New Publications Offered by the AMS

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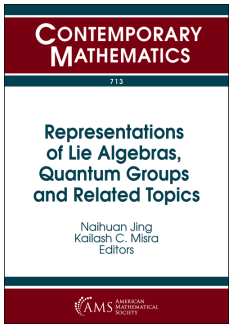
Algebra and Algebraic Geometry



Representations of Lie Algebras, Quantum Groups and Related Topics

Naihuan Jing, *North Carolina State University, Raleigh, NC*, and **Kailash C. Misra**, *North Carolina State University, Raleigh, NC*, Editors

This volume contains the proceedings of the AMS Special Session on Representations of Lie Algebras, Quantum Groups and Related Topics, held from November 12–13, 2016, at North Carolina State University, Raleigh, North Carolina.

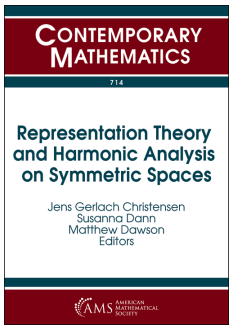
The articles cover various aspects of representations of Kac–Moody Lie algebras and their applications, structure of Leibniz algebras and Krichever–Novikov algebras, representations of quantum groups, and related topics.

Contents: I. I. Anguelova, The two bosonizations of the CKP hierarchy: Overview and character identities; **B. Bakalov** and **M. Sullivan**, Inhomogeneous supersymmetric bilinear forms; **B. Cox**, **V. Futorny**, and **K. C. Misra**, Imaginary crystal bases for $U_q(\widehat{\mathfrak{sl}(2)})$-modules in category $\mathcal{O}^q_{\mathrm{red,im}}$; **B. Cox** and **M. S. Im**, On the module structure of the center of hyperelliptic Krichever-Novikov algebras; **I. Demir**, Classification of 5-dimensional complex nilpotent Leibniz algebras; **V. Futorny**, **D. Grantcharov**, and **L. E. Ramirez**, Gelfand-Tsetlin modules of $\mathfrak{sl}(3)$ in the principal block; **J. Hong**, Fusion rings revisited; **N. Jing**, **K. C. Misra**, and **H. Yamane**, Kostant-Lusztig $\mathbb{A}$-bases of multiparameter quantum groups; **K.-H. Lee** and **S.-J. Oh**, Catalan triangle numbers and binomial coefficients; **D. Muthiah** and **D. Orr**, Walk algebras, distinguished subexpressions, and point counting in Kac-Moody flag varieties; **A. Varchenko** and **T. Woodruff**, Critical points of master functions and mKdV hierarchy of type $A^{(2)}_{2n}$.

Contemporary Mathematics, Volume 713

September 2018, 240 pages, Softcover, ISBN: 978-1-4704-3696-4, LC 2018005031, 2010 *Mathematics Subject Classification:* 05E10, 11B39, 14M15, 17A32, 17B10, 17B37, 17B67, 17B69, 20G05, 81R50, **AMS members US$93.60**, List US$117, Order code CONM/713

Analysis



Representation Theory and Harmonic Analysis on Symmetric Spaces

Jens Gerlach Christensen, *Colgate University, Hamilton, NY*, **Susanna Dann**, *Vienna University of Technology, Wien, Austria*, and **Matthew Dawson**, *CIMAT, Mérida, Mexico*, Editors

This volume contains the proceedings of the AMS Special Session on Harmonic Analysis, in honor of Gestur Ólafsson's 65th birthday, held on January 4, 2017, in Atlanta, Georgia.

The articles in this volume provide fresh perspectives on many different directions within harmonic analysis, highlighting the connections between harmonic analysis and the areas of integral geometry, complex analysis, operator algebras, Lie algebras, special functions, and differential operators. The breadth of contributions highlights the diversity of current research in harmonic analysis and shows that it continues to be a vibrant and fruitful field of inquiry.

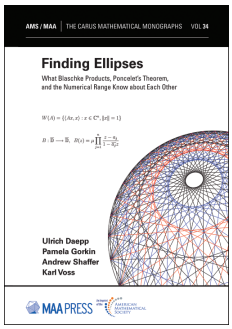
This item will also be of interest to those working in algebra and algebraic geometry.

