Marianne Johnson

30th June, 2012

School of Mathematics,
University of Manchester,
Manchester, M13 9PL,
United Kingdom.

Telephone: +44 161 275 5891
Email: marianne.johnson@maths.manchester.ac.uk
Web: http://personalpages.manchester.ac.uk/staff/Marianne.Johnson/

CAREER HISTORY

Research Associate, School of Mathematics, University of Manchester (Sept. 2010 – Mar. 2013)

- Research position working with Dr Mark Kambites on the EPSRC funded research project 'Multiplicative Structure of Tropical Matrix Algebra'. The main focus of my current research is to understand the algebraic structure of the semigroup of $n \times n$ tropical matrices and its connection with the geometry of *tropical polytopes*.

- Joint work with Kambites and Izhakian: In [14] we studied the notion of *projectivity* for tropical semimodules and the related concepts of *idempotent* and *von Neumann regular* matrices. We discovered a remarkable connection between von Neumann regular matrices and tropical polytopes of *pure dimension*. In [13] we studied groups of tropical matrices. We proved that every *maximal subgroup* of the semigroup of $n \times n$ tropical matrices can be identified with the full linear automorphism group of a related tropical polytope. Furthermore, we proved that each such maximal subgroup is isomorphic to a direct product of the real numbers with a finite group.

- Joint work with Kambites: In [1] we gave a characterisation of *Green's $\mathcal{J}$-relation*, describing the connection between this equivalence relation and various ideas of the *rank* of a tropical matrix. In [12] we considered the connection between tropical idempotent matrices and finite metric spaces, proving that every n-point metric space can be realised in *tropical n-space* by the columns of an $n \times n$ idempotent matrix with respect to the *tropical Hilbert projective metric*.

Research Associate, Mathematical Institute, University of Oxford (Jan. 2010 – Aug. 2010)

- Research position working with Dr Karin Erdmann on the EPSRC funded research project 'Modular Lie powers and applications'.

- Joint work with Bryant: We proved a characteristic p version of a result of Klyachko on *Lie powers* of the natural module for GL(n, K). Our results describe the isomorphism types of the *indecomposable tilting modules* occurring as direct summands of Lie powers in degrees not equal to a power of p.

- Joint work with Erdmann: In [2] we analysed Lie powers of the natural module for GL$(2, K)$ in some detail, in particular concentrating on Lie powers of prime power degree.

Research Associate, School of Mathematics, University of Manchester (Jan. 2009 – Dec. 2009)

- Research position working with Professor Roger Bryant on the EPSRC funded research project 'Modular Lie powers and applications'.

- Joint work with Bryant: We studied the *Adams operations* on the *Green ring* of a finite group G over a field K of characteristic p. These operations encapsulate the module structure of the *exterior* and *symmetric powers* of KG-modules. In [6] we proved that the Adams operations are periodic if and only if the Sylow p-subgroups of G are cyclic. We showed that a deep result of Peter Symonds concerning symmetric and exterior powers of modules for cyclic p-groups may be attractively formulated in terms of Adams operations. In [8] we studied the Adams operations for cyclic p-groups in detail.

- Joint work with Stöhr: In [7] we proved that the *free centre-by-(nilpotent of class $(c-1)$)-by-abelian groups* $F/[\gamma_c(F'), F]$ are torsion-free whenever c is divisible by at least two distinct primes. This is in stark contrast to the case where c is a prime or $c = 4$, where these relatively free groups contain non-trivial elements of finite order.

Research Associate, CICADA, University of Manchester (Jan. 2008 – Dec. 2008)

- Part of a large interdisciplinary research team working at the boundaries between mathematics, computer science and control engineering. In particular, I studied algebraic structures related to *asynchronous systems*, such as the max-plus (or tropical) semiring.

- Joint work with Kambites: In [4] we described *Green's relations* on the semiring of 2×2 tropical matrices, in particular, showing that this semigroup is regular.

- Joint work with Broomhead and Furber: In [15] we showed that a 'heuristic' used to calculate the minimum clock period in the early design of the ARM hardware corresponds exactly to the solution of a certain *tropical eigenvalue problem*.

Academic Degrees

PhD in Mathematics, School of Mathematics, University of Manchester, 2008.

- Title: 'On group actions on free Lie algebras'. Supervisor: Professor Ralph Stöhr.
- Considered the problem of describing the module structure of the free Lie algebra under the action of a group. This led to four publications ([5], [9], [10] and [11]).

MMath Mathematics (First Class Honours), Department of Mathematics, UMIST, 2004.

- Departmental prizes for best performance in 1st, 2nd, 3rd and 4th year examinations.
- IMA Prize for best final year project.

