

Fall 2006
University of Michigan-Department of Mathematics
<http://www.math.lsa.umich.edu/seminars/index.shtml>
Ann Arbor, MI 48109-1043
October 30th – November 5th

Monday, October 30

- 3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Ellen Veomett (UM) *Secondary polytopes* --- 3866 EH
- 3:10-4:30pm **Arithmetic/Number Theory Seminar** --- Matthew L. Smith (UM) *On solution-free sets for simultaneous quadratic and linear equations* --- 4096 EH
- 4:10-5:00pm **Several Complex Variables Seminar** --- Michael Bolt (Calvin College) *Complex ellipsoids and the Bochner-Martinelli kernel* --- 3096 EH
- 4:10-6:00pm **Geometry & Physics** --- Tom Coats (Imperial College) *Mirror Symmetry and Lagrangian Cones* --- 3088 EH
- 4:10-6:00pm **Group Theory/Lie Theory Seminar** --- Alireza Salehi (Princeton) *Discrete Transitive Actions on Bruhat-Tits Building* --- 4088 EH

Tuesday, October 31

- 12:10-1:00pm **Student Algebraic Geometry Seminar** --- Jose Gonzalez (UM) *Zak's theorems* --- 1068 EH
- 2:10-3:00pm **Geometry Seminar** --- Tom Coates (Imperial College) *Symplectic Linear Algebra, Gromov-Witten Theory, and Toric Crepant Resolutions* --- 4088 EH
- 3:10-4:00pm **Algebra Seminar** --- Tanya Chmutova (UM) *Continuous Hecke algebras of type GL (2)* --- 3096 EH
- 4:10-5:00pm **Colloquium (Rainich Lectures)** --- Philip Holmes (Princeton) *From Neural Oscillators through Stochastic Dynamics to Optimal Decisions, or Does Math Matter to Gray Matter?* --- 1360 EH

Wednesday, November 1

- 3:10-4:00pm **Student Arithmetic Seminar** --- Nick Ramsey (UM) *The Eigencurve* --- 3866 EH
- 3:10-4:00pm **Student AIM Seminar** --- Zhengjie XU (UM) *Decay of correlation implies chaos in the sense of Devaney* --- 3096 EH
- 3:10-4:00pm **Geometry Seminar (Special Seminar)** --- Alireza Salehi Golsefidy (Princeton) *S-Arithmetic Khintchine Type Theorem: The Convergence Case* --- 3088 EH
- 3:10-4:00pm **Geometric Function Theory Seminar** --- Stefan Wenger (Courant Institute) *Gromov hyperbolic spaces and sharp constants for isoperimetric and filling radius inequalities* --- 4096 EH
- 4:10-5:00pm **Colloquium (Rainich Lectures)** --- Philip Holmes (Princeton) *Thirty-Three Years of Nonlinear Dynamics: More is Different and Less is More* --- 1360 EH
- 4:10-5:30pm **Working Seminar in Several Complex Variables and Complex Dynamics** --- John Erik Fornæss (UM) *Solving $\bar{\partial}$ on Kohn-Nirenberg domain* --- 4088 EH
- 4:10-5:00pm **Student Analysis Seminar** --- Johanna Mangahas (UM) *Introduction to Teichmüller Space and Quasiconformal Maps* --- 3866 EH
- 4:10-6:00pm **Algebraic Geometry Seminar** --- Not meeting this week --- 3088 EH

Thursday, November 2

- 3:10-4:00pm **Commutative Algebra Seminar** --- Not meeting this week --- 3096 EH
- 3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Matt Davison (Univ. of Western Ontario) *Success and failure in (modeling) Deregulated Electricity Markets* --- 3088 EH
- 3:10-4:00pm **Topology Seminar** --- Not meeting this week --- 4096 EH
- 3:10-5:00pm **Analysis Study Seminar** --- Jang-Mei Wu (Univ. of Illinois) *Tug of war with noise: a game theoretic view of the p -Laplacian (after Peres and Sheffield)* --- 2866 EH

Thursday, November 2 Cont.....

