TIM D. COCHRAN

Department of Mathematics, Rice University
6100 Main St, Houston, TX 77005-1892
cochran@math.rice.edu

Education

PhD University of California, Berkeley, 1982
MA University of California, Berkeley, 1979
BS Massachusetts Institute of Technology, 1977

Areas of Research

Topology, especially topology of 3- and 4-dimensional manifolds, theory of knots and links and associated group theory

Fellowships

Research Professorship, MSRI, Berkeley, 1996–97
NSF Postdoctoral Fellowship, 1985–87
Postdoctoral Fellowship, MSRI, 1984–85
U.Calif. Regents Graduate Fellow, 1977–78

Professional Appointments

Professor, Rice University, 1998–
Research Professor, M.S.R.I., Berkeley, Ca., 1996–97
Associate Professor, Rice University, 1990–98
Assistant Professor, Northwestern Univ., 1988–90
Visiting Assistant Professor, U.C. Berkeley, 1987–88
C.L.E. Moore Postdoctoral Instructor, Massachusetts Institute of Technology, 1982–84

Departmental Activities

Research Mentor for Danielle O'Donnol, G.C. Evans Instructor, 2008-
Research Mentor for Elena Pavalescu, G.C. Evans Instructor, 2008-
Research and Teaching Mentor for Maggie Tomova, G.C. Evans Instructor, 2007-2008
Teaching Mentor for Kelly McKinnie, NSF Postdoctoral Fellow and G.C. Evans Instructor, 2007–2009
Teaching Mentor for Keiko Kawamuro, G.C. Evans Instructor, 2006-2008
Graduate Committee, chair 1997–2007, member 1992-1996, 1997-present.
Undergraduate Committee, member 2005–present
Undergraduate Advisor (approximately 20 students), 2004–present
Research Advisor for MA and PhD students, 3 current (15 since 1990)
Appointments Committee, chair 1999, member 2003, co-chair, 2005, 2007, 2008
Mathematics Department Computer Committee Chair, 1991–96
Participant in Undergraduate Conference on Applications of Mathematics to Biology, 2004
Organizer of 2 Undergraduate Conferences, 2002,2000.
Co-organizer of Topology Seminar

Service to the Profession

Associate Editor, Journal of Knot Theory and Its Ramifications

Dr. Cochran sponsored and organized a special session on Low-Dimensional Topology at annual meetings of the American Mathematical Society 2002 and 2004 for the purpose of allowing new Ph.D.'s, especially of under-represented groups, a forum to present their research to potential employers and colleagues.

Co-sponsored two undergraduate math conferences at Rice University.

Service to the University

presented lecture in Dean of Natural Science Lecture Series, April 2007
Orientation Week advisor
Undergraduate Advisor (approximately 20 students), 2004–present
Mathematics Department Graduate Committee, member, (Chair 2000–2005)
Curriculum Committee of the Wiess School of Natural Sciences, 1997-2006
Sponsor of Undergraduate Mathematics Conference, Rice University, March 2001,2003
Planning Committee for the Center for Teaching and Curricular Innovation, 2000
Faculty Associate of Wiess College, 1990–2001
Outstanding Faculty Associate, 1992–93
Rice University Admissions Committee, 1991–94

Service to the Community

Volunteer Houston Ind. School District-Math Enrichment, Spring 1996
Volunteer Soccer Coach STYSA, 1995, 1997, 1998

Thesis Supervision

"Higher-order Analogues of Genus and Slice Genus of Classical Knots," Peter Horn, Ph.D. 2009 National Science Foundation Postdoctoral Fellow.

"Surface Homeomorphisms That Do Not Extend to Any Handlebody and the Johnson Filtration," Jamie Jorgensen, Ph.D. 2008.

