

# Curriculum Vitae — Dr Mark Grant

## CONTACT DETAILS

Institute of Mathematics  
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## EDUCATION

- University of Manchester, UK** Sep 2002 to Dec 2005  
\* **Ph. D** – supervised by Prof. Peter J Eccles  
Thesis title – ‘Bordism of Immersions’  
Graduated May 2006
- University of Edinburgh, UK** Oct 1998 to May 2002  
\* **MA Mathematics** – First Class Honours  
Graduated Jul 2002

## POSITIONS HELD

- University of Aberdeen, UK**  
\* **Senior Lecturer** Aug 2018 to present  
**Lecturer** Sep 2014 to Aug 2018
- Newcastle University, UK** Sep 2013 to Aug 2014  
\* **Lecturer**
- University of Nottingham, UK** Sep 2011 to Jun 2013  
\* **Lecturer**
- University of Edinburgh, UK** Sep 2008 to Aug 2011  
\* **Lecturer**
- Durham University, UK** Jan 2006 to Sep 2008  
\* **Research Associate**

## RESEARCH INTERESTS

- \* **Applied Algebraic Topology** – topological complexity of robot motion planning, applications of topology to soft matter physics
- \* **Algebraic Topology** – Lusternik–Schnirelmann category, rational homotopy theory, algebraic topology of smooth manifolds
- \* **Differential Topology** – immersions and their self-intersections, cobordism theory, connections with homotopy theory
- \* **Cohomology of groups** – finiteness properties of torsion-free groups

PAPERS AND PREPRINTS

1. *Directed topological complexity of spheres* (with A. Borat), submitted. [arXiv:1810.00339](#)
2. *Topological complexity of symplectic manifolds* (with S. Mescher), submitted. [arXiv:1802.04746](#)
3. *The Topological Period-Index Problem for  $\text{spin}^c$  6-manifolds* (with D. Crowley), submitted. [arXiv:1802.01296](#)
4. *Hopf Invariants for sectional category with applications to topological robotics* (with J. González and L. Vandembroucq), submitted. [arXiv:1405.6891](#)
5. *Bredon cohomology and robot motion planning* (with M. Farber, G. Lupton and J. Oprea), to appear in *Algebr. Geom. Topol.* [arXiv:1711.10132](#)
6. *Symmetrized topological complexity*, to appear in *J. Topol. Anal.* [arXiv:1703.07142](#)
7. *An upper bound for topological complexity* (with M. Farber, G. Lupton and J. Oprea), *Topology Appl.* **255** (2019), 109–125.
8. *Hopf invariants, topological complexity, and LS-category of the cofiber of the diagonal map for two-cell complexes* (with J. González and L. Vandembroucq), *Contemp. Math.* **702** (2018), 133–150.
9. *Topological complexity of subgroups of Artin’s braid groups* (with D. Recio-Mitter), *Contemp. Math.* **702** (2018), 165–176.
10. *Realizing homology classes up to cobordism* (with A. Szűcs and T. Terpai), *Osaka J. Math.* **54** (2017), no. 4, 803–807.
11. *The Poincaré–Hopf Theorem for line fields revisited* (with D. Crowley), *J. Geom. Phys.* **117** (2017), 187–196.
12. *A mapping theorem for topological complexity* (with G. Lupton and J. Oprea), *Algebr. Geom. Topol.* **15** (2015), 1643–1666.
13. *Sequential motion planning of non-colliding particles in Euclidean spaces* (with J. González), *Proc. Amer. Math. Soc.* **143** (2015), 4503–4512.
14. *New lower bounds for the topological complexity of aspherical spaces* (with G. Lupton and J. Oprea), *Topology Appl.* **189** (2015), 78–91.
15. *Homologies are infinitely complex* (with A. Szűcs), *Topol. Methods Nonlinear Anal.* **45** (2015), no. 1, 55–61.
16. *Spaces of topological complexity one* (with G. Lupton and J. Oprea), *Homology Homotopy Appl.* **15** (2013), no. 2, 73–81.
17. *On realizing homology classes by maps of restricted complexity* (with A. Szűcs), *Bull. Lond. Math. Soc.* **45** (2013), no. 2, 329–340.
18. *Topological complexity of motion planning in projective product spaces* (with J. González, E. Torres-Giese and M. Xicoténcatl), *Algebr. Geom. Topol.* **13** (2013), no. 2, 1027–1047.

