Rotations Quaternions And Double Groups

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DOMINIK GIANNA

Group Theory From the Eightfold Way to the Periodic Table Springer
The objective of this book is to provide a comprehensive introduction to ?nite rotation shells and to non-linear shell ?nite elements. It is divided into 5 parts: I. Preliminaries (20 pages), II. Shell equations (104 pages), III. Finite rotations for shells (103 pages), IV. Four-node shell elements (189 pages), and V. Numerical examples (41 pages). Additional numerical examples are presented in Parts III and IV. The bibliography includes 270 entries. The book is intended for both teaching and self-study, and emphasizes fundamental aspects and techniques of the subject. Some familiarity with non-linear mechanics and the ?nite element method is assumed. Shell elements are a subject of active research which results in many publications every year and several conferences and sessions are held r-ularly, among them, two large international conferences: \Computation of Shell and Spatial Structures" and \Shell Structures. Theory and - plications" (SSTA). The literature is voluminous, not easy to follow and evaluate, and the subject is di–cult to comprehend. I hope that this will be facilitated by the book. I would like to express my gratitude to several persons who helped me in my professional life, in this way contributing to the book. I thank Prof. R.L. Taylor from the University of California at Berkeley, Prof. B. Schre er from the University of Padua, and Prof. J.T. Santos from the Instituto Superior Tecnico at Lisbon, for hosting and supporting me when I was a post-doctoral researcher.
Group Theory with Applications in Chemical Physics Dr. Marco A. V. Bitetto
This dissertation has as its central focus the study of hyperspatial dynamics and as such makes use of mathematics in such an understanding and also the MAXYMA artificial intelligence computer simulation and programming language. As such, it will both discuss the use of MAXYMA in the understanding of hyperspatial dynamics and also include MAXYMA programs as well. This dissertation will conclude with a discussion of hyperspace and how one can travel through hyperspace and why one would want to travel through hyperspace.
Computations in Crystallographic Textures Springer
Handbook of Algebra
Problem Solving with Mathematica
Princeton University Press
This book introduces systematically the eigenfunction method, a new approach to the group representation theory which was developed by the authors in the 1970's and 1980's in accordance with the concept and method used in quantum mechanics. It covers the applications of the group theory in various branches of physics and quantum chemistry, especially nuclear and molecular physics. Extensive tables and computational methods are presented. Group Representation Theory for Physicists may serve as a handbook for researchers doing group theory calculations. It is also a good reference book and textbook for undergraduate and graduate students who intend to use group theory in their future research careers.
Handbook of Algebra John Wiley & Sons
Sir William Rowan Hamilton was a genius, and will be remembered for his significant contributions to physics and mathematics. The Hamiltonian, which is used in quantum physics to describe the total energy of a system, would have been a major achievement for anyone, but Hamilton also invented quaternions, which paved the way for modern vector analysis. Quaternions are one of the most documented inventions in the history of mathematics, and this book is about their invention, and how they are used to rotate vectors about an arbitrary axis. Apart from introducing the reader to the features of quaternions and their associated algebra, the book provides valuable historical facts that bring the subject alive. Quaternions for Computer Graphics introduces the reader to quaternion algebra by describing concepts of sets, groups, fields and rings. It also includes chapters on imaginary quantities, complex numbers and the complex plane, which are essential to understanding quaternions. The book contains many illustrations and worked examples, which make it essential reading for students, academics, researchers and professional practitioners.
CRC Concise Encyclopedia of Mathematics
John Wiley & Sons
Matrix groups touch an enormous spectrum of the mathematical arena. This textbook brings them into the undergraduate curriculum. It makes an excellent one-semester course for students familiar with linear and abstract algebra and prepares them for a graduate course on Lie groups. Matrix Groups for Undergraduates is concrete and example-driven, with geometric motivation and rigorous proofs. The story begins and ends with the rotations of a globe. In between, the author combines rigor and intuition to describe the basic objects of Lie theory: Lie algebras, matrix exponentiation, Lie brackets, maximal tori, homogeneous spaces, and roots. This second edition includes two new chapters that allow for an easier transition to the general theory of Lie groups.
Essays in Philosophy of Mathematics
CRC Press
This book presents a new approach for the analysis of chaotic behavior in non-linear dynamical systems, in which output can be represented in quaternion parametrization. It offers a new family of methods for the analysis of chaos in the quaternion domain along with extensive numerical experiments performed on human motion data and artificial data. All methods and algorithms are designed to allow detection of deterministic chaos behavior in quaternion data representing the rotation of a body in 3D space. This

