

Cambridge University Press

978-1-009-01888-3 — Surveys in Combinatorics 2021

Edited by Konrad K. Dabrowski, Maximilien Gadouleau, Nicholas Georgiou, Matthew Johnson,
George B. Mertzios, Daniël Paulusma

Frontmatter

[More Information](#)

LONDON MATHEMATICAL SOCIETY LECTURE NOTE SERIES

Managing Editor: Professor Endre Süli, Mathematical Institute, University of Oxford,
Woodstock Road, Oxford OX2 6GG, United KingdomThe titles below are available from booksellers, or from Cambridge University Press at
www.cambridge.org/mathematics

- 360 Zariski geometries, B. ZILBER
 361 Words: Notes on verbal width in groups, D. SEGAL
 362 Differential tensor algebras and their module categories, R. BAUTISTA, L. SALMERÓN & R. ZUAZUA
 363 Foundations of computational mathematics, Hong Kong 2008, F. CUCKER, A. PINKUS & M.J. TODD (eds)
 364 Partial differential equations and fluid mechanics, J.C. ROBINSON & J.L. RODRIGO (eds)
 365 Surveys in combinatorics 2009, S. HUCZYNSKA, J.D. MITCHELL & C.M. RONEY-DOUGAL (eds)
 366 Highly oscillatory problems, B. ENGQUIST, A. FOKAS, E. HAIRER & A. ISERLES (eds)
 367 Random matrices: High dimensional phenomena, G. BLOWER
 368 Geometry of Riemann surfaces, F.P. GARDINER, G. GONZÁLEZ-DIEZ & C. KOUROUNIOTIS (eds)
 369 Epidemics and rumours in complex networks, M. DRAIEF & L. MASSOULIÉ
 370 Theory of p -adic distributions, S. ALBEVERIO, A.YU. KHRENNIKOV & V.M. SHELKOVICH
 371 Conformal fractals, F. PRZYTYCKI & M. URBANSKI
 372 Moonshine: The first quarter century and beyond, J. LEPOWSKY, J. MCKAY & M.P. TUIE (eds)
 373 Smoothness, regularity and complete intersection, J. MAJADAS & A. G. RODICIO
 374 Geometric analysis of hyperbolic differential equations: An introduction, S. ALINHAC
 375 Triangulated categories, T. HOLM, P. JØRGENSEN & R. ROUQUIER (eds)
 376 Permutation patterns, S. LINTON, N. RUŠKUC & V. VATTER (eds)
 377 An introduction to Galois cohomology and its applications, G. BERHUY
 378 Probability and mathematical genetics, N. H. BINGHAM & C. M. GOLDIE (eds)
 379 Finite and algorithmic model theory, J. ESPARZA, C. MICHAUX & C. STEINHORN (eds)
 380 Real and complex singularities, M. MANOEL, M.C. ROMERO FUSTER & C.T.C. WALL (eds)
 381 Symmetries and integrability of difference equations, D. LEVI, P. OLVER, Z. THOMOVA & P. WINTERNITZ (eds)
 382 Forcing with random variables and proof complexity, J. KRAJČEK
 383 Motivic integration and its interactions with model theory and non-Archimedean geometry I, R. CLUCKERS, J. NICAISE & J. SEBAG (eds)
