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British citizen, Hong Kong permanent resident

Research Interests

Algebraic structures on combinatorial objects (e.g. symmetric functions, combinatorial Hopf algebras/monoids, dual graded graphs, Solomon's descent algebra), and their interaction with Markov chains.

Employment

2016 - present Assistant Professor, Hong Kong Baptist University, Hong Kong
2014 - 2016 CRM-ISM postdoctoral fellow, Laboratoire de Combinatoire et d'Informatique Mathématique (LaCIM), Université du Québec à Montréal (UQAM), Canada
2015 Course Lecturer (part time), McGill University, Montreal, Canada

Education

2014 PhD in Mathematics, Stanford University, USA (*Advisor: Persi Diaconis; dissertation title: Hopf Algebras and Markov Chains*)
2009 Certificate of Advanced Study in Mathematics ('Part III') with distinction, Trinity Hall, University of Cambridge, UK
2008 BA in Mathematics with first class honours, Trinity Hall, University of Cambridge, UK

Awards

2019 Faculty/School/Academy Performance Award in Early Career Teaching

Research Grants

2018-2020 RGC-ECS: *Markov Chains driven by Permuted and Hyperoctahedral Descent Operators on Combinatorial Hopf Algebras.*

Publications

- 7 [Lumpings of Algebraic Markov Chains arise from Subquotients](#), J. Theoret. Probab., 32 (2019), no. 4, 1804–1844.
- 6 (with M. Josuat-Vergès) [Subalgebras of Solomon's Descent Algebra based on Alternating Runs](#), J. Combin. Theory Ser. A, 158 (2018), 36–65.
- 5 [Card-Shuffling via Convolutions of Projections on Combinatorial Hopf Algebras](#), 27th Annual International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2015), 49–60, Discrete Math. Theor. Comput. Sci. Proc., Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2015.
- 4 (with P. Diaconis, A. Ram) [Hopf Algebras and Markov Chains: Two Examples and a Theory](#), J. Algebraic Combin., 39 (2014), no. 3, 527–585.

- 3 [A Hopf-power Markov chain on Compositions](#), 25th Annual International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2013), 499-510, Discrete Math. Theor. Comput. Sci. Proc., AS, Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2013.
- 2 (with 27 others) [Supercharacters, Symmetric Functions in Noncommuting variables, and related Hopf Algebras](#), Adv. Math. 229 (2012), no. 4, 2310–2337.
- 1 (with 27 others) [Supercharacters, symmetric functions in noncommuting variables \(extended abstract\) and related Hopf Algebras](#), 23rd Annual International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2011), 3-14, Discrete Math. Theor. Comput. Sci. Proc., AO, Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2011.

Preprints

[Markov Chains from Descent Operators on Combinatorial Hopf Algebras](#)

arxiv.org/abs/1609.04312

[Hopf Algebras and Markov Chains](#) (thesis) arxiv.org/abs/1412.8221

Presentations

Invited Talks

- 03/2018 *Lumpings of Algebraic Markov Chains arise from Subquotients*, Hong Kong Probability Seminar
- A Uniform Analysis of Combinatorial Markov Chains using Hopf Algebras*,
 10/2016 Department of Stat. Seminar, Chinese University of Hong Kong
- 01/2016 Department of Math. Colloquium, Hong Kong Baptist University
- 01/2016 Numerical Methods and Applied Analysis Seminar, University of Hong Kong
- 10/2015 *A Hopf-Algebraic Lift of the Down-Up Markov Chain on Partitions to Permutations*, Special Session on Hopf Algebraic Combinatorics, AMS Sectional Meeting, Chicago, USA.
- Card Shuffling and Convolutions of Projections on graded Hopf Algebras*,
 01/2015 Applied Algebra Seminar, York University
- 09/2014 Combinatorics Seminar, LaCIM
- 12/2014 *Card Shuffling, Tree-Pruning and Convolutions of Projections on graded Hopf Algebras*, CRM-ISM Probability Seminar
- Card Shuffling and other Hopf-Power Markov Chains*,
 06/2014 Combinatorics Seminar, LaCIM
- 01/2014 Combinatorics Seminar, University of Michigan
- 08/2013 Algebra/Geometry/Topology Seminar, University of Melbourne
- 03/2013 Algebra and Combinatorics Seminar, Loyola University Chicago
- 02/2014 *Markov Chains from Combinatorial Hopf Algebras*, Probability Seminar, Cornell University

Other Research Presentations

- 06/2019 *Deformations of Comonoids-in-Species, Coalgebras, Hopf Algebras and their Quasisymmetric Invariants (8-minute flash talk on work-in-progress)*, New Directions in Algebraic Combinatorics, San Diego, USA.
- 05/2018 *Markov Chains and Descent Subalgebras*, HKBU-NCKU Joint Workshop on Mathematical Sciences, National Cheng Kung University, Taiwan.
- 07/2015 [Card-Shuffling via Convolutions of Projections on Combinatorial Hopf Algebras](#), 27th International Conference on Formal Power Series and Algebraic Combinatorics, Daejeon, South Korea.

