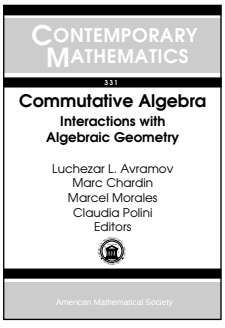
New Publications Offered by the AMS

Algebra and Algebraic Geometry



Commutative Algebra

Interactions with Algebraic Geometry

Luchezar L. Avramov, *University of Nebraska, Lincoln,* **Marc Chardin**, *Université de Paris VI,* **Marcel Morales**, *University of Grenoble I, St. Martin d'Heres, France*, and **Claudia Polini**, *University of Notre Dame, IN*, Editors

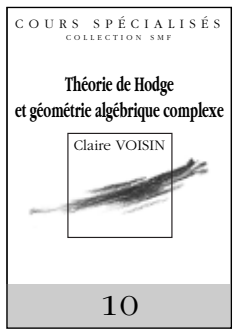
This volume contains 21 articles based on invited talks given at two international conferences held in France in 2001. Most of the papers are devoted to various problems of commutative algebra and their relation to properties of algebraic varieties.

The book is suitable for graduate students and research mathematicians interested in commutative algebra and algebraic geometry.

Contents: J. À. Montaner and **S. Zarzuela**, Linearization of local cohomology modules; **M. Brion**, Multiplicity-free subvarieties of flag varieties; **R.-O. Buchweitz**, Morita contexts, idempotents, and Hochschild cohomology—with applications to invariant rings—; **A. Campillo** and **S. Encinas**, Some applications of two dimensional complete ideals; **S. D. Cutkosky**, Generically finite morphisms and simultaneous resolution of singularities; **J. Elias**, Two results on the number of generators; **K. Eto**, When is a binomial ideal equation equal to a lattice ideal up to radical?; **H.-B. Foxby** and **S. Iyengar**, Depth and amplitude for unbounded complexes; **A. Guerrieri** and **I. Swanson**, On the ideal of minors of matrices of linear forms; **M. Hashimoto**, Surjectivity of multiplication and *F*-regularity of multigraded rings; **J. Herzog**, **D. Popescu**, and **M. Vladoiu**, On the Ext-modules of ideals of Borel type; **M. R. Johnson**, Sums of linked tepli ideals; **B. Malgrange**, Cartan involutiveness = Mumford regularity; **C. Miller**, The Frobenius endomorphism and homological dimensions; **U. Nagel**, Characterization of some projective subschemes by locally free resolutions; **O. Piltant**, On unique factorization in semigroups of complete ideals; **J.-E. Roos**, Modules with strange homological properties and Chebychev polynomials; **M. E. Rossi** and **I. Swanson**, Notes on the behavior of the Ratliff-Rush filtration; **S. Sather-Wagstaff**, On symbolic powers of prime ideals; **W. V. Vasconcelos**, Multiplicities and the number of generators of Cohen-Macaulay ideals; **K.-i. Watanabe**, Chains of integrally closed ideals.

Contemporary Mathematics, Volume 331

August 2003, 376 pages, Softcover, ISBN 0-8218-3233-6, LC 2003050343, 2000 *Mathematics Subject Classification*: 13B22, 13C40, 13D02, 13D45, 13E15, 13H10, 13H15, 14E22, 14M05, 35N10, **All AMS members $71**, List $89, Order code CONM/331N



Théorie de Hodge et géometrie algébrique complexe

Claire Voisin

This book uses material from both complex differential geometry and complex algebraic geometry.

The first part of the book presents the fundamental results of Hodge theory, including a few preliminary chapters on Kähler geometry and sheaf cohomology. It concludes with the development of the notion of Hodge structure and the study of its variation with respect to the complex structure.

The second part is more advanced and presents applications of Hodge theory to complex algebraic geometry. It starts with a study of the topology of families of algebraic varieties, both from a classical and modern point of view, and then focuses on the applications of the theory of infinitesimal variations of Hodge structure. The last chapters are devoted to the presentation of the relations between Hodge theory and algebraic cycles, whose conjectural part is the famous Bloch-Beilinson conjecture.

This book will be useful for Ph.D. students and for researchers interested in modern methods of differential and algebraic geometry. Readers will find here a complete didactic exposition and an up-to-date presentation of applications of Hodge theory to the study of algebraic cycles.