19. *On self-intersection invariants*, Glasgow Math. J. **55** (2013), no. 2, 259–273.
20. *Equivariant topological complexity* (with H. Colman), Algebr. Geom. Topol. **12** (2012), no. 4, 2299–2316.
21. *Self-intersections of Immersions and Steenrod Operations* (with P. J. Eccles), Acta Math. Hungar. **137** (2012), no. 4, 272–281.
22. *Topological complexity, fibrations and symmetry*, Topology Appl. **159** (2012), no. 1, 88–97.
23. *Topological complexity of configuration spaces* (with M. Farber), Proc. Amer. Math. Soc. **137** (2009), no. 5, 1841–1847.
24. *Topological complexity of motion planning and Massey products*, In “Algebraic Topology—Old and New: M. M. Postnikov Memorial Conference” M. Golasiński et al (eds), Banach Center Publ. **85** (2009), 193–203.
25. *Robot motion planning, weights of cohomology classes, and cohomology operations* (with M. Farber), Proc. Amer. Math. Soc. **136** (2008), no. 9, 3339–3349.
26. *Symmetric Motion Planning* (with M. Farber), In “Topology and Robotics”, M. Burger, M. Farber, R. Ghrist and D. Koditschek (eds), Contemp. Math. **438** (2007), 85–104.
27. *Topological complexity of collision free motion planning algorithms in the presence of multiple moving obstacles* (with M. Farber and S. Yuzvinsky), In “Topology and Robotics”, M. Burger, M. Farber, R. Ghrist and D. Koditschek (eds), Contemp. Math. **438** (2007), 75–83.
28. *Bordism Groups of Immersions and Classes Represented by Self-intersections*, (with P. J. Eccles), Algebr. Geom. Topol. **7** (2007), 1081–1097.
29. *Bordism classes represented by multiple point manifolds of immersed manifolds*, (with P. J. Eccles), Proc. Steklov Inst. Math. **252** (2006), no. 1, 47–52.

## BOOKS

1. *Topological complexity and related topics*, M. Grant, G. Lupton and L. Vandembroucq (eds), Contemp. Math. **702**, (2018), 176pp.

## EDITORIAL WORK

- \* Apr 2017 to present – Editor of *Proceedings of the Royal Society of Edinburgh Section A: Mathematics*

## UNDERGRADUATE TEACHING

- \* **(Lecturer at University of Aberdeen, 2014 to present)** ‘Algebra’ (Level 1), ‘Engineering Mathematics’ (Level 1 service), ‘Mathematical Foundations of Everyday Life’ (Level 3), ‘Metric and Topological Spaces’ (Level 3), ‘Project’ (Level 4)
- \* **(Lecturer at Newcastle University, 2013 to 2014)** ‘Survey Mathematics’ (Level 2 service), ‘Group Project Module’ (Level 3), ‘The Foundations of Calculus’ (Level 2)

- \* **(Lecturer at University of Nottingham, 2011 to 2013)** ‘Analytical and Computational Foundations’ (Level 1), ‘Metric and Topological Spaces’ (Level 3)
- \* **(Lecturer at University of Edinburgh, 2008 to 2011)** ‘Applicable Mathematics 1’ and ‘Applicable Mathematics 2’ (Level 1 service), ‘Numbers and Rings’ (Level 3), ‘Individual Project’ (Level 4)

#### POSTGRADUATE TEACHING

- \* **(Lecturer at University of Aberdeen, 2017)** ‘Algebraic Topology’ (SMSTC graduate course)
- \* **(Lecturer at University of Nottingham, 2011 to 2013)** ‘Foundations of Advanced Analysis’ (MMath course)
- \* **Ph. D student:** David Recio-Mitter (University of Aberdeen, Sep 2015 to present)
- \* Apr 2018 – Internal examiner for Ph.D thesis of R. Boyd, ‘Homology of Coxeter and Artin groups’, University of Aberdeen
- \* May 2017 – Thesis reviewer for Ph.D thesis of B. Gutiérrez, ‘Multitasking motion planning in some configuration spaces and polyhedral products’, CINVESTAV, Mexico.
- \* Dec 2014 – External examiner for Ph.D thesis of A. Longdon, ‘Stably complex structures on self-intersection manifolds of immersions’, University of Manchester
- \* May 2011 – Internal examiner for Ph.D thesis of J. Collins, ‘On the concordance orders of knots’, University of Edinburgh

#### ADMINISTRATION

- \* Oct 2017 to present – Digital Learning Representative for Mathematics at University of Aberdeen
- \* Sep 2017 to present – Member of Executive Committee of the School of Natural and Computing Sciences at University of Aberdeen
- \* Jun 2016 to present – Organizer of Topology Seminar at University of Aberdeen
- \* Sep 2014 to present – Personal Tutor at University of Aberdeen
- \* Sep 2014 to Jun 2016 – Recruitment Officer for the Department of Mathematics at University of Aberdeen (coordinator of undergraduate Applicant Days and Open Days, and student visits)

#### CONFERENCE ORGANIZATION AND OTHER SERVICE

- \* Jun 2018 – Co-organizer of International Conference on Manifolds, Groups and Homotopy, Sabhal Mòr Ostaig, Isle of Skye
- \* Sep 2017 – Co-organizer of Topology sessions at joint meeting of the EMS-SCM

