Fall 2008
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
September 22nd – September 28th

Monday, September 22

3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Matt Simpson (UM) *Hilbert Schemes and Hom Schemes* --- 2866 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Jonathan Bober (UM) *Integral ratios of factorials and related problems* --- 4096 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Zhou Zhang (UM) *Complex Monge-Amp\`ere Equations over closed K\"ahler Manifolds* --- 3866 EH
4:10-5:00pm **Student Combinatorics** --- Luis Serrano (UM) *Horn Conjecture I* --- 3866 EH
5:15-6:30pm **Teaching Mathematics** --- TBA --- 3096 EH

Tuesday, September 23

2:10-3:00pm "**What is … " Seminar** --- Richard Hain (Duke University) *What is … de Rham homotopy theory?* --- 3096 EH
3:10-4:00pm **Geometry Seminar** --- Not meeting this week --- 4096 EH
3:10-4:00pm **Algebra Seminar** --- Jan Draisma (Technical U of Eindhoven) *Set-theoretic finiteness for the k-factor model* --- 3096 EH
3:10-4:00pm **Student Algebraic Geometry Seminar** --- Eugene Eisenstein (UM) *Basic notions in algebraic groups* --- 3088 EH
4:10-5:00pm **Colloquium** --- Richard Hain (Duke University) *Elliptic curves and Multiple zeta numbers* --- 1360 EH
4:10-5:00pm **Student AIM Seminar** --- Speaker TBA *Machine Learning 1* --- 3088 EH

Wednesday, September 24

3:10-4:00pm **Geometric Function Theory Seminar** --- Maria-Jose Gomez-Martin (UM/Universidad Autónoma de Madrid) *Multiplicative isometries and isometric zero divisors* --- 4096 EH
3:10-4:00pm **Student Representation Theory Seminar** --- Brian Jurgelewicz (UM) *Presentations of derived categories, part 2* --- 3096 EH
4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics** --- Chris Hammond (UM) *Moving Frames and Normal Forms* --- Room TBA
4:10-6:00pm **Algebraic Geometry Seminar** --- Xinyi Yuan (IAS) *Positivity in arithmetic geometry* --- 3088 EH

Thursday, September 25

3:10-4:00pm **Commutative Algebra Seminar** --- Daniel Hernandez (UM) *F-singularities and F-jumping number* --- 3096 EH
3:10-4:00pm **Financial/Actuarial Mathematics Seminar** --- Song Yao (UM) *Risk Measures and Non-linear Expectations* --- 3088 EH
3:10-4:00pm **Topology Seminar** --- Christopher Mooney (UM) *On Boundaries of CAT(O) Groups* --- 4096 EH
4:10-5:00pm **Differential Equations** --- Joel Smoller (UM) *The Penrose Process: Extraction of Energy From a Rotating Black Hole* --- 4088 EH
4:10-5:00pm **Math Club** --- Karl Schwede (UM) *Bezout's Theorem* --- 2nd floor Nesbitt Common Room
4:10-5:00pm **Reading Group in Probabilistic Methods in Geometric Functional Analysis and Combinatorics** --- 1360 EH
4:10-6:00pm **Geometry & Physics** --- Alan Stapledon (UM) *Duality of cones: mirror symmetry and equivariant cohomology* --- 4096 EH
4:10-6:00pm **RTG Study Seminar** --- Qian Yin (UM) *The existence of closed hyperbolic manifolds* --- 3866 EH

Friday, September 26

10:10-11:00am **Student Quadratic Forms Seminar** --- TBA --- 4096 EH

11:10-12:00pm **Theoretical Computer Science Seminar** --- Krzysztof Onak (MIT) *Constant-Time Approximation Algorithms via Local Improvements* --- 3941 CSE

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Jean-Luc Thiffeault (U of Wisconsin) *Topology of Surfaces and the Stirring of Fluids* --- 1084 EH

4:10-5:00pm **Student Geometry/Topology (Special Time)** --- Jeff Meyer (UM) *An Introduction to Cohomology Operations* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Pavlo Pylyavskyy (UM) *A_2-web immanants* --- 3866 EH

ABSTRACTS FOR THE WEEK OF SEPT. 22 – SEPT. 28, 2008

Group Theory/Lie Theory/Number Theory Seminar
Monday, September 22, 3:10-5:00pm
4096 EH
Jonathan Bober (UM)
Integral ratios of factorials and related problems

Motivated by the Beurling-Nyman criterion for the Riemann Hypothesis, Vasyunin studied the question of when certain linear combinations of floor functions are always nonnegative. This turns out to be equivalent to determining for which a_1...a_k and b_1...b_{k+1} the factorial ratio

$$\frac{(a_1\, n)!\ldots(a_k\, n)!}{(b_1\, n)!\ldots(b_{k+1}\, n)!}$$

is an integer for all n. I'll describe the complete classification of such a and b (there are 2 infinite families, and 52 sporadic solutions), and some related questions. The classification comes from the classification of monodromy groups for hypergeomtric functions, and also turns out to be related to the classification of cyclic quotient singularities.