(continued)

A publication of the Société Mathématique de France (SMF). Distributed by the AMS in North America. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

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

Contents: Introduction; *Partie I. Préliminaires:* Fonctions holomorphes de plusieurs variables; Variétés complexes; Métriques kählériennes; Faisceaux et cohomologie; *Partie II. La décomposition de Hodge:* Formes harmoniques et cohomologie; Cas des variétés kählériennes; Structures de Hodge et polarisations; Complexes de de Rham holomorphes et suites spectrales; *Partie III. Variations de structure de Hodge:* Familles et déformations; Variation de structure de Hodge; *Partie IV. Cycles et classes de cycles:* Classes de Hodge; Cohomologie de Deligne-Beilinson et application d'Abel-Jacobi; *Partie V. Topologie des variétés algébriques:* Le théorème de Lefschetz sur les sections hyperplanes; Étude des pinceaux de Lefschetz; Monodromie; Suite spectrale de Leray; *Partie VI. Variation de structure de Hodge:* Transversalité et applications; Filtration de Hodge des hypersurfaces; Fonctions normales et invariants infinitésimaux; Travaux de Nori; *Partie VII. Cycles algébriques:* Groupes de Chow; Le théorème de Mumford et ses généralisations; La conjecture de Bloch et ses génèralisations; Bibliographie; Index.

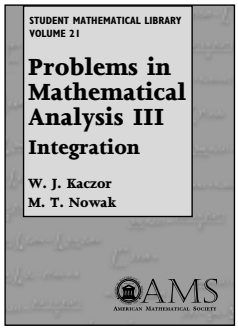
Cours Spécialisés—Collection SMF, Number 10

May 2003, 595 pages, Softcover, ISBN 2-85629-129-5, 2000 *Mathematics Subject Classification*: 14Cxx, 14Dxx, 32Cxx, 32Gxx, **Individual member $62**, List $69, Order code COSP/10N

Analysis

Supplementary Reading

Independent Study



Problems in Mathematical Analysis III

Integration

W. J. Kaczor and **M. T. Nowak**, *Marie Curie-Sklodowska University, Lublin, Poland*

From reviews for Volumes I and II:

A valuable resource.

—American Mathematical Monthly

Would be an ideal choice for tutorial or problem-solving seminars. The volume is also suitable for self-study … presentation of material is designed to help student comprehension and to encourage them to ask their own questions and to start research … a really useful book for practice in mathematical analysis.

—Zentralblatt MATH

Belongs to the great tradition of Eastern European problem books … if you love mathematics and are serious about understanding analysis, this book is a must.

—MAA Online

A very stimulating problem book … The style … is proven to be a motivating approach in constructing and conveying mathematical knowledge … leads the readers to find new solutions and hence boosts their ability to carry out further research … thorough coverage of some topics that are covered very briefly in other compatible books … of interest to anyone who wishes to pursue research in mathematical analysis and its applications … also excellent for students who want to enhance their skills in real analysis … a useful supplement to any graduate textbook in mathematical analysis … some problems are also suitable for undergraduate students.

—MAA Online

The best way to penetrate the subtleties of the theory of integration is by solving problems. This book, like its two predecessors, is a wonderful source of interesting and challenging problems. As a resource, it is unequaled. It offers a much richer selection than is found in any current textbook. Moreover, the book includes a complete set of solutions.

This is the third volume of *Problems in Mathematical Analysis*. The topic here is integration for real functions of one real variable. The first chapter is devoted to the Riemann and the Riemann-Stieltjes integrals. Chapter 2 deals with Lebesgue measure and integration.

The authors include some famous, and some not so famous, inequalities related to Riemann integration. Many of the problems for Lebesgue integration concern convergence theorems and the interchange of limits and integrals. The book closes with a section on Fourier series, with a concentration on Fourier coefficients of functions from particular classes and on basic theorems for convergence of Fourier series.

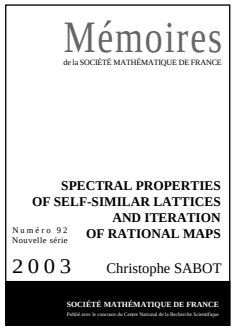
The book is mainly geared toward students studying the basic principles of analysis. However, given its selection of problems, organization, and level, it would be an ideal choice for tutorial or problem-solving seminars, particularly those geared toward the Putnam exam. It is also suitable for self-study. The presentation of the material is designed to help student comprehension, to encourage them to ask their own questions, and to start research. The collection of problems will also help teachers who wish to incorporate problems into their lectures. The problems are grouped into sections according to the methods of solution. Solutions for the problems are provided.

Problems in Mathematical Analysis I and *II* are available as Volumes 4 and 12 in the AMS series, Student Mathematical Library.

Contents: *Problems:* The Riemann-Stieltjes integral; The Lebesgue integral; *Solutions:* The Riemann-Stieltjes integral; The Lebesgue integral; Bibliography; Index.