- 4:10-5:00pm **Colloquium (Rainich Lectures)** --- Philip Holmes (Princeton) *On the Neuromechanics of Swimming in Lamprey* --- 1360
- 4:10-5:00pm **Differential Equations** --- Alex Sotirov (UM) *Particle Path Structure of Kinetic Boundary Layers* --- 4096 EH
- 4:10-5:00pm **Math Club** --- Bhramar Mukherjee (UM-Biostatistics) *To Bayes or not to Bayes* --- 1324 EH
- 4:10-5:00pm **Student Combinatorics** --- Nina White (UM) *An Introduction to Cluster Algebras* --- 3866 EH
- 4:10-5:30pm **Logic Seminar** --- Not meeting this week --- 3096 EH
- 4:30-5:30pm **Theoretical Computer Science Seminar** --- Yufan Zhu (UM) *Ranking Systems: The PageRank Axioms* --- CSE 3941
- 5:15-6:30pm **Teaching Mathematics** --- Not meeting this week --- 3088 EH

Friday, November 3

- 3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Smadar Karni (UM) *Two-layer shallow water: a relaxation approach* ---1084 EH
- 3:10-4:00pm **Student Geometry/Topology** --- Marshall Williams (UM) *Dimension Theory in General Metric Spaces* --- 3096 EH
- 4:10-5:00pm **Combinatorics** --- Ellen Veomett (UM) *The computational complexity of convex bodies* --- 3866 EH

ABSTRACTS FOR THE WEEK OF OCT. 30 – NOV. 5, 2006

Several Complex Variables Seminar

**Monday, October 30, 4:10-5:00pm
3096 EH**

Michael Bolt (Calvin College)

Complex ellipsoids and the Bochner-Martinelli kernel

This talk concerns symmetry properties of certain Cauchy-Fantappie kernels that arise in the study of holomorphic functions in complex Euclidean space.

We show that among bounded domains the Bochner-Martinelli and Leray-Aizenberg kernels are self-adjoint with respect to weighted boundary measure only for complex ellipsoids, i.e., the complex linear images of balls. The relevant measure is the Fefferman measure. Furthermore, the Leray-Aizenberg kernel is shown to be Mobius invariant when defined with respect to Fefferman measure.

Geometry & Physics

**Monday, October 30, 4:10-6:00pm
3088 EH**

Tom Coats (Imperial College)

Mirror Symmetry and Lagrangian Cones

Work of Givental has revealed a close connection between the Gromov-Witten theory of a space X and a certain symplectic vector space $H(X)$. Genus-zero Gromov-Witten invariants can be encoded in a Lagrangian submanifold L of $H(X)$, and many results in Gromov-Witten theory can be interpreted as simple statements about the geometry of L . This gives a powerful language for working with Gromov-Witten invariants. We give a gentle introduction to this language and, drawing on ideas of Barannikov, explain what mirror symmetry for toric varieties looks like from this perspective. This is part of a joint project with Alessio Corti, Hiroshi Iritani, and Hsian-Hua Tseng.

Group Theory/Lie Theory Seminar
Monday, October 30, 4:10-6:00 pm
4088 EH

Alireza Salehi (Princeton)
Discrete Transitive Actions on Bruhat-Tits Building

(Joint with A. Mohammadi) There are lots of discrete transitive actions on a q -regular tree, i.e. rank one Bruhat-Tits tree. However it is rare to have such an action on a higher rank Bruhat-Tits Building. Indeed, we would like to classify all such actions on a Bruhat-Tits Building over a characteristic zero local field. For instance, in this talk I will show how one can use the arithmetic structure of such actions and Prasad's work on the covolume of arithmetic lattices to derive that for n larger than 8, there is no discrete transitive action on the Bruhat-Tits building of $\mathrm{PGL}_n(K)$, where K is a characteristic zero local field, in contrast to the positive characteristic case, where D. Cartwright and Tim Steger explicitly constructed such actions for any dimension.

Student Algebraic Geometry Seminar
Tuesday, October 31, 12:10-1:00pm
1068 EH

Jose Gonzalez (UM)
Zak's theorems

Zak found some interesting applications of the connectedness theorems to questions involving tangencies of projective varieties. He then used these results to prove Hartshorne's conjecture that smooth subvarieties of sufficiently small codimension in projective space are linearly normal. This talk is devoted to a presentation of part of Zak's work.

Geometry Seminar
Tuesday, October 31, 2:10-3:00pm
4088 EH

Tom Coates (Imperial College)
Symplectic Linear Algebra, Gromov-Witten Theory, and Toric Crepant Resolutions

We describe a perspective on Gromov-Witten theory which reveals close and surprising connections with linear symplectic geometry. We explain how quantum cohomology fits into this picture, and then use it to describe how the Gromov-Witten invariants of certain toric orbifolds are related to those of their toric crepant resolutions. The geometric framework here is due to Givental; the work on crepant resolutions is joint with Alessio Corti, Hiroshi Iritani, and Hsian-Hua Tseng.

