Applications Of Algebraic Geometry To Coding Theory Physics And Computation Nato Science Series Ii

This volume covers many topics, including number theory, Boolean functions, combinatorial geometry, and algorithms over finite fields. It contains many new, theoretical and applicable results, as well as surveys that were presented by the top specialists in these areas. New results include an answer to one of Serre''s questions, posted in a letter to Top; cryptographic applications of the discrete logarithm problem related to elliptic curves and hyperelliptic curves; construction of function field towers; construction of new classes of Boolean cryptographic functions; and algorithmic applications of algebraic geometry. Sample Chapter(s). Chapter 1: Fast addition on non-hyperelliptic genus 3 curves (424 KB). Contents: Symmetric Cryptography and Algebraic Curves (F Voloch); Galois Invariant Smoothness Basis (J-M Couveignes & R Lercier); Fuzzy Pairing-Based CL-PKC (M Kiviharju); On the Semiprimitivity of Cyclic Codes (Y Aubry & P Langevin); Decoding of Scroll Codes (G H Hitching & T Johnsen); An Optimal Unramified Tower of Function Fields (K Brander); On the Number of Resilient Boolean Functions (S Mesnager);

On Quadratic Extensions of Cyclic Projective Planes (H F Law & P P W Wong); Partitions of Vector Spaces over Finite Fields (Y Zelenyuk); and other papers. Readership: Mathematicians, researchers in mathematics (academic and industry R&D).

This volume contains 18 papers at the Algebraic Geometry Conference, Yaroslavl', August 10-14, 1992. These conferences in algebraic geometry have a great tradition in Russia and are helt since 1979 in Yaroslavl' every second year. The present conference, the eighth one, was the first in which several foreign mathematicians participated. From the Russian side, there was a large group of specialists in algebraic geometry and related fields (invariant theory, topology of manifolds, theory of categories, mathematical physics etc.). Lectures on modern directions in algebraic geometry, such as the theory of exceptional bundles and helices on algebraic varieties, moduli of vector bundles on algebraic surfaces with applications to Donaldson's theory, geometry of Hilbert schemes of points, twistor spaces and applications to string theory, and more traditional areas, such as birational geometry of manifolds, adjunction theory, Hodge theory, problems of rationality in the invariant theory, topology of complex algebraic varieties, and others are

contained in this volume.

An illustration of the many uses of algebraic geometry, highlighting the more recent applications of Groebner bases and resultants. Along the way, the authors provide an introduction to some algebraic objects and techniques more advanced than typically encountered in a first course. The book is accessible to non-specialists and to readers with a diverse range of backgrounds, assuming readers know the material covered in standard undergraduate courses, including abstract algebra. But because the text is intended for beginning graduate students, it does not require graduate algebra, and in particular, does not assume that the reader is familiar with modules.

Papers about algebraic geometry and their applications.

Future Vision and Trends on Shapes, Geometry and Algebra

Tensors

Collections of Papers from Shreeram S. Abhyankar ' s 60th Birthday Conference

Using Algebraic Geometry

This monograph is based, in part, upon lectures given in the Princeton School of

Engineering and Applied Science. It presupposes mainly an elementary knowledge of linear algebra and of topology. In topology the limit is dimension two mainly in the latter chapters and questions of topological invariance are carefully avoided. From the technical viewpoint graphs is our only requirement. However, later, questions notably related to Kuratowski's classical theorem have demanded an easily provided treatment of 2-complexes and surfaces. January 1972 Solomon Lefschetz 4 INTRODUCTION The study of electrical networks rests upon preliminary theory of graphs. In the literature this theory has always been dealt with by special ad hoc methods. My purpose here is to show that actually this theory is nothing else than the first chapter of classical algebraic topology and may be very advantageously treated as such by the well known methods of that science. Part I of this volume covers the following ground: The first two chapters present, mainly in outline, the needed basic elements of linear algebra. In this part duality is dealt with somewhat more extensively. In Chapter III the merest elements of general topology are discussed. Graph theory proper is covered in Chapters IV and v, first structurally and then as algebra. Chapter VI discusses the applications to networks. In Chapters VII and VIII the elements of the theory of 2-dimensional complexes and surfaces are presented.