 384 Motivic integration and its interactions with model theory and non-Archimedean geometry II, R. CLUCKERS, J. NICAISE & J. SEBAG (eds)
 385 Entropy of hidden Markov processes and connections to dynamical systems, B. MARCUS, K. PETERSEN & T. WEISSMAN (eds)
 386 Independence-friendly logic, A.L. MANN, G. SANDU & M. SEVENSTER
 387 Groups St Andrews 2009 in Bath I, C.M. CAMPBELL *et al* (eds)
 388 Groups St Andrews 2009 in Bath II, C.M. CAMPBELL *et al* (eds)
 389 Random fields on the sphere, D. MARINUCCI & G. PECCATI
 390 Localization in periodic potentials, D.E. PELINOVSKY
 391 Fusion systems in algebra and topology, M. ASCHBACHER, R. KESSAR & B. OLIVER
 392 Surveys in combinatorics 2011, R. CHAPMAN (ed)
 393 Non-abelian fundamental groups and Iwasawa theory, J. COATES *et al* (eds)
 394 Variational problems in differential geometry, R. BIELAWSKI, K. HOUSTON & M. SPEIGHT (eds)
 395 How groups grow, A. MANN
 396 Arithmetic differential operators over the p -adic integers, C.C. RALPH & S.R. SIMANCA
 397 Hyperbolic geometry and applications in quantum chaos and cosmology, J. BOLTE & F. STEINER (eds)
 398 Mathematical models in contact mechanics, M. SOFONEA & A. MATEI
 399 Circuit double cover of graphs, C.-Q. ZHANG
 400 Dense sphere packings: a blueprint for formal proofs, T. HALES
 401 A double Hall algebra approach to affine quantum Schur–Weyl theory, B. DENG, J. DU & Q. FU
 402 Mathematical aspects of fluid mechanics, J.C. ROBINSON, J.L. RODRIGO & W. SADOWSKI (eds)
 403 Foundations of computational mathematics, Budapest 2011, F. CUCKER, T. KRICK, A. PINKUS & A. SZANTO (eds)
 404 Operator methods for boundary value problems, S. HASSI, H.S.V. DE SNOO & F.H. SZAFRANIEC (eds)
 405 Torsors, étale homotopy and applications to rational points, A.N. SKOROBOGATOV (ed)
 406 Appalachian set theory, J. CUMMINGS & E. SCHIMMERLING (eds)
 407 The maximal subgroups of the low-dimensional finite classical groups, J.N. BRAY, D.F. HOLT & C.M. RONEY-DOUGAL
 408 Complexity science: the Warwick master's course, R. BALL, V. KOLOKOLTSOV & R.S. MACKAY (eds)
 409 Surveys in combinatorics 2013, S.R. BLACKBURN, S. GERKE & M. WILDON (eds)
 410 Representation theory and harmonic analysis of wreath products of finite groups, T. CECCHERINI-SILBERSTEIN, F. SCARABOTTI & F. TOLLI
 411 Moduli spaces, L. BRAMBILA-PAZ, O. GARCÍA-PRADA, P. NEWSTEAD & R.P. THOMAS (eds)
 412 Automorphisms and equivalence relations in topological dynamics, D.B. ELLIS & R. ELLIS