Contents: A. Alldridge, **S. Sahi**, and **H. Salmasian**, Schur Q-functions and the Capelli eigenvalue problem for the Lie superalgebra $\mathfrak{q}(n)$; **I. Cho** and **P. E. T. Jorgensen**, Analysis of free products of the general linear groups $GL_2(\mathbb{Q}_p)$ and Hecke algebras $\mathcal{H}(GL_2(\mathbb{Q}_p))$ over primes p; **J. G. Christensen**, Atomic decompositions of mixed norm Bergman spaces on tube type domains; **P. Clare**, C*-algebraic normalization and Godement-Jacquet factors; **M. Dawson** and **R. Quiroga-Barranco**, Radial Toeplitz operators on the weighted Bergman spaces

of Cartan domains; **R. W. Donley, Jr.** and **W. G. Kim**, A rational theory of Clebsch-Gordan coefficients; **R. Estrada** and **B. Rubin**, Radon-John transforms and spherical harmonics; **S. Helgason**, Spherical functions on Riemannian symmetric spaces; **M. Hunziker**, **M. R. Sepanski**, and **R. J. Stanke**, Schrödinger-type equations and unitary highest weight representations of the metaplectic group; **T. Kobayashi**, Residue formula for regular symmetry breaking operators; **K.-H. Neeb**, On the geometry of standard subspaces; **M. J. Slupinski** and **R. J. Stanton**, Pure spinors and a construction of the E_*-Lie algebras; **J. A. Wolf**, Representations on partially holomorphic cohomology spaces, revisited.

Contemporary Mathematics, Volume 714

September 2018, 303 pages, Softcover, ISBN: 978-1-4704-4070-1, LC 2018005036, 2010 *Mathematics Subject Classification:* 15A66, 17B40, 20C08, 22E46, 22E50, 32L25, 32M15, 43A90, 53C35, 81R40, **AMS members US$93.60**, List US$117, Order code CONM/714



Finding Ellipses

What Blaschke Products, Poncelet's Theorem, and the Numerical Range Know about Each Other

Ulrich Daepp, **Pamela Gorkin**, **Andrew Shaffer**, and **Karl Voss**, *Bucknell University, Lewisburg, PA*

Mathematicians delight in finding surprising connections between seemingly disparate areas of mathematics. Whole domains of modern mathematics have arisen from exploration of such connections—consider analytic number theory or algebraic topology. *Finding Ellipses* is a delight-filled romp across a three-way unexpected connection between complex analysis, linear algebra, and projective geometry.

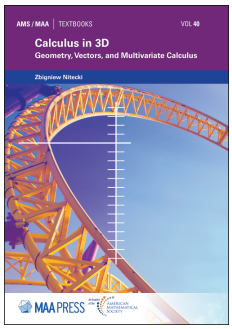
The book begins with Blaschke products, complex-analytic functions that are generalizations of disk automorphisms. In the analysis of Blaschke products, we encounter, in a quite natural way, an ellipse inside the unit disk. The story continues by introducing the reader to Poncelet's theorem—a beautiful result in projective geometry that ties together two conics and, in particular, two ellipses, one circumscribed by a polygon that is inscribed in the second. The Blaschke ellipse and the Poncelet ellipse turn out to be the same ellipse, and the connection is illuminated by considering the numerical range of a 2×2 matrix. The numerical range is a convex subset of the complex plane that contains information about the geometry of the transformation represented by a matrix. Through the numerical range of $n \times n$ matrices, we learn more about the interplay between Poncelet's theorem and Blaschke products.

The story ranges widely over analysis, algebra, and geometry, and the exposition of the deep and surprising connections is lucid and compelling. Written for advanced undergraduates or beginning graduate students, this book would be the perfect vehicle for an invigorating and enlightening capstone exploration. The exercises and collection of extensive projects could be used as an embarkation point for a satisfying and rich research project. You are invited to read actively using the accompanying interactive website, which allows you to visualize the concepts in the book, experiment, and develop original conjectures.