A comprehensive, self-contained treatment presenting general results of the theory. Establishes a geometric intuition and a working facility with specific geometric practices. Emphasizes applications through the study of interesting examples and the development of computational tools. Coverage ranges from analytic to geometric. Treats basic techniques and results of complex manifold theory, focusing on results

applicable to projective varieties, and includes discussion of the theory of Riemann surfaces and algebraic curves, algebraic surfaces and the quadric line complex as well as special topics in complex manifolds.

An up-to-date report on the current status of important research topics in algebraic geometry and its applications, such as computational algebra and geometry, singularity theory algorithms, numerical solutions of polynomial systems, coding theory, communication networks, and computer vision. Contributions on more fundamental aspects of algebraic geometry include expositions related to counting points on varieties over finite fields, Mori theory, linear systems, Abelian varieties, vector bundles on singular curves, degenerations of surfaces, and mirror symmetry of Calabi-Yau manifolds.

The application of geometric algebra to the engineering sciences is a young, active subject of research. The promise of this field is that the mathematical structure of geometric algebra together with its descriptive power will result in intuitive and more robust algorithms. This book examines all aspects essential for a successful application of geometric algebra: the theoretical foundations, the representation of geometric constraints, and the numerical estimation from uncertain data. Formally, the book consists of two parts: theoretical foundations and applications. The first part includes chapters on random variables in geometric algebra, linear estimation methods that incorporate the uncertainty of algebraic elements, and the representation of geometry in Euclidean, projective, conformal and conic space. The second part is dedicated to applications of geometric algebra, which include uncertain geometry and

transformations, a generalized camera model, and pose estimation. Graduate students, scientists, researchers and practitioners will benefit from this book. The examples given in the text are mostly recent research results, so practitioners can see how to apply geometric algebra to real tasks, while researchers note starting points for future investigations. Students will profit from the detailed introduction to geometric algebra, while the text is supported by the author's visualization software, CLUCalc, freely available online, and a website that includes downloadable exercises, slides and tutorials.

Graphs and Networks. The Picard-Lefschetz Theory and Feynman Integrals

Dedicated to Gilles Lachaud on His 60th Birthday : Proceedings of the First SAGA Conference, Papeete, France, 7-11 May 2007

Computations in Algebraic Geometry with Macaulay 2

Geometric Algebra Applications Vol. II

Principles of Algebraic Geometry

Algebraic Geometry and its Applications will be of interest not only to mathematicians but also to computer scientists working on visualization and related topics. The book is based on 32 invited papers presented at a conference in honor of Shreeram Abhyankar's 60th birthday, which was held in June 1990 at Purdue University and attended by many renowned mathematicians (field medalists), computer scientists and engineers. The keynote paper is by G. Birkhoff; other contributors include such leading names in algebraic geometry as R. Hartshorne, J.

Heintz, J.I. Igusa, D. Lazard, D. Mumford, and J.-P. Serre.

Mathematical algorithms are a fundamental component of Computer Aided Design and Manufacturing (CAD/CAM) systems. This book provides a bridge between algebraic geometry and geometric modelling algorithms, formulated within a computer science framework. Apart from the algebraic geometry topics covered, the entire book is based on the unifying concept of using algebraic techniques – properly specialized to solve geometric problems – to seriously improve accuracy, robustness and efficiency of CAD-systems. It provides new approaches as well as industrial applications to deform surfaces when animating virtual characters, to automatically compare images of handwritten signatures and to improve control of NC machines. This book further introduces a noteworthy representation based on 2D contours, which is essential to model the metal sheet in industrial processes. It additionally reviews applications of numerical algebraic geometry to differential equations systems with multiple solutions and bifurcations. Future Vision and Trends on Shapes, Geometry and Algebra is aimed specialists in the area of mathematics and computer science on the one hand and on the other hand at those who want to become familiar with the practical application of algebraic geometry and geometric modelling such as students, researchers and doctorates.

