Winter 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
February 9th – February 15th

Monday, February 9

3:10-4:00pm **Topics in Algebraic Geometry Seminar** --- Mihai Fulger (UM) *Linearization of actions* --- 2866 EH

3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Ronny Hadani (Chicago) *Group representation patterns in digital signal processing* --- 4096 EH

4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Araceli Bonifant (U of Rhode Island) *Cubic Polynomial Maps with Periodic Critical Orbit* --- 3096 EH

4:10-5:00pm **Student Combinatorics** --- Paul Shearer (UM) *Tanner Codes and Expander Graphs* --- 3866 EH

4:10-6:00pm **Geometry and Physics Seminar** --- Yongbin Ruan (UM) *Integrable hierarchies and singularity theory* --- 4088 EH

5:15-6:30pm **Teaching Mathematics** --- Not meeting this week --- 3096 EH

Tuesday, February 10

2:10-3:00pm "**What is … " Seminar** --- Divakar Viswanath (UM) *What is … Turbulence?* --- 3096 EH

3:10-4:00pm **Algebra Seminar** --- Bob Griess (UM) *Midwest Cousins of Barnes-Wall lattices* --- 3096 EH

3:10-4:00pm **Geometry Seminar** --- TBA --- 3866 EH

3:10-4:00pm **Student Algebraic Geometry Seminar** --- Zhixian Zhu (UM) *Classification of surface singularities* --- 3088 EH

3:10-4:00pm **Student Seminar in Complex Dynamical Systems** --- TBA --- 4088 EH

4:10-5:00pm **Colloquium (Keeler Lecture I)** --- Jason Starr (SUNY) *Rational simple connectedness and Serre's "Conjecture II"* --- 1360 EH

4:10-5:00pm **Student AIM Seminar** --- TBA --- 3088 EH

Wednesday, February 11

11:10-12:00pm **Financial/Actuarial Mathematics Seminar (Non-standard day/time)** --- Mitja Stadje (Princeton) *Dynamic Risk Measures and Stochastic Calculus* --- 3088 EH

3:10-4:00pm **Geometric Function Theory Seminar** --- Laurent Moonens (visiting UM) *Charges in Euclidean space* --- 4096 EH

3:10-4:00pm **Student Representation Theory Seminar** --- Farkhod Eshmatov (UM) *Around the theorem of Peng-Xiao, part 2* --- 3096 EH

3:10-4:00pm **Student Arithmetic Seminar** --- TBA --- 3088 EH

4:10-5:00pm **RTG Working Seminar in Several Complex Variables and Complex Dynamics** --- Al Taylor (UM) *Extremal plurisubharmonic functions for linear growth (Part II)* --- 3096 EH

4:10-6:00pm **Algebraic Geometry Seminar (Keeler Lecture II)** --- Jason Starr (Stony Brook) *Abel maps for fibrations over a curve* **---** 3088 EH

Thursday, February 12

3:10-4:00pm **Commutative Algebra Seminar** --- TBA --- 3096 EH

3:10-4:00pm **Topology Seminar** --- David Fisher (Indiana U) *On the space of discrete linear groups* --- 4088 EH

4:10-5:00pm **Keeler Lecture III** --- Jason Starr (Stony Brook) *Weak approximation and R-equivalence* --- 3088 EH

4:10-5:00pm **Differential Equations** --- Not meeting this week --- 4088 EH

4:10-5:00pm **Math Club** --- Zachary Maddock (Columbia) *Plane Ol' Birational Geometry* --- 2nd floor Nesbitt Common Room

4:10-6:00pm **RTG Study Seminar** --- Mario Bonk (UM) *Isometric actions on trees and degenerations of hyperbolic structures, Part II* --- 3866 EH

Friday, February 13

11:10-12:00pm **Theoretical Computer Science Seminar** --- Paul Shearer (UM) *A Tanner code over the real numbers* --- CSE 3941

3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Robert Kohn (NYU-Courant) *Cloaking by Change of Variables* --- 1084 EH

3:10-4:00pm **Student Geometry/Topology** --- Becky Hoai (UM) *Geometrization Conjecture* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Michael Shapiro (MSU) *Skew-symmetric cluster algebras of finite mutation type* --- 3866 EH

ABSTRACTS FOR THE WEEK OF FEB. 9 – FEB. 15, 2009

Topics in Algebraic Geometry Seminar
Monday, February 9, 3:10-4:00pm
2866 EH
Mihai Fulger (UM)
Linearization of actions

Sufficiently nice actions on a variety can be linearized, in the sense that the variety can be embedded in such a way that the action essentially becomes the restriction of a linear representation. This allows us to restrict much our study of actions to comparatively simple linear actions.

