
The series is designed to bring together those mathematicians who are seriously interested in getting new challenging stimuli from economic theories with those economists who are seeking effective mathematical tools for their research. A lot of economic problems can be formulated as constrained optimizations and equilibration of their solutions. Various mathematical theories have been supplying economists with indispensable machineries for these problems arising in economic theory. Conversely, mathematicians have been stimulated by various mathematical difficulties raised by economic theories.

This volume collects contributions written by different experts in honor of Prof. Jaime Muñoz Masqué. It covers a wide variety of research topics, from differential geometry to algebra, but particularly focuses on the geometric formulation of variational calculus; geometric mechanics and field theories; symmetries and conservation laws of differential equations, and pseudo-Riemannian geometry of homogeneous spaces. It also discusses algebraic applications to cryptography and number theory. It offers state-of-the-art contributions in the context of current research trends. The final result is a challenging panoramic view of connecting problems that initially appear distant.

This volume honors Sir Peter Swinnerton-Dyer's mathematical career spanning more than 60 years of amazing creativity in number theory and algebraic geometry.

Fascinating and surprising developments are taking place in the classification of algebraic varieties. The work of Hacon and McKernan and many others is causing a wave of breakthroughs in the minimal model program: we now know that for a smooth projective variety the canonical ring is finitely generated. These new results and methods are reshaping the field. Inspired by this exciting progress, the editors organized a meeting at Schiermonnikoog and invited leading experts to write papers about the recent developments. The result is the present volume, a lively testimony to the sudden advances that originate from these new ideas. This volume will be of interest to a wide range of pure mathematicians, but will appeal especially to algebraic and analytic geometers.

This book provides comprehensive summaries of theoretical (algebraic) and computational aspects of tensor ranks, maximal ranks, and typical ranks, over the real number field. Although tensor ranks have often been argued in the complex number field, it should be emphasized that this book treats real tensor ranks, which have direct applications in statistics. The book provides several interesting ideas, including determinant polynomials, determinantal ideals, absolutely nonsingular tensors, absolutely full column rank tensors, and their connection to bilinear maps and Hurwitz-Radon numbers. In addition to reviews of methods to determine real tensor ranks in details, global theories such as the Jacobian method are also reviewed in details. The book includes as well an accessible and comprehensive introduction of mathematical backgrounds, with basics of positive polynomials and calculations by using the Groebner basis. Furthermore, this book provides insights into numerical methods of finding tensor ranks through simultaneous singular value decompositions.

This volume contains the proceedings of two AMS Special Sessions "Geometric and Algebraic Aspects of Representation Theory" and "Quantum Groups and Noncommutative Algebraic Geometry" held October 13–14, 2012, at Tulane University, New Orleans, Louisiana. Included in this volume are original research and some survey articles on various aspects of representations of algebras including Kac-Moody algebras, Lie superalgebras, quantum groups, toroidal algebras, Leibniz algebras and their connections with other areas of mathematics and mathematical physics.

This title introduces the theory of arc schemes in algebraic geometry and singularity theory, with special emphasis on recent developments around the Nash problem for surfaces. The main challenges are to understand the global and local structure of arc schemes, and how they relate to the nature of the singularities on the variety. Since the arc scheme is an infinite dimensional object, new tools need to be developed to give a precise meaning to the notion of a singular point of the arc scheme. Other related topics are also...
explored, including motivic integration and dual intersection complexes of resolutions of singularities. Written by leading international experts, it offers a broad overview of different applications of arc schemes in algebraic geometry, singularity theory and representation theory.

