

**40<sup>th</sup>** ANNUAL NEW YORK STATE REGIONAL  
GRADUATE MATHEMATICS CONFERENCE

**Syracuse University**  
**April 11, 2015**

**Keynote Address**  
**GORDANA G.**  
**TODOROV**

NORTHEASTERN UNIVERSITY

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All participants, particularly graduate students, are invited to give a 30 minute talk. Presentations should be aimed at a graduate student audience.

For more information contact James Heffers or visit our web site.

Web Site: <http://students.syr.edu/mgo/conference.html>  
Contact: James Heffers at [jjheffer@syr.edu](mailto:jjheffer@syr.edu)

This conference is supported by the Syracuse University Department of Mathematics and the Graduate Student Organization.

We would like to express our thanks to all the people who helped us in making this conference possible, especially the Syracuse University Department of Mathematics. We would like to extend special thanks to our departmental office staff, without whom this conference would not be possible. We would also like to thank all the graduate students involved in helping with putting this conference together. The main organizers are: James Heffers, Patrick Biermann, Patrick Neary, Joshua Stangle, Maureen Jeffery, and Taylor Borcyk.

Lastly, we would like to thank you all for coming and we hope that your stay at Syracuse University is as pleasant as possible.

<b>Time</b>	<b>HL 202</b>	<b>HL 214</b>
8:00 - 8:50	Breakfast and Registration (HL 102)	
9:00 - 9:15	Greeting (HL 107)	
9:15-10:15	Colleen Ackermann <i>Quasiconformal Mappings on Generalized Grushin Planes</i>	Ben Cortese <i>Change point detection and estimation in dependent sequences of random variables with applications in clustered regression models</i>
10:30 - 11:00	Patrick Biermann <i>The distortion of subsets of Hilbert space</i>	Caleb McWhorter <i>A Zero Divisor Conjecture for Hopf Algebras</i>
11:10 - 11:40	Jeff McLean <i>The Development of Introductory Statistics Students Inferential Reasoning via Simulation</i>	Denise Tracy <i>On Matrix Factorizations</i>
11:45 - 1:00	Lunch	
1:00 - 2:00	<b>Gordana Todorov</b> <b><i>Semi-invariant pictures and some applications</i></b>  HL 107	
2:15 - 2:45	Dann Cuneo <i>Mappings Between Annuli of Smallest <math>p</math>-Harmonic Energy</i>	Feishe Chen <i>Composite Minimization and its Application to Image Deblurring</i>

## Semi-invariant pictures and some applications:

Gordana Todorov, Northeastern University, Boston, MA

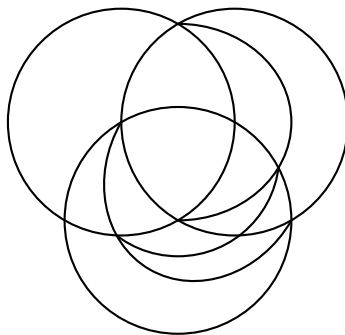
In this lecture I will talk about many topics, with main emphasis on the connections between these topics. I will lightly (sometimes only with examples) introduce: quiver representations, their relation to root systems, Auslander-Reiten quivers, derived categories of the representation category, cluster category, cluster tilting objects, semi-invariants, domains of semi-invariants, c-vectors from cluster theory, mutations, green mutations as mutations in the direction of non-negative c-vectors, sequences of green mutations (the last notions are related to some of the notions in BPS states in physics).

I will state two conjectures that we proved using semi-invariant pictures and indicate how the semi-invariant pictures were used.

Below is the semi-invariant picture for the following quiver of type  $A_3$ :

$$Q = (1 \leftarrow 2 \leftarrow 3).$$

Each part of the picture (vertex, line segment, triangle, circle, semi-circle) has several interpretations, and I will be adding the following information on the picture: roots of Lie algebra, indecomposable quiver representations, cluster objects, cluster tilting objects, domains of semi-invariants, c-vectors, mutations, green mutations, etc.



**References:** Clearly, there are very many references that should be included here, however we are including only the very latest one (which contains many of the other references).

*Semi-invariant pictures and two conjectures about maximal green sequences.* arXiv:1503.07945 (Thomas Brustle, Stephen Hermes, Kiyoshi Igusa, Gordana Todorov)

*The 40th Annual New York Regional Graduate Mathematics Conference, Syracuse University, Saturday, April 11, 2015.*

**Quasiconformal Mappings on Generalized Grushin Planes**

*Colleen Ackermann, University of Illinois, 9:15-10:15am*

Abstract: I will first define and discuss basic properties of quasiconformal mappings and the Grushin plane. Then I will give a method for studying quasiconformal mappings on a class of generalized Grushin planes, and use this method to give an analytic definition of quasi symmetric maps on these spaces. Finally, I will discuss various ways to characterize conformal mappings on the Grushin plane.

