PAUL MATTHEW NIALL FEEHAN

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Education

- **Columbia University**, New York, New York
  Doctor of Philosophy in Mathematics 1992
  Master of Philosophy in Mathematics 1988
- **University of Southern California**, Los Angeles, California
  Master of Arts in Mathematics 1987
- **University of Missouri**, Rolla, Missouri
  Master of Science in Electrical Engineering 1984
- **University College Dublin**, Dublin, Ireland
  Bachelor of Engineering in Electronic Engineering (First class honors) 1982

Full-Time Academic Positions

- **Rutgers University**, New Brunswick, New Jersey
  Associate Professor of Mathematics 2001–Present
- **University of Dublin (Trinity College)**, Dublin, Ireland
  Professor of Mathematics (1762 Erasmus Smith Chair) 2000–2001
- **Ohio State University**, Columbus, Ohio
  Associate Professor of Mathematics 2000–2001
  Assistant Professor of Mathematics 1997–2000
- **Harvard University**, Cambridge, Massachusetts
  National Science Foundation Postdoctoral Fellow 1993–1997
- **Mathematical Sciences Research Institute**, Berkeley, California
  Postdoctoral Research Fellow 1992–1993

Visiting Academic Positions

- Max Planck Institut für Mathematik, Bonn January 2004
- Max Planck Institut für Mathematik, Bonn August 2003
- Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette August 2003
- Max Planck Institut für Mathematik, Bonn January 2003
- Max Planck Institut für Mathematik, Bonn June–Sept 2001
- Max Planck Institut für Mathematik, Bonn March–Sept 2000
- Max Planck Institut für Mathematik, Bonn September 1999
- Institute for Advanced Study, Princeton 1998–1999
- Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette July–Sept 1998
- Max Planck Institut für Mathematik, Bonn April–June 1998

Grants, Honors, and Awards

• Fellow, Livingston College, Rutgers University	2001–Present
• NSF Grant Principal Investigator (Geometric Analysis)	2001–2004
• Enterprise Ireland Basic Research Grant (Mathematics) —Award declined	2001
• NSF Grant Principal Investigator (Geometric Analysis)	1997–2002
• Ohio State University Research Foundation Seed Grant Award	1998–1999
• NSF Mathematical Sciences Postdoctoral Fellowship	1993–1997
• Columbia University Faculty Fellowship	1987–1991
• Smurfit-Alton Fellowship, University of Missouri	1982–1983
• Final examination prizes, University College Dublin	1979–1982

Publications

Please see attached *bibliography* for further details:

- **Articles published in refereed journals:** 11 articles appearing in Communications in Analysis and Geometry, Journal für die Reine und Angewändte Mathematik, Journal of Differential Geometry, Mathematical Research Letters, Pacific Mathematics Journal, and Topology and its Applications.
- **Technical reports:** 4 reports for public and private companies, including CDC IXIS Asset Management North America (New York), the McDonnell-Douglas Corporation, and the National Aeronautics and Space Administration.
- **Other:** 2 submitted articles, 2 preprints, 2 theses, and 5 articles in preparation.

Invited Public Presentations

Please see attached *list* for further details:

- **Colloquium and seminar lectures (United States):** Over 50 presentations at universities and institutes, including Columbia, Harvard, the Institute for Advanced Study (Princeton), Massachusetts Institute of Technology, the Mathematical Sciences Research Institute (Berkeley), New York University, Princeton, Stanford, Yale, the University of California (Berkeley), UCLA, and the University of Michigan.
- **Conference lectures (United States):** 12 presentations.
- **Colloquium and seminar lectures (International):** Over 16 presentations at universities and institutes, including the Ecole Polytechnique (France), Imperial College London, the Max Planck Institut für Mathematik (Germany), McMaster University (Canada), the University of Frankfurt, the University of Munich, and the University of Osnabruck.
- **Conference lectures (United States):** 13 presentations, including conferences in Bonn, Coventry, Dublin, Lyon, Montreal, Oberwolfach (Germany), Pisa, Strasbourg, and Gökova (Turkey).

Teaching Experience

Please see attached *teaching experience* vita for further details:

- **Graduate course in mathematical finance**: Autumn 2003, Rutgers University. Curriculum available at http://www.math.rutgers.edu/~feehan/math611.html.
- **Undergraduate and graduate mathematics courses**. Over 12 different courses, in differential geometry, differential topology) at Columbia, Harvard, the Ohio State University, and Rutgers University (New Brunswick), 1988–present.
- **Undergraduate courses on communication theory and digital signal processing.** Taught at the Department of Electrical Engineering, University of Missouri (Rolla), 1982–1984, and University of Southern California, Los Angeles, 1984–1985.