The theory of Riemann surfaces occupies a very special place in mathematics. It is a culmination of much of traditional calculus, making surprising connections with geometry and arithmetic. It is an extremely useful part of mathematics, knowledge of which is needed by specialists in many other fields. It provides a model for a large number of more recent developments in areas including manifold topology, global analysis, algebraic geometry, Riemannian geometry, and diverse topics in mathematical physics. This graduate text on Riemann surface theory proves the fundamental analytical results on the existence of meromorphic functions and the Uniformisation Theorem. The approach taken emphasizes PDE methods, applicable more generally in global analysis. The connection with geometric topology, and in particular the role of the mapping class group, is also explained. To this end, some more sophisticated topics have been included, compared with traditional texts at this level. While the treatment is novel, the roots of the subject in traditional calculus and complex analysis are kept well in mind. Part I sets up the interplay between complex analysis and topology, with the latter treated informally. Part II works as a rapid first course in Riemann surface theory, including elliptic curves. The core of the book is contained in Part III, where the fundamental analytical results are proved. Following this section, the remainder of the text illustrates various facets of the more advanced theory.

Offers information on entrance and degree requirements, expenses and financial aid, programs of study, and faculty research specialties.

This volume consists of the written presentations of lectures given at two special sessions: the AMS Special Session on Topology in Dynamics (Winston-Salem, NC) and the AMS-AWM Special Session on Geometry in Dynamics (San Antonio, TX). Each article concerns aspects of the topology or geometry of dynamical systems. Topics covered include the following: foliations and laminations, iterated function systems, the three-body problem, isotopy stability, homoclinic tangles, fractal dimension, Morse homology, knotted orbits, inverse limits, contact structures, Grassmanians, blowups, and continua. New results are presented reflecting current trends in topological aspects of dynamical systems. The book offers a wide variety of topics of special interest to those working in area bridging topology and dynamical systems.

The articles in this volume cover a broad range of topics in algebraic geometry: classical varieties, linear system, birational geometry, Minimal Model Program, moduli spaces, toric varieties, enumerative theory of singularities, equivariant cohomology and arithmetic questions.

A n accessible introduction to convex algebraic geometry and semidefinite optimization. For graduate students and researchers in mathematics and computer science.

This book contains a collection of survey articles of exciting new developments in geometry, written in tribute to Simon Donaldson to celebrate his 60th birthday. Reflecting the wide range of Donaldson's interests and influence, the papers range from algebraic geometry and topology through symplectic geometry and geometric analysis to mathematical physics. Their expository nature means the book acts as an invitation to the various topics described, while also giving a sense of the links between these different areas and the unity of modern geometry.

This is Part 1 of a two-volume set. Since Oscar Zariski organized a meeting in 1954, there has been a major algebraic geometry meeting every decade: Woods Hole (1964), Arcata (1974), Bowdoin (1985), Santa Cruz (1995), and Seattle (2005). The American Mathematical Society has supported these summer institutes for over 50 years. Their proceedings volumes have been extremely influential, summarizing the state of algebraic geometry at the time and pointing to future developments. The most recent Summer Institute in Algebraic Geometry was held July 2015 at the University of Utah in Salt Lake City, sponsored by the AMS with the collaboration of the Clay Mathemtics Institute. This volume includes surveys growing out of plenary lectures and seminar talks during the meeting. Some present a broad overview of their topics, while others develop a distinctive perspective on an emerging topic. Topics span both complex algebraic geometry and arithmetic questions, specifically, analytic techniques, enumerative geometry, moduli theory, derived categories, birational geometry, tropical geometry, Diophantine questions, geometric representation theory, characteristic and -adic tools, etc. The resulting articles will be important references in these areas for years to come.

This book provides an introduction to state-of-the-art applications of homotopy theory to arithmetic geometry. The contributions to this volume are based on original lectures by leading researchers at the LMS-CMI Research School on 'Homotopy Theory and Arithmetic Geometry - Motivic and Diophantine Aspects' and the Nelder Fellow Lecturer Series, which both took place at Imperial College London in the summer of 2018. The contribution by Brazelton, based on the lectures by Wickelgren, provides an introduction to arithmetic enumerative geometry, the notes of Ciocan-Fontanine present motivic sheaves and new cohomological methods for intersection theory, and Schlank's contribution gives an overview of the use of étale homotopy theory for obstructions to the existence of rational points on algebraic varieties. Finally, the article by Asok and Østvær, based in part on the Nelder Fellow lecture series by Østvær, gives a survey of the interplay between motivic homotopy theory and affine algebraic geometry, with a focus on contractible algebraic varieties. Now a major trend in arithmetic geometry, this volume offers a detailed guide to the fascinating circle of recent applications of homotopy theory to number theory. It will be invaluable to research students entering the field, as well as postdoctoral and more established researchers.