**Change point detection and estimation in dependent sequences of random variables with applications in clustered regression models**

*Ben Cortese, Syracuse University, 9:15-10:15am*

Abstract: Techniques and results for the detection and estimation of change points in independent sequences of random variables are reasonably well known. In practice, sequences often demonstrate some structural dependence. For this talk, we assume one step Markov time dependence for binomial and multinomial random sequences. A modified likelihood ratio  $G^2$  is proposed. Applications to clustered time series models to detect changes in the overall structure over time are discussed.

**The Distortion of Subsets of Hilbert Space**

*Patrick Biermann, Syracuse University, 10:30-11:00 am*

The distortion of a space  $X$  is the smallest constant  $C$  such that the length of a curve between two points  $x$  and  $y$  is bounded from above by  $C|x - y|$ . Gromov observed that sets in  $\mathbb{R}^n$  with distortion less than  $\frac{\pi}{2}$  are simply connected and sets with distortion less than  $\frac{\pi}{2\sqrt{2}}$  are contractible. We will show a different approach that will generalize these results to Hilbert space.

**A Zero Divisor Conjecture for Hopf Algebras**

*Caleb McWhorter, Syracuse University, 10:30 -11:00am*

Abstract: Given a field  $K$  and a group  $G$ , the Kaplansky Zero-Divisor conjecture asserts that  $K[G]$  is a domain if and only if  $G$  is a torsion-free group. This problem has remained unsolved for 50 years. The purpose of the talk will be to discuss progress on the conjecture as well as to present a variant of the zero-divisor conjecture for Hopf algebras, which is also unsolved.

**The Development of Introductory Statistics Students Inferential Reasoning via Simulation**

*Jeff McLean, Syracuse University, 11:10 - 11:40am*

Abstract: A trend in statistics education is the shift from a focus on theoretical distributions and numerical approximations to an emphasis on data analysis. Researchers have asserted that many statistics curricula are outdated and based on how statistics could be learned prior to the computing power of modern times. The use of probability distributions, such as the normal distribution, were once needed since the conceptually simpler approach of simulations by hand was far too tedious to perform. Technology now allows these simulations to be performed nearly instantaneously. This talk will focus on the construction of a data driven instructional unit and the development of introductory statistics students' informal inferential reasoning while engaging in the unit. Through the use of hands-on manipulatives and simulations with TinkerPlots software, the students constructed empirical sampling distributions in order to investigate the inferences that can be drawn from the data.

**On Matrix Factorizations**

*Denise Tracy, Syracuse University, 11:10-11:40am*

Abstract: First defined in 1980 by David Eisenbud as a way to describe certain syzygy modules over a hyper- surface ring, matrix factorizations are used in a wide variety of fields including representation theory, knot theory, and mathematical physics. In this talk, we will give the basics of matrix factorizations, as well as discuss some of their applications.

**Mappings Between Annuli of Smallest  $p$ -Harmonic Energy**

*Dann Cunneo, Syracuse University, 2:15-2:45pm*

Abstract: A classic problem in the theory of nonlinear partial differential equations is that of finding mappings satisfying the  $p$ -harmonic equation

$$\operatorname{div}(|Dh|^{p-2}Dh) = 0.$$

Such mappings are called  $p$ -harmonics. Finding  $p$ -harmonics can also be understood in a variational sense as finding minimizers of the so-called  $p$ -harmonic energy

$$\mathcal{E}_p[h] = \int_{\mathbb{X}} |Dh|^p dx.$$

The Dirichlet problem of finding such minimizers subject to given values on the boundary of  $\mathbb{X}$  is well-understood, and can be solved by the direct method in the calculus of variations. However, this method fails for the traction-free problem of finding absolute minimizers that may slip on the boundary. In this talk, I will outline a solution to this problem for mappings between annuli. This solution relies on the use of free Lagrangians- special differential forms  $L(x, h, Dh)dx$  whose integral depends only on the homotopy class of a mapping  $h$ .

**Composite Minimization and its Application to Image Deblurring**

*Feishe Chen, Syracuse University, 2:15 -2:45pm*

Abstract: In this talk, a composite minimization problem is considered. Fixed point iterative algorithms are proposed to solve the composite minimization problem. The convergence of the proposed algorithms is guaranteed under certain conditions. Application of the proposed algorithms to L2-TV and L1-TV deblurring problems will be shown.



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