collections, the book is both interdisciplinary and strongly practical. It brings together and integrates Bamberger's background in music theory, research in music perception and music education, performance, cognitive development, artificial intelligence, and procedural music composition. Her multi-faceted approach to music theory and music pedagogy is guided throughout by her commitment to an understanding and respect for an individual's natural, creative musical intelligence. This natural competence becomes the formative ground on which to help people of all ages build an ever growing understanding and engagement with the evolving structures of the world's music. Bringing together a body of research currently scattered across a range of journals, or simply no longer available, the book will make fascinating reading for those in the fields of musical developmental and educational psychology.

A commonsense, self-contained introduction to the mathematics and physics of music; essential reading for musicians, music engineers, and anyone interested in the intersection of art and science. "Mathematics can be as effortless as

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humming a tune, if you know the tune,” writes Gareth Loy. In *Musimathics*, Loy teaches us the tune, providing a friendly and spirited tour of the mathematics of music—a commonsense, self-contained introduction for the nonspecialist reader. It is designed for musicians who find their art increasingly mediated by technology, and for anyone who is interested in the intersection of art and science. In Volume 1, Loy presents the materials of music (notes, intervals, and scales); the physical properties of music (frequency, amplitude, duration, and timbre); the perception of music and sound (how we hear); and music composition. Calling himself “a composer seduced into mathematics,” Loy provides answers to foundational questions about the mathematics of music accessibly yet rigorously. The examples given are all practical problems in music and audio. Additional material can be found at <http://www.musimathics.com>. The second volume of a commonsense, self-contained introduction to the mathematics and physics of music, focusing on the digital and computational domain; essential reading for musicians, music engineers, and anyone interested in the intersection of art and science. Volume 2 of *Musimathics* continues the story of music engineering begun in Volume 1, focusing on the digital and computational domain. Loy goes deeper into the mathematics of music and sound, beginning with digital audio, sampling, and binary numbers, as well as

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complex numbers and how they simplify representation of musical signals. Chapters cover the Fourier transform, convolution, filtering, resonance, the wave equation, acoustical systems, sound synthesis, the short-time Fourier transform, and the wavelet transform. These subjects provide the theoretical underpinnings of today's music technology. The examples given are all practical problems in music and audio. Additional material can be found at <http://www.musimathics.com>.

Mathematics and Music: Composition, Perception, and Performance, Second Edition includes many new sections and more consistent expectations of a student's experience. The new edition of this popular text is more accessible for students with limited musical backgrounds and only high school mathematics is required. The new edition includes more illustrations than the previous one and the added sections deal with the XronoMorph rhythm generator, musical composition, and analyzing personal performance. The text teaches the basics of reading music, explaining how various patterns in music can be described with mathematics, providing mathematical explanations for musical scales, harmony, and rhythm. The book gives students a deeper appreciation showing how music is informed by both its mathematical and aesthetic structures. Highlights of the Second Edition: Now updated for more consistent expectations of students'

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backgrounds More accessible for students with limited musical backgrounds Full-color presentation Includes more thorough coverage of spectrograms for analyzing recorded music Provides a basic introduction to reading music Features new coverage of building and evaluating rhythms

This textbook is a first introduction to mathematics for music theorists, covering basic topics such as sets and functions, universal properties, numbers and recursion, graphs, groups, rings, matrices and modules, continuity, calculus, and gestures. It approaches these abstract themes in a new way: Every concept or theorem is motivated and illustrated by examples from music theory (such as harmony, counterpoint, tuning), composition (e.g., classical combinatorics, dodecaphonic composition), and gestural performance. The book includes many illustrations, and exercises with solutions.

This book is a comprehensive examination of the conception, perception, performance, and composition of time in music across time and culture. It surveys the literature of time in mathematics, philosophy, psychology, music theory, and somatic studies (medicine and disability studies) and looks ahead through original research in performance, composition, psychology, and education. It is the first monograph solely devoted to the theory of construction of musical time since Kramer in 1988, with new insights, mathematical precision, and an expansive global and historical context. The

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mathematical methods applied for the construction of musical time are totally new. They relate to category theory (projective limits) and the mathematical theory of gestures. These methods and results extend the music theory of time but apply also to the applied performative understanding of making music. In addition, it is the very first approach to a constructive theory of time, deduced from the also quite recent theory of musical gestures and their categories. Making Musical Time is intended for a wide audience of scholars with interest in music. These include, mathematicians, music theorists, (ethno)musicologists, music psychologists/educators/therapists, philosophers of music, audiologists, and acousticians.

This book presents a deep spectrum of musical, mathematical, physical, and philosophical perspectives that have emerged in this field at the intersection of music and mathematics. In particular the contributed chapters introduce advanced techniques and concepts from modern mathematics and physics, deriving from successes in domains such as Topos theory and physical string theory. The authors include many of the leading researchers in this domain, and the book will be of value to researchers working in computational music, particularly in the areas of counterpoint, gesture, and Topos theory.

How music has influenced mathematics, physics, and astronomy from ancient Greece to the twentieth century Music is filled with mathematical elements. The works of Bach are often said to possess a math-like logic, and Arnold Schoenberg, Iannis Xenakis,

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and Karlheinz Stockhausen wrote music explicitly based on mathematical principles. Yet Eli Maor argues that it is music that has had the greater influence on mathematics, not the other way around. Starting with Pythagoras, proceeding through Schoenberg, and bringing the story up to the present with contemporary string theory, *Music by the Numbers* tells a fascinating story of composers, scientists, inventors, and eccentrics who have played a role in the age-old relationship between music, mathematics, and the physical sciences. Weaving compelling stories of historical episodes with Maor's personal reflections as a mathematician and lover of classical music, this book will delight anyone who loves math and music.

This book offers a lively exploration of the mathematics, physics, and neuroscience that underlie music. Written for musicians and music lovers with any level of science and math proficiency, including none, *Music, Math, and Mind* demystifies how music works while testifying to its beauty and wonder.

Mathematics and Music Composition, Perception, and Performance CRC Press

The Routledge Companion to Embodied Music Interaction captures a new paradigm in the study of music interaction, as a wave of recent research focuses on the role of the human body in musical experiences. This volume brings together a broad collection of work that explores all aspects of this new approach to understanding how we interact with music, addressing the issues that have roused the curiosities of scientists for ages: to understand the complex and multi-faceted way in which music manifests itself not

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just as sound but also as a variety of cultural styles, not just as experience but also as awareness of that experience. With contributions from an interdisciplinary and international array of scholars, including both empirical and theoretical perspectives, the Companion explores an equally impressive array of topics, including: Dynamical music interaction theories and concepts Expressive gestural interaction Social music interaction Sociological and anthropological approaches Empowering health and well-being Modeling music interaction Music-based interaction technologies and applications This book is a vital resource for anyone seeking to understand human interaction with music from an embodied perspective.

This volume comprises a selection of papers presented at the first International Conference on Mathematics and Computation in Music – mcm2007. The conference took place at the Staatliches Institut für Musikforschung PK – National Institute for Music Research in Berlin during May 18–20, 2007 and was jointly organized by the National Institute for Music Research Berlin and the Society of Mathematics and Computation in Music. The papers were selected for the conference by the program committee and classified into talks and posters. All papers underwent further selection, revision and elaboration for this book publication. The articles cover a research field which is heterogeneous with respect to content, scientific language and methodology. On one hand, this reflects the heterogeneity and richness of the musical subject domain itself. On the other hand, it exemplifies a transition which has been explicitly intended by both

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the organizers and the founders of the society, namely to support the integration of mathematical and computational - proaches to music theory, composition, analysis and performance. The subdivision into three parts reflects the original structure of the program. These parts are opened by invited papers and followed by talks and posters. With the ongoing development of algorithmic composition programs and communities of practice expanding, algorithmic music faces a turning point. Joining dozens of emerging and established scholars alongside leading practitioners in the field, chapters in this Handbook both describe the state of algorithmic composition and also set the agenda for critical research on and analysis of algorithmic music. Organized into four sections, chapters explore the music's history, utility, community, politics, and potential for mass consumption. Contributors address such issues as the role of algorithms as co-performers, live coding practices, and discussions of the algorithmic culture as it currently exists and what it can potentially contribute society, education, and e-commerce. Chapters engage particularly with post-human perspectives - what new musics are now being found through algorithmic means which humans could not otherwise have made - and, in reciprocation, how algorithmic music is being assimilated back into human culture and what meanings it subsequently takes. Blending technical, artistic, cultural, and scientific viewpoints, this Handbook positions algorithmic music making as an essentially human activity.

Exploring the application of Bayesian probabilistic modeling techniques to musical issues,

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including the perception of key and meter.

Rhythm and Transforms is a book that explores rhythm in music, its structure and how we perceive it. The book will be bought by engineers interested in acoustic signal processing as well as musicians, composers and computer scientists. Anyone interested in the scientific basis of music from psychologists to the designers of electronic musical instruments will be interested in this book.

This annual anthology brings together the year's finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, *The Best Writing on Mathematics 2014* makes available to a wide audience many articles not easily found anywhere else—and you don't need to be a mathematician to enjoy them. These writings offer surprising insights into the nature, meaning, and practice of mathematics today. They delve into the history, philosophy, teaching, and everyday occurrences of math, and take readers behind the scenes of today's hottest mathematical debates. Here John Conway presents examples of arithmetical statements that are almost certainly true but likely unprovable; Carlo Séquin explores, compares, and illustrates distinct types of one-sided surfaces known as Klein bottles; Keith Devlin asks what makes a video game good for learning mathematics and shows why many games fall short of that goal; Jordan Ellenberg reports on a recent breakthrough in the study of prime numbers; Stephen Pollard argues that mathematical practice, thinking, and experience transcend the utilitarian value of mathematics; and much, much more. In addition to presenting the year's most memorable writings on mathematics, this must-have anthology includes an introduction by editor Mircea Pitici. This book belongs on the shelf of anyone interested in where math has taken us—and where it is headed.

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In Western Civilization Mathematics and Music have a long and interesting history in common, with several interactions, traditionally associated with the name of Pythagoras but also with a significant number of other mathematicians, like Leibniz, for instance. Mathematical models can be found for almost all levels of musical activities from composition to sound production by traditional instruments or by digital means. Modern music theory has been incorporating more and more mathematical content during the last decades. This book offers a journey into recent work relating music and mathematics. It contains a large variety of articles, covering the historical aspects, the influence of logic and mathematical thought in composition, perception and understanding of music and the computational aspects of musical sound processing. The authors illustrate the rich and deep interactions that exist between Mathematics and Music. For artists, scholars, researchers, educators and students of arts theory interested in culture and the arts, a proper understanding of the questions surrounding 'interculturality' and the arts requires a full understanding of the creative, methodological and interconnected possibilities of theory, practice and research. The International Handbook of Intercultural Arts Research provides concise and comprehensive reviews and overviews of the convergences and divergences of intercultural arts practice and theory, offering a consolidation of the breadth of scholarship, practices and the contemporary research methodologies, methods and multi-disciplinary analyses that are emerging within this new field.

From prehistoric bone flutes to pipe organs to digital synthesizers, instruments have been important to musical cultures around the world. Yet, how do instruments affect musical organization? And how might they influence players' bodies and minds? *Music at Hand* explores these questions with a distinctive blend of music theory, psychology, and philosophy.

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Practicing an instrument, of course, builds bodily habits and skills. But it also develops connections between auditory and motor regions in a player's brain. These multi-sensory links are grounded in particular instrumental interfaces. They reflect the ways that an instrument converts action into sound, and the ways that it coordinates physical and tonal space.

Ultimately, these connections can shape listening, improvisation, or composition. This means that pianos, guitars, horns, and bells are not simply tools for making notes. Such technologies, as creative prostheses, also open up possibilities for musical action, perception, and cognition. Throughout the book, author Jonathan De Souza examines diverse musical case studies—from Beethoven to blues harmonica, from Bach to electronic music—introducing novel methods for the analysis of body-instrument interaction. A companion website supports these analytical discussions with audiovisual examples, including motion-capture videos and performances by the author. Written in lucid prose, *Music at Hand* offers substantive insights for music scholars, while remaining accessible to non-specialist readers. This wide-ranging book will engage music theorists and historians, ethnomusicologists, organologists, composers, and performers—but also psychologists, philosophers, media theorists, and anyone who is curious about how musical experience is embodied and conditioned by technology.

Musical imagination and creativity are amongst the most abstract and complex aspects of musical behaviour. This book is a wide ranging, multidisciplinary review of the latest theory and research on musical creativity, performance and perception by some of the most eminent scholars in their respective disciplines.

The *Psychology of Music* serves as an introduction to an interdisciplinary field in psychology, which focuses on the interpretation of music through mental function. This interpretation leads

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to the characterization of music through perceiving, remembering, creating, performing, and responding to music. In particular, the book provides an overview of the perception of musical tones by discussing different sound characteristics, like loudness, pitch and timbre, together with interaction between these attributes. It also discusses the effect of computer resources on the psychological study of music through computational modeling. In this way, models of pitch perception, grouping and voice separation, and harmonic analysis were developed. The book further discusses musical development in social and emotional contexts, and it presents ways that music training can enhance the singing ability of an individual. The book can be used as a reference source for perceptual and cognitive psychologists, neuroscientists, and musicians. It can also serve as a textbook for advanced courses in the psychological study of music.

Encompasses the way the brain perceives, remembers, creates, and performs music
Contributions from the top international researchers in perception and cognition of music
Designed for use as a textbook for advanced courses in psychology of music

Pendragon Press is proud to offer this new, revised, and expanded edition of *Formalized Music*, Iannis Xenakis's landmark book of 1971. In addition to three totally new chapters examining recent breakthroughs in music theory, two original computer programs illustrating the actual realization of newly proposed methods of composition, and an appendix of the very latest developments of stochastic synthesis as an invitation to future exploration, Xenakis offers a very critical self-examination of his theoretical propositions and artistic output of the past thirty-

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five years. This edition of *Formalized Music* is an essential tool for understanding the man and the thought processes of one of this century's most important and revolutionary musical figures.

The original edition of *The Geometry of Musical Rhythm* was the first book to provide a systematic and accessible computational geometric analysis of the musical rhythms of the world. It explained how the study of the mathematical properties of musical rhythm generates common mathematical problems that arise in a variety of seemingly disparate fields. The book also introduced the distance approach to phylogenetic analysis and illustrated its application to the study of musical rhythm. The new edition retains all of this, while also adding 100 pages, 93 figures, 225 new references, and six new chapters covering topics such as meter and metric complexity, rhythmic grouping, expressive timbre and timing in rhythmic performance, and evolution phylogenetic analysis of ancient Greek paeonic rhythms. In addition, further context is provided to give the reader a fuller and richer insight into the historical connections between music and mathematics.

French composer Maurice Ravel was described by critics as a magician, conjurer, and illusionist. Scholars have been aware of this historical curiosity, but none so far have explained why Ravel attracted such critiques or what they might

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tell us about how to interpret his music. *Magician of Sound* examines Ravel's music through the lens of illusory experience, considering how timbre, orchestral effects, figure/ground relationships, and impressions of motion and stasis might be experienced as if they were conjuring tricks. Applying concepts from music theory, psychology, philosophy, and the history of magic, Jessie Fillerup develops an approach to musical illusion that newly illuminates Ravel's fascination with machines and creates compelling links between his music and other forms of aesthetic illusion, from painting and poetry to fiction and phantasmagoria. Fillerup analyzes scenes of enchantment and illusory effects in Ravel's most popular works, including *Boléro*, *La Valse*, *Daphnis et Chloé*, and *Rapsodie espagnole*, relating his methods and musical effects to the practice of theatrical conjurers. Drawing on a rich well of primary sources, *Magician of Sound* provides a new interdisciplinary framework for interpreting this enigmatic composer, linking magic and music.

This anthology provides an informative and timely introduction to ongoing research on music as a cognitive process, bringing a new coherence to the emerging science of musical activity. Following the foreword, which is based on a conversation with Marvin Minsky, 26 contributions explore musical composition, analysis, performance, perception, and learning and tutoring. Their goal is to

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discover how these activities can be interpreted, understood, modeled, and supported through the use of computer programs. Each chapter is put into perspective by the editors, and empirical investigations are framed by a discussion of the nature of cognitive musicology and of epistemological problems of modeling musical action. The contributions, drawn from two international workshops on AI and Music held in 1988 and 1989, are grouped in seven sections. Topics in these sections take up two views of the nature of cognitive musicology (Kugel, Laske), principles of modeling musical activity (Balaban, Bel, Blevins, Glasgow and Jenkins, Courtot, Smoliar), approaches to music composition (Ames and Domino, Laske, Marsella, Riecken), music analysis by synthesis (Cope, Ebcioglu, Maxwell), realtime performance of music (Bel and Kippen, Ohteru and Hashimoto), music perception (Desain and Honing, Jones, Miller and Scarborough, Linster), and learning/tutoring (Baker, Widmer). M. Balaban is Senior Lecturer in the Department of Mathematics and Computer Science at Ben-Gurion University. K. Ebcioglu is Research Scientist in the Computer Sciences Department, IBM Thomas J. Watson Research Center. O. Laske is a composer and President of NEWCOMP, Inc., The New England Computer Arts Association, Inc.

The study of musical composition has been marked by a didactic, technique-

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based approach, focusing on the understanding of musical language and grammar -harmony, counterpoint, orchestration and arrangement - or on generic and stylistic categories. In the field of the psychology of music, the study of musical composition, even in the twenty-first century, remains a poor cousin to the literature which relates to musical perception, music performance, musical preferences, musical memory and so on. Our understanding of the compositional process has, in the main, been informed by anecdotal after-the-event accounts or post hoc analyses of composition. *The Act of Musical Composition: Studies in the Creative Process* presents the first coherent exploration around this unique aspect of human creative activity. The central threads, or key themes - compositional process, creative thinking and problem-solving - are integrated by the combination of theoretical understandings of creativity with innovative empirical work.

Essays in diatonic set theory, transformation theory, and neo-Riemannian theory -- the newest and most exciting fields in music theory today.

Mathemusical Conversations celebrates the understanding of music through mathematics, and the appreciation of mathematics through music. This volume is a compilation of the invited talks given at the *Mathemusical Conversations* workshop that took place in Singapore from 13–15 February 2015, organized by

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Elaine Chew in partnership with Gérard Assayag for the scientific program and with Bernard Lanskey for the artistic program. The contributors are world experts and leading scholars, writing on the intersection of music and mathematics. They also focus on performance and composition, two topics which are foundational both to the understanding of human creativity and to the creation of tomorrow's music technologies. This book is essential reading for researchers in both music and mathematics. It will also appeal more broadly to scholars, students, musicians, and anyone interested in new perspectives on the intimate relationship between these two universal human activities. Contents: Foreword by Series Editors Foreword by Workshop Organizers Mathemusical Engagement: Without Our Consent (Paul Schoenfield) Approaches to Musical Expression in Harmonix Video Games (Eran Egozy) Motion and Gravitation in the Musical Spheres (Elaine Chew) Mathemusical Creativity: Improvising in Creative Symbolic Interaction (Gérard Assayag) Music, Creativity, and Computers (Margaret A Boden) Tiling Canons as a Key to Approaching Open Mathematical Conjectures? (Moreno Andreatta) Shaping Performance: Musical Motives in Performance: A Study of Absolute Timing Patterns (Neta Spiro, Nicolas Gold and John Rink) Playing with Variables: Anticipating One Particular Performance of Bach's Goldberg Variations (Bernard Lanskey and Stephen Emmerson) The

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Informatics Philharmonic in the Indiana University Summer String Academy (Christopher Raphael) Educating the Mathemusical: Mathematical Thought and Empirical Approaches in Higher Education in Music (Jian Yang) Action and Symbol: An Essential Tension (Jeanne Bamberger) Educating the Mathemusical: Balancing the Equation (Don McLean) Geometries: Graph-theoretic and Geometric Models of Music (Richard Cohn) In Quest of Musical Vectors (Dmitri Tymoczko) A Topological Approach of Musical Relationships (Jean-Louis Giavitto and Antoine Spicher) List of Contributors Readership: Advanced secondary school students; post-secondary school students; and scientists, mathematicians, musicians and members of the public interested in the mathematical music sciences.

Explores interaction between music and mathematics including harmony, symmetry, digital music and perception of sound.

With contributions by numerous experts

From the first chapter through the last, readers eager to learn more about the connections between mathematics and music will find a comprehensive textbook designed to satisfy their natural curiosity.

During the past 40 years, mathematical music theory has grown and developed in both the fields of music and mathematics. In music pedagogy, the need to analyze patterns of modern composition has produced Musical Set Theory, and the use of Group Theory and other modern

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mathematical structures have become almost as common as the application of mathematics in the fields of engineering or chemistry. Mathematicians have been developing stimulating ideas when exploring mathematical applications to established musical relations. Mathematics students have seen in Music in Mathematics courses, how their accumulated knowledge of abstract ideas can be applied to an important human activity while reinforcing their dexterity in Mathematics. Similarly, new general education courses in Music and Mathematics are being developed and are arising at the university level, as well as for high school and general audiences without requiring a sophisticated background in either music nor mathematics. Mathematical Music Theorists have also been developing exciting, creative courses for high school teachers and students of mathematics. These courses and projects have been implemented in the USA, in China, Ireland, France, Australia, and Spain. The objective of this volume is to share the motivation and content of some of these exciting, new Mathematical Theory and Music in Mathematics courses while contributing concrete materials to interested readers.

The idea of this monograph is to present an overview of decisive theoretical, computational, technological, aesthetical, artistic, economical, and sociological directions to create future music. It features a unique insight into dominant scientific and artistic new directions, which are guaranteed by the authors' prominent publications in books, software, musical, and dance productions. Applying recent research results from mathematical and computational music theory and software as well as new ideas of embodiment approaches and non-Western music cultures, this book presents new composition methods and technologies. Mathematical, computational, and semiotic models of artistic presence (imaginary time, gestural creativity) as

