Matthew Leingang

Addresses Courant Institute of Mathematical Sciences
New York University
251 Mercer Street
New York, NY 10012
tel: (212) 998-3107
e-mail: mailto:leingang@cims.nyu.edu
www: http://www.math.nyu.edu/~leingang/

Appointments

2008–	**New York University** Clinical Associate Professor of Mathematics
2003–2008	**Harvard University** Preceptor in Mathematics
2000–2003	**Rutgers, the State University of New Jersey** Hill Assistant Professor of Mathematics

Education

2000	**Harvard University.** Ph.D., Mathematics
1998	**Harvard University.** A.M., Mathematics
1995	**University of Chicago.** A.B., Mathematics, with honors in the College and in Mathematics

Professional and Research Interests

97B50	Teacher education
97D40	Teaching methods and classroom techniques. Lesson preparation. Educational principles
97U70	Technological tools (computers, calculators, software, etc.) and their use in the classroom
37J05	Finite-dimensional Hamiltonian and Lagrangian systems–general theory

53D20	Differential geometry—Moment maps; symplectic reduction
53D12	Differential geometry—Lagrangian submanifolds
55N91	Equivariant cohomology

Publications

2007 **"Dirac structures on manifolds with G_2 holonomy"** with S. Kariagiannis, in preparation

"A brief history of teaching fellow training at Harvard" with D. Bruff and R. Gottlieb, in preparation

"Inquriry-based learning approaches to geometry and probability for high school teachers" with B. Benesh, in preparation

2003 **"Symmetric space valued moment maps"** *Pacific Journal of Mathematics*, November 2003.

ABSTRACT: For a compact Lie group G, three examples of G-spaces which can serve as the target of a moment map are discussed. Abstracting the work of Alekseev, Meinrenken, and Malkin, we cast these theories into a unified framework.

2000 ***Symmetric Space Valued Moment Maps*** Harvard University Ph.D. Thesis.

ABSTRACT: We discuss the examples of moment maps that arise from the action of a compact Lie group G on a manifold. The first such is the classical moment map on Hamiltonian G-spaces, which takes its values in the dual $\mathfrak{g}^*$ of the Lie algebra of G. There is, however, a newly developing theory of G-valued moment maps. Finally, a third moment map takes values in a noncompact symmetric space lying in the complexification of G. In bringing all of these examples together, we arrive at a class of symmetric pairs over G with a certain pairing on the associated Lie algebra. From such pairs we can construct equivariantly closed three-forms on the corresponding symmetric space. All known examples of targets for moment maps arise this way. We prove that for simple groups there are no other examples, and

thus for semisimple groups the only possible examples are combinations of these.

Talks

2007 **"Two non-traditional content courses for in-service high school teachers at the Har vard Extension School"** with B. Benesh and T.W. Judson. *Critical Issues in Education: Teaching Teachers Mathematics* conference, Mathematical Sciences Research Institute, Berkeley, California

"IBL approaches to Geometry and Probability for High School Teachers" with B. Benesh. *The 10th annual Legacy of R.L. Moore Conference*, Austin, Texas

"Gilligan, MOPE, and TiVO". Special Faculty Colloquium, University of California, Irvine

"Changing sections" a case study in student preparartion, Derek Bok Center for Teaching and Learning Winter Teaching Conference

2006 **"The quicksand of problem four"** a case study in classroom assessment, Derek Bok Center for Teaching and Learning Fall Teaching Conference

2006 **"Symmetric Space Valued Moment Maps"** University of Connecticut Faculty Colloquium

2005 **"Salad Days"** a case study in students with problems, Harvard Teaching Undergraduate Mathematics Seminar

2005 **"What were they thinking?"** a case study in expectations, Harvard Teaching Undergraduate Mathematics Seminar

2005 **"Seeking points"** a case study in grading, Derek Bok Center for Teaching and Learning Fall Teaching Conference

2005 **"Lesson planning"** Harvard Teaching Undergraduate Mathematics Seminar

2005 **"Advantages, challenges, and dividends of online placement"** AMS/MAA Joint Meetings

2004	**"Conic sections"** Mathematics Warm-Up Series
2004	**"Constructing** $\cos(2\pi/17)$**"** Mather House Math Table
2004	**"To Infinity and beyond: Graduate School in math and science"** Panel discussion during *Taking the Next Step*, a University of Chicago career day event for juniors
2003	**Calculus Class Open House** Opened my class to the department to spark a discussion of methods and pedagogy.
2003	**"The Cayley-Menger determinant and you"** Mather House Math Table
2003	**"Momentum through the centuries"** Rochester Institute of Technology Colloquium
2001	**"Course preparation from start to finish"** Rutgers VIGRE Seminar.
2000	**"Symmetric space valued moment maps"** Rutgers Lie Theory Seminar.
1995–2000	**Expository Lectures** Spoke in graduate student seminars, with topics including equivariant cohomology, Clifford algebras, and Bott periodicity.