"Higher-order linking forms for 3-manifolds," Connie Leidy, Ph.D. 2004
"Bordism Invariants of the mapping class group," Aaron Heap, Ph.D. 2004
"S-equivalence of links," Carol Gwosdz Gee, Ph.D. 2004
"Knots and Quandies," Steven Wallace, M.A. 2004
"Higher-order polynomial invariants of 3-manifolds giving lower bounds for Thurston's norm," Shelly Harvey (awarded Watt Fellowship and NSF Postdoctoral Fellowship) Ph.D. May 2002
"Divisibility of the Conway Polynomial of Links," Amy Noel Lampazzi (awarded NSF-GK12 Fellowship) Ph.D. May 2001
"On 3-manifolds equivalent by homologically trivial surgeries," Amir Gerges, Ph.D. December 1996
"Homology Boundary Links, Patterns, and Seifert Forms," Paul Bellis, Ph.D. May 1996
"Invariants of Graphs," Simrat Ghuman, Ph.D. May 1996;
"Approximation of Knot Invariants by Vassiliev Invariants," Serguei A. Sirotine, Ph.D., Rice University, May 1995;
additional current students: 3

Research Grants

National Science Foundation:
DMS-0706929 "Noncommutativity in Low-Dimensional Topology", 7/07–7/10
DMS-0406573 "Noncommutative algebraic invariants in low-dimensional topology", 5/04–7/07

DMS-0104275 "Noncommutative algebraic phenomena in the topology of 3 and 4-dimensional, spaces", 6/01–7/04
DMS-9803694 "Knotting and Linking Phenomena in Topology," 6/15/98–6/15/01
DMS-9626565 "SCREMS" Rice Univ., 6/1/96–5/31/99
DMS-9400224 "Knotting Phenomena in Topology," Rice Univ., 12/31/94–12/31/97
DMS-9205540 "Computation in Geometry, Topology and Ergodic Theory," SCREMS Rice Univ., 5/1/92–4/20/95
DMS-9100254 "Topology and Geometry of Manifolds," Rice Univ., 7/1/91–6/30/94
DMS-8903514 "Topology and Geometry of Manifolds," Northwestern Univ., 7/1/89–6/30/91
DMS-8841714 U. Calif. Berkeley, 7/1/88–6/30/89
DMS-8303241 M.I.T., 7/1/83–12/31/85

PUBLICATIONS

1. Slice links in S^4, *Trans. Amer. Math. Soc.* **285** (1983), 389–401.
2. Embedding 4-manifolds in S^5, *Topology* **23** no. 3 (1984), 257–269.
3. Four-manifolds which embed in $\mathbf{R}^6$ but not in $\mathbf{R}^5$ and Seifert manifolds for fibered knots, *Inventiones Math.* **77** (1984), 173–184
4. Ribbon knots in S^4, *Journal of London Math. Soc.* **28** (1984), 563–576.
5. On an invariant of link cobordism in dimension 4, *Topology and its Appl.* **18** (1984), 97–108.
6. A topological proof of Stallings' theorem on lower central series of groups, *Math. Proc. Camb. Phil. Soc.* **97** (1985), 465–472.
7. Geometric invariants of link cobordism, *Commentarii Math. Helvetii* **60** (1985), 291–311.
8. Concordance invariance of coefficients of Conway's link polynomial, *Inventiones Math.* **82** (1985), 527–541.
9. Unknotting information from 4-manifolds (with W.B.R. Lickorish), *Trans. Amer. Math. Soc.* **297:1** (1986), 125–142.
10. Link concordance invariants and homotopy theory, *Inventiones Math.* **90** (1987), 635–645.
11. Applications of Donaldson's 4-manifold theorems to classical knot theory, homology 3-spheres and Property P (with R.E. Gompf), *Topology* **27** (1988), 495–512.
12. Invariants of tangles (with D. Ruberman), *Math. Proc. Cambridge Phil. Soc.* **105** (1989), 299–306.
13. Localization and finiteness in link concordance, *Topology and its Applications* **32** (1989), 121–133.
14. Derivatives of links: Massey products and Milnor's concordance invariants, *Memoirs of Amer. Math. Soc.* **84** no. 427 (1990)
15. On the homotopy theory of simply-connected 4-manifolds (with N. Habegger), *Topology* **29** (1990).
16. Links with trivial Alexander Module but non-vanishing Massey products, *Topology* **29** (1990), 189–204.

17. Not all links are concordant to boundary links (with K.E. Orr), *Bulletin of American Math. Soc.* **23** (1990), 99–106.