Cambridge University Press

978-1-009-01888-3 — Surveys in Combinatorics 2021

Edited by Konrad K. Dabrowski, Maximilien Gadouleau, Nicholas Georgiou, Matthew Johnson,
George B. Mertzios, Daniël Paulusma

Frontmatter

[More Information](#)

- 413 Optimal transportation, Y. OLLIVIER, H. PAJOT & C. VILLANI (eds)
 414 Automorphic forms and Galois representations I, F. DIAMOND, P.L. KASSAEI & M. KIM (eds)
 415 Automorphic forms and Galois representations II, F. DIAMOND, P.L. KASSAEI & M. KIM (eds)
 416 Reversibility in dynamics and group theory, A.G. O'FARRELL & I. SHORT
 417 Recent advances in algebraic geometry, C.D. HACON, M. MUSTAŢĂ & M. POPA (eds)
 418 The Bloch–Kato conjecture for the Riemann zeta function, J. COATES, A. RAGHURAM, A. SAIKIA &
 R. SUJATHA (eds)
 419 The Cauchy problem for non-Lipschitz semi-linear parabolic partial differential equations, J.C. MEYER &
 D.J. NEEDHAM
 420 Arithmetic and geometry, L. DIEULEFAIT *et al* (eds)
 421 O-minimality and Diophantine geometry, G.O. JONES & A.J. WILKIE (eds)
 422 Groups St Andrews 2013, C.M. CAMPBELL *et al* (eds)
 423 Inequalities for graph eigenvalues, Z. STANIĆ
 424 Surveys in combinatorics 2015, A. CZUMAJ *et al* (eds)
 425 Geometry, topology and dynamics in negative curvature, C.S. ARAVINDA, F.T. FARRELL &
 J.-F. LAFONT (eds)
 426 Lectures on the theory of water waves, T. BRIDGES, M. GROVES & D. NICHOLLS (eds)
 427 Recent advances in Hodge theory, M. KERR & G. PEARLSTEIN (eds)
 428 Geometry in a Fréchet context, C.T.J. DODSON, G. GALANIS & E. VASSILIOU
 429 Sheaves and functions modulo p , L. TAELEMAN
 430 Recent progress in the theory of the Euler and Navier–Stokes equations, J.C. ROBINSON, J.L. RODRIGO,
 W. SADOWSKI & A. VIDAL-LÓPEZ (eds)
 431 Harmonic and subharmonic function theory on the real hyperbolic ball, M. STOLL
 432 Topics in graph automorphisms and reconstruction (2nd Edition), J. LAURI & R. SCAPELLATO
 433 Regular and irregular holonomic D-modules, M. KASHIWARA & P. SCHAPIRA
 434 Analytic semigroups and semilinear initial boundary value problems (2nd Edition), K. TAIRA
 435 Graded rings and graded Grothendieck groups, R. HAZRAT
 436 Groups, graphs and random walks, T. CECCHERINI-SILBERSTEIN, M. SALVATORI &
 E. SAVA-HUSS (eds)
 437 Dynamics and analytic number theory, D. BADZIAHIN, A. GORODNIK & N. PEYERIMHOFF (eds)
 438 Random walks and heat kernels on graphs, M.T. BARLOW
 439 Evolution equations, K. AMMARI & S. GERBI (eds)
 440 Surveys in combinatorics 2017, A. CLAESON *et al* (eds)
 441 Polynomials and the mod 2 Steenrod algebra I, G. WALKER & R.M.W. WOOD
 442 Polynomials and the mod 2 Steenrod algebra II, G. WALKER & R.M.W. WOOD
 443 Asymptotic analysis in general relativity, T. DAUDÉ, D. HÄFNER & J.-P. NICOLAS (eds)
 444 Geometric and cohomological group theory, P.H. KROPHOLLER, I.J. LEARY, C. MARTÍNEZ-PÉREZ &
 B.E.A. NUCINKIS (eds)
 445 Introduction to hidden semi-Markov models, J. VAN DER HOEK & R.J. ELLIOTT
 446 Advances in two-dimensional homotopy and combinatorial group theory, W. METZLER &
 S. ROSEBROCK (eds)
 447 New directions in locally compact groups, P.-E. CAPRACE & N. MONOD (eds)
 448 Synthetic differential topology, M.C. BUNGE, F. GAGO & A.M. SAN LUIS
 449 Permutation groups and cartesian decompositions, C.E. PRAEGER & C. SCHNEIDER
 450 Partial differential equations arising from physics and geometry, M. BEN AYED *et al* (eds)
 451 Topological methods in group theory, N. BROADDUS, M. DAVIS, J.-F. LAFONT & I. ORTIZ (eds)
 452 Partial differential equations in fluid mechanics, C.L. FEFFERMAN, J.C. ROBINSON & J.L. RODRIGO (eds)
 453 Stochastic stability of differential equations in abstract spaces, K. LIU
 454 Beyond hyperbolicity, M. HAGEN, R. WEBB & H. WILTON (eds)
 455 Groups St Andrews 2017 in Birmingham, C.M. CAMPBELL *et al* (eds)
 456 Surveys in combinatorics 2019, A. LO, R. MYCROFT, G. PERARNAU & A. TREGLOWN (eds)
 457 Shimura varieties, T. HAINES & M. HARRIS (eds)
 458 Integrable systems and algebraic geometry I, R. DONAGI & T. SHASKA (eds)
 459 Integrable systems and algebraic geometry II, R. DONAGI & T. SHASKA (eds)
 460 Wigner-type theorems for Hilbert Grassmannians, M. PANKOV
 461 Analysis and geometry on graphs and manifolds, M. KELLER, D. LENZ & R.K. WOJCIECHOWSKI
 462 Zeta and L -functions of varieties and motives, B. KAHN
 463 Differential geometry in the large, O. DEARRICOTT *et al* (eds)
 464 Lectures on orthogonal polynomials and special functions, H.S. COHL & M.E.H. ISMAIL (eds)
 465 Constrained Willmore surfaces, Á.C. QUINTINO
 466 Invariance of modules under automorphisms of their envelopes and covers, A.K. SRIVASTAVA,
 A. TUGANBAEV & P.A. GUIL ASENSIO
 467 The genesis of the Langlands program, J. MUELLER & F. SHAHIDI
 468 (Co)end calculus, F. LOREGIAN
 469 Computational cryptography, J.W. BOS & M. STAM

