### Monday, April 08, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>10:00am-11:00am</td>
<td>Student Homotopy Theory -- Montek Gill (University of Michigan) (Co)homology operations: Steenrod and Dyer-Lashof operations -- 3088 East Hall</td>
</tr>
<tr>
<td>12:00pm-12:50pm</td>
<td>Mathematical Biology -- Leonid Rubchinsky (IUPUI) Dynamics of intermittent neural synchronization: observations, mechanisms, and functions -- 335 West Hall</td>
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<tr>
<td>3:00pm-4:00pm</td>
<td>Student Dynamics -- Benjamin Krakoff (UM) Complex Tori and Lattes Maps -- 3866 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td>Group, Lie and Number Theory -- TBA (TBA) TBA -- 3866 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td>Complex Analysis, Dynamics and Geometry -- Alexander Kupers (Harvard) (TOPOLOGY SEMINAR - SPECIAL TIME) The cohomology of Torelli spaces -- 3096 East Hall</td>
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<tr>
<td>4:00pm-5:00pm</td>
<td>Student Combinatorics -- Trevor Hyde (University of Michigan) FI-sets and representation stability -- 3866 East Hall</td>
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<tr>
<td>4:00pm-6:00pm</td>
<td>Geometry &amp; Physics -- Daniel Halpern-Leistner (Cornell) Categorical stable envelopes -- 4096 East Hall</td>
</tr>
<tr>
<td>7:00pm-8:00pm</td>
<td>Geometric Quantization and Symplectic Geometry -- Alejandro Uribe (UM) Berezin-Toeplitz operators -- 4088 East Hall</td>
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### Tuesday, April 09, 2019

<table>
<thead>
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<tbody>
<tr>
<td>3:00pm-4:00pm</td>
<td>Student Geometry/Topology -- Sayantan Khan (University of Michigan) The geodesic flow on symmetric spaces -- 1866 East Hall</td>
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<tr>
<td>3:00pm-3:50pm</td>
<td>Student Commutative Algebra -- Shubhodip Mondal (University of Michigan) ind-etales vs formally etale -- 3866 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:00pm</td>
<td>Colloquium Series -- Claudiu Raicu (University of Notre Dame) Koszul Modules and Green’s Conjecture -- 1360 East Hall</td>
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### Wednesday, April 10, 2019

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<tbody>
<tr>
<td>2:30pm-4:00pm</td>
<td>Student Machine Learning -- TBA (TBA) TBA -- 3866 East Hall</td>
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<tr>
<td>4:00pm-5:20pm</td>
<td>Algebraic Geometry -- Chiu-Chu Melissa Liu (Columbia) Cosection localized virtual cycles in enumerative geometry -- 4096 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:30pm</td>
<td>RTG Seminar on Geometry, Dynamics and Topology -- John Wiltshire-Gordon (University of Wisconsin-Madison ) Teaching a computer to dance -- 3866 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:00pm</td>
<td>Student Arithmetic -- Ilia Nekrasov (University of Michigan) Explicit formulas for the Hilbert pairing -- 3088 East Hall</td>
</tr>
<tr>
<td>5:00pm-6:00pm</td>
<td>Working Group on Anderson Localization -- Yuxin Wang (University of Michigan) The Wegner Estimate -- 4088 East Hall</td>
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### Thursday, April 11, 2019