Contents: *Part 1:* The surprising ellipse; The ellipse three ways; Blaschke products; Blaschke products and ellipses; Poncelet's theorem for triangles; The numerical range; The connection revealed; *Intermezzo:* And now for something completely different...Benford's law; *Part 2:* Compressions of the shift operator: The basics; Higher dimensions: Not your Poncelet ellipse; Interpolation with Blaschke products; Poncelet's theorem for n-gons; Kippenhahn's curve and Blaschke's products; Iteration, ellipses, and Blaschke products; On suprising connections; *Part 3:* Fourteen projects for fourteen chapters; Index; Bibliography.

Carus Mathematical Monographs, Volume 34

October 2018, approximately 264 pages, Hardcover, ISBN: 978-1-4704-4383-2, LC 2018021655, 2010 *Mathematics Subject Classification:* 47A05, 47A12, 30J10, 15-02, 15A60, 51-02, 51M04, 51N35, **Individual member US$47.25**, List US$63, Institutional member US$50.40, Order code CAR/34



Calculus in 3D

Geometry, Vectors, and Multivariate Calculus

Zbigniew Nitecki, *Tufts University, Medford, MA*

Calculus in 3D is an accessible, well-written textbook for an honors course in multivariable calculus for mathematically strong first- or second-year university students. The treatment given here carefully balances theoretical rigor, the development of student facility in the procedures and algorithms, and inculcating intuition into underlying geometric principles. The focus throughout is on two or three dimensions. All of the standard multivariable material is thoroughly covered, including vector calculus treated through both vector fields and differential forms. There are rich collections of problems ranging from the routine through the theoretical to deep, challenging problems suitable for in-depth projects. Linear algebra is developed as needed. Unusual features include a rigorous formulation of cross products and determinants as oriented area, an in-depth treatment of conics harking back to the classical Greek ideas, and a more extensive than usual exploration and use of parametrized curves and surfaces.

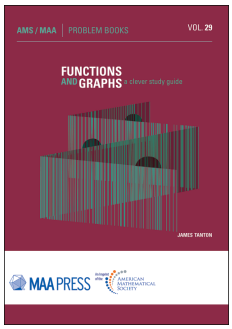
Zbigniew Nitecki is Professor of Mathematics at Tufts University and a leading authority on smooth dynamical systems. He is the author of *Differentiable Dynamics*, MIT Press; *Differential Equations, A First Course* (with M. Guterman), Saunders; *Differential Equations with Linear Algebra* (with M. Guterman), Saunders; and *Calculus Deconstructed*, MAA Press.

Contents: Coordinates and vectors; Curves and vector-valued functions of one variable; Differential calculus for real-valued functions of several variables; Integral calculus for real-valued functions of several variables; Integral calculus for vector fields and differential forms; Appendix; Bibliography; Index.

MAA Textbooks, Volume 40

October 2018, 405 pages, Hardcover, ISBN: 978-1-4704-4360-3, LC 2018020561, 2010 *Mathematics Subject Classification:* 26-01, **Individual member US$59.25**, List US$79, Institutional member US$63.20, Order code TEXT/40

General Interest



Functions and Graphs

A Clever Study Guide

James Tanton, *Mathematical Association of America, Washington, DC*

A playful, readable, and thorough guide to precalculus, this book is directed at readers who would like a holistic look at the high school curriculum material on functions and their graphs. Tanton provides a coherent guided tour of exploration and discovery of a rich mathematical landscape. The exploration is presented through problems selected from the history of the Mathematical Association of America's American Mathematics Competition (AMC).

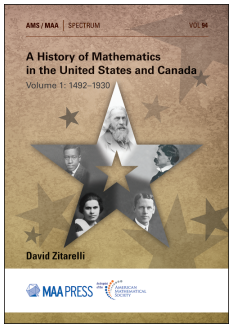
Secondary school teachers looking for supplementary and enrichment materials will find this a rich resource, which aligns with national curriculum standards. High school and college calculus and precalculus students will discover an approachable and thought-provoking review, preview, and overview of these central mathematical ideas. Students preparing for the AMC should find it especially helpful. Active reading, with pencil in hand, will result in a deep appreciation and understanding of the properties of functions.