Group Theory/Lie Theory/Number Theory Seminar
Monday, February 9, 3:10-5:00pm
4096 EH
Ronny Hadani (Chicago)
Group representation patterns in digital signal processing

In the first part of my talk, I will explain how various fundamental structures from group representation theory appear naturally in the context of discrete harmonic analysis and can be applied to solve concrete problems from digital signal processing. I will begin by describing our solution to the problem of finding a canonical orthonormal basis of eigenfunctions of the discrete Fourier transform (DFT). Then I will explain how to generalize the construction to obtain a larger collection of functions that we call "The oscillator dictionary". Functions in the oscillator dictionary admit many interesting properties, in particular, I will explain several of these properties which arise in the context of problems of current interest in areas such as communication and radar.

If time permits and pending the audience will - in the second part of my talk I will describe the geometric Weil representation which is the algebra-geometric avatar of the Weil representation over finite fields. I will hint towards its fundamental role in the proof of the results presented in the first part of my talk.

Joint work with Shamgar Gurevich (Berkeley) and Nir Sochen (Tel Aviv).

Several Complex Variables and Complex Dynamics Seminar
Monday, February 9, 4:10-5:00pm
3096 EH
Araceli Bonifant (U of Rhode Island)
Cubic Polynomial Maps with Periodic Critical Orbit

The parameter space ${\mathcal S}_p$ for cubic polynomial maps with a marked critical point of period p is a complicated algebraic curve whose genus increases rapidly with p. Each ${\mathcal S}_p$ consists of a compact connectedness locus together with finitely many escape regions, each biholomorphic to a punctured disk. The parameter rays in the various escape regions provide a tool for studying the dynamics.

Student Combinatorics
Monday, February 9, 4:10-5:00pm
3866 EH
Paul Shearer (UM)
Tanner Codes and Expander Graphs

This introductory talk will define a class of high-quality error correcting codes called Tanner codes, introduce the bipartite "expander graphs" needed to construct them, and describe the diverse applications of both in math and computer science. A Tanner code is formed by pasting together a smaller code's codewords according to a set of combination rules. The combination rules are expressed with a bipartite graph which "expands quickly" in the sense that small sets of vertices always have a near-maximal number of distinct neighbors. We will show how a good expander ensures a good Tanner code. If time permits, we will touch on applications of expanders to combinatorial group testing and compressed sensing.

Geometry and Physics Seminar
Monday, February 9, 4:10-6:00pm
4088 EH
Yongbin Ruan (UM)
Integrable hierarchies and singularity theory

Almost twenty years ago, the celebrated theorem of Witten-Kontsevich asserts that the intersection theory of Deligne-Mumford space is governed by KdV-hierarchies. Around the same time, Witten proposed a sweeping generalization which leads to the representation theory of infinite dimensional Lie algebra and singularity theory. In the talk, we will sketch the recent resolution of Witten's vision by Fan-Jarvis and author and the appearance of new phenomenon such as mirror symmetry in the integrable hierarchy problem.

"What is … " Seminar
Tuesday, February 10, 2:10-3:00pm
3096 EH
Divakar Viswanath (UM)
What is … Turbulence?

Nearly all flows in nature and in technology, with exceptions such as flows in tiny capillaries, are turbulent. In the 19th century, Reynolds was intrigued that so dramatic a phenomenon revealed nothing to the eye without the use of tracers. Since Reynolds, we have learnt that the incompressible Navier-Stokes equation with the right boundary conditions can capture all the features of turbulent velocity fields, including the law of the wall, coherent motions, intermittency, and energy spectra. This talk will outline the computational and experimental investigations that have brought us to that understanding.

Algebra Seminar
Tuesday, February 10, 3:10-4:00pm
3096 EH
Bob Griess (UM)
Midwest Cousins of Barnes-Wall lattices

Given a rational lattice and suitable set of linear transformations, we construct a cousin lattice. Sufficient conditions are given for integrality, evenness and unimodularity.
When the inputs are Barnes-Wall lattices, we get multi-parameter series of cousins. There is a subseries consisting of unimodular lattices which have ranks 2^{d-1} +/- 2^{d-k-1}, for odd integers d≥3 and integers k=1,2,..., (d-1)/2. Their minimum norms are moderately high: $2^{[d/2]-1}$.
The techniques are finite group theoretic in nature, hence the midwest reference.
These first cousin lattices seem to be "new". A few of these have neighbors or slightly distant cousins which meet records for highest possible norms.
At the beginning of the seminar, we shall briefly sketch background, including the much-studied series of Barnes-Wall lattices, their remarkable groups of isometries, and connections to other lattices of interest such as E_8 and the Leech lattice.