- 03/2015 *Card Shuffling and Markov Chains on Combinatorial Hopf Algebras*, Probability Seminar, University of Ottawa
- 01/2015 *Card Shuffling and Convolutions of Projections on graded Hopf Algebras*, Combinatorial Algebra meets Algebraic Combinatorics, Kingston, Canada.
- 07/2013 *A Hopf-power Markov chain on Compositions (poster)*, 25th International Conference on Formal Power Series and Algebraic Combinatorics, Paris, France.
- 04/2012 *Ribbon Characters, Garsia-Reutenauer idempotents and a Biased Amazing Matrix??*, Student Probability and Related Fields Seminar, Stanford University
- 05/2011 *Kolmogorov's Rock-Breaking and Related Walks on Species*, Student Probability and Related Fields Seminar, Stanford University

Expository Presentations

- 03/2014 *What is a Combinatorial Hopf Algebra?* Graduate Student Colloquium, Stanford University
- 05/2011 *Card Games and Crystals*, Graduate Student Colloquium, Stanford University
- 04/2010 *The Art Gallery Problem*, Stanford University Mathematics Organisation
- Hopf Algebras and Representation Theory*
- 10/2009 Graduate Student Colloquium, Stanford University
- 03/2009 Part III seminar, University of Cambridge

Teaching

at Hong Kong Baptist University:

- 2016 - present Math 2207, Linear Algebra
(including 7 lectures recorded online, and one semester given over Zoom video-conferencing)
- 2019 - present Math 3407, Advanced Linear Algebra
- 2017 Math 2205, Multivariate Calculus

Course Lecturer at McGill University:

- 2015 Math 141, Integral Calculus

Guest Lecturer at Université du Québec à Montréal (3 lectures):

- 2015 Mat 995B, Research Seminar on Combinatorics: Descent Algebras

Teaching Assistant at Stanford University (leading recitations):

- 2013 Math 41A, Accelerated Differential Calculus
- 2010 - 2013 Math 51, Linear Algebra and Multivariable Calculus

Course Assistant at Stanford University (office hours, grading):

- 2012 Math 19, Differential Calculus
- 2012 Math 110, Applied Number Theory and Field Theory
- 2011 Math 210B, Graduate Algebra
- 2010 Math 113, Linear Algebra and Matrix Theory
- 2009 Math 120, Introduction to Abstract Algebra

Administrative Teaching Assistant at Stanford University:

- 2014 Math 51, Linear Algebra and Multivariable Calculus (200 students)

Teaching Assistant at Stanford University Mathematics Camp:

- 2009 - 2010 Program I, Abstract Algebra and Number Theory

Teaching Assistant at Enrichment Program for Young Mathematical Talents, Chinese University of Hong Kong:

- 2007 Non-Euclidean Geometry

Student Supervision

PhD supervision, Hong Kong Baptist University:

2019-present *Quasisymmetric Power Sums* (working title)

Undergraduate research honours projects, Hong Kong Baptist University:

2019-2020 *Free Dual Graded Graphs*

2019-2020 *The Hopf Algebra of Bicoloured Complete Graphs*

2018-2019 *Cocycles on Graphs*

2017-2018 *A Remove-and-Reattach Markov Chain on Planar Binary Trees*

2017-2018 *A Vertex Deletion Markov Chain on Graphs*

2017-2018 *A Vertex Deletion Markov Chain on Ordered Trees*

2017-2018 *The Catalan Hopf Algebra*

Undergraduate expository honours projects, Hong Kong Baptist University:

2018-2019 *Sim and Ramsey Theory*

2016-2017 *Around Sylow's Theorems*

2016-2017 *Partition Bijections*

Summer undergraduate research fellowship, Hong Kong Baptist University:

2018 *Comonoids on finite vector spaces*

Conference and Workshop Participation

Research

07/2020 24th International Conference on Formal Power Series and Algebraic Combinatorics, online

06/2020 Algebraic Combinatorics Virtual Expedition, online

04/2020 Algebraic Combinatorics Online Workshop, online

05/2018 SIAM Conference on Applied Linear Algebra, Hong Kong

08/2017 3rd International Congress in Algebras and Combinatorics, Hong Kong

12/2016 Joint UM-HKBU Workshop on Mathematics and Statistics, Macau

06/2016 4th Institute of Mathematical Statistics Asia Pacific Rim Meeting, Hong Kong

12/2015 Canadian Mathematical Society Winter Meeting, Montreal, Canada

08/2015 BIRS workshop on Positivity in Algebraic Combinatorics, Banff, Canada

06/2015 SageDays65, Chicago, USA

04/2015 SageDays67, Montreal, Canada

2011 - 2014 Bay Area Discrete Mathematics Days, USA

02/2014 Lie Groups, Lie Algebras and Their Representations, Stanford, USA

01/2013 Algebraic Groups and Representation Theory - a Conference in Memory of Tonny A. Springer, Hong Kong

07/2012 24th International Conference on Formal Power Series and Algebraic Combinatorics, Nagoya, Japan

Teaching

2019-present Teaching and Learning Experience Sharing – co-facilitated one session and attended 27 sessions on online teaching, at HKBU

07/2020 Teaching and Learning Expo, CUHK, Hong Kong

07/2019 Symposium on Emerging Innovations and Evaluation of Technology Enhanced Active Learning Pedagogies in Tertiary Education, Hong Kong

06/2018 Mini Symposium on Technology Enhanced Active Learning in Tertiary STEM Education, Hong Kong Polytechnic University, Hong Kong

Service

Academic

- 2014 - present Journal referee, J. Alg. Combi.; J. Combin. Theory Ser. A; Ann. Comb.; Random Structures Algorithms; J. Alg. Appl.
- 2018 Program committee member, 28th International Conference on Formal Power Series and Algebraic Combinatorics

Departmental

- 2018 - present HKBU coordinator, Simon Marais Mathematics Competition
- 2019 - present Interviewer, exchange to McGill University from HKBU Computer Science Department
- 2018,
- 2020 - present Interviewer, year 1 entry to HKBU Science Faculty
- 2017 - present Interviewer, year 3 direct entry to HKBU Math Department
- 2017 - 2019 Library coordinator, HKBU Math Department
- 2017 - 2019 Science faculty representative, Advisory Committee for Language Enhancement Program (HKBU)
- 2011 - 2013 Co-organiser, Stanford Women in Math
- 2010 - 2011 Co-organiser, Stanford Graduate Student Colloquium