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<thead>
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<tbody>
<tr>
<td>3:00pm-4:00pm</td>
<td>Topology -- Marissa Loving (UIUC) Least dilatation of pure surface braids -- 4096 East Hall</td>
</tr>
<tr>
<td>3:00pm-4:00pm</td>
<td>Commutative Algebra -- Zhan Jiang (University of Michigan) Closure operations in complete local rings of mixed characteristic -- 3866 East Hall</td>
</tr>
<tr>
<td>4:00pm-5:00pm</td>
<td>Student Algebraic Geometry -- Andy Gordon (UM) Enumerative Problems on Grassmanians -- B735 East Hall</td>
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<td>Time</td>
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| 3:00pm-4:00pm  | **Applied Interdisciplinary Mathematics (AIM)** -- Mimi Dai (University of Illinois at Chicago)  
Non-uniqueness of weak solutions for the 3D Hall-MHD system in Leray-Hopf space -- 1084 East Hall |
| 3:00pm-5:00pm  | **Geometry** -- Dmitri Gekhtman (Caltech)  
Holomorphic retracts of Teichmuller space -- 3866 East Hall |
| 3:00pm-4:00pm  | **Combinatorics** -- Eric Katz (Ohio State University)  
The Unipotent Torelli Theorem for Graphs -- 4088 East Hall |
| 4:00pm-6:00pm  | **Junior Colloquium Series** -- Jose Rodriguez (University of Wisconsin)  
Euclidean distance degrees and nearest point problems -- 3088 East Hall |
| 4:00pm-4:50pm  | **Student AIM Seminar** -- Will Clark (University of Michigan)  
Continuous Direct Sparse Visual Odometry from RGB-D Images -- 1084 East Hall |
Student Homotopy Theory  
Monday, April 08, 2019, 10:00am-11:00am  
3088 East Hall  
Montek Gill (University of Michigan)  

(Co)homology operations: Steenrod and Dyer-Lashof operations

Given any space whatsoever, its mod $p$ cohomology admits certain operations, the Steenrod operations, and these operations can be assembled so that the mod $p$ cohomology of any space is a module over a particular algebra, the Steenrod algebra. On the other hand, given any space which is equipped with a homotopy commutative multiplication (e.g., E-infinity spaces, infinite loop spaces), its mod $p$ homology admits certain operations, the Dyer-Lashof operations, and these operations can be assembled so that the mod $p$ homology of any such space is a module over a particular algebra, the Dyer-Lashof algebra. I will describe a construction of both the Steenrod and Dyer-Lashof operations, via a streamlined algebraic approach due to May which shows that one can view these operations as different manifestations of one and the same thing. I'll also give some small concrete examples.

Mathematical Biology  
Monday, April 08, 2019, 12:00pm-12:50pm  
335 West Hall  
Leonid Rubchinsky (IUPUI)

Dynamics of intermittent neural synchronization: observations, mechanisms, and functions

Synchronization of neural activity in the brain is involved in a variety of brain functions including perception, cognition, memory, and motor behavior. Excessively strong, weak, or otherwise improperly organized patterns of synchronous oscillatory activity may contribute to the generation of symptoms of different neurological and psychiatric diseases. However, neuronal synchrony is frequently not perfect, but rather exhibits intermittent dynamics. The same synchrony strength may be achieved with markedly different temporal patterns of activity. I will discuss methods to describe these phenomena and will present the application of this analysis to the neurophysiological data in healthy brain, Parkinson's disease, and drug addiction disorders. I will finally discuss potential cellular mechanisms and functional advantages of some of the observed temporal patterning of neural synchrony.

Student Dynamics  
Monday, April 08, 2019, 3:00pm-4:00pm  
3866 East Hall  
Benjamin Krakoff (UM)  

Complex Tori and Lattes Maps

We'll define Lattes maps coming from affine maps of Tori and demonstrate why they have interesting dynamical properties. These come in two distinct types, rigid and flexible, and for small cases we can give explicit formulas for the corresponding rational map.
Group, Lie and Number Theory  
**Monday, April 08, 2019, 4:00pm-5:20pm**  
4088 East Hall  
TBA

Complex Analysis, Dynamics and Geometry  
**Monday, April 08, 2019, 4:00pm-5:00pm**  
3096 East Hall  
Alexander Kupers (Harvard)  
*(TOPOLOGY SEMINAR - SPECIAL TIME)*  
The cohomology of Torelli spaces

I will discuss joint work with Oscar Randal-Williams, in which we compute the rational cohomology of the Torelli spaces of highly-connected high-dimensional manifolds in a stable range, as a representation of the arithmetic part of the mapping class group. These Torelli spaces are the classifying spaces of the group of those diffeomorphisms which act by the identity on homology, and bring us one step closer to understanding the rational homotopy type of diffeomorphism groups.