Spine title: AISMC-3 : artificial intelligence and symbolic mathematical computation.
A comprehensive collection of expository articles on cutting-edge topics at the forefront of research in algebraic geometry.

This volume contains the papers presented at 6th Conference on Geometric Modeling and Processing (GMP 2010) held in Castro Urdiales, Spain during June 16–18, 2010. Geometric Modeling and Processing is an international conference series on geometric modeling, simulation and computing. Previously, GMP has been held in Hong Kong, Saitama, Japan, Beijing, China, Pittsburgh, USA, and Hangzhou, China. GMP 2010 received a total of 30 submissions that were reviewed by three to four Program Committee members on average. While the number of submissions dropped significantly from previous years, the quality did not and was still quite high overall. Based on the reviews received, the committee decided to accept 20 papers for inclusion in the proceedings. Additionally, extended versions of selected papers were considered for a special issue of Computer Aided Geometric Design (CAAD) and Computer-Aided Geometric Design (CAAD). The papers spanned a wide variety and include: Solutions of transcendental equations – Volume parameterization – Smooth curves and surfaces – Isogeometric analysis – Implicit surfaces – Computational geometry.

Any person who helped make this conference happen and we are grateful for their help. We would especially like to thank the Conference Chair, all of the authors who submitted papers, the Program Committee members who reviewed the papers and all of the participants at the conference.

A run-to-date account of algebraic statistics and information geometry, which also explores the emerging connections between these two disciplines.

More than a study of shapes and angles, geometry reflects an amalgamation of discoveries over time. This book not only provides readers with a comprehensive understanding of geometric shapes, axioms, and formulas, it presents the field’s brilliant minds—from Euclid to Wendelin Werner and many in between—whose works reflect a progression of mathematical thought throughout the centuries and have helped produce the various branches of geometry as we are known today. Detailed diagrams illustrate various concepts and help make geometry accessible to all.

This book constitutes the refereed proceedings of the 6th Conference on Computability in Europe, CiE 2010, held in Ponta Delgada, Azores, Portugal, in June/July 2010. The 28 revised papers presented together with 20 invited lectures were carefully reviewed and selected from 90 submissions. The papers address not only the more established lines of research of computational complexity and the interplay between proofs and computation, but also novel views that rely on physical and biological processes and models to find new ways of tackling computations and improving their efficiency.

This volume is based on lectures delivered at the 2019 AMS Short Course “Sum of Squares: Theory and Applications”, held January 14–15, 2019, in Baltimore, Maryland. This book provides a concise state-of-the-art overview of the theory and applications of polynomials that are sums of squares. This is an exciting and timely topic, with rich connections to many areas of mathematics, including polynomial and semidefinite optimization, real and convex algebraic geometry, and theoretical computer science. The six chapters introduce and survey recent developments in this area; specific topics include the algebraic and geometric aspects of sums of squares and spectrahedra, lifted representations of convex sets, and the algorithmic and computational implications of viewing sums of squares as a meta algorithm. The book also showcases practical applications of the techniques across a variety of areas, including control theory, statistics, finance and machine learning.

The Moment-SOS hierarchy is a powerful methodology that is used to solve the Generalized Moment Problem (GMP) where the list of applications in various areas of Science and Engineering is almost endless. Initially designed for solving polynomial optimization problems (the simplest example of the GMP), it applies to solving any instance of the GMP whose description only involves semialgebraic functions and sets. It consists of solving a sequence (a hierarchy) of convex relaxations of the initial problem, and each convex relaxation is a semidefinite program whose size increases in the hierarchy. The goal of this book is to describe in a unified and detailed manner how this methodology applies to solving various problems in different areas ranging from Optimization, Probability, Statistics, Signal Processing, Computational Geometry, Control, Optimal Control and Analysis of a certain class of nonlinear PDEs. For each application, this unconventional methodology differs from traditional approaches and provides an unusual viewpoint. Each chapter is devoted to a particular application, where the methodology is thoroughly described and illustrated on some appropriate examples. The exposition is kept at an appropriate level of detail to aid the different levels of readers not necessarily familiar with these tools, to better know and understand this methodology.

