

8th Annual Davis Math Conference

Schedule and Abstracts

Organizers: Kirill Paramonov and Jingyang Shu

January 11th 2018

1 Schedule

Breakfast	9:00 AM	
Introductory Remarks	9:25 AM	Jordan Snyder
Partial Differential Equations	9:30 AM	Joseph Biello
Mathematical Physics	10:05 AM	John Murray
TBA	10:30 AM	TBA
Topology	11:05 AM	Kevin Lamb
Number Theory	11:30 AM	Elena Fuchs
Optimization	12:05 PM