Student Combinatorics  
**Monday, April 08, 2019, 4:00pm-5:00pm**  
3866 East Hall  
Trevor Hyde (University of Michigan)  
FI-sets and representation stability

Representation stability is a phenomenon, first characterized by Church and Farb, in which the structure of a naturally occurring sequence $V_n$ of symmetric group $S_n$-representations eventually stabilizes in a precise sense. Church, Ellenberg, and Farb later showed that representation stability may be understood through the study of representations of the category $\text{FI}$ of finite sets with injections. In this talk I will introduce representation stability and then use combinatorics to explain the connection between representations of $\text{FI}$ and their stability phenomena.
I will discuss a categorification of the stable basis in the equivariant cohomology of an algebraic symplectic
variety with a torus action, introduced by Maulik and Okounkov in their work on the quantum cohomology of
Nakajima quiver varieties. The categorical stable envelopes are certain objects in the equivariant derived
category of coherent sheaves characterized by support and weight conditions, and they are part of a more
general story involving semiorthogonal decompositions of equivariant derived categories. I will discuss this
construction, which also provides the first general construction of stable bases in the equivariant K-theory of
algebraic symplectic varieties (although other constructions exist in the case of quiver varieties). This is joint
work with Davesh Maulik and Andrei Okounkov.

The operators of the title are the analogues of pseudo-differential operators in the context of a symplectic
manifold with a positive complex polarization. I will present all necessary definitions, and will describe how the
structure of the Bergmann projector allows us to do semi-classical analysis on Kähler phase spaces.

The goal of this talk is to understand geodesics and the geodesic flow on "nice" spaces, like symmetric
spaces. We'll see that on such spaces, the geometry of the space can be translated more or less completely
into linear algebra. This will also allow us to give an easy proof of the fact that the geodesic flow on a negatively
curved space is ergodic. We'll also work out a lot of examples, where the translation to linear algebra is easy to
see, like the hyperbolic plane $\mathbb{H}^2$. This talk will assume no prior knowledge of ergodic theory or
symmetric spaces.
Student Commutative Algebra  
Tuesday, April 09, 2019, 3:00pm-3:50pm  
3866 East Hall  
Shubhodip Mondal (University of Michigan)  
Ind-etale vs formally etale  

It is well-known that a finitely generated algebra over a field with no nonzero differential forms is etale. We talk about what happens in the absence of finiteness assumptions. The analogous story for perfect rings in characteristic $p$ will also be discussed.

Colloquium Series  
Tuesday, April 09, 2019, 4:00pm-5:00pm  
1360 East Hall  
Claudiu Raicu (University of Notre Dame)  
Koszul Modules and Green's Conjecture  

Formulated in 1984, Green's Conjecture predicts that one can recognize the intrinsic complexity of an algebraic curve from the syzygies of its canonical embedding. Green's Conjecture for a general curve has been resolved using geometric methods in two landmark papers by Voisin in the early 00s. I will explain how the theory of Koszul modules provides a more elementary solution to this problem, by relating it via Hermite reciprocity to the study of the syzygies of the tangent developable surface to a rational normal curve. Joint work with M. Aprodu, G. Farkas, S. Papadima, and J. Weyman.