Cambridge University Press

978-1-009-01888-3 — Surveys in Combinatorics 2021

Edited by Konrad K. Dabrowski, Maximilien Gadouleau, Nicholas Georgiou, Matthew Johnson,
George B. Mertzios, Daniël Paulusma

Frontmatter

[More Information](#)

London Mathematical Society Lecture Note Series: 470

Surveys in Combinatorics 2021

Edited by

KONRAD K. DABROWSKI

Durham University

MAXIMILIEN GADOLEAU

Durham University

NICHOLAS GEORGIU

Durham University

MATTHEW JOHNSON

Durham University

GEORGE B. MERTZIOS

Durham University

DANIËL PAULUSMA

Durham University



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press

978-1-009-01888-3 — Surveys in Combinatorics 2021

Edited by Konrad K. Dabrowski, Maximilien Gadouleau, Nicholas Georgiou, Matthew Johnson,
George B. Mertzios, Daniël Paulusma

Frontmatter

[More Information](#)

CAMBRIDGE UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre,
New Delhi – 110025, India

79 Anson Road, #06–04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of
education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781009018883

DOI: 10.1017/9781009036214

© Cambridge University Press 2021

This publication is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without the written
permission of Cambridge University Press.

First published 2021

Printed in the United Kingdom by TJ Books Limited, Padstow Cornwall

A catalogue record for this publication is available from the British Library.

ISBN 978-1-009-01888-3 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of
URLs for external or third-party internet websites referred to in this publication
and does not guarantee that any content on such websites is, or will remain,
accurate or appropriate.

Contents

<i>Preface</i>	<i>page vii</i>
Konrad K. Dabrowski, Maximilien Gadouleau, Nicholas Georgiou, Matthew Johnson, George B. Mertzios, Daniël Paulusma	
1 The partition complex: an invitation to combinatorial commutative algebra	1
Karim Adiprasito and Geva Yashfe	
2 Hasse-Weil type theorems and relevant classes of polynomial functions	43
Daniele Bartoli	
3 Decomposing the edges of a graph into simpler structures	103
Marthe Bonamy	
4 Generating graphs randomly	133
Catherine Greenhill	
5 Recent advances on the graph isomorphism problem	187
Martin Grohe and Daniel Neuen	
6 Extremal aspects of graph and hypergraph decomposition problems	235
Stefan Glock, Daniela Kühn and Deryk Osthus	
7 Borel combinatorics of locally finite graphs	267
Oleg Pikhurko	
8 Codes and designs in Johnson graphs with high symmetry	321
Cheryl E. Praeger	
9 Maximal subgroups of finite simple groups: classifications and applications	343
Colva M. Roney-Dougal	

Cambridge University Press

978-1-009-01888-3 — Surveys in Combinatorics 2021

Edited by Konrad K. Dabrowski, Maximilien Gadouleau, Nicholas Georgiou, Matthew Johnson,
George B. Mertzios, Daniël Paulusma

Frontmatter

[More Information](#)

Preface

The Twenty-Eighth British Combinatorial Conference is to be delivered online from Durham University from 5th July to 9th July 2021. The British Combinatorial Committee has invited nine distinguished combinatorialists to give survey lectures in areas of their expertise, and this volume contains survey articles on which these lectures are based.

In compiling this volume, we are indebted to the authors for preparing their articles so accurately and professionally, and to the referees for their rapid responses and constructive comments. We would also like to thank Tom Harris and Anna Scriven at Cambridge University Press. Finally, without the previous efforts of editors of earlier Surveys and the guidance of the British Combinatorial Committee, the preparation of this volume would have been somewhat daunting.

This conference is organised in partnership with the Clay Mathematics Institute, the Institute of Combinatorics and its Applications and Durham University; we thank each of these organisations for their generous involvement and support.

Konrad K. Dabrowski
Maximilien Gadouleau
Nicholas Georgiou
Matthew Johnson
George B. Mertzios
Daniël Paulusma
Durham University

January 2021