book is an excellent reference for engineers, researchers, and postgraduate students conducting research on human gait analysis, healthcare informatics, dynamical systems with deterministic chaos or time series analysis.
Multisensor Attitude Estimation CRC Press
While group theory and its application to solid state physics is well established, this textbook raises two completely new aspects. First, it provides a better understanding by focusing on problem solving and making extensive use of Mathematica tools to visualize the concepts. Second, it offers a new tool for the photonics community by transferring the concepts of group theory and its application to photonic crystals. Clearly divided into three parts, the first provides the basics of group theory. Even at this stage, the authors go beyond the widely used standard examples to show the broad field of applications. Part II is devoted to applications in condensed matter physics, i.e. the electronic structure of materials. Combining the application of the computer algebra system Mathematica with pen and paper derivations leads to a better and faster understanding. The exhaustive discussion shows that the basics of group theory can also be applied to a totally different field, as seen in Part III. Here, photonic applications are discussed in parallel to the electronic case, with the focus on photonic crystals in two and three dimensions, as well as being partially expanded to other problems in the field of photonics. The authors have developed Mathematica package GTPack which is available for download from the book's homepage. Analytic considerations, numerical calculations and visualization are carried out using the same software. While the use of the Mathematica tools are demonstrated on elementary examples, they can equally be applied to more complicated tasks resulting from the reader's own research.
Medical Robotics John Wiley & Sons
"Quaternions are members of a noncommutative division algebra first invented by William Rowan Hamilton. They form an interesting algebra where each object contains 4 scalar variables, instead of Euler angles, which is useful to overcome the gimbal lock phenomenon when treating the rotation of objects. This book is about the mathematical basics and applications of quaternions. The first four chapters mainly concerns the mathematical theories, while the latter three chapters are related with three application aspects. It is expected to provide useful clues for researchers and engineers in the related area. In detail, this book is organized as follows: In Chapter 1, mathematical basics including the quaternion algebra and operations with quaternions, as well as the relationships of quaternions with other mathematical parameters and representations are demonstrated. In Chapter 2, how quaternions are formulated in Clifford Algebra, how it is used in explaining rotation group in symplectic vector space and parallel transformation in holonomic dynamics are presented. In Chapter 3, the wave equation for a spin 3/2 particle, described by 16-component vector-bispinor, is investigated in spherical coordinates. In Chapter 4, hyperbolic Lobachevsky and spherical Riemann models, parameterized coordinates with spherical and cylindric symmetry are studied. In Chapter 5, ship hydrodynamics with allowance of trim and sinkage is investigated and validated with experiments. In Chapter 6, the ballast flying phenomenon based on Discrete Discontinuous Analysis is presented. In Chapter 7, a numerical study is proposed to analyze the effect of the caisson sliding subjected to a hydrodynamic loading in the stability of the rear side of the rubble mound breakwater"--
Second Edition Springer
This book provides a thorough background to the emerging field of medical robotics. It covers the mathematics needed to understand the use of robotic devices in medicine, including but not limited to robot kinematics, hand-eye and robot-world calibration, reconstruction, registration, motion planning, motion prediction, motion correlation, motion replication and motion learning. Additionally, basic methods behind state-of-the art robots like the DaVinci system, the CyberKnife, motorized C-arms and operating microscopes as well as stereotactic frames are presented. The book is a text book for undergraduates in computer science and engineering. The main idea of the book is to motivate the methods in robotics in medical applications rather than industrial applications. The book then follows the standard path for a robotics textbook. It is thus suitable for a first course in robotics for undergraduates. It is the first textbook on medical robotics.
Volume 2 Relativistic Effects in Atoms and Molecules Springer Science & Business Media
Ever since the Irish mathematician William Rowan Hamilton introduced quaternions in the nineteenth century--a feat he celebrated by carving the founding equations into a stone bridge--mathematicians and engineers have been fascinated by these mathematical objects. Today, they are used in applications as various as describing the geometry of spacetime, guiding the Space Shuttle, and developing computer applications in virtual reality. In this book, J. B. Kuipers introduces quaternions for scientists and engineers who have not encountered them before and shows how they can be used in a variety of practical situations. The book is primarily an exposition of the quaternion, a 4-tuple, and its primary application in a rotation operator. But Kuipers also presents the more conventional and familiar 3 x 3 (9-element) matrix rotation operator. These parallel presentations allow the reader to judge which approaches are preferable for specific applications. The volume is divided into three main parts. The opening chapters present introductory material and establish the book's terminology and notation. The next part presents the mathematical properties of quaternions, including quaternion algebra and geometry. It includes more advanced special topics in spherical trigonometry, along with an introduction to quaternion calculus and perturbation theory, required in many situations involving dynamics and kinematics. In the final section, Kuipers discusses state-of-the-art applications. He presents a six degree-of-freedom electromagnetic position and orientation transducer and concludes by discussing the computer graphics necessary for the development of applications in virtual reality.
Oxford University Press
This open access textbook presents a comprehensive treatment of the arithmetic theory of quaternion algebras and orders, a subject with applications in diverse areas of mathematics. Written to be accessible and approachable to the graduate student reader, this text collects and synthesizes results from across the literature. Numerous pathways offer explorations in many different directions, while the unified treatment makes this book an essential reference for students and researchers alike. Divided into five parts, the book begins with a basic introduction to the noncommutative algebra underlying the theory of quaternion algebras over fields, including the relationship to quadratic forms. An in-depth exploration of the arithmetic of quaternion algebras and orders follows. The third part considers analytic aspects, starting with zeta functions and then passing to an idelic approach, offering a pathway from local to global that includes strong approximation. Applications of unit