Systems of polynomial equations can be used to model an astonishing variety of

phenomena. This book explores the geometry and algebra of such systems and includes numerous applications. The book begins with elimination theory from Newton to the twenty-first century and then discusses the interaction between algebraic geometry and numerical computations, a subject now called numerical algebraic geometry. The final three chapters discuss applications to geometric modeling, rigidity theory, and chemical reaction networks in detail. Each chapter ends with a section written by a leading expert. Examples in the book include oil wells, HIV infection, phylogenetic models, four-bar mechanisms, border rank, font design, Stewart-Gough platforms, rigidity of edge graphs, Gaussian graphical models, geometric constraint systems, and enzymatic cascades. The reader will encounter geometric objects such as Bézier patches, Cayley-Menger varieties, and toric varieties; and algebraic objects such as resultants, Rees algebras, approximation complexes, matroids, and toric ideals. Two important subthemes that appear in multiple chapters are toric varieties and algebraic statistics. The book also discusses the history of elimination theory, including its near elimination in the middle of the twentieth century. The main goal is to inspire the reader to learn about the topics covered in the book. With this in mind, the book has an extensive bibliography containing over 350 books and papers.

In the last decade, there has been a burgeoning of activity in the design and

implementation of algorithms for algebraic geometric computation. The workshop on Algorithms in Algebraic Geometry that was held in the framework of the IMA Annual Program Year in Applications of Algebraic Geometry by the Institute for Mathematics and Its Applications on September 2006 is one tangible indication of the interest. This volume of articles captures some of the spirit of the IMA workshop.

Homotopical Algebraic Geometry II: Geometric Stacks and Applications

Geometry and Applications

Algorithms in Algebraic Geometry

Robot Modelling and Control

Abstract Algebra

The present volume contains a selection of refereed papers from the MEGA-94 symposium held in Santander, Spain, in April 1994. They cover recent developments in the theory and practice of computation in algebraic geometry and present new applications in science and engineering, particularly computer vision and theory of robotics. The volume will be of interest to researchers working in the areas of computer algebra and symbolic computation as well as to mathematicians and computer scientists interested in gaining access to these topics.

Algebraic K-Theory is crucial in many areas of modern mathematics,

especially algebraic topology, number theory, algebraic geometry, and operator theory. This text is designed to help graduate students in other areas learn the basics of K-Theory and get a feel for its many applications. Topics include algebraic topology, homological algebra, algebraic number theory, and an introduction to cyclic homology and its interrelationship with K-Theory.

A gem of a book bringing together 30 years worth of results that are certain to interest anyone whose research touches on quadratic forms.

These notes present a polished introduction to tropical geometry and contain some applications of this rapidly developing and attractive subject. It consists of three chapters which complete each other and give a possibility for non-specialists to make the first steps in the subject which is not yet well represented in the literature. The notes are based on a seminar at the Mathematical Research Center in Oberwolfach in October 2004. The intended audience is graduate, post-graduate, and Ph.D. students as well as established researchers in mathematics.

Proceedings of the 8th Algebraic Geometry Conference, Yaroslavl' 1992. A Publication from the Steklov Institute of Mathematics. Adviser: Armen Sergeev

Algebraic Geometry and Its Applications

Algorithms in Algebraic Geometry and Applications

Applications of Algebraic K-theory to Algebraic Geometry and Number Theory Bould

Algebraic Geometry and its Applications

The first application of modern algebraic techniques to a comprehensive selection of classical geometric problems. Written with spirit and originality, this is a valuable book for anyone interested in the subject from other than the purely algebraic point of view. Originally published in 1953. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

The discovery of new algorithms for dealing with polynomial equations, and their implementation on fast, inexpensive computers, has revolutionized algebraic geometry and led to

exciting new applications in the field. This book details many uses of algebraic geometry and highlights recent applications of Grobner bases and resultants. This edition contains two new sections, a new chapter, updated references and many minor improvements throughout.