Student Mathematical Library, Volume 21

September 2003, approximately 368 pages, Softcover, ISBN 0-8218-3298-0, LC 99-087039, 2000 *Mathematics Subject Classification*: 00A07, 26A42; 26A45, 26A46, 26D15, 28A12, **All AMS members $39**, List $49, Order code STML/21N



Spectral Properties of Self-Similar Lattices and Iterations of Rational Maps

Christophe Sabot, *Université Paris VI*

In this text, the author considers discrete Laplace operators defined on lattices based on finitely ramified self-similar sets and their continuous analogs defined on the self-similar sets. He focuses on the spectral properties of these operators. The basic example is the lattice based on the Sierpinski gasket. He introduces a new renormalization map which appears to be a rational map defined on a smooth projective variety. (More precisely, this variety is isomorphic to a product of three types of Grassmannians: complex Grassmannians, Lagrangian Grassmannian, and orthogonal Grassmannians.) He relates some characteristics of the dynamics of its iterates with some characteristics of the spectrum of the operator. Specifically, he gives an explicit formula for the density of states in terms of the Green current of the map, and he relates the indeterminacy points of the map with the so-called Neumann-Dirichlet eigenvalues which lead to eigenfunctions with compact support on the unbounded lattice. Depending on the asymptotic degree of the map, he can prove drastically different spectral properties of the operators. The formalism is valid for the general class of finitely ramified self-similar sets.

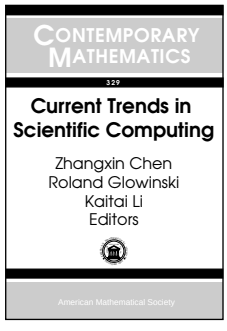
A publication of the Société Mathématique de France (SMF). Distributed by the AMS in North America. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Definitions and basic results; Preliminaries; The renormalization map. Expression of the density of states; Analysis of the psh function $G_{|\pi^{-1}(\mathbb{L}^G)}$; Examples; Remarks, questions and conjecture; Appendix; Bibliography.

Mémoires de la Société Mathématique de France, Number 92

April 2003, 104 pages, Softcover, ISBN 2-85629-133-3, 2000 *Mathematics Subject Classification*: 82B44, 32H50, 28A80, **Individual member $32**, List $36, Order code SMFMEM/92N

Applications



Current Trends in Scientific Computing

Zhangxin Chen, *Southern Methodist University, Dallas, TX*, **Roland Glowinski**, *University of Houston, TX*, and **Kaitai Li**, *Xi'an Jiaotong University, PRC*, Editors

This volume contains 36 research papers written by prominent researchers. The papers are based on a large satellite conference on scientific computing held at the International Congress of Mathematics (ICM) in Xi'an, China.

Topics covered include a variety of subjects in modern scientific computing and its applications, such as numerical discretization methods, linear solvers, parallel computing, high performance computing, and applications to solid and fluid mechanics, energy, environment, and semiconductors. The book will serve as an excellent reference work for graduate students and researchers working with scientific computing for problems in science and engineering.