RESEARCH INTERESTS

Research in Pure Mathematics

Expertise in analysis on Riemannian manifolds, topology of 4-dimensional manifolds, differential geometry, and non-linear partial differential equations (especially those arising in theoretical physics).

- **Applications of gauge theory to topology of smooth 4-dimensional manifolds**
  Gauge theory is a mathematical tool used by theoretical physicists to describe the interactions of Nature's elementary particles, such as electrons and photons, while 4-dimensional manifolds can be viewed as 4-dimensional universes ("space-time"). Developed major research program to prove conjecture of Edward Witten regarding the relationship between Donaldson-Yang-Mills and Seiberg-Witten gauge-theoretic invariants of 4-manifolds, as well as provide rigorous mathematical justification of quantum-field theory predictions. (Collaboration with Thomas G. Leness, 1995–Present)
- **Analysis on manifolds, gauge theory, and non-linear partial differential equations**
  Proved conjecture of Simon Donaldson regarding the volume and diameter of the moduli space of Yang-Mills connections over the 4-dimensional sphere. Answered question of Tomasz Mrowka regarding use of critical exponent Solobev norms to prove an optimal slice theorem for quotient space of connections over a compact 4-manifold. Proved a new Kato-Yau inequality for the Dirac operator. (1989–Present)

Research in Applied Mathematics

Expertise in stochastic differential equations, digital signal processing, and mathematical control theory.

- **Portfolio insurance and risk analysis** — for *CDC-IXIS Asset Management (New York)*
  Responsible for developing analytical and numerical models for analyzing risks and expected returns for constant proportion portfolio insurance (CPPI) products offered by their hedge fund division. Developed stochastic models for behavior of risky assets using geometric Brownian motion and jump diffusion processes. Performed analytical probability risk study of model portfolios consisting of a combination of risky and safe, reserve assets and numerical analysis using Excel and Visual Basic, Mathematica, and C++. (June 2002–Present)
- **Flight-control guidance system** — for the *McDonnell-Douglas* division of *Boeing Co.*
  Designed and wrote FORTRAN computer program to analyze flight-control guidance system for fighter jets. (Summer 1985)
- **Digital signal analysis of space shuttle antenna gain measurements** — for the *National Aeronautics and Space Administration*
  Developed sparse data interpolation method using piecewise polynomial (cubic) splines for application to modeling of space shuttle antenna gain patterns. Designed and wrote FORTRAN computer program to implement data analysis. (June 1983–July 1984)

Computer Software Expertise

- **Operating systems:** Linux, UNIX, Windows.
- **Languages:** FORTRAN, C++.
- **Packages:** Mathematica, Maple, and Matlab.

Languages

- French and German — reading knowledge and basic conversation.

ACADEMIC SERVICE ACTIVITIES

Professional Service Activities

- **Reviewer** for the National Science Foundation, Division of Mathematical Sciences, grant applications. 1992–Present
- **Referee** for the following mathematics journals:
  Commentarii Mathematici Helvetici
  Communications in Analysis and Geometry
  Communications in Mathematical Physics
  Journal of Differential Geometry
  Topology and its Applications
- **Member** – External Ph.D. Defense Committees:
  Adrian Clingher (Advisor: Professor J. Morgan, Columbia University) April 2002
  Phi Long Nguyen Thanh (Advisor: Professor D. Phong, Columbia University) April 2003
- **Member** – *Graduate School of Arts and Sciences Student Advisory Committee*. 1989–1991
  Representative for Columbia Department of Mathematics graduate students.

Mathematics Department Service Activities

- **Member** – *Master's Program in Math Finance Working Group.* Oct 2002–Present
  Wrote initial drafts of program curriculum. Established over a dozen contacts with mathematical finance practitioners for advice on program and board membership. Coordinated group meetings with practitioners.
- **Member** – *Computer Advisory Committee.* Jan 2002–Present
  Committee oversees work of the department computer systems administrator, setting work priorities, reviewing computer security, and major computing initiatives.
- **Undergraduate Summer Advisor**. May–Aug 2002
- **Chair** – *Written Qualifying Exam Committee.* May–Aug 2003
- **Chair** – *Colloquium Committee.* Sep 2001–Present
- **Member** – *Written Qualifying Exam Committee.* Sep 2001–Present
- **Member** – *Oral Qualifying Exam Committees:*
  Alexander Zarechnak (Advisor: Professor Sheldon GoldStein) May 2003
  Qinian Jin (Advisor: Professor Yanyan Li) February 2003