Now back in print, this highly regarded book has been updated to reflect recent advances in the theory of semistable coherent sheaves and their moduli spaces, which include moduli spaces in positive characteristic, moduli spaces of principal bundles and of complexes, Hilbert schemes of points on surfaces, derived categories of coherent sheaves, and moduli spaces of sheaves on Calabi-Yau threefolds. The authors review changes in the field since the publication of the original edition in 1997 and point the reader towards further literature. References have been brought up to date and errors removed. Developed from the authors’ lectures, this book is ideal as a text for graduate students as well as a valuable resource for any mathematician with a background in algebraic geometry who wants to learn more about Grothendieck’s approach.

This book is a collection of selected papers written by researchers of our “RISC” institute (Research Institute for Symbolic Computation) along with the ESPRIT MEDLAR Project (Mechanizing Deduction in the Logics of Practical Reasoning). Naturally, the MEDLAR Project was and is the focal point for our institute whose main objective is the combination of foundation research in the area of symbolic computation and possible applications thereof for high-tech industrial projects. I am grateful to the director of the MEDLAR project, Jim Cunningham, for his enthusiasm, profound expertise, and continuous effort to manage a fruitful cooperation between various European working groups in the area of the project and for giving us the opportunity to be part of this challenging endeavor. I also acknowledge and feel indebted to Jochen Pfalzgraf for managing the RISC part of the MEDLAR project and to both him and Dongming Wang for editing this volume and organizing the refereeing process.
The field of geometry reflects a conglomeration of discoveries over time. Filled with detailed diagrams, this insightful volume offers serious students a comprehensive understanding of the fundamentals of geometry, including geometric shapes, axioms, and formulas. In addition, it covers some of the field's most illustrious minds, from Euclid to Wendelin Werner, figures who have helped produce the various branches of geometry as we know them today. This enlightening volume will help students understand the principles of geometry, and also the fascinating story behind the numbers.

This book concerns the theory of unipotent elements in simple algebraic groups over algebraically closed or finite fields, and nilpotent elements in the corresponding simple Lie algebras. These topics have been an important area of study for decades, with applications to representation theory, character theory, the subgroup structure of algebraic groups and finite groups, and the classification of the finite simple groups. The main focus is on obtaining full information on class representatives and centralizers of unipotent and nilpotent elements. Although there is substantial literature on this topic, this book is the first single source where such information is presented completely in all characteristics. In addition, many of the results are new—for example, those concerning centralizers of nilpotent elements in small characteristics. Indeed, the whole approach, while using some ideas from the literature, is novel, and yields many new general and specific facts concerning the structure and embeddings of centralizers.

Torsors, also known as principal bundles or principal homogeneous spaces, are ubiquitous in mathematics. The purpose of this book is to present expository lecture notes and cutting-edge research papers on the theory and applications of torsors and étale homotopy, all written from different perspectives by leading experts. Part one of the book contains lecture notes on recent uses of torsors in geometric invariant theory and representation theory, plus an introduction to the étale homotopy theory of A 6 and Mazar. Part two of the book features a milestone paper on the étale homotopy approach to the arithmetic of rational points. Furthermore, the reader will find a collection of research articles on algebraic groups and homogeneous spaces, rational and K 3 surfaces, geometric invariant theory, rational points, descent, and the Brauer–Manin obstruction. Together, these give a state-of-the-art view of a broad area at the crossroads of number theory and algebraic geometry.