James Tanton is the MAA's mathematician-at-large. A research mathematician with experience teaching at both the college and high school levels, he now works to encourage and aid all mathematics instructors to teach—and all mathematics students to learn—joyously and effectively.

Contents: *Functions and graphs:* What is a function? A swift conceptual overview; Sequences as functions on $\mathbb{N}$; Numerical functions on $\mathbb{R}$; Composite functions and inverse functions; Graphing; Transformations of graphs; Average rate of change, constant rate of change; Quadratic functions; Polynomial functions; Rational functions; Select special functions and equations; Fitting formulas to data points; *Solutions:* Solutions; *Appendices:* Ten problem-solving strategies; Connections to the Common Core State Standards: Practice standards and content standards.

Problem Books, Volume 29

September 2018, 218 pages, Softcover, ISBN: 978-1-4704-4349-8, 2010 *Mathematics Subject Classification:* 97-XX, **Individual member US$22.50**, List US$30, Institutional member US$24, Order code PRB/29



A History of Mathematics in the United States and Canada

Volume 1: 1492–1930

David E. Zitarelli, *Temple University, Philadelphia, PA*

This is the first truly comprehensive and thorough history of the development of mathematics in the United States and Canada. This first volume of a two-volume work takes the reader from the European encounters with North America in the fifteenth century up to the emergence of the United States as a world leader in mathematics in the 1930s.

In the story of the Colonial period particular emphasis is given to several prominent Colonial figures—Jefferson, Franklin, and Rittenhouse—and four important early colleges—Québec, Harvard, Yale, and William & Mary. During the first three-quarters of the nineteenth century, mathematics in North America was largely the occupation of scattered individual pioneers: Bowditch, Farrar, Adrain, B. Peirce. This period is given a fuller treatment here than previously in the literature, including the creation of the first PhD programs and attempts to form organizations and found journals.

With the founding of Johns Hopkins University in 1876, the American mathematical research community was finally, and firmly, founded. The programs at Hopkins, Chicago, and Clark are detailed as are the influence of major European mathematicians, including especially Klein, Hilbert, and Sylvester. Extensive histories of early areas of American emphasis are provided, including axiomatics, topology, and group theory. Also included are the early histories of statistics and cryptology in America, laying the foundation for the latter topic's role in abstract algebra in the 1950s. The stories of both the American Mathematical Society and the Mathematical Association of America are presented in detail.

David Zitarelli is emeritus Professor of Mathematics at Temple University. A decorated and acclaimed teacher, scholar, and expositor, he is one of the world's leading experts on the development of American mathematics. Author or co-author of over a dozen books, this is his *magnum opus*—sure to become the leading reference on the topic and essential reading, not just for historians. In clear and compelling prose, Zitarelli spins a tale accessible to experts, generalists, and anyone interested in the history of science in North America.

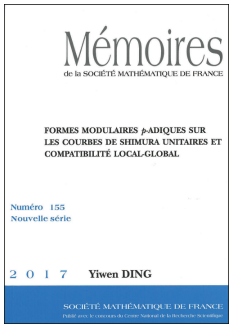
Contents: *Part I: Colonial Era and Period of Confederation, 1492–1800:* Beginnings; Independence; Transition 1776: The patriot; *Part II: New republic, 1800–1876:* The age of Bowditch; The age of Peirce; Transition 1876: Story vs. Klein; *Part III: Research community, 1876–1900:* Sylvester, Klein, AMS; Chicago; The 1890s; Transition 1900: Hilbert's American colony; *Part IV: Consolidation and growth, 1900–1930:* Establishment, 1900–1914; Wartime, 1914–1920; The Roaring Twenties; More Roaring Twenties; Transition 1930: Albert vs. Hasse; Endnotes; Bibliography; Index.