Research Service Activities

- **Organizer** – Gauge Theory and Topology Seminar, University of Dublin. 2000–2001
- **Organizer** – Analysis and Geometry Seminar, Ohio State University. 1997–2000

BIBLIOGRAPHY

Articles Published In Refereed Journals

1. P. M. N. Feehan and T. G. Leness, *On Donaldson and Seiberg-Witten Invariants*, Proceedings of the 2001 Georgia Topology Conference, Proceedings of Symposia in Pure Mathematics, to appear.
2. P. M. N. Feehan and T. G. Leness, *SO(3) monopoles, level-one Seiberg-Witten moduli spaces, and Witten's conjecture in low degrees*, Topology and its Applications **124** (2002), 221–326; arXiv:math.DG/0106238.
3. P. M. N. Feehan, *A Kato-Yau inequality and decay estimate for eigenspinors*, Journal of Geometric Analysis **11** (2001), 469–489; arXiv:math.DG/9903021.
4. P. M. N. Feehan, *Critical-exponent Sobolev norms and the slice theorem for the quotient space of connections*, Pacific Journal of Mathematics **200** (2001), 71-118; arXiv:dg-ga/9711004.
5. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles. II: Top-level Seiberg-Witten moduli spaces and Witten's conjecture in low degrees*, Journal für die Reine und Angewändte Mathematik **538** (2001), 135-212; arXiv:dg-ga/9712005.
6. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles and links of top-level Seiberg-Witten moduli spaces*, Journal für die Reine und Angewändte Mathematik **538** (2001), 57-133; arXiv:math.DG/0007190.
7. P. M. N. Feehan, *Generic metrics, irreducible rank-one PU(2) monopoles, and transversality*, Communications in Analysis & Geometry **8** (2000), 905-967; arXiv:math.DG/9809001.
8. P. M. N. Feehan, P. B. Kronheimer, T. G. Leness, and T. S. Mrowka, *PU(2) monopoles and a conjecture of Mariño, Moore, and Peradze*, Mathematical Research Letters **6** (1999), 169-182; arXiv:math.DG/9812125.
9. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles and relations between four-manifold invariants*, Topology and its Applications **88** (1998), 111-145; arXiv:dg-ga/9709022.
10. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles. I: Regularity, compactness and transversality*, Journal of Differential Geometry **49** (1998), 265-410; arXiv:dg-ga/9710032.
11. P. M. N. Feehan, *Geometry of the ends of the moduli space of anti-self-dual connections*, Journal of Differential Geometry **43** (1995), 465-553.

Applied Mathematics Technical Reports

1. P. M. N. Feehan, *CPPI with rebalancing at regular, discrete time intervals*, Technical report for CDC IXIS Asset Management North America, New York, New York, June 2003, 8 pages.
2. P. M. N. Feehan, *Probability calculations for CPPI-type algorithms using diffusion process models and extreme value theory*, Technical report for CDC IXIS Asset Management North America, New York, New York, May 2003, 21 pages.
3. L. Silverman and P. M. N. Feehan, *A fly-by-wire guidance control system*, Technical report for the McDonnell-Douglas Corporation, USA, September 1985.
4. P. M. N. Feehan and W. H. Tranter, *Calibration consistency analysis for antenna gain measurements*, Technical report for the National Aeronautics and Space Administration, USA, November 1983.

Articles Submitted For Publication

1. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles. III: Existence of gluing and obstruction maps*, 91 pages, submitted; arXiv:math.DG/9907107.
2. P. M. N. Feehan and T. G. Leness, *Donaldson invariants and wall-crossing formulas. I: Continuity of gluing maps*, 86 pages, submitted; arXiv:math.DG/9812060.

Preprint Articles

1. P. M. N. Feehan and T. G. Leness, *Witten's conjecture for four-manifolds of simple type*, 35 pages, preprint.
2. P. M. N. Feehan and T. G. Leness, *A general SO(3)-monopole cobordism formula relating Donaldson and Seiberg-Witten invariants*, 103 pages, preprint; arXiv:math.DG/0203047.