Analytic and algebraic geometers often study the same geometric structures but bring different methods to bear on them. While this dual approach has been spectacularly successful at solving problems, the language differences between algebra and analysis also represent a difficulty for students and researchers in geometry, particularly complex geometry. The PCMI program was designed to partially address this language gap, by presenting some of the active developments in algebraic and analytic geometry in a form suitable for students on the ‘other side’ of the analysis-algebra language divide. One focal point of the summer school was multiplier ideals, a subject of wide current interest in both subjects. The present volume is based on a series of lectures at the PCMI summer school on analytic and algebraic geometry. The series is designed to give a high-level introduction to the advanced techniques behind some recent developments in algebraic and analytic geometry. The lectures contain many illustrative examples, detailed computations, and new perspectives on the topics presented, in order to enhance access of this material to non-specialists. *Analytic and algebraic geometers often study the same geometric structures but bring different methods to bear on them. While this dual approach has been spectacularly successful at solving problems, the language differences between algebra and analysis also represent a difficulty for students and researchers in geometry, particularly complex geometry. The PCMI program was designed to partially address this language gap, by presenting some of the active developments in algebraic and analytic geometry in a form suitable for students on the ‘other side’ of the analysis-algebra language divide. One focal point of the summer school was multiplier ideals, a subject of wide current interest in both subjects. The present volume is based on a series of lectures at the PCMI summer school on analytic and algebraic geometry. The series is designed to give a high-level introduction to the advanced techniques behind some recent developments in algebraic and analytic geometry. The lectures contain many illustrative examples, detailed computations, and new perspectives on the topics presented, in order to enhance access of this material to non-specialists. *--Publisher's description.

Visionary articles explaining approaches to important problems on the interface of pure mathematics and mathematical physics.

Despite the renown of the Fields Medals, J. C. Fields has been until now a rather obscure figure, and recovering details about his professional activities and personal life was not at all a simple task. This work is a triumph of persistence with far-friaging archival and documentary sources, and provides a rich non-mathematical portrait of the man in all aspects of his life and career. Highly readable and replete with period detail, the book sheds light on the mathematical and scientific world of Fields' time, and is sure to remain the definitive biographical study. *-Tom Archibald, Simon Fraser University, Burnaby, BC, Canada Drawing on a wide array of archival sources, Riehm and Hoffman provide a vivid account of Fields' life and his part in the founding of the highest award in mathematics. Filled with intriguing detail—-from a childhood on the shores of Lake Ontario, through the mathematics seminars of late 19th century Berlin, to the post-WW1 years of the fragmented international mathematical community--it is a richly textured story engagingly and sympathetically told. Read this book and you will understand why Fields never wanted the medal to bear his name and yet why, quite rightly, it does. --June Barrow-Green, Open University, Milton Keynes, United Kingdom One of the little-known effects of World War I was the collapse of international scientific cooperation. In mathematics, the discord continued after the war’s end and after the Treaty of Versailles had been signed in 1919. Many distinguished scientists were involved in the war and its aftermath, and from their letters and papers, now almost a hundred years old, we learn of their anguished wartime views and their struggles afterwards to prolong the schism in mathematics or to end it. J. C. Fields, the foremost Canadian mathematician of his time, was educated in Canada, the United States, and Germany, and championed an international spirit of cooperation to further the frontiers of mathematics. It was during the awkward post-war period that J. C. Fields established the Fields Medal, an international prize for outstanding research, which soon became the highest award in mathematics. J. C. Fields intended it to be an international medal, and a glance at the varying backgrounds of the fifty-two Fields medalists shows it to be so. Who was Fields? What carried him from Hamilton, Canada West, where he was born in 1863, into the middle of this turbulent era of international scientific politics? A modest mathematician, he was an unassuming man. This biography outlines Fields’ life and times and the difficult circumstances in which he created the Fields Medal. It is the first such published study.