Emerging Applications of Algebraic GeometrySpringer Science & Business Media

Algorithms in algebraic geometry go hand in hand with software packages that implement them. Together they have established the modern field of computational algebraic geometry which has come to play a major role in both theoretical advances and applications. Over the past fifteen years, several excellent general purpose packages for computations in algebraic geometry have been developed, such as, CoCoA, Singular and Macaulay 2. While these packages evolve continuously, incorporating new mathematical advances, they both motivate and demand the creation of new mathematics and smarter algorithms. This volume reflects the workshop "Software for Algebraic Geometry" held in the week from 23 to 27 October 2006, as the second workshop in the thematic year on Applications of Algebraic Geometry at the

IMA. The papers in this volume describe the software packages Bertini, PHClab, Gfan, DEMiCs, SYNAPS, TrIm, Gambit, ApaTools, and the application of Risa/Asir to a conjecture on multiple zeta values. They offer the reader a broad view of current trends in computational algebraic geometry through software development and applications.

Applications of Algebraic Geometry to Error-correcting Codes

Workshop on Algebraic Geometry and Geometric Modeling, July 29-August 2, 2002, Vilnius University, Lithuania

Tropical Algebraic Geometry

Emerging Applications of Algebraic Geometry

Applications of Algebraic Geometry to Coding & Cryptography

This is the second part of a series of papers called ""HAG"", devoted to developing the foundations of homotopical algebraic geometry. The authors start by defining and studying generalizations of standard notions of linear algebra in an abstract monoidal model category, such as derivations, etale and smooth morphisms, flat and projective modules, etc. They then use their theory of stacks over model categories to define a general notion of geometric stack over a base symmetric monoidal model category C, and prove that this notion satisfies the expected properties.

An accessible introduction to convex algebraic geometry and semidefinite optimization.

For graduate students and researchers in mathematics and computer science.
This book presents algorithmic tools for algebraic geometry, with experimental applications. It also introduces Macaulay 2, a computer algebra system supporting research in algebraic geometry, commutative algebra, and their applications. The algorithmic tools presented here are designed to serve readers wishing to bring such tools to bear on their own problems. The first part of the book covers Macaulay 2 using concrete applications; the second emphasizes details of the mathematics.
Tensors are ubiquitous in the sciences. The geometry of tensors is both a powerful tool for extracting information from data sets, and a beautiful subject in its own right. This book has three intended uses: a classroom textbook, a reference work for researchers in the sciences, and an account of classical and modern results in (aspects of) the theory that will be of interest to researchers in geometry. For classroom use, there is a modern introduction to multilinear algebra and to the geometry and representation theory needed to study tensors, including a large number of exercises. For researchers in the sciences, there is information on tensors in table format for easy reference and a summary of the state of the art in elementary language. This is the first book containing many classical results regarding tensors. Particular applications treated in the book include the complexity of matrix multiplication, P versus NP, signal processing, phylogenetics, and algebraic statistics. For geometers, there is material on secant varieties, G-varieties, spaces with finitely many orbits and how these objects arise in

applications, discussions of numerous open questions in geometry arising in applications, and expositions of advanced topics such as the proof of the Alexander-Hirschowitz theorem and of the Weyman-Kempf method for computing syzygies.

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Applications of Polynomial Systems

Geometric Algebra Applications Vol. I

Semidefinite Optimization and Convex Algebraic Geometry

Algebra, Arithmetic and Geometry with Applications

Bridging the gap between novice and expert, the aim of this book is to present in a self-contained way a number of striking examples of current diophantine problems to which Arakelov geometry has been or may be applied. Arakelov geometry can be seen as a link between algebraic geometry and diophantine geometry. Based on lectures from a summer school for graduate students, this volume consists of 12 different chapters, each written by a different author. The first chapters provide some background and introduction to the subject. These are followed by a presentation of different applications to arithmetic geometry. The final part describes the recent application of Arakelov geometry to Shimura varieties and the proof of an averaged version of Colmez's conjecture. This book thus blends initiation to fundamental tools of Arakelov geometry with original material corresponding to current research. This book will be particularly useful for graduate students and researchers interested in the connections between algebraic geometry and number theory. The prerequisites are some knowledge of number theory and algebraic geometry.