Algebra Seminar
Tuesday, October 31, 3:00-4:00pm
3096 EH

Tanya Chmutova (UM)
Continuous Hecke algebras of type $GL(2)$

Continuous Cherednik algebras were introduced by Etingof, Gan and Ginzburg as a generalization of Hecke algebras to the case of reductive algebraic group. The representation theory of these algebras is not yet studied, but we will see from the examples, that, when developed, it should unify the representation theory of real reductive group groups and symplectic reflection algebras. In this talk we will consider in details the representations of the continuous Hecke algebra of type $GL(2)$.

Colloquium (Rainich Lectures)
Tuesday, October 31, 4:10-5:00pm
1360 EH

Philip Holmes (Princeton)

From Neural Oscillators through Stochastic Dynamics to Optimal Decisions, or Does Math Matter to Gray Matter?

The sequential probability ratio test (SPRT) is optimal in that it allows one to accept or reject hypotheses, based on noisy incoming evidence, with the minimum number of observations for a given level of accuracy. There is increasing neural and behavioral evidence that primate and human brains employ a continuum analogue of SPRT: the drift-diffusion (DD) process. I will review this and also describe how a biophysical model of a pool of spiking neurons can be simplified to a phase oscillator and analysed to yield spike rates in response to stimuli. These spike rates tune DD parameters via neurotransmitter release. This study is a small step toward the construction of a series of models, at different time and space scales, linking neural spikes to human decisions. This work is joint with Eric Brown, Jeff Moehlis, Rafal Bogacz and Jonathan Cohen at Princeton, and Garry Aston-Jones' group at the Laboratory of Neuromodulation and Behavior, University of Pennsylvania .

Note: (A reception for Professor Holmes will be held at 5:00 p.m. in the Mathematics Upper Atrium, East Hall)

Student AIM Seminar
Wednesday, November 1, 3:10-4:00pm
3096 EH

Zhengjie XU (UM)

Decay of correlation implies chaos in the sense of Devaney

In 1975, the term of "chaos" was first mathematically proposed by two mathematicians, Li and Yorke, who also investigated the ergodicity of a transformations from interval to itself. And another definition of chaos, from the viewpoint of topology, was advanced by Devaney in 1989 in his book. Afterwards, Banks, Vellekoop and their colleagues further investigated the inner relations between three properties of the chaos definition in the sense of Devaney. The basic research techniques adopted in their papers are related to the mathematical real and functional analysis. On the other hand, some researchers devoted their research to theoretically investigating the chaotic dynamical systems with the aid of symbolic dynamics by constructing a topological conjugate map through a homomorphism. Moreover, the studies of the existence and stochastic properties in chaotic systems having strange attractors, such as Henon system producing correspondingly Henon attractor, also have been arousing a great deal of interest from many researchers and mathematicians. The more progress in the theoretical research of stochastic dynamics in chaotic system is achieved, the more detailedly the relation between chaos and randomness is turned up.

Surely, this will significantly improve the application of chaos theory. I investigate the relations between the chaos definition in the sense of Devaney and some concepts proposed in the research of stochastic dynamics of deterministic systems. A mixing transformation $f : M \rightarrow M$ on a manifold M is proved to be sensitively dependent on the initial value of the iteration f and topologically transitive.

Furthermore, a chaotic transformation f in the sense of Devaney with some assumption is proved to be an expanding map, which implies several statistical properties in this transformation map.

Geometry Seminar (Special Seminar)
Wednesday, November 1, 3:10-4:00pm
3088 EH

Alireza Salehi Golsefidy (Princeton)
S-Arithmetic Khintchine Type Theorem: The Convergence Case

(Joint with A. Mohammadi) One can view this work on one hand as a continuation of Bernik, Kleinbock, and Margulis' work, in which they proved a Khintchine-type theorem for "non-degenerate" submanifolds of \mathbb{R}^n , and on the other hand, as continuation of a more recent work of Kleinbock and Tomonov, in which they proved extremality of product of "non-degenerate" p -adic manifolds. In this work, we try to come up with an S -arithmetic Khintchine-type theorem, for the convergence case. For instance, we generalize Beresnevich, Bernik, and Kovalevskaya's work from p -adic manifolds with polynomial patches to p -adic analytic manifolds, which partially answers a question asked by Kleinbock and Tomonov.