Colloquium (Keeler Lecture I)
Tuesday, February 10, 4:10-5:00pm
1360 EH
Jason Starr (SUNY)
Rational simple connectedness and Serre's "Conjecture II"

Rational connectedness and rational simple connectedness are algebro-geometric analogues of path connectedness and simple connectedness. Just as a fibration with 2-dimensional base and simply connected fibers admits a continuous section, also an algebraic fibration over a surface with rationally simply connected fibers admits a rational section (assuming some extra hypotheses). Following a strategy of Ph.
Gille, this implies a conjecture of Serre: an (algebraic) principal fiber bundle over a surface for a simply connected, semisimple group has a rational section. This is joint work with A. J. de Jong and Xuhua He.

Financial/Actuarial Mathematics Seminar (Non-standard day/time)
Wednesday, February 11, 11:10-12:00pm
3088 EH
Mitja Stadje (Princeton)
Dynamic Risk Measures and Stochastic Calculus

The main aim of this talk is to present an approach for the transition from risk measures in discrete time to their counterparts in continuous time. After a general introduction to risk assessment in mathematical finance it is shown that a large class of risk measures in continuous time can be obtained very naturally as limits of time-consistent risk measures in a discrete setting. The discrete-time risk measures are constructed from properly rescaled (`tilted') one-period risk measures, using a d-dimensional random walk converging to a Brownian Motion. Under suitable conditions (covering the classical one-period risk measures) we obtain convergence of the discrete risk measures to the solution of a backward stochastic differential equation, defining a risk measure in continuous time, whose driver can then be viewed as the continuous-time analogue of the discrete 'driver' characterizing the one-period risk. We derive the limiting drivers for the semi-deviation risk measure, Average Value at Risk, and the Gini risk measure in closed form.
This is joint work with my PhD advisor Patrick Cheridito.

Geometric Function Theory Seminar
Wednesday, February 11, 3:10-4:00pm
4096 EH
Laurent Moonens (visiting UM)
Charges in Euclidean space

A *m-dimensional flat cochain* in the *n*-dimensional Euclidean space is a linear functional on the space of *m*-dimensional polyhedral chains, that is continuous with respect to the *flat norm* topology. On the other hand, a *flat m-form* is a bounded (measurable) *m*-differential form whose weak exterior derivative is also bounded. Wolfe's theorem shows that any *m*-dimensional flat cochain *A* is associated to an *m*-flat form *w* by an integral representation formula.

Relaxing the continuity condition, we call *m*-charge any linear functional on the space of *m*-dimensional polyhedral chains whose values asymptotically vanishes on chains whose flat norms go to zero **and** they are all supported in a fixed compact set and remain bounded in perimeter. As we will show, any *m*-charge can be represented by a pair *(w,z)* of **continuous** *m*- and *(m-1)*-forms. This yields in particular a new integral representation of *m*-dimensional flat cochains.

This is a joint work with T. De Pauw and W.F. Pfeffer."

RTG Working Seminar in Several Complex Variables and Complex Dynamics
Wednesday, February 11, 4:10-5:00pm
3096 EH
Al Taylor (UM)
Extremal plurisubharmonic functions for linear growth (Part II)

We will discuss properties of the extremal function $\Lambda_E(z)$, associated to plurisubharmonic functions of linear growth, i.e. the upper envelope of all psh functions u that are bounded above by zero on the set E and satisfy $u(z) \le |z| + o(|z|)$. Questions about this function arise naturally in trying to classify the algebraic varieties with sufficiently many real points that they satisfy the strong radial Phragmen-Lindelof condition.
This extremal function is also an analogue of the Siciak-Zaharuta extremal psh function L_E of logarithmic growth. However, we will show that it fails to have most of the properties that make L_E such a useful function in pluripotential theory.
We will present enough of the proofs to explain all the main techniques used in the work. All of the material is taken from the 1998 Ph.D. thesis of David Bainbridge.

Algebraic Geometry Seminar (Keeler Lecture II)
Wednesday, February 11, 4:10-6:00pm
3088 EH
Jason Starr (Stony Brook)
Abel maps for fibrations over a curve

The theorem from Lecture 1 regarding fibrations over a surface follows from a result about fibrations over a curve. For a rationally simply connected fibration over a curve the Abel map from the parameter space of sections to the Jacobian of the curve has rationally connected fibers if the homology class of the fiber is sufficiently positive.

Topology Seminar
Thursday, February 12, 3:10-4:00pm
4088 EH
David Fisher (Indiana U)
On the space of discrete linear groups

I will discuss a work in progress with Emmaneul Breuillard. Let Hom(F_k, G) be the set of homomorphisms from a free group F_k into a Lie group G. We study the subset of this space consisting of homomorphisms with discrete image and prove several results generalizing classical results of Jorgensen in the case where G is SL(2,R) or SL(2,C). As additional motivation for this work, we use an idea of Lubotzky to produce an interesting new class of locally rigid subgroups of Lie groups.