Articles In Preparation

1. P. M. N. Feehan and T. G. Leness, *Donaldson invariants and wall-crossing formulas. III: Intersection theory*, in preparation.
2. P. M. N. Feehan and T. G. Leness, *Donaldson invariants and wall-crossing formulas. II: Surjectivity of gluing maps*, in preparation.
3. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles. V: Intersection theory*, in preparation.
4. P. M. N. Feehan and T. G. Leness, *PU(2) monopoles. IV: Surjectivity of gluing maps*, in preparation.
5. P. M. N. Feehan, *On universal L^p estimates for elliptic operators in Yang-Mills theory*, in preparation.

Doctoral And Master's Degree Theses

1. P. M. N. Feehan, *Geometry of the moduli space of self-dual connections over the four-sphere*, Columbia University Ph.D. Thesis, New York, 1992, 150 pages.
2. P. M. N. Feehan, *An investigation of methods of surface estimation with applications to the interpolation of antenna patterns*, University of Missouri-Rolla Master's Thesis, May 1984.

TEACHING EXPERIENCE

Rutgers University, New Brunswick, New Jersey

- Math 611. Topics in applied mathematics (mathematical finance) — Autumn 2003
- Math 244. Differential equations for engineering & physics — Autumn 2003
- Math 244. Differential equations for engineering & physics – *2 sections* — Spring 2003
- Math 534. Topics in differential geometry — Autumn 2002
- Math 532. Differential geometry — Spring 2002
- Math 151. Calculus I — Autumn 2001
- Math 250. Introduction to linear algebra — Autumn 2001

University of Dublin (Trinity College), Dublin, Ireland

- Math 131. Mathematical methods and linear algebra — Spring 2001
- Math 421. Algebraic topology — Spring 2001
- Math 131. Mathematical methods and linear algebra — Autumn 2000
- Math 421. Algebraic topology — Autumn 2000

Ohio State University, Columbus, Ohio

- Math 867. Differential topology II — Winter 2000
- Math 254. Multivariable calculus — Winter 2000
- Math 866. Differential topology I — Autumn 1999
- Math 151. Calculus I — Autumn 1999
- Math 254. Multivariable calculus – *2 sections* — Winter 1998
- Math 254. Multivariable calculus – *2 sections* — Autumn 1997

Harvard University, Cambridge, Massachusetts

- Math 21A. Multivariable calculus – *2 sections* — Autumn 1993
- Math 21A. Multivariable calculus – *2 sections* — Autumn 1994
- Math 21A. Multivariable calculus – *2 sections* — Autumn 1995

Columbia University, New York, New York

- Math W1003. College algebra and analytic geometry — Summer 1992
- Math W1003. College algebra and analytic geometry — Spring 1992
- Math W1003. College algebra and analytic geometry — Autumn 1991
- Math V1201. Calculus III — Summer 1991
- Math V1101. Calculus I — Summer 1991
- Math V1101. Calculus I — Summer 1990
- Math V1102. Calculus II — Summer 1989
- Math V1101. Calculus I — Summer 1988
- Teaching assistant for undergraduate mathematics courses — 1988–1991

University of Southern California, Los Angeles

- Teaching assistant for undergraduate mathematics courses — 1985–1987
- Teaching assistant for undergraduate electrical engineering courses — 1984–1985

University of Missouri, Rolla, Missouri

- Electrical Engineering 243. Communication systems — Summer 1984
- Teaching assistant for undergraduate electrical engineering courses — 1982–1984

INVITED PUBLIC PRESENTATIONS

Addresses at International Conferences

- First Joint American Mathematical Society & Unione Matematica Italiana, Pisa, Italy (2002)
- Conference on Topology and Group Actions, Centre de Recherche Mathématiques, Montréal, Canada (2001)
- First Joint American Mathematical Society & Sociétè Mathématique de France International Meeting, Lyon, France (2001)
- Mathematisches Forschungsinstitut Oberwolfach, Four-manifolds workshop (participant), Germany (2001)
- Mathematische Arbeitstagung, Max Planck Institut für Mathematik, Bonn, and Mathematisches Institut der Universität Bonn, Germany (2001)
- Symposium on Geometry and Topology, University of Warwick, Coventry, England (2000)
- Seventh Gökova Geometry/Topology Conference, Gökova, Turkey (2000)
- Conference on Geometry, Analysis, and Mathematical Physics, European Science Foundation, Strasbourg, France (1999)
- Mathematisches Forschungsinstitut Oberwolfach, Four-manifolds workshop, Germany (1996)