Student Machine Learning  
Wednesday, April 10, 2019, 2:30pm-4:00pm  
3866 East Hall  
TBA (TBA)  

TBA  

Algebraic Geometry  
Wednesday, April 10, 2019, 4:00pm-5:20pm  
4096 East Hall  
Chiu-Chu Melissa Liu (Columbia)  
Cosection localized virtual cycles in enumerative geometry  

Given a Deligne-Mumford stack with a perfect obstruction theory and a cosection of the obstruction sheaf, Kiem and Li constructed a localized virtual cycle which lies in the Chow group of the degeneracy locus of the cosection. We will describe some applications of this construction in enumerative geometry.
RTG Seminar on Geometry, Dynamics and Topology
Wednesday, April 10, 2019, 4:00pm-5:30pm
3866 East Hall
John Wiltshire-Gordon (University of Wisconsin-Madison)

Teaching a computer to dance

Learning homological algebra is learning to dance: short exact sequences are box steps, and the long exact sequence is a waltz. The connecting homomorphism, which falls just before each downbeat, is the best part of the dance—but also the hardest. We learn the connecting homomorphism, and then teach a computer to do it, too. Our method uses the derived category in an explicit, hands-on way. Then, we try it in examples, including applications to configuration spaces of points.

Student Arithmetic
Wednesday, April 10, 2019, 4:00pm-5:00pm
3088 East Hall
Ilia Nekrasov (University of Michigan)

Explicit formulas for the Hilbert pairing

We will begin with a formulation of the celebrated Gauss Reciprocity Law, the first reciprocity law. Then I will briefly remind the story about other classical reciprocity laws, like the Eisenstein reciprocity law.

It turns out that for a proper formulation of the most general (classical, i.e. one-dimensional) reciprocity law we need explicit formulae for the Hilbert pairing. General explicit formulae were computed in 70s, which I will present. But as we know, appetite comes with eating - from that time many other generalization were obtained, e.g. formal group laws, L-functions, p-adic spectral theory and many other objects have entered the play. I will try to connect some of the recent magnificent results with a classical story of the Gauss reciprocity law.

Working Group on Anderson Localization
Wednesday, April 10, 2019, 5:00pm-6:00pm
4088 East Hall
Yuxin Wang (University of Michigan)

The Wegner Estimate

Section 5.5 of Kirsch's notes.
Topology
Thursday, April 11, 2019, 3:00pm-4:00pm
4096 East Hall
Marissa Loving (UIUC)
Least dilation of pure surface braids

The n-stranded pure surface braid group of a genus g surface can be described as the subgroup of the pure mapping class group of a surface of genus g with n-punctures which becomes trivial on the closed surface. I am interested in the least dilation of pseudo-Anosov pure surface braids. For the n=1 case, upper and lower bounds on the least dilation were proved by Dowdall and Aougab-Taylor, respectively. In this talk, I will describe the upper and lower bounds I have proved as a function of g and n.

Commutative Algebra
Thursday, April 11, 2019, 3:00pm-4:00pm
3866 East Hall
Zhan Jiang (University of Michigan)
Closure operations in complete local rings of mixed characteristic

Closure operations are important tools in commutative algebra. The most well-known closure operation is the tight closure introduced by Hochster and Huneke, which turns out to be very powerful and fruitful. Other examples are epf and r1f closure defined by Heitmann for rings of mixed characteristic. Dietz and R.G. axiomatized some nice properties of tight closure and its relation to big Cohen-Macaulay algebras/modules. In this talk, we will introduce their axioms and define a new closure operation called "weak epf closure" in mixed characteristic. This closure operation satisfies all axioms mentioned above, which suggests that it may be a good analogue of tight closure. Other related results and remaining questions will be discussed.

Student Algebraic Geometry
Thursday, April 11, 2019, 4:00pm-5:00pm
B735 East Hall
Andy Gordon (UM)
Enumerative Problems on Grassmanians

Given 4 general lines in projective 3-space, how many lines are there that simultaneously meet all 4? In my talk, I will discuss an analog of Bezout's theorem that reduces the above problem (and many more like it) to easy calculations. I will discuss some interesting corollaries, (including an easy proof that there are 27 lines on a smooth cubic surface) and how these results generalize to varieties other than Grassmanians.
Applied Interdisciplinary Mathematics (AIM)
Friday, April 12, 2019, 3:00pm-4:00pm
1084 East Hall
Mimi Dai (University of Illinois at Chicago)
Non-uniqueness of weak solutions for the 3D Hall-MHD system in Leray-Hopf space

We will talk about the non-uniqueness of weak solutions in Leray-Hopf space for the three dimensional magneto-hydrodynamics with Hall effect. We adapt the widely appreciated convex integration framework developed in a recent work of Buckmaster and Vicol for the Navier-Stokes equation, and with deep roots in a sequence of breakthrough papers for the Euler equation.