Several Complex Variables and Complex Dynamics Seminar
Monday, September 22, 4:10-5:00pm
3096 EH
Zhou Zhang (UM)
Complex Monge-Amp\`ere Equations over closed K\"ahler Manifolds

In recent years, pluripotential theory has given more life to the study of complex Monge-Amp\`ere equation and its parabolic version, K\"ahler-Ricci flow. More precisely, the argument, originated by S. Kolodziej, coming from the study of Monge-Amp\`ere operator, has provided new (and better) way to achieve some key estimates. It's role in degenerate case is of special interests as indicated by many people's results. The fundamental works on this subject by Bedford and Taylor are heavily relied on.

Student Combinatorics
Monday, September 22, 4:10-5:00pm
3866 EH
Luis Serrano (UM)
Horn Conjecture I

The Horn Conjecture deals with the following question: given two Hermitian matrices A and B, what are the possible eigenvalues of the matrix A+B?

We will discuss the strong connections this question has to algebraic combinatorics, by introducing the Horn inequalities and the Littlewood-Richardson coefficients.

Algebra Seminar
Tuesday, September 23, 3:10-4:00pm
3096 EH
Jan Draisma (Technical U of Eindhoven)
Set-theoretic finiteness for the k-factor model

Factor analysis addresses the problem of testing whether n observed random variables are conditionally independent given k hidden variables, called the factors. In the case where the joint distribution of all n+k variables is multivariate Gaussian, the parameter space $F_{n,k}$ for the k-factor model is the set of nxn-covariance matrices of the form D+S where D is diagonal and positive definite and S is positive semidefinite of rank at most k. An algebraic approach to factor analysis seeks to determine all polynomial relations among the matrix entries in $F_{n,k}$; these relations are called model invariants. Clearly, model invariants for $F_{m,k}$ yield model invariants for $F_{n,k}$ for any n>m by taking principal mxm-submatrices. This leads to the natural question of whether, for fixed k and varying n, the model invariants are finitely generated in the natural manner. I will discuss a set-theoretic version of this question, which we recently settled.

Student AIM Seminar
Tuesday, September 23, 4:10-5:00pm
3088 EH
Speaker TBA
Machine Learning 1

We will have our first talk on machine learning. We are reading from "Ensemble Methods in Machine Learning" by Thomas Deitterich. From that paper's abstract:
Ensemble methods are learning algorithms that construct a set of classifiers and then classify new data points by taking a weighted vote of their predictions. The original ensemble method is Bayesian averaging but more recent algorithms include error-correcting output coding Bagging, and boosting. This paper reviews these methods and explains why ensembles can often perform better than any single classifier. Some previous studies comparing ensemble methods are reviewed, and some new experiments are presented to uncover the reasons that Adaboost does not overfit rapidly.

Geometric Function Theory Seminar
Wednesday, September 24, 3:10-4:00pm
4096 EH
Maria-Jose Gomez-Martin (UM/Universidad Autónoma de Madrid)
Multiplicative isometries and isometric zero divisors

A key result in the theory of Hardy spaces is the classical theorem of F. Riesz that the Blaschke products serve as isometric zero-divisors. More recently, it was shown that the Bergman space A^p has no isometric zero-divisors. The proof consisted of producing contractive zero-divisors of unit norm, proving their uniqueness up to rotation, and showing that they are not isometric.
We will give a much simpler proof that the Bergman spaces have no isometric zero-divisors. This is deduced from the easily proved fact that the only isometric pointwise multipliers of A^p are the unimodular constants. The same approach is applied to the Bloch space, the Dirichlet space, and more general spaces with weighted integral norms. It is shown that none of those spaces admit isometric zero-divisors.
This is a joint work with A. Aleman, P. L. Duren, and D. Vukotic.

RTG Working Seminar in Several Complex Variables and Complex Dynamics
Wednesday, September 24, 4:10-5:00pm
Room TBA
Chris Hammond (UM)
Moving Frames and Normal Forms

We will discuss Cartan's and Chern's moving frames approach to the local equivalence problem for real hypersurfaces in C^n. We will also discuss recent work of Peter Olver relating normal forms to moving frames. If time allows, we will examine the relationship in a simple test case, e.g., real curves in two-dimensional real projective space.

Financial/Actuarial Mathematics
Thursday, September 25, 3:10-4:00pm
3088 EH
Song Yao (UM)
Risk Measures and Non-linear Expectations

As tools to quantify the downside risk exposed to portfolios, risk measures have been widely used in the financial market. It has recently been shown that any coherent risk measure under certain “domination condition” can be represented by g-expectation with g being Lipschitz continuous. As a nonlinear expectation, g-expectation is generated from backward stochastic differential equations (BSDE for short), which has attracted more and more attention because of its wide applications in many areas. Unfortunately, to date the representation results of this kind exclude an importance class of convex risk measures, including the ubiquitous entropic risk measures.
We would show that the representation theorem can still hold for a fairly large class of convex risk measures, as long as they have at most quadratic growth. We introduce the notion of quadratic g-expectation in light of the recent development of the quadratic BSDEs. However, the extension becomes surprisingly subtle due to the breakdown of the original domination condition.
We overcome this difficulty with the help of the BMO theory, especially a so-called ”Reversed Holder Inequality”.