groups of quaternion orders to hyperbolic geometry and low-dimensional topology follow, relating geometric and topological properties to arithmetic invariants. Arithmetic geometry completes the volume, including quaternionic aspects of modular forms, supersingular elliptic curves, and the moduli of QM abelian surfaces. Quaternion Algebras encompasses a vast wealth of knowledge at the intersection of many fields. Graduate students interested in algebra, geometry, and number theory will appreciate the many avenues and connections to be explored. Instructors will find numerous options for constructing introductory and advanced courses, while researchers will value the all-embracing treatment. Readers are assumed to have some familiarity with algebraic number theory and commutative algebra, as well as the fundamentals of linear algebra, topology, and complex analysis. More advanced topics call upon additional background, as noted, though essential concepts and motivation are recapped throughout.

Applications of Geometric Algebra in Computer Science and Engineering Springer Science & Business Media

The book deals with kinematics of mechanisms. It focuses on a solid theoretical foundation and on mathematical methods applicable to the solution of problems of very diverse nature. Applications are demonstrated in a large number of fully worked-out problems. In kinematics a wide variety of mathematical tools is applicable. In this book, wherever possible vector equations are formulated instead of lengthy scalar coordinate equations. The principle of transference is applied to problems of very diverse nature. 15 chapters of the book are devoted to spatial kinematics and three chapters to planar kinematics. In Chapt. 19 nonlinear dynamics equations of motion are formulated for general spatial mechanisms. Nearly one half of the book is dealing with position theory and the other half with motion. The book is intended for use as reference book for researchers and as textbook in advanced courses on kinematics of mechanisms.

Updated and Expanded Edition Springer Nature

Essentially, Orientations and Rotations treats the mathematical and computational foundations of texture analysis. It contains an extensive and thorough introduction to parameterizations and geometry of the rotation space. Since the notions of orientations and rotations are of primary importance for science and engineering, the book can be useful for a very broad audience using rotations in other fields.

Models and Algorithms for Quaternions World Scientific Publishing Company

This book investigates the geometry of quaternion and octonion algebras. Following a comprehensive historical introduction, the book illuminates the special properties of 3- and 4-dimensional Euclidean spaces using quaternions, leading to enumerations of the corresponding finite groups of symmetries. The second half of the book discusses the less f

Quaternions and Rotation Sequences Springer Science & Business Media

Thisvolumehasitsbeginningsinalaboratoryproject,developmentofaradiolocator for the Wi-Fi network that was growing by leaps and bounds on the campus of Indiana University at that time. What started as a very focused and practical attempt to improve network management, touched in its lifetime upon broader issues of the use of radio spectrum, design of system architectures for the wireless medium, and image formation outside the limits of geometrical optics. Ihaveintendedthisbookmostlyfortheaudienceofengineersandsystemdesi- ers, in the growing ?eld of radio communication among small, portable, ubiquitous devices that have become hybrid platforms for personal communication and p- sonal computing. It is also a book addressed to network professionals, people to whom radio is largely a black box, a medium that they usually rely upon, but s- dom fully understand. In fact, in the course of my work in the ?eld, I have witnessed, to my dismay, a wide disconnect between the networking world and the radio technology that n- working has come to depend upon so heavily. Perhaps, because digital wireless communication is seen as digital ?rst and wireless second, there is often a m- placed emphasis on its information-processingside, with the methodologycentered around the discrete symbol, and with little intuition of the underlying physics. I had it once suggested to me, in apparent seriousness, to use radio cards for intra-system communication within a radiolocator! Wireless communication is radio, plain and simple.