18. Homology boundary links and the Andrews-Curtis conjecture (with J. Levine), *Topology* **30** (1991), 231–240.

19. K-cobordism for links in S^3, *Transactions of A.M.S.* **327** (1991) 641–654.

20. Classical link invariants and the Hawaiian earrings space, *Journal of Knot Theory and its Ramifications*, **Vol 1, No. 4** (1992).

21. Not all links are concordant to boundary links (with K.E. Orr), *Annals of Mathematics* **138** (1993), 519–554.

22. Homology boundary links and Blanchfield forms: Concordance classification and new tangle-theoretic constructions (with K.E. Orr), *Topology* **33**, no. 3 (1994), 397–427.

23. Non-trivial links and Plats with trivial Gassner matrices, *Proc. Cambridge Philosophical Soc.* **119**, no. 43 (1996), 43–53.

24. Stability of Lower Central Series of Compact 3-manifold Groups (with K.E. Orr), *Topology* **37**, no. 3 (1998), 497–526.

25. Homology Cobordism and Generalizations of Milnors Invariants, *Journal of Knot Theory and its Ramifications* **8**, no. 4 (1999), 429–436.

26. Finite Type Invariants of 3-manifolds (with Paul Melvin), *Inventiones Math.* **140** (2000), 45–100.

27. Dehn Surgery Equivalence Relations on 3-Manifolds (with Amir Gerges and K.E. Orr), *Math. Proc. of Cambridge Phil. Soc* **131** (2001), 97–127.

28. Quantum Cyclotomic Orders of 3-manifolds (with Paul Melvin), *Topology* **40** (2001), 96–125.

29. Knot Concordance, Whitney Towers and L^2-signatures (with Kent Orr and Peter Teichner), *Annals of Math.* **157** (2003), 433–519.

30. Structure in the Classical Knot Concordance Group (with K. Orr and P. Teichner), *Commentarii Mathematica* **79**, no. 1 (2004), 105–123.

31. Noncommutative Knot Theory, *Algebraic and Geometric Topology* **4** (2004), 347–398.

32. Homology and Derived Series of Groups (with Shelly Harvey), *Geometry and Topology*, *v.9*,(2005)2159-2191.

33. The Growth Rate of the First Betti Number of Abelian Covers of 3-Manifolds (with Joseph Masters), *Math.Proc.Cambridge Phil.Soc.*, **141** (2006), 465-476.

34. Knot Concordance and von Neumann rho invariants (with P. Teichner), *Duke Math. Journal*, **137**, no.2. (2007), 337–379.

35. Higher-Order Alexander Modules and Filtrations of the Knot Concordance Group (with Taehee Kim), *Trans.Amer.Math.Soc.*, *Trans. Amer. Math Soc*, 360 no.3 (2008)1407-1441.

36. Homology and Derived Series of Groups II: Dwyer's Theorem, (with Shelly Harvey), *Geometry and Topology*,12, (2008) 199-232.

37. Homology and derived p-series of Groups, (with Shelly Harvey), *Jour. London Math. Soc.*, 78, part3,(2008),677-692; doi: 10.1112/jlms/jdn046.

38. New Constructions of Slice Links, (with Stefan Friedl and Peter Teichner), *Commentarii Math. Helv.*,83, no.3,(2009),617-638.

39. Link concordance and generalized doubling operators , (with Shelly Harvey and Constance Leidy), *Alg. Geom. Top.*,8(2008),1593-1646,DOI: 10.2140/agt.2008.8.1593.

40. Knot Concordance and Blanchfield Duality, (with Shelly Harvey and Constance Leidy), preprint available at math.GT/0705.3987.

41. Knot Concordance and Higher-Order Blanchfield Duality, (with Shelly Harvey and Constance Leidy),*Geometry and Topology*, 13(2009),1419-1482.

42. Homological Stability of Series of Groups (with Shelly Harvey),*Pacific Math Journal*,to appear, preprint available at http://front.math.ucdavis.edu/0802.2390.

43. The Milnor degree of a 3-manifold (with Paul Melvin), submitted, preprint available at http://front.math.ucdavis.edu/0902.1731.

44. Second order signatures and Derivatives of Knots, (with Shelly Harvey and Constance Leidy), submitted, preprint available at http://front.math.ucdavis.edu/0808.1432.