Research Supervised

2002	**Research Experiences for Undergraduates (REU)** Ran a project with one undergraduate student and one graduate assistant. Investigated Hilbert's Third Problem in hyperbolic geometry.
2001	**Research Experiences for Undergraduates (REU)** Assisted in a project with C. Woodward (Rutgers University), three undergraduates, and one graduate assistant. Studied quantum $6j$-symbols and their relationship to three-manifolds.
2000	**Harish Bhat** Studied under my supervision the syzygy crossings in a simplification of the three-body problem.

Seminars

1996–1997	**Trivial Notions Seminar** Ran a graduate student semi-

nar of expository talks.

Teaching Experience

A full list of courses taught may be found in my teaching portfolio.

Harvard University

2003– **Course Head** During different semesters for many courses in the calculus sequence. Topics include functions, differential calculus, integral calculus, series, differential equations, multivariable calculus and linear algebra. Responsible for choosing the text, setting the syllabus, managing section leaders, writing exams, and assigning final grades. Teach two sections each semester.

Theory and Practice of Teaching Courses in probability and geometry. Teach middle school teachers in the A.L.M. program in the Harvard Extension School.

Rutgers University

2000–2003 **Courses in Calculus and Applied Mathematics** Taught sections of calculus. Ran my own courses in linear algebra, applied mathematics, and mathematical reasoning. Taught a reading course in representation theory.

Harvard University

1997–2000 **Teaching Fellow** Taught a section of multivariable calculus. Taught quantitative reasoning in the Summer School. Developed a course in decision theory taught in the Harvard College Core. Designed and taught a tutorial on chaos theory for mathematics concentrators. Served as course assistant in graduate-level algebra classes and undergraduate-level dynamical systems classes.

Teacher Development

2003– **A.L.M in Teaching Program**, Harvard Extension School. Teach content knowledge mathematics courses (mainly in geometry and probability) to middle- and high-school teachers from the Boston area.

2005– **Teaching Undergraduate Mathematics Seminar (TUMS)** Responsible for expanding the Apprentice program to a mandatory pre-service teaching seminar in lesson planning, managing classrooms, and public speaking. Organized the existing TUMS seminar into an in-service seminar based on case studies.

2003– **Apprentice Coach** Mentored graduate students in a two-week training program for undergraduate teaching. Apprentices observe one of my classes for one week then teach for one week. In between we discuss aspects of teaching and monitor progress.

Independent Contracting

2007 **Freelance Writer** Wrote a guide to Web 2.0 services for undergraduates and web novices

2005– **Subject Matter Expert** content-verified online courses in college mathematics and linear algebra.

2004– **Technical Book Reviewer** Reviewed books on Slashdot (`http://slashdot.org/`) covering PHP and Mac OS X. Have reviewed book proposals and content-verified finished manuscripts for these subjects as well as MySQL, Unix.

2004– **Mathematics Textbook Reviewer** Reviewed book proposals and content-checked finished manuscripts in calculus and linear algebra.

1998– **LaTeX consultant**. Various projects include

- *The Geometry and Cohomology of Some Simple Shimura Varieties* by M. Harris and R. Taylor (Princeton University Press, 2002)
- *Calculus: An Integrated Approach to Functions and Their Rates of Change* by R. Gottlieb (Addison–Wesley, 2002)
- *Supersymmetry and Equivariant De Rham Theory* by V.W. Guillemin and S.Z. Sternberg (Springer, 1999).

Computer Skills

Operating Systems UNIX (Linux, Sun), Mac OS X

Languages	PHP, Perl, Python, bash, tcsh, awk, sed, JavaScript
Applications	TEX, LATEX, MySQL, Emacs, Microsoft Office, Open Office

Computer Projects

2003– **Mathematical Online Placement Exam (MOPE)** Headed a project to administer placement tests through the web. Principal investigator for a $50,000 grant from the Provost's Fund for Instructional Technology.

2001–2003 **PHPSlash** Made several contributions to this open-source content-management system written in PHP, including

- a programming interface with a choice of underlying implementations for converting times in a database between timezones, and formatting dates according to custom and locale.
- a system of class registration to minimize excess code compilation additionally allowing for easy user customization of applications.

Fellowships, Awards, and Prizes

2000 **National Science Foundation.** VIGRE Postdoctorate Fellowship

1995–1998 **National Science Foundation.** Graduate Research Fellowship

May 1995 **University of Chicago Mathematics Department** Paul R. Cohen Memorial Prize in Mathematics

References

Daniel L. Goroff
Professor of Mathematics and Humanities
Dean of Faculty
Harvey Mudd College
301 Platt Boulevard
Claremont, CA 91711
mailto:daniel_goroff@hmc.edu

Clifford H. Taubes
Professor of Mathematics and Department Chair
Harvard University
One Oxford Street
Cambridge, MA 02138
mailto:chtaubes@math.harvard.edu

Robin Gottlieb
Professor of the Practice of Mathematics
Harvard University
One Oxford Street
Cambridge, MA 02138
mailto:gottlieb@math.harvard.edu

Victor W. Guillemin
Professor of Mathematics
Massachusetts Institute of Technology
Building 2, Room 236
77 Massachusetts Avenue
Cambridge, MA 02139-4307
mailto:vwg@math.mit.edu

James Mancall
Assistant Dean of Advising Programs
University Hall
Harvard University
Cambridge, MA 02138
mailto:jmancall@fas.harvard.edu