Funding and grant applications

- 2012: Co-author and named researcher on EPSRC grant 'Tropical Algebraic Methods in Numerical Matrix Analysis' as part of the New Directions for EPSRC Research Leaders call (P.I. Dr F. Tisseur), April 2012–March 2014 (value £240,967). Grant attached to EPSRC grant EP/I005293/1.
- 2011: Secured additional funding (£3,497) from CICADA for the LMS workshop 'Future Directions in Tropical Mathematics & its Applications', January 2012.
- 2008: Co-wrote successful bid (value £7,500) for the LMS Northern Regional Meeting, January 2009.
- 2008: Co-wrote successful bid (value £15,000) for the MAGIC Postgraduate Conference, January 2009.
- 2008: Co-author on EPSRC grant 'Multiplicative Structure of Tropical Matrix Algebra' (P.I. Dr M. Kambites), November 2009–March 2013 (value £298,636). This is the grant on which I am currently employed.
- 2006: Secured MIMS funding (value £600) for Manchester-Leeds Pure Postgraduate Seminars, May 2006.
- 2004–2007: EPSRC doctoral training account funding.
- 2003: Summer research bursary (value £300), University of Keele, June–July 2003.
- 2000-2004: Scholarship, Department of Mathematics, UMIST.

Refereed Research Publications

[1] *Green's $\mathcal{J}$-order and the rank of tropical matrices*, with Mark Kambites,
Journal of Pure and Applied Algebra, to appear.

[2] *Lie powers of the natural module for* $GL(2, K)$, with Karin Erdmann,
Quarterly Journal of Mathematics, to appear.

[3] *A modular version of Klyachko's theorem on Lie representations of the general linear group*,
with R. M. Bryant, Mathematical Proceedings Cambridge Philosophical Society, 153 (2012), 79-98.

[4] *Multiplicative structure of 2×2 tropical matrices*, with Mark Kambites.
Linear Algebra and its Applications, 435 (2011), 1612–1625.

[5] *Lie powers and pseudo-idempotents*, with Ralph Stöhr.
Canadian Mathematical Bulletin, 54 (2011), 297–301.

[6] *Periodicity of Adams operations on the Green ring of a finite group*, with R. M. Bryant.
Journal of Pure and Applied Algebra, 215 (2011), 989–1002.

[7] *Free central extensions of groups and modular Lie powers of relation modules*, with Ralph Stöhr.
Proceedings of the American Mathematical Society, 138 (2010), 3807–3814.

[8] *Adams operations on the Green ring of a cyclic group of prime-power order*, with R. M. Bryant.
Journal of Algebra, 323 (2010), no. 10, 2818–2833.

[9] *Free centre-by-nilpotent-by-abelian groups*, with Ralph Stöhr.
Bulletin of the London Mathematical Society, 41 (2009), no. 5, 795–803.

[10] *Lie powers and Witt vectors*, with R. M. Bryant.
    Journal of Algebraic Combinatorics, 28 (2008), no. 1, 169–187.

[11] *Standard tableaux and Klyachko's Theorem on Lie representations*,
    Journal of Combinatorial Theory, Series A, 114 (2007), no. 1, 151–158.

Preprints and Papers Submitted

[12] *Idempotent tropical matrices and finite metric spaces*, with Mark Kambites.
    Preprint available at arXiv:1203.2480v1.

[13] *Tropical matrix groups*, with Zur Izhakian and Mark Kambites.
    Preprint available at arXiv:1203.2449v1.

[14] *Pure dimension and projectivity of tropical convex sets*, with Zur Izhakian and Mark Kambites.
    Preprint available at arXiv:math.RA/1106.4525.

[15] *An algebraic approach to time borrowing*, with David Broomhead and Steve Furber.
    MIMS EPrint 2012.60, Manchester Institute for Mathematical Sciences, University of Manchester, May 2012.

Selected Participations

Invited plenary talks
- LMS Network Meeting on Tropical Mathematics and its Applications, Birmingham, 28th June 2012.
- CICADA: The final frontier, Manchester, 25th April 2012.
- 5th MOPNET Meeting, UCL, London, 12th September 2011.
- 8th North British Semigroups and Applications Network Meeting, St Andrews, 20th May 2011.
- CoSyDy2: Complexity in the real world, Bath, 15th April 2011.
- A Meeting in Honour of Dave Broomhead's 60th Birthday, Manchester, 16th November 2010.
- Lie powers one day meeting, Manchester, 23rd September 2010.
- Modular Lie powers and related topics, Oxford, 25th May 2010.
- Modular Lie powers and applications one day meeting, Oxford, 18th March 2010.
- 4th North British Semigroups and Applications Network, York, 25th November 2009.

Invited seminar presentations
- York Semigroup Seminar: 29th February 2012.
- Kent Mathematics Seminar: 6th December 2011.
- Cambridge Algebra Seminar: 9th February 2011.
- Leeds Algebra Seminar: 11th October 2010.
- Bristol Algebra and Geometry Seminar: 12th May 2010.
- Manchester Algebra Seminar: 10th November 2009, 3rd June 2008 and 4th October 2005.