The goal of the Volume I Geometric Algebra for Computer Vision, Graphics and Neural Computing is to present a unified mathematical treatment of diverse problems in the general domain of artificial intelligence and associated fields using Clifford, or geometric, algebra. Geometric algebra provides a rich and general mathematical framework for Geometric Cybernetics in order to develop solutions, concepts and computer algorithms without losing geometric insight of the problem in question. Current mathematical subjects can be treated in an unified manner without abandoning the mathematical system of geometric algebra for instance: multilinear algebra, projective and affine geometry, calculus on manifolds, Riemann geometry, the representation of Lie algebras and Lie groups using bivector algebras and conformal geometry. By treating a wide spectrum of problems in a common language, this Volume I offers both new insights and new solutions that should be useful to scientists, and engineers working in different areas related with the development and building of intelligent machines. Each chapter is written in accessible terms accompanied by numerous examples, figures and a complementary appendix on Clifford algebras, all to clarify the theory and the crucial aspects of the application of geometric algebra to problems in graphics engineering, image processing, pattern recognition, computer vision, machine learning, neural computing and cognitive systems.

This textbook equips graduate students and advanced undergraduates with the necessary theoretical tools for applying algebraic geometry to information theory, and it covers primary applications in coding theory and cryptography. Harald Niederreiter and Chaoping Xing provide the first detailed discussion of the interplay between nonsingular projective curves and algebraic function fields over finite fields. This interplay is fundamental to research in the field

today, yet until now no other textbook has featured complete proofs of it. Niederreiter and Xing cover classical applications like algebraic-geometry codes and elliptic-curve cryptosystems as well as material not treated by other books, including function-field codes, digital nets, code-based public-key cryptosystems, and frameproof codes. Combining a systematic development of theory with a broad selection of real-world applications, this is the most comprehensive yet accessible introduction to the field available. Introduces graduate students and advanced undergraduates to the foundations of algebraic geometry for applications to information theory Provides the first detailed discussion of the interplay between projective curves and algebraic function fields over finite fields Includes applications to coding theory and cryptography Covers the latest advances in algebraic-geometry codes Features applications to cryptography not treated in other books

Algebraic geometry and geometric modeling both deal with curves and surfaces generated by polynomial equations. Algebraic geometry investigates the theoretical properties of polynomial curves and surfaces; geometric modeling uses polynomial, piecewise polynomial, and rational curves and surfaces to build computer models of mechanical components and assemblies for industrial design and manufacture. The NSF sponsored the four-day Ỳilnius Workshop on Algebraic Geometry and Geometric Modeling", which brought together some of the top experts in the two research communities to examine a wide range of topics of interest to both fields. This volume is an outgrowth of that workshop. Included are surveys, tutorials, and research papers. In addition, the editors have included a translation of Minding's 1841 paper, Ὸn the determination of the degree of an equation obtained by elimination", which foreshadows the modern application of mixed volumes in algebraic geometry. The volume is suitable for

mathematicians, computer scientists, and engineers interested in applications of algebraic geometry to geometric modeling.

Papers from Shreeram S. Abhyankar's 70th Birthday Conference

Applications of Algebraic Topology

Geometric Algebra with Applications in Engineering

Applications to Galois Theory, Algebraic Geometry, Representation Theory and Cryptography

Geometric Stacks and Applications

A new approach to conveying abstract algebra, the area that studies algebraic structures, such as groups, rings, fields, modules, vector spaces, and algebras, that is essential to various scientific disciplines such as particle physics and cryptology. It provides a well written account of the theoretical foundations and it also includes a chapter on cryptography. End of chapter problems help readers with accessing the subjects.