- \* Dec 2016 to present – Co-organizer of the Scottish Topology Seminar (supported by the Glasgow Mathematical Journal Trust)
- \* Feb 2016 – Co-organizer of MF Oberwolfach mini-workshop on ‘Topological complexity and related topics’ (with G. Lupton and L. Vandembroucq)
- \* Jan 2015 to present – Co-organizer of UK research network in Applied Algebraic Topology (with J. Brodzki, M. Farber, J. Grbić, V. Kurlin and D. Schütz)
- \* Mar 2012 – Organizer of the 83<sup>rd</sup> meeting of the Transpennine Topology Triangle, held at the University of Nottingham (supported by the LMS)
- \* Dec 2007 – Co-organizer of ‘Prospects in Mathematics’, a conference for potential graduate students held at Durham University
- \* **Referee for:** *Geom. Dedicata*, *J. Lond. Math. Soc.*, *Proc. Amer. Math. Soc.*, *Commun. Contemp. Math.*, *Math. Proc. Cambridge Philos. Soc.*, *Algebr. Geom. Topol.*, *Topology Appl.*, *Topol. Methods Nonlinear Anal.*, *Bol. Soc. Mat. Mexicana*, *Contemp. Math.*, *Banach Center Publ.*, *J. Mechanisms Robotics*, *Publ. Mat.*, *J. Topol. Anal.*, *Forum Math.*, *J. Applied and Computational Topology*, *Ann. Math. Artif. Intell.*, *Results Math.*, *Bull. Aust. Math. Soc.*, *Topology Proc.*
- \* **Reviewer for** *Mathematical Reviews* and *Zentralblatt Math*

#### GRANTS AWARDED

- \* May 2018 – London Mathematical Society Undergraduate Bursary (£1440) to work with Miss Agata Sienicka on a project “Geometric and topological aspects of the theory of braids”
- \* Nov 2017 – London Mathematical Society Scheme 1 grant (£6,000) and grants from the Glasgow Mathematical Journal Trust Fund (£4,000) and Edinburgh Mathematical Society Research Support Fund (£700) for International Conference on Manifolds, Groups and Homotopy, Sabhal Mòr Ostaig, Isle of Skye (with D. Crowley, R. Hepworth, J. Kędra, R. Levi and A. Libman)
- \* Nov 2015 – London Mathematical Society Scheme 3 grant (£2,000) and grants from the Glasgow Mathematical Journal Trust Fund (£1,135) and Institute of Mathematics and its Applications (£600) to continue Applied Algebraic Topology research network into second year (with J. Brodzki, M. Farber, J. Grbić, V. Kurlin and D. Schütz)
- \* Sep 2014 – London Mathematical Society Scheme 3 grant (£2,000) and Edinburgh Mathematical Society Research Support Fund (£1,200) to establish UK research network in Applied Algebraic Topology (with J. Brodzki, M. Farber, J. Grbić, V. Kurlin and D. Schütz)
- \* Apr 2013 – Institute of Mathematics and its Applications small grant (£300) to attend Applied Topology conference in Będlewo, Poland in July 2013
- \* May 2010 – Royal Society International Travel Grant (£2,300) to visit Prof. Aniceto Murillo at the University of Málaga

## SELECTED INVITED TALKS

- \* Jan 2019 – Kyoto University, Japan – Workshop on Applied topology (two 1 hour lectures)
- \* Sep 2018 – Wrocław, Poland – UMI–SIMAI–PTM Joint meeting (invited session speaker)
- \* Aug 2018 – Kyoto University, Japan – Mapping Spaces in Algebraic Topology (plenary lecture)
- \* Oct 2016 – Amiens, France – Colloque 2016 du GDR 2875, Topologie Algébrique et Applications – “Topological complexity of configuration spaces”
- \* Apr 2016 – British Applied Mathematics Colloquium, Oxford, UK – “A survey of Farber’s topological complexity”
- \* Apr 2015 – Université Internationale de Casablanca, Morocco – Colloque MASSIF 2 – “Topology and robot motion planning”
- \* Feb 2015 – Durham University, UK – Pure Mathematics Colloquium – “Lower bounds for the topological complexity of groups”
- \* Feb 2015 – IST, Lisbon, Portugal – XXI Oporto meeting on Geometry, Topology and Physics – “Hopf invariants for sectional category with applications to Topological Robotics”
- \* Jul 2014 – CIEM, University of Cantabria, Spain – Applied Algebraic Topology workshop – “A mapping theorem for topological complexity”
- \* Jul 2013 – Stefan Banach International Mathematical Center, Będlewo, Poland – Applied Topology conference – “Topological complexity of braid groups”
- \* Mar 2011 – Edinburgh University, UK – Informatics seminar – “Topological complexity of motion planning algorithms”

## SELECTED CONTRIBUTED TALKS

- \* Jun 2017 – Stefan Banach International Mathematical Center, Będlewo, Poland – Applied Topology in Będlewo 2017 – “Symmetrized topological complexity”
- \* Aug 2016 – Saas-Almagell, Switzerland – Alpine Algebraic and Applied Topology Conference – “The Poincaré–Hopf Theorem for line fields (revisited)”