Short talks and poster presentations
- Contributed short talk at 83rd Workshop on General Algebra & the 27th Conference of Young Algebraists (AAA83), Novi Sad, Serbia, 16th March, 2012.
- Invited short talk at the Young Researchers Minisymposium on Max-plus Linearity and its Applications in Computer Science and Scheduling, 17th ILAS Conference, Braunschweig, Germany, 24th August 2011.
- Contributed short talk at Groups and Semigroups: Interactions and Computations, Lisbon, Portugal, 29th July 2011.
- Contributed short talk at International Conference on Semigroups, General Algebra, and Applications - 82nd Workshop on General Algebra (AAA82), Potsdam, Germany, 25th June 2011.
- Contributed short talk at ICRA XIV, Tokyo, Japan, 15th August 2010.

- Contributed short talk at Groups at St Andrews, Bath, 7th August 2009.
- Contributed short talk at 60th British Mathematics Colloquium, York, 26th March 2008.
- Antalya Algebra Days IX, Antalya, Turkey, 23rd May 2007.
- Contributed poster at LMS Midlands Regional Meeting, Leicester, 15th May 2006. Prize for the best poster.

Teaching and Outreach Work

- 2012: Graduate mini-course in tropical mathematics, as part of the CICADA graduate course.
- 2007–2009, 2011–2012: Supervisor for first year feedback supervision classes ('Linear Algebra' and 'Sets, numbers and functions').
- 2007: Maths Squad Co-ordinator for the Engineering and Physical Sciences Widening Participation team. Organised several events for Y9 pupils from the Greater Manchester area, designed to encourage them to study Mathematics at a higher level.
- 2006: Revision classes for first year undergraduate resit examinations.
- 2006: Marker for first year undergraduate examinations.
- 2005–2007: Invigilator for undergraduate examinations and coursework tests.
- 2005–2007: Teaching assistant for a variety of second year and third year courses ('Problems Course','Algebra A', 'Algebra B' and 'Algebraic Structures').
- 2004–2005: Postgraduate demonstrator for various service teaching courses (ON1, ON2, OJ1).
- 2004–2007: Postgraduate helper at several outreach activities organised within the School of Mathematics.

Research Supervision and Examination

- 2012: Examiner for three 4th year MMath. projects and one MSc. project in the School of Mathematics.
- 2011: Examiner for three MSc. dissertations in the School of Mathematics. On the examination board for the MSc. in pure mathematics.
- 2011: Supervised MSc. dissertation of Androniki Zinonos (MSc. in pure mathematics). The title of her dissertation was 'Tropical Matrices'.
- 2009: Co-internal examiner for an MPhil. candidate from the School of Computer Science.

Selected Training and Professional Development

- Royal Society communication skills and media training course (19th–20th July 2012).
- Training in Equality & Diversity Issues, Staff Training and Development Unit, Manchester (5th July 2012).
- Teaching for Researchers Programme, EPS Researcher Development, Manchester (February–June 2012).
- National HE STEM Programme Science Communication Workshop (30th January 2012).

Event Organisation

- Co-organiser of the LMS joint research network meetings 'Tropical Mathematics and its Applications' (Manchester, April 2011 and January 2012).
- Administrative assistant in the organisation of the 9th NBSAN meeting (Manchester, August 2011).
- Co-organiser of the MAGIC Postgraduate Student Conference and the LMS Northern Regional meeting that followed (Manchester, 2009). Designed the scientific programme of both events (including timetabling of parallel sessions) and created various promotional materials and the booklet of abstracts. The conference, attended by around 120 participants, included plenary lectures from seven leading mathematicians and contributed talks and posters from around 50 students.
- Organiser of the Tropical reading group. Members included pure and applied mathematicians, computer scientists and biologists. The programme incorporated talks from both internal and external speakers. Some of the ideas developed in the reading group formed the basis of the EPSRC project 'Multiplicative Structure of Tropical Matrix Algebra' on which I am currently employed.

- Organiser of the Manchester Pure Postgraduate Seminar Series and the first Manchester-Leeds Pure Postgraduate Seminar Meeting (Manchester, May 2006).

Other Professional Activities and Administrative Service

- Reviewer for Journal of Algebra, Communications in Algebra and Linear Algebra and Applications.
- 2010–2012: I am the Researcher Development Ambassador in the School of Mathematics. My role involves engaging with researchers within the School to discuss their training needs. I report their views at quarterly meetings with the EPS Researcher Development Team. These meetings provide input to the Skills Training & Development Steering Group.
- 2005–2006: Served on the Staff-Student Liaison Committee.

References

Available upon request.