Geometric Function Theory Seminar
Wednesday, November 1, 3:10-4:00pm
4096 EH

Stefan Wenger (Courant Institute)
Gromov hyperbolic spaces and sharp constants for isoperimetric and filling radius inequalities

Hyperbolic metric spaces in the sense of Gromov have played an important role both in Geometric Group Theory and in Geometry and have been subject to intense research over the past 20 years. They were introduced and first studied by M. Gromov in his seminal paper on Hyperbolic Groups and can be thought of as spaces of negative curvature in a coarse sense.

In this talk we will discuss the following optimal characterization of Gromov hyperbolicity via an isoperimetric inequality. Let (X, d) be a geodesic metric space and suppose there exist $\epsilon > 0$, $s_0 > 0$ such that the filling area of each rectifiable loop of length $s \geq s_0$ is bounded above by $(1 - \epsilon)(4\pi)^{-1}s^2$. Then (X, d) is Gromov hyperbolic. (As is well-known, (X, d) then even admits a linear isoperimetric inequality, i.e. the filling area is bounded by Cs for some constant C .) Here, the filling area of a loop γ is by definition the least area of a 2-chain with boundary γ . Our theorem is optimal as shows the case of Euclidean space and is new even for Riemannian manifolds. It strengthens results in Gromov's paper in which the constant $(16\pi)^{-1}$ was obtained for a large class of Riemannian manifolds and $(4000)^{-1}$ for geodesic metric spaces. In the end, we will give a similarly optimal characterization involving filling radius inequalities.

Colloquium (Rainich Lectures)
Wednesday, November 1, 4:10-5:00pm
1360 EH

Philip Holmes (Princeton)
Thirty-Three Years of Nonlinear Dynamics: More is Different and Less is More

In the early 1970's dynamical systems theory was just reapproaching earth after a 70-year sojourn in the stratosphere of pure mathematics. Catastrophe theory was hot (if controversial), complexity was yet to come, and some prominent mechanicians and applied mathematicians told me that chaos didn't exist, or would be irrelevant if it did. I will review some of the successes and failures of nonlinear dynamics since that time, traveling back to check its origins in the work of Poincare, and returning to current frontiers in infinite-dimensional evolution equations, hybrid and piecewise-smooth systems, and stochastic models. These will illustrate the first subtitle, drawn from an article by Philip Anderson (Science 177: 393, 1972). I will also emphasize the central ideas of dimension reduction via invariant manifolds, normal forms, and the role of simple canonical examples such as Smale's horseshoe, thus justifying the second subtitle (due to Mies van der Rohe). I will close by speculating on future directions, and, in doing so, probably repeat the lack of foresight to which I alluded at the beginning.

Student Analysis Seminar
Wednesday, November 1, 4:10-5:00pm
3866 EH

Johanna Mangahas (UM)
Introduction to Teichmuller Space and Quasiconformal Maps

The Teichmuller space of a surface is the set of marked conformal structures it may have. The notion of quasiconformality allows one to quantify the "nearness" of two conformal structures and to define a metric on Teichmuller space. Teichmuller theory applies to many areas, including hyperbolic geometry, moduli spaces, complex dynamics, and ergodic theory. This talk will be very introductory!

Financial/Actuarial Mathematics Seminar
Thursday, November 2, 3:10-4:00pm
3088 EH

Matt Davison (Univ. of Western Ontario)
Success and failure in (modeling) Deregulated Electricity Markets

Techniques and ideas from many fields must be employed in the study of electricity markets. They are young enough that public policy issues long ago settled in other financial markets are still important. Because electricity cannot easily be stored, supply and demand issues are more transparently involved in price formation than in other markets, binding operational research and even engineering issues together with these markets in a fundamental way. In this talk I will present some of the electricity market ideas we've been working on at Western before focusing on the mathematical formulation and numerical solution of some real options problems arising in the study of simple hydroelectric facilities.

Analysis Study Seminar
Thursday, November 2, 3:10-5:00pm
2866 EH

Jang-Mei Wu (Univ. of Illinois)
Tug of war with noise: a game theoretic view of the p -Laplacian (after Peres and Sheffield)

We study a recent preprint (August 2006) of Y. Peres and S. Sheffield, in which they develop an interpretation of the solutions to the boundary value problem for the p -Laplacian from game theoretic point of view. This can be regarded as an analogue of the Brownian motion for nonlinear equations.