45. Higher-order signature cocycles for mapping class groups and homology cylinders, (with Shelly Harvey and Peter Horn), in preparation.

46. Primary decomposition and the fractal nature of knot concordance (with Shelly Harvey and Constance Leidy), submitted, preprint available at http://front.math.ucdavis.edu/0906.1373.

47. 2-torsion in the n-solvable Filtration of the Knot Concordance group (with Shelly Harvey and Constance Leidy), submitted, preprint available at.

Presentations:

"Torsion in the knot concordance group" Georgia International Topology Conference 2009, Athens, Georgia. (05/26/2009) with Shelly Harvey (presenter), Constance Leidy.

"Subgroups of the mapping class group and higher-order signature cocycles", Math Colloquium, Indiana University (3/6/2009), with Shelly Harvey(presenter) and Constance Leidy.

"New Characteristic Series for Groups and the Fractal Nature of Knot Concordance", Topology seminar, Indiana University (3/5/2009), with Shelly Harvey and Constance Leidy.

"Filtrations of the knot concordance group" 50 Years since Fox and Milnor: a conference in honor of the memory of Jerry Levine, Brandeis University. (06/04/2008) With Shelly Harvey (presenter), Constance Leidy.

"Second-Order signatures of Knots" 50 Years since Fox and Milnor: a conference in honor of the memory of Jerry Levine, Brandeis University. (06/02/2008) With Shelly Harvey, Constance Leidy (presenter).

"Derivatives of Knots and Second-order signatures" U. Cal. Berkeley Topology Seminar. (04/24/2008) With Shelly Harvey, Constance Leidy.

"Higher-Order Signature Cocycles for Subgroups of the Torelli Group" Columbia University Geometric Topology Seminar. (03/28/2008) With Shelly Harvey, Constance Leidy.

"Knot Concordance and Blanchfield Duality" Boston College Topology Seminar. (03/13/2008) With Shelly Harvey, Constance Leidy (presenter).

"Derivatives of Knots and Second-order signatures" Finite Type Invariants, Fat Graphs and Torelli-Johnson-Morita Theory, Center for the Topology and Quantization of Moduli Spaces (CTQM), Dept. Mathematical Sciences, University of Aarhus. (04/04/2008) With Shelly Harvey.

"Knots and the Fourth Dimension" Bryn Mawr/ Haverford Math Colloquium, Bryn Mawr College. (01/29/2007) With Shelly Harvey, Constance Leidy.

"Knot Concordance and Blanchfield duality" AMS Special Session on Knots, 3-Manifolds, and Their Invariants, New Orleans, Lousisana. (01/06/2007) With Shelly Harvey, Constance Leidy.

Keynote Speaker: "Classical knot concordance and Blanchfield duality" Geometric Topology Conference Beijing University, Beijing University, Beijing, China. (06/19/2007) With Shelly Harvey (presenter), Constance Leidy.

"The Fractal Nature of the knot concordance Group" Geometric Topology Conference Beijing University, Beijing University, Beijing, China. (06/22/2007) With Shelly Harvey, Constance Leidy.

"Homology and Derived p-series of groups" Warwick Mathematics Institute, Coventry, England. (July 2007) With Shelly Harvey.

"Homology and p-series of Groups" Pro-p groups and low dimensional topology, Hamilton Math. Institute, Trinity College Dublin Ireland. (09/2007) With Shelly Harvey.

"Knot Concordance and Blanchfield Duality" Columbia University Geometric Topology Seminar, Columbia University. (10/12/2007) With Shelly Harvey, Constance Leidy.

"On the Enormity of the Knot Concordance Group" Wesleyan Mathematics Department, Wesleyan University. (10/18/2007) With Shelly Harvey, Constance Leidy.

"Structure in the knot concordance group" MIT Geometry Seminar, MIT. (10/22/2007) With Shelly Harvey, Constance Leidy.

"Derivatives of Knots and Higher-Order Signature Invariants" University of Texas at Austin Topology Seminar, University of Texas at Austin. (11/26/2007) With Shelly Harvey, Constance Leidy.

"Infinite Generation in the COT filtration of the Knot Concordance Group" University of Texas at Austin Topology Seminar, University of Texas at Austin. (11/26/2007) With Shelly Harvey, Constance Leidy.

"Untying Knots in 4-Dimensions" Dean of Natural Sciences, Rice University, Rice University. (04/19/2007) With Shelly Harvey, Constance Leidy.

"New Phenomena in Knot and Link Concordance" 4-dimensional Manifolds, Mathematisches Forschungsinstitut Oberwolfach. (August 7, 2006) With Shelly Harvey and Constance Leidy.

"Knot Concordance" Knots , Groups and 3-Manifolds, Marseille, France. (May 25, 2006) With Kent Orr, Peter Teichner and Taehee Kim.

"Groping Around Link Concordance" PCMI Low-Dimensional Topology, Park City Utah. (July 7, 2006) With Shelly Harvey, Peter Teichner.

"Group Theoretic Invariants of Homology Equivalence and Homology Cobordism" Columbia University Gauge Theory Seminar, New York, New York. (April 14, 2006) With Shelly Harvey.

Lecture Series: "Noncommutative Knot Theory" KAIST: Korean Institute for Advanced Science and Technology, Gyeongsangbuk-do, Korea. (June 29 - July 2, 2005) With Shelly Harvey, Kent Orr, Peter Teichner, Taehee Kim.

Lecture Series: "Homology and Derived Series of Groups" KAIST, Gyeongsangbuk-do, Korea. (July 1, 2005) With Shelly Harvey.

"Grope Filtrations of Homology Cobordism" First Louisiana-Texas Topology Retreat, Baton Rouge, Louisiana. (March 25, 2006) With Shelly Harvey, Peter Teichner.

Submanifolds, Singular Varieties and Stratified Spaces, Shanesonfest, (Plenary Lecture), Courant, March 16, 2005

3-Manifolds and Knot Theory (Gordonfest), Plenary Lecture, Austin, Texas, May 25, 2005

Homology and Derived Series of Groups, University of Pennsylvania, Philadelphia, Pennsylvania, October 14, 2004

"Groping around in 3- and 4- dimensional space" Bi-College Mathematics Colloquium, Bryn Mawr College, October 18, 2004

"Groping around in 3- and 4- dimensions with von Neumann algebras" Harvard-Brandeis-MIT Joint Colloquium, Brandeis University, October 21, 2004

"Knots, Gropes and von Neumann rho invariants" Columbia University Mathematics Department, New York, October 29, 2004

"Homology and Derived Series of Groups" New York Group Theory Seminar, CUNY Graduate Center, October 29, 2004

"Knots, Gropes and von Neumann rho invariants" Brandeis University Topology Seminar, November 2, 2004

"Homology and Derived Series of Groups" Bay Area Topology Seminar, Stanford University, November 9, 2004

"Filtrations of the Knot Concordance Group" Banff International Research Station, Banff, Canada, May 11, 2004

"Survey of Work of COT" Banff International Research Station, Banff, Canada, May 5, 2004

" Filtrations of the knot Concordance Group" AMS National Meeting, Phoenix, Arizona, January 10, 2004

" Filtrations of knots and knot concordance" Topology Seminar, Indiana University, Bloomington, Indiana, March 4, 2004

" Filtrations of knots and knot concordance" Workshop on Knots and their Manifold Stories, BIRS, Banff, Canada, May, 2004

" Filtrations of the knot concordance group" Korea Institute for Advanced Study, Seoul, Korea, June 4, 2004

" Filtrations of the knot concordance group" Topology Seminar, Konkuk University, Korea, June 8, 2004

"Homology and Derived Series of Groups" AMS meeting, Houston, Texas, May 14, 2004

"Knots, Gropes and von Neumann rho invariants" University of Pennsylvania Topology Seminar, Philadelphia, Pennsylvania, October 15, 2004

"Knots, Gropes and von Neumann rho invariants" MIT Algebraic Topology Seminar, Cambridge, Massachusetts, December 6, 2004

Low-Dimensional Topology Conference, Univ. Virginia, December 16, 2004

"Knots and DNA" Undergraduate Conference on Applications of Math. to Biology, Rice University, February 15, 2004

Plenary Speaker Borders In Dimensional Topology/Ohio State, Columbus, Ohio, December 6, 2003