This book provides a comprehensive and up-to-date introduction to Hodge theory—one of the central and most vibrant areas of contemporary mathematics—from leading specialists on the subject. The topics range from the basic topology of algebraic varieties to the study of variations of mixed Hodge structure and the Hodge theory of maps. Of particular interest is the study of algebraic cycles, including the Hodge and Bloch-Belinson Conjectures. Based on lectures delivered at the 2010 Summer School on Hodge Theory at the ICTP in Trieste, Italy, the book is intended for a broad group of students and researchers. The exposition is as accessible as possible and doesn't require a deep background. At the same time, the book presents some topics at the forefront of current research. The book is divided between introductory and advanced lectures. The introductory lectures address Kähler manifolds, variations of Hodge structure, mixed Hodge structures, the Hodge theory of maps, period domains and period mappings, algebraic cycles (up to and including the Bloch-Belinson conjecture) and Chow groups, sheaf cohomology, and a new treatment of Grothendieck’s algébric de Rham theorem. The advanced lectures address a Hodge-theoretic perspective on Shimura varieties, the spread philosophy in the study.
of algebraic cycles, absolute Hodge classes (including a new, self-contained proof of Deligne's theorem on absolute Hodge cycles), and variation of mixed Hodge structures. The contributors include Patrick Brosnan, James Carlson, Eduardo Cattani, François Charles, Mark Andrea de Cataldo, Fouad El Zein, Mark L. Green, Phillip A. Griffiths, Matt Kerr, Lê D?ng Tráng, Luca Migliorini, Jacob P. Murre, Christian Schnell, and Loring W. Tu.

Here are the refereed proceedings of the 8th International Conference on Artificial Intelligence and Symbolic Computation, AISC 2006. The book presents 18 revised full papers together with 4 invited papers, organized in topical sections on artificial intelligence and theorem proving, symbolic computation, constraint satisfaction/solving, and mathematical knowledge management. Coverage includes mathematical foundations, implementations, and applications in industry and academia.

This monograph provides a systematic treatment of the Brauer group of schemes, from the foundational work of Grothendieck to recent applications in arithmetic and algebraic geometry. The importance of the cohomological Brauer group for applications to Diophantine equations and algebraic geometry was discovered soon after this group was introduced by Grothendieck. The Brauer–Manin obstruction plays a crucial role in the study of rational points on varieties over global fields. The birational invariance of the Brauer group was recently used in a novel way to establish the irrationality of many new classes of algebraic varieties. The book covers the vast theory underpinning these and other applications. Intended as an introduction to cohomological methods in algebraic geometry, most of the book is accessible to readers with a knowledge of algebra, algebraic geometry and algebraic number theory at graduate level. Much of the more advanced material is not readily available in book form elsewhere; notably, de Jong’s proof of Gabber’s theorem, the specialisation method and applications of the Brauer group to rationality questions, an in-depth study of the Brauer–Manin obstruction, and proof of the finiteness theorem for the Brauer group of abelian varieties and K3 surfaces over finitely generated fields. The book surveys recent work and also gives detailed proofs of basic theorems, maintaining a balance between general theory and concrete examples. Over half a century after Grothendieck’s foundational seminars on the topic, The Brauer–Grothendieck Group is a treatise that fills a longstanding gap in the literature, providing researchers, including research students, with a valuable reference on a central object of algebraic and arithmetic geometry.

This book provides a comprehensive introduction to the interactions between noncommutative algebra and classical algebraic geometry.

Offers information on entrance and degree requirements, expenses and financial aid, programs of study, and faculty research specialties.

Moduli theory is the study of how objects, typically in algebraic geometry but sometimes in other areas of mathematics, vary in families and is fundamental to an understanding of the objects themselves. First formalised in the 1960s, it represents a significant topic of modern mathematical research with strong connections to many areas of mathematics (including geometry, topology and number theory) and other disciplines such as theoretical physics. This book, which arose from a programme at the Isaac Newton Institute in Cambridge, is an ideal way for graduate students and more experienced researchers to become acquainted with the wealth of ideas and problems in moduli theory and related areas. The reader will find articles on both fundamental material and cutting-edge research topics, such as: algebraic stacks; BPS states and the P=W conjecture; stability conditions; derived differential geometry; and counting curves in algebraic varieties, all written by leading experts.

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