Differential Equations
Thursday, November 2, 4:10-5:00pm
4096 EH

Alex Sotirov (UM)
Particle Path Structure of Kinetic Boundary Layers

We consider particles trapped near a flat boundary and subjected to collisions with a uniform background. We determine the structure of the distribution of particle velocities at the time of return to the boundary. This is done in terms of the given distribution of the velocities of the emitted particles. The situation considered represents a state far from the classical thermodynamic equilibrium: a contrast will be made with the study of particles diffused by a uniform background in free space.

Colloquium (Rainich Lectures)
Thursday, November 2, 4:10-5:00pm
1360 EH
Philip Holmes (Princeton)
On the Neuromechanics of Swimming in Lamprey

I will describe joint work with Tyler McMillen in which we develop a model for anguilliform (eel-like) swimming as an elastic rod actuated via time-dependent intrinsic curvature and subject to hydrodynamic drag forces. We employ a geometrically exact theory and discretize the resulting nonlinear partial differential evolution both to perform numerical simulations, and to compare with previous models consisting of chains of rigid links connected by springs, dampers, and force generators representing muscles. We show that muscle activations driven by motoneuronal spike trains via calcium dynamics produce intrinsic curvatures corresponding to near-sinusoidal body shapes in longitudinally-uniform rods, but that passive elasticity leads to time-periodic motions and lower speeds than those predicted by G.I. Taylor in his prescribed shape resistive theory (Proc. Roy. Soc. Lond. A214: 158, 1952). We investigate the effects of bending stiffness, body geometry, and activation patterns on swimming speed, turning behavior, and acceleration to mean steady speed.

Math Club
Thursday, November 2, 4:10-5:00pm
1324 EH
Bhramar Mukherjee (UM-Biostatistics)
To Bayes or not to Bayes

Thomas Bayes (1702-1761), an English theologian and mathematician, put forward his theory of probability in an "Essay towards solving a problem in the doctrine of chances" published in the Philosophical Transactions of the Royal Society of London in 1764. Since then, Bayes' techniques have remained a subject of discussion, debate and have generated much controversy. In this talk, I will present an introduction to the Bayesian paradigm as it has evolved in Statistics since the introduction of "Bayes' Theorem". There will be plenty of examples, pictures and a casestudy in bio-medical research to illustrate the application of Bayesian methods in the context of real problems.

Applied and Interdisciplinary Mathematics Seminar
Friday, November 3, 3:10-4:00pm
1084 EH
Smadar Karni (UM)
Two-layer shallow water: a relaxation approach

The two-layer shallow water system is an averaged flow model. It forms a nonconservative system which is only conditionally hyperbolic. The coupling between the layers, due to the hydrostatic pressure assumption, does not provide explicit access to the system eigenstructure, which is inconvenient for Riemann solution based numerical schemes. We consider a relaxation approach to 'hyperbolize' the system, which offers greater decoupling and accessible eigenstructure. The stability of the model is discussed. Numerical results are shown for unsteady flows as well as for smooth and nonsmooth steady flows.

Student Geometry/Topology
Friday, November 3, 3:10-4:00pm
3096 EH
Marshall Williams (UM)
Dimension Theory in General Metric Spaces

There are many notions of what the dimension of a separable metric space should be. We'll talk about some of the most common definitions (topological dimension, Hausdorff dimension, and time permitting, the more recent Assouad Dimension). We'll discuss some elementary facts about the various definitions, and then show that while in general, topological dimension is smaller than Hausdorff dimension (which is in turn smaller than the Assouad dimension), a suitable metric can be found on any space so that the definitions coincide. Along the way, we'll show how to embed any (topologically) n dimensional space into $\mathbb{R}^{(2n+1)}$.

Combinatorics
Friday, November 3, 4:10-5:00pm
3866 EH
Ellen Veomett (UM)
The computational complexity of convex bodies

For convex bodies associated to many interesting and important questions, deciding whether a given point is a member of the body is computationally hard. Thus, one looks for an approximating body for which deciding membership is computationally feasible. In this talk, I will discuss using polytopes, projections of polytopes, and sections of the cone of positive semidefinite quadratic forms to approximate convex bodies. I will discuss in particular the case where the set approximated is the Traveling Salesman Polytope.