Keeler Lecture III
Thursday, February 12, 4:10-5:00pm
3088 EH
Jason Starr (Stony Brook)
Weak approximation and R-equivalence

Hassett and Tschinkel asked: does a rationally connected fibration over a curve satisfy "weak approximation"? In other words, is every power series section approximated to arbitrary order by rational sections? Mike Roth and I prove that a rationally connected fibration over a curve satisfies weak approximation if the associated fibers over Laurent series fields are each "R-connected" -- an analogue of rationally connected for varieties over non-algebraically closed fields. This gives new proofs of known weak approximation results. It also suggests most RC fibrations do not satisfy weak approximation. The proof uses a new notion, pseudo ideal sheaves, which are is an analogue of Fulton's pseudo-divisors (the effective ones) for cycles of higher codimension.

Math Club
Thursday, February 12, 4:10-5:00pm
2nd floor Nesbitt Common Room
Zachary Maddock (Columbia)
Plane Ol' Birational Geometry

Given a polynomial equation like y2 = x3 + x2, one can ask whether one can parameterize the solutions (x,y) with rational functions x = ß(t) and y = µ(t). It turns out, we can reformulate this question into the language of field theory to obtain a satisfactory answer.
In this talk, I will explore these first steps into the branch of algebraic geometry called birational geometry. Furthermore, for all those Calc II enthusiasts (I know you're out there), I will show how one can use these parameterizations to compute some tricky integrals.

Theoretical Computer Science Seminar
Friday, February 13, 11:10-12:00p
CSE 3941
Paul Shearer (UM)
A Tanner code over the real numbers

In the emerging field of compressed sensing, we seek to recover a sparse vector from a small series of carefully chosen linear measurements of the vector. These measurements can be expressed as rows of a matrix whose kernel is composed of "flat" vectors, meaning that all the vector's entries have roughly the same magnitude. For many applications it is desirable for this matrix to be sparse and use a low number of random bits in its construction. We present a construction of Guruswami, Lee, Razborov, and Wigderson which meets these criteria fairly well. Inspired by the analogy between compressed sensing and error-correcting codes, the construction is a Tanner code over the real numbers. We will introduce compressed sensing and Tanner codes, describe the construction of Guruswami et al, and discuss its strengths and limitations with respect to compressed sensing.

Applied and Interdisciplinary Mathematics Seminar
Friday, February 13, 3:10-4:00pm
1084 EH
Robert Kohn (NYU-Courant)
Cloaking by Change of Variables

We say a region of space is "cloaked" with respect to electromagnetic measurements if its contents -- and even the existence of the cloak -- are inaccessible to such measurements. One recent proposal for such cloaking takes advantage of the coordinate-invariance of Maxwell's equations. As usually presented, this scheme uses a singular change of variables. That makes the mathematical analysis subtle, and the practical implementation difficult. This talk examines the correctness and robustness of the change-of-variable-based scheme, for scalar waves modelled by Helmholtz's equation, drawing on joint work with Onofrei, Shen, Vogelius, and Weinstein. The central idea is to use a less singular change of variables. The quality of the resulting "approximate cloak" can be assessed by studying the detectability of a small inclusion in an otherwise uniform medium. We show that a small inclusion can be made nearly undetectable (regardless of its contents) by surrounding it with a suitable lossy layer.

Student Geometry/Topology
Friday, February 13, 3:10-4:00pm
3096 EH
Becky Hoai (UM)
Geometrization Conjecture

The purpose of this talk is to provide a brief survey of Thurston's geometrization conjecture, which establishes a complete characterization of geometric structures on 3-manifolds. We will begin by discussing its 2-dimensional analogue, the uniformization theorem for surfaces. A vague notion of what curvature is and some knowledge of covering space theory will be assumed.

Combinatorics
Friday, February 13, 4:10-5:00pm
3866 EH
Michael Shapiro (MSU)
Skew-symmetric cluster algebras of finite mutation type

Fomin and Zelevinsky obtained a Cartan-Killing type classification of *cluster algebras of finite type*, i.e. cluster algebras with finitely many distinct cluster variables. A wider class of cluster algebras is formed by *cluster algebras of finite mutation type*, which have finitely many exchange matrices (but are allowed to have infinitely many cluster variables). In a joint work with Anna Felikson and Pavel Tumarkin, we classify all cluster algebras of finite mutation type with skew-symmetric exchange matrices. We show that besides cluster algebras of rank 2 and cluster algebras associated with triangulations of surfaces, there are exactly 11 exceptional skew-symmetric cluster algebras of finite mutation type. To be specific, 9 of them are associated with finite, affine, and elliptic root systems of exceptional types E_6, E_7, and E_8, and the remaining two were recently found by Derksen and Owen. We also describe a criterion which determines if a skew-symmetric cluster algebra is of finite mutation type, and discuss growth rates of cluster algebras.