Spectrum, Volume 94

October 2018, 768 pages, Hardcover, ISBN: 978-1-4704-4829-5, 2010 *Mathematics Subject Classification:* 01A60, 01A70, 01A72, 01A73, **Individual member US$90**, List US$120, Institutional member US$96, Order code SPEC/94

New AMS-Distributed Publications

Algebra and Algebraic Geometry



Formes Modulaires p-Adiques sur les Courbes de Shimura Unitaires et Compatibilité Local-Global

Yiwen Ding, *Peking University, Beijing, China*

The author studies p-adic modular forms over unitary Shimura curves and proves the existence of overconvergent companion forms over unitary Shimura curves using p-adic comparison theorems. Together with some locally analytic representation theory of $\mathrm{GL}_2(L)$, the author deduces some local-global compatibility results on the socle for the completed H^1 of unitary Shimura curves. In addition, using an adjunction formula for the Jacquet-Emerton functor in family and global triangulation theory, the author also proves some local-global compatibility results for non semi-simple locally analytic representations.

This item will also be of interest to those working in number theory.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Mémoires de la Société Mathématique de France, Number 155

May 2018, 245 pages, Softcover, ISBN: 978-2-85629-877-0, 2010 *Mathematics Subject Classification:* 11F85, 22E50, **AMS members US$53.60**, List US$67, Order code SMFMEM/155

Actes du 1er Congrès National de la SMF—Tours, 2016

Cédric Lecouvey, *Université François, Rabelais-Tours, France*, Editor

This volume gathers the contributions of plenary speakers of the first congress of the French Mathematical Society, which took place in 2016 in Tours. Marie-Claude Arnaud explains the link between Hamiltonian dynamics and Lagrangian variational methods as a smooth introduction to Aubry-Mather's theory.

Sophie Grivaux, with Catalin Badea, discusses some classes of integers, namely Jamison and Kazhhan sets, in light of operator theory and harmonic analysis. Bertrand Toën, with Gabriele Vezzosi, presents a general approach for establishing Bloch's conductor formula, which is a conjectural formula describing how the topology in a family of algebraic varieties changes when the parameter is specialized to a critical value. Sébastien Gouëzel exploits all the richness of subadditivity properties and of horofunctions to describe the asymptotic behavior of random semi-contractions. Finally, Alexander Tsybakov, with Pierre Bellec and Guilaume Lecué, focuses on the performance of some least squares estimators with convex penalty and presents the main ideas and tools that have shown substantial improvements in recent years.

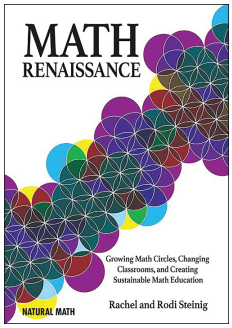
This item will also be of interest to those working in number theory.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Séminaires et Congrès, Number 31

May 2018, 136 pages, Softcover, ISBN: 978-2-85629-866-4, 2010 *Mathematics Subject Classification:* 14A22, 14F05, 14F42, 22D10, 22D40, 37A15, 37A30, 37H15, 37J05, 37J35, 37J40, 37J50, 43A07, 46M05, 47A10, 62J05, 62J07, 70H05, **AMS members US$41.60**, List US$52, Order code SECO/31

Math Education



Math Renaissance

Growing Math Circles, Changing Classrooms, and Creating Sustainable Math Education

Rachel Steinig and **Rodi Steinig**

Math Renaissance is a book for teachers and parents of children ages five and up. The co-authors Rodi and Rachel Steinig share their insights as mother and daughter, co-teachers, and co-learners. In her chapters, Rodi tells stories about her math circle and exactly what happens there. Rachel discusses why so many kids hate math, documents the ways math is taught in the classroom, and celebrates improvements in mathematics education. The book shifts mathematics education toward inquiry, discovery, conceptual understanding, and lasting joy.

The book gives voice to many students, parents, and teachers. It is a grassroots effort to make people aware of problems and successes in math education. It will help you find validation of your feelings, math circle know-how, and classroom investigations of geometry, logic, functions, and optimization.

Everybody can access the beauty and joy in mathematics. Parents, teachers, and mathematicians have a vision of math being taught in a way that's collaborative, profound, and accessible to everybody, a Math Renaissance, if you will. The authors hope the book will repair damaged relationships with math and enhance good ones.

A publication of Delta Stream Media, an imprint of Natural Math. Distributed in North America by the American Mathematical Society.

Natural Math Series, Volume 8

May 2018, 205 pages, Softcover, ISBN: 978-1-945899-04-1, **AMS members US$19.20**, List US$24, Order code NMATH/8