Differential Equations
Thursday, September 25, 4:10-5:00pm
4088 EH
Joel Smoller (UM)
The Penrose Process: Extraction of Energy From a Rotating Black Hole

In 1969 Roger Penrose proposed a "gedanken" experiment in which energy can be extracted from a rotating black hole. People then showed numerically, or via asymptotic expansions that this is possible. We give a more convincing argument, at the level of the Cauchy problem, proving that this can be made rigorous. The method is to send (finely tuned, of course) "wave packet" initial data towards the black hole and study the evolution of this data. The main tool is to use our previously derived integral representation for the solution, together with a new result which implies that the outgoing energy is finite.

Math Club
Thursday, September 25, 4:10-5:00pm
2nd floor Nesbitt Common Room
Karl Schwede (UM)
Bezout's Theorem

How many times can a line intersect a quadratic polynomial? You probably said the answer is zero, one, or two. How many times can two ellipses intersect? What if you count imaginary or complex intersection points? Do parallel lines ever intersect? What if we change the rules of the game and consider parallel lines in a twisted pac-man-like world? Bezout's theorem tells us exactly how many times two implicit polynomial curves intersect, provided you count complex intersections, intersections at infinity (where parallel lines meet up), and double/triple/multiple roots correctly.

Geometry & Physics
Thursday, September 25, 4:10-6:00pm
4096 EH
Alan Stapledon (UM)
Duality of cones: mirror symmetry and equivariant cohomology

In the spirit of mirror symmetry, we show how polarized resolutions of a toric singularity correspond to degenerations of its `mirror' toric singularity. We show that the central fiber of the degeneration is determined by the equivariant orbifold cohomology of the resolution. Conversely, we show that the resolution can be recovered from the equivariant orbifold cohomology of the central fiber.

RTG Study Seminar
Thursday, September 25, 4:10-6:00pm
3866 EH
Qian Yin (UM)
The existence of closed hyperbolic manifolds

I will talk about a proof of the existence of closed hyperbolic manifolds with dimension is less or equal to three. Then show the generalization of this approach to any dimension. I will give a concrete example at the end if time permits.

Theoretical Computer Science Seminar
Friday, September 26, 11:10-12:00pm
3941 CSE
Krzysztof Onak (MIT)
Constant-Time Approximation Algorithms via Local Improvements

We present a technique for transforming classical approximation algorithms into constant-time algorithms that approximate the size of the optimal solution. Our technique is applicable to a certain subclass of algorithms that compute a solution in a constant number of phases. The technique is based on greedily considering local improvements in random order. The problems amenable to our technique include Vertex Cover, Maximum Matching, Maximum Weight Matching, Set Cover, and Minimum Dominating Set. For example, for Maximum Matching, we give the first constant-time algorithm that for the class of graphs of degree bounded by d, computes the maximum matching size to within epsilon * n, for any epsilon > 0, where n is the number of nodes in the graph. The running time of the algorithm is independent of n, and only depends on d and epsilon. Joint work with Huy N. Nguyen (MIT)

Applied and Interdisciplinary Mathematics Seminar
Friday, September 26, 3:10-4:00pm
1084 EH
Jean-Luc Thiffeault (U of Wisconsin)
Topology of Surfaces and the Stirring of Fluids

There is a famous theory due to Thurston and Nielsen that classifies all possible continuous transformations of surfaces up to topological equivalence. When we stir a fluid in two dimensions we are essentially mapping fluid elements from a starting position to a final position, a continuous transformation. Therefore the Thurston-Nielsen theory applies and we can use it to learn a lot about the types of fluid motions that lead to good mixing, that is, those that give rise to complex, chaotic fluid motion.

Student Geometry/Topology (Special Time)
Friday, September 26, 4:10-5:00pm
3096 EH
Jeff Meyer (UM)
An Introduction to Cohomology Operations

Cohomology operations, as described by Mosher and Tangora, are a "technique for supplementing and enriching the algebraic structure of the cohomology ring." This talk will be the first of three on cohomology operations and their applications to homotopy theory. We will begin by introducing the notions of a cohomology ring and cohomology operations. Due to the representability of cohomology, these operations are fundamentally related to Eilenberg-MacLane spaces. We will conclude by exploring the correspondence between cohomology operations of a certain type and the cohomology of Eilenberg-MacLane spaces.

Combinatorics
Friday, September 26, 4:10-5:00pm
3866 EH
Pavlo Pylyavskyy (UM)
A_2-web immanants

We introduce web immanants, inspired by Temperley-Lieb immanants of Rhoades and Skandera. We show that web immanants are positive when evaluated on totally positive matrices, and describe some further properties.