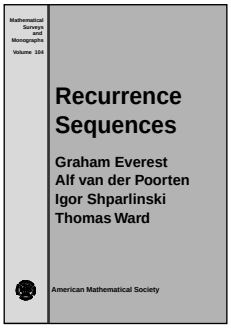
Contents: R. Abgrall, **M. Papin**, and **L. Hallo**, A scheme for compressible two-phase flows and interface problems; **S. Amini** and **A. T. J. Profit**, Multi-level fast multipole Galerkin method for the boundary integral solution of the exterior Helmholtz equation; **T. Arbogast**, An overview of subgrid upscaling for elliptic problems in mixed form; **D. N. Arnold** and **R. Winther**, Mixed finite elements for elasticity in the stress-displacement formulation; **W. Auzinger**, **O. Koch**, and **E. Weinmüller**, New variants of defect correction for boundary value problems in ordinary differential equations; **Z. Chen**, **R. Glowinski**, and **J. He**, Scientific computing in energy and environment; **S.-S. Chow** and **G. F. Carey**, Approximate analysis of extended Williamson fluids for Powell-Sabin-Heindl elements; **P. Cummings** and **X. Feng**, Frequency domain method for the scalar wave equation with second order absorbing boundary condition; **Z. Dostál** and **D. Horák**, Scalable FETI with optimal dual penalty for semicoercive variational inequalities; **C. C. Douglas** and **G. Haase**, Algebraic multigrid and Schur complement strategies within a multilayer spectral element ocean model; **J. Douglas, Jr.**, **S. Kim**, and **H. Lim**, An improved alternating-direction method for a viscous wave equation; **Q. Du**, Diverse vortex dynamics in superfluids; **R. E. Ewing**, **J. Liu**, and **H. Wang**, Adaptive wavelet methods for advection-reaction equations; **J. L. Guermond** and **P. D. Minev**, Approximation of an MHD problem using Lagrange finite elements; **B. Guo**, Best approximation for the p-version of the finite element method in three dimensions in the framework of the Jacobi-weighted Besov spaces; **Guo Ben-Yu** and **Wang Li-Lian**, Non-isotropic Jacobi spectral method; **N. Herrmann**, Improved method for solving the heat equation with BEM and collocation; **M. Hokr**, **J. Maryška**, and **J. Šembera**, Modelling of transport with non-equilibrium effects in dual-porosity media; **Y. Hou** and **K. Li**, Error estimate for a two-level scheme of Newton type for the Navier-Stokes equations; **Y. Kuznetsov**, **K. Lipnikov**, **S. Lyons**, and **S. Maliassov**, Mathematical modeling and numerical algorithms for poroelastic problems; **M.-C. Lai**, Fast Poisson solver in a three-dimensional ellipsoid; **B. Li**, **Z. Chen**, and **G. Huan**, Modeling horizontal wells with the CVFA method in black oil reservoir simulations; **J. Li** and **Y. Chen**, Radial basis function based meshless method for groundwater modeling; **D. Liang**, Upwinding finite covolume methods for unsteady convection-diffusion problems; **J. Liu**, **Z. Chen**, **R. E. Ewing**, **G. Huan**, **B. Li**, and **Z. Wang**, Parallel computing in the black oil model; **J. Maryška**, **J. Novák**, **P. Rálek**, and **J. Šembera**, Finite element model of piezoelectric resonator; **B. Rivière** and **M. F. Wheeler**, Discontinuous finite element methods for acoustic and elastic wave problems; **L. Schaefer** and **P. Wang**, Heuristics for developing variations on future air traffic schedule characteristics for air traffic simulation; **J. Šembera**, **J. Maryška**, and **J. Novák**, FEM/FVM modelling of processes in a combustion engine; **J. Shi**, **D. L. S. McElwain**, and **E. Donskoi**, A finite control volume method for the reduction of an iron ore-coal composite pellet in an axisymmetric temperature field; **J. Tausch**, The fast multipole method for arbitrary Green's functions; **R. Wang** and **Z. Chen**, A mathematical model for ESP simulation; **M. Vohralík**, **J. Maryška**, and **O. Severýn**, Mixed-hybrid discrete fracture network model; **H. Xu**, **C. Zhang**, and **R. M. Barron**, A new numerical algorithm for treatment of

convective terms and its applications to PDEs; **J. Xu**, **S. Dong**, **M. R. Maxey**, and **G. E. Karniadakis**, Direct numerical simulation of turbulent channel flow with bubbles; **X. Yu** and **Q. Dai**, RKDG finite element schemes combined with a gas-kinetic method for one-dimensional compressible Euler equations.

Contemporary Mathematics, Volume 329

September 2003, approximately 392 pages, Softcover, ISBN 0-8218-3261-1, LC 2003048135, 2000 *Mathematics Subject Classification*: 76S05, 74S10, 65N30, 68W10, 65M60, 41A10, 35L05, 93A30, 80A32, **All AMS members $71**, List $89, Order code CONM/329N

Number Theory



Recurrence Sequences

Graham Everest, *University of East Anglia, Norwich, England*, **Alf van der Poorten** and **Igor Shparlinski**, *Macquarie University, Sydney, NSW, Australia*, and **Thomas Ward**, *University of East Anglia, Norwich, England*

Recurrence sequences are of great intrinsic interest and have been a central part of number theory for many years. Moreover, these sequences appear almost everywhere in mathematics and computer science. This book surveys the modern theory of linear recurrence sequences and their generalizations. Particular emphasis is placed on the dramatic impact that sophisticated methods from Diophantine analysis and transcendence theory have had on the subject. Related work on bilinear recurrences and an emerging connection between recurrences and graph theory are covered. Applications and links to other areas of mathematics are described, including combinatorics, dynamical systems and cryptography, and computer science. The book is suitable for researchers interested in number theory, combinatorics, and graph theory.

This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: Definitions and techniques; Zeros, multiplicity and growth; Periodicity; Operations on power series and linear recurrence sequences; Character sums and solutions of congruences; Arithmetic structure of recurrence sequences; Distribution in finite fields and residue rings; Distribution modulo 1 and matrix exponential functions; Applications to other sequences; Elliptic divisibility sequences; Sequences arising in graph theory and dynamics; Finite fields and algebraic number fields; Pseudo-random number generators; Computer science and coding theory; Appendix: Sequences from the on-line encyclopedia; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 104

August 2003, 318 pages, Hardcover, ISBN 0-8218-3387-1, LC 2003050346, 2000 *Mathematics Subject Classification*: 11B37, 11B39, 11G05, 33B10, 11J71, 11K45, 11B85, 37B15, 94A60, 11T23, **All AMS members $63**, List $79, Order code SURV/104N