Geometry
Friday, April 12, 2019, 3:00pm-5:00pm
3866 East Hall
Dmitri Gekhtman (Caltech)
Holomorphic retracts of Teichmuller space

The Teichmuller space of a closed surface carries a natural complex structure, whose analytic properties reflect the topology and geometry of the surface. In this talk, we discuss the problem of classifying the holomorphic retracts of Teichmuller space. Our approach hinges on the analysis of two dynamical flows - one in the moduli space of half-translation surfaces, and the other in the space of bounded holomorphic functions on the polydisk.

Combinatorics
Friday, April 12, 2019, 3:00pm-4:00pm
4088 East Hall
Eric Katz (Ohio State University)
The Unipotent Torelli Theorem for Graphs

The classical Torelli theorem says that a Riemann surface can be recovered from its Jacobian which is a principally polarized Abelian variety. There is an analogous theorem for graphs, due to Artamkin and Caporaso-Viviani that the 2-isomorphism class of a graph can be recovered from its cycle space, equipped with its cycle pairing. We ask what happens when one encodes mildly non-abelian data as in the Unipotent Torelli theorem for Riemann surfaces due to Hain and Pulte. This leads us to introducing the analogue of iterated integrals on graphs and encoding them in a particular structure. This structure turns out to recover bridgeless graphs up to isomorphism. We discuss some of the application of this result. This is joint work with Raymond Cheng.
Determining the closest point to a model (subset of Euclidean space) is an important problem in many applications in science, engineering, and statistics. One way to solve this problem is by minimizing the squared Euclidean distance function using a gradient descent approach. However, when there are multiple local minima, there is no guarantee of convergence to the true global minimizer. An alternative method is to determine the critical points of the objective function on the model.

In algebraic statistics, the models of interest are algebraic sets, i.e., solution sets to a system of multivariate polynomial equations. In this situation, the number of critical points of the squared Euclidean distance function on the model's Zariski closure is a topological invariant called the Euclidean Distance (ED) Degree.

In this talk, I will present some models from computer vision and statistics that may be described as algebraic sets. Moreover, I will describe a topological method for determining Euclidean distance degree and a numerical algebraic geometry approach for determining critical points of the squared Euclidean distance function.
This talk reports on a novel formulation and evaluation of visual odometry from RGB-D images. Assuming a static scene, the developed theoretical framework generalizes the widely used direct energy formulation (photometric error minimization) technique for obtaining a rigid body transformation that aligns two overlapping RGB-D images to a continuous formulation. The continuity is achieved through functional treatment of the problem and representing the process models over RGB-D images in a reproducing kernel Hilbert space; consequently, the registration is not limited to the specific image resolution and the framework is fully analytical with a closed-form derivation of the gradient. We solve the problem by maximizing the inner product between two functions defined over RGB-D images, while the continuous action of the rigid body motion Lie group is captured through the integration of the flow in the corresponding Lie algebra. Energy-based approaches have been extremely successful and the developed framework in this paper shares many of their desired properties such as the parallel structure on both CPUs and GPUs, sparsity, semi-dense tracking, avoiding explicit data association which is computationally expensive, and possible extensions to the simultaneous localization and mapping frameworks. The evaluations on experimental data and comparison with the energy-based formulation of the problem confirm the effectiveness of the proposed technique, especially, when the lack of structure and texture in the environment is evident.