Proceedings of the Conference on Algebra and Algebraic Geometry with Applications, July 19 – 26, 2000, at Purdue University to honor Professor Shreeram S. Abhyankar on the occasion of his seventieth birthday. Eighty-five of Professor Abhyankar's students, collaborators, and colleagues were invited participants. Sixty participants presented papers related to Professor Abhyankar's broad areas of mathematical interest. Sessions were held on algebraic geometry, singularities, group theory, Galois theory, combinatorics,

Drinfield modules, affine geometry, and the Jacobian problem. This volume offers an outstanding collection of papers by expert authors. An introduction to abstract algebraic geometry, with the only prerequisites being results from commutative algebra, which are stated as needed, and some elementary topology. More than 400 exercises distributed throughout the book offer specific examples as well as more specialised topics not treated in the main text, while three appendices present brief accounts of some areas of current research. This book can thus be used as textbook for an introductory course in algebraic geometry following a basic graduate course in algebra. Robin Hartshorne studied algebraic geometry with Oscar Zariski and David Mumford at Harvard, and with J.-P. Serre and A. Grothendieck in Paris. He is the author of "Residues and Duality", "Foundations of Projective Geometry", "Ample Subvarieties of Algebraic Varieties", and numerous research titles.
Recent advances in both the theory and implementation of computational algebraic geometry have led to new, striking applications to a variety of fields of research. The articles in this volume highlight a range of these applications and provide introductory material for topics covered in the IMA workshops on "Optimization and Control" and "Applications in Biology, Dynamics, and Statistics" held during the IMA year on Applications of Algebraic

Geometry. The articles related to optimization and control focus on burgeoning use of semidefinite programming and moment matrix techniques in computational real algebraic geometry. The new direction towards a systematic study of non-commutative real algebraic geometry is well represented in the volume. Other articles provide an overview of the way computational algebra is useful for analysis of contingency tables, reconstruction of phylogenetic trees, and in systems biology. The contributions collected in this volume are accessible to non-experts, self-contained and informative; they quickly move towards cutting edge research in these areas, and provide a wealth of open problems for future research.

Algebraic Geometry

Quadratic Forms with Applications to Algebraic Geometry and Topology

Topics in Algebraic Geometry and Geometric Modeling

Algebraic K-Theory and Its Applications

Applications of Algebraic Geometry to Coding Theory, Physics and Computation

This book presents a unified mathematical treatment of diverse problems in the general domain of robotics and associated fields using Clifford or geometric alge- bra. By addressing a wide spectrum of problems in a common language, it offers both fresh insights and new solutions that are useful to scientists and engineers working in areas related with robotics. It introduces non-specialists to Clifford and geometric algebra, and provides ex- amples to help readers learn how to compute using geometric

entities and geomet- ric formulations. It also includes an in-depth study of applications of Lie group theory, Lie algebra, spinors and versors and the algebra of incidence using the universal geometric algebra generated by reciprocal null cones. Featuring a detailed study of kinematics, differential kinematics and dynamics using geometric algebra, the book also develops Euler Lagrange and Hamiltoni- ans equations for dynamics using conformal geometric algebra, and the recursive Newton-Euler using screw theory in the motor algebra framework. Further, it comprehensively explores robot modeling and nonlinear controllers, and discusses several applications in computer vision, graphics, neurocomputing, quantum com- puting, robotics and control engineering using the geometric algebra framework. The book also includes over 200 exercises and tips for the development of future computer software packages for extensive calculations in geometric algebra, and a entire section focusing on how to write the subroutines in C++, Matlab and Maple to carry out efficient geometric computations in the geometric algebra framework. Lastly, it shows how program code can be optimized for real-time computations. An essential resource for applied physicists, computer scientists, AI researchers, roboticists and mechanical and electrical engineers, the book clarifies and demon- strates the importance of geometric computing for building autonomous systems to advance cognitive systems research.

Algebraic Geometry in Coding Theory and Cryptography

Arakelov Geometry and Diophantine Applications

Computer Vision, Graphics and Neurocomputing

Applications of Category Theory to Algebraic Geometry

Software for Algebraic Geometry