International Colloquium and Seminar Lectures

- University of Göttingen, Colloquium, Germany, (2004)
- McMaster University, Colloquium, Canada, (2003)
- Max Planck Institut für Mathematik, Gauge theory seminar, Bonn, Germany (2003)
- Max Planck Institut für Mathematik, Gauge theory seminar, Bonn, Germany (2002)
- Max Planck Institut für Mathematik, Gauge theory seminar, Bonn, Germany (2001)
- Imperial College, London, England (2001)
- University College, National University of Ireland, Maynooth, Ireland (2000)
- Max Planck Institut für Mathematik, Gauge theory seminar, Bonn, Germany (2000)
- Mathematisches Institut, Universität Bielefeld, Germany (2000)
- University of Frankfurt, Colloquium, Germany, (2000)
- McMaster University, Colloquium, Canada, (1999)
- University of Dublin, Trinity College, Seminar, Ireland (1999)
- Ecole Polytechnique, Differential geometry seminar, Paris, France (1998)
- Mathematisches Institut, Universität München , Germany (1998)
- Mathematisches Institut, Universität Osnabruck, Germany (1998)
- Max Planck Institut für Mathematik, Oberseminar, Bonn, Germany (1998)
- University College, National University of Ireland, Dublin, Ireland (1994)

Addresses at Conferences in the United States

- Georgia International Topology Conference, Athens, Georgia (2001)
- AMS Special Session, Gauge theory and low-dimensional topology, North Carolina (1999)
- Marston Morse conference on gauge theory and symplectic geometry, Institute for Advanced Study, Princeton (1999)
- AMS Special Session, Holomorphic vector bundles and complex geometry, Illinois (1999)
- Mathematical Sciences Research Institute, Four-manifolds workshop, Berkeley (1997)
- AMS Special Session, Gauge theory and its interaction with holomorphic and symplectic geometry, Missouri (1996)
- AMS Special Session, Invariants of smooth four-manifolds, New Jersey (1996)
- Georgia Topology Conference, Symplectic topology, Athens (1996)
- AMS Special Session, Gauge field theory, New York (1996)
- AMS Special Session, Partial differential equations and math physics, Boston (1995)
- AMS Special Session, Gauge theory and applications, Brooklyn (1994)
- AMS Special Session, Gauge theory and four-manifolds, Los Angeles (1992)

Colloquium and Seminar Lectures in the United States

2002
- Lafayette College, Colloquium
- Haverford College, Colloquium
- State University of New York, Stony Brook, Analysis seminar

2001
- Michigan State University, East Lansing, Gauge theory seminar
- Rutgers University, New Brunswick, Non-linear analysis seminar
- Rutgers University, New Brunswick, Geometry and topology seminar

2000
- Brown University, Seminar
- University of Wisconsin, Madison, Colloquium
- Rutgers University, Seminar

1999
- Johns Hopkins University, Mathematical physics seminar
- University of Michigan, Ann Arbor, Colloquium
- University of Michigan, Ann Arbor, Seminar
- Harvard University, Gauge theory and topology seminar
- Yale University, Topology seminar

1998
- Boston University, Differential geometry seminar
- Brown University, Differential geometry seminar
- Princeton University, Topology seminar
- Rutgers University, Topology seminar

1997
- Columbia University, Geometry and analysis seminar
- Massachusetts Institute of Technology, Analysis seminar
- University of Wisconsin, Madison, Differential geometry seminar
- University of Wisconsin, Madison, Topology seminar
- Yale University, Topology seminar
- Ohio State University, Columbus, Seminar
- State University of New York, Stony Brook, Seminar
- Texas A & M University, Seminar
- Stanford University, Colloquium
- University of California, Los Angeles, Differential geometry seminar
- University of Washington, Seattle, Colloquium

- University of California, Santa Barbara, Differential geometry seminar

1996

- Courant Institute, Differential geometry and topology seminar
- University of Illinois, Urbana-Champaign, Differential geometry seminar
- Ohio State University, Columbus, Colloquium
- Ohio State University, Columbus, PDEs and several complex variables seminar
- Harvard University, Gauge theory and topology seminar
- Princeton University, Differential geometry and topology seminar
- Brown University, Differential geometry seminar
- Massachusetts Institute of Technology, Symplectic geometry seminar

1995

- Columbia University, Geometry and analysis seminar
- Boston University, Differential geometry seminar

1994

- Institute for Advanced Study/Park City, Colloquium

1993

- State University of New York, Buffalo, Colloquium
- Harvard University, Gauge theory and topology seminar
- Stanford University, Gauge theory seminar
- University of California, Berkeley, Differential geometry seminar
- Mathematical Sciences Research Institute, Area I I seminar
- Columbia University, Geometry and analysis seminar

1992

- Columbia University, Geometry and analysis seminar