Orientations and Rotations Elsevier

Thisvolume isdevotedtomethodsfor thestudyoftheeffectsofrelativity on theelectronicstructure ofatomsand molecules. The accurate descrip tionofrelativisticeffectsinheavyatomshaslongbeenrecognizedasoneof the central problems ofatomic physics. Contemporary relativistic atomic structure calculations can be performed almost routinely. Recent years have seen agrowinginterestin thestudyoftheeffects ofrelativityon the structureofmolecules. Even for molecularsystemscontainingatoms from thesecondrowoftheperiodictable theenergyassociatedwith relativistic effects is often larger than that arising from electron correlation. For moleculescontainingheavieratoms relativistic effects become increasingly important, andforsystemscontainingveryheavyatomsrelativityisknown todominatemanychemicalproperties. In this volum, one of the pioneers of relativistic atomic structure calculations, Ian P. Grant, providesadetailedsurveyofthecomputational techniquesemployedincontemporarystudiesoftheeffectsofrelativityon atomicstructure. Thisisanareaofresearchinwhichcalculations canoften lead to a particularly impressive degreeofagreement between theoryand experiment. Furthermore, theseatomicstudies haveprovided manyofthe foundations of a fully relativistic quantum chemistry. However, the spherical symmetry ofatoms allows significantsimplificationsto bemade in their quantum mechanical treatment, simplifications which are not possibleinstudiesofmolecules. Inparticular, as is wellknown from non relativistictheoriesofmolecularelectronicstructure, itisalmostobligatory to invoke the algebraic approximation in molecular work and use finite basis set expansions. The problem of describing relativistic effects in molecules is addressed in Chapter2 by Stephen Wilson. This chapter is devotedtoab initiorelativisticmolecularstructurecalculationsinwhichall electrons are explicitly considered. The problem of induding relativistic effects in molecular studies is also addressed in Chapters3 and 4. In Chapter 3, Odd Gropen describes the use of relativistic effective core ix x Preface potentials in calculations on molecular systems involving heavy atoms. This approach can lead to more tractable algorithms than the methods described in Chapter2 and thus significantly extends the range of applications. The use of semiempirical methods has yielded a wealth of informationabouttheinfluenceofrelativityonthechemistryoftheheavier elements. Thisimportantarea is reviewed inChapter4 by Pekka Pyykk6. Finally, inChapter5, Harry M."

Fundamental Concepts and Applications CRC Press
There has been an increasing interest in multi-disciplinary research on multisensor attitude estimation technology driven by its versatility and diverse areas of application, such as sensor networks, robotics, navigation, video, biomedicine, etc. Attitude estimation consists of the determination of rigid bodies' orientation in 3D space. This research area is a multilevel, multifaceted process handling the automatic association, correlation, estimation, and combination of data and information from several sources. Data fusion for attitude estimation is motivated by several issues and problems, such as data imperfection, data multi-modality, data dimensionality, processing framework, etc. While many of these problems have been identified and heavily investigated, no single data fusion algorithm is capable of addressing all the aforementioned challenges. The variety of methods in the literature focus on a subset of these issues to solve, which would be determined based on the application in hand. Historically, the problem of attitude estimation has been introduced by Grace Wahba in 1965 within the estimate of satellite attitude and aerospace applications. This book intends to provide the reader with both a generic and comprehensive view of contemporary data fusion methodologies for attitude estimation, as well as the most recent researches and novel advances on multisensor attitude estimation task. It explores the design of algorithms and architectures, benefits, and challenging aspects, as well as a broad array of disciplines, including: navigation, robotics, biomedicine, motion analysis, etc. A number of issues that make data fusion for attitude estimation a challenging task, and which will be discussed through the different chapters of the book, are related to: 1) The nature of sensors and information sources (accelerometer, gyroscope, magnetometer, GPS, inclinometer, etc.); 2) The computational ability at the sensors; 3) The theoretical developments and convergence proofs; 4) The system architecture, computational resources, fusion level.
3D Kinematics Springer Science & Business Media
In its traditional form, Clifford analysis provides the function theory for solutions of the Dirac equation. From the beginning, however, the theory was used and applied to problems in other fields of mathematics, numerical analysis, and mathematical physics. recently, the theory has enlarged its scope considerably by incorporating geometrical methods from global analysis on manifolds and methods from representation theory. New, interesting branches of the theory are based on conformally invariant, first-order systems other than the Dirac equation, or systems that are invariant with respect to a group other than the conformal group. This book represents an up-to-date review of Clifford analysis in its present form, its applications, and directions for future research. Readership: Mathematicians and theoretical physicists interested in Clifford analysis itself, or in its applications to other fields.
The Rotation and Lorentz Groups and Their Representations for Physicists American Mathematical Soc.
Group Theory is an indispensable mathematical tool in many branches of chemistry and physics. This book provides a self-contained and rigorous account on the fundamentals and applications of the subject to chemical physics, assuming no prior knowledge of group theory. The first half of the book focuses on elementary topics, such as molecular and crystal symmetry, whilst the latter half is more advanced in nature. Discussions on more complex material such as space groups, projective representations, magnetic crystals and spinor bases, often omitted from introductory texts, are expertly dealt with. With the inclusion of numerous exercises and worked examples, this book will appeal to advanced undergraduates and beginning graduate students studying physical sciences and is an ideal text for use on a two-semester course.