"Filtrations of Knots and the Knot concordance group," Invited Talk: Topology In and Around Dimension 3/ Bampff International Research Station, Bampff Canada, September 2003

Milnor Degree and Quantum Order of 3-manifoldsTopology Seminar, Princeton University, April 2003

Milnor Degree and Quantum Order of 3-manifolds, Columbia Topology Seminar, Columbia University, April 2003

Milnor Degree and Quantum Order of 3-manifolds Topology Seminar, University of California Berkeley, April 2003

Ribbon concordance and higher-order Arf invariants, AMS meeting, New York, April 2003

"Virtual Betti Number of 3-manifolds," Invited Talk: American Mathematical Society regional meeting, Baton Rouge, Louisiana, March 2003

"Noncommutativity in Low-Dimensional Topology," Spring Topology and Dynamics Conference, Austin, TX, March 2002

"Noncommutative Knot Theory," AMS Conference, San Diego, January 2002

"Noncommutative Knot Theory," Georgia International Topology and Geometry Conference, Athens, Georgia, May 2001

"Noncommutative knot theory," Topology seminar, UC San Diego, La Jolla, California, June 2001

"Knots and von Neumann Rho Invariants," Mathematical Institute for Research, Oberwolfach, Germany, July 2001

"Knots and von Neumann eta Invariants," Topology Conference in Honor of Jerome Levine, University of Tel Aviv, Israel, August 2001

"Noncommutative Knot Theory," National meeting of American Math. Soc., New Orleans, Louisiana, January 2001

"Knot Concordance, Whitney Towers and L^2-signatures I," University of California, San Diego, August 2000

"Knot Concordance, Whitney Towers and L^2-signatures II," University of California, San Diego, August 2000

"Noncommutative Knot Theory," New Mexico State University, Las Cruces, New Mexico, October 2000

"Knot Concordance and L^2-signatures," South Korea, August 2000

"Knot Concordance and L^2-signatures," Georgia Institute of Technology, Atlanta, Georgia, October 2000

"Knot Concordance and L^2-signatures, I," Oberwolfach, Germany September 1999

"Knot Concordance and L^2-signatures, II," Oberwolfach, Germany, September 1999

"Knot Concordance and L^2-signatures," Oberwolfach, Germany, September 1999

"Untying Knots in 4-Dimensions and Von Neumann Algebras," Louisiana State University, April 1999

"Slice Knots and Von Neumann Algebras," University of Texas Austin, November 1999

"Knot Concordance and L^2-signatures," Topology/Geometry Conference, Ohio State University, December 1999

"Knot Concordance and L^2-signatures," Bay Area Topology Conference, Stanford California, March 1999

"Knot Concordance and L^2-signatures," Mainz, Germany, September 1999

"Slice Knots and L^2-signatures," Southern California Topology Conference, University of Southern California, March 1999

"Knot Concordance and L^2-signatures," University of California at Berkeley, March 1999

"Untying Knots and Von Neumann Dimension," Yale University, November 1999

"Knot Concordance and L^2-signatures," Harvard University, November 1999

"Knot Concordance and Whitney Towers," Midwest Topology Conference, October 1999

"Knot Concordance and 4-manifolds," Denver, Colorado, June 1999

"Knot Concordance," Topology Seminar, University of Chicago, May 1999

Knots in Hellas, Delphi, Greece, August 1998

Low Dimensional Topology: The Kirby Fest, June 1998

Conference on Geometry and Topology, Lehigh University, June 1998

Combinatorial Aspects of Finite Type and Quantum Invariants, MSRI, Berkeley, Jan. 1997

International Conference on Knot Theory, Tokyo, Japan, July 1996

International Conference on Knot Theory, Oberwolfach, Germany, September 1995

International Conference on Knot Theory, Siegen, Germany, July 1993

Low-dimensional Topology and Knot Theory, Oberwolfach, Germany, September 1991

International Conference on Knot Theory, Osaka, Japan, 1990

Cornell Topology Festival, May 1990

4-manifolds Conference, Oberwolfach, September 1988

Georgia Topology Conferences, University of Georgia, 1983, 1987, 1991

Geometry of 4-manifolds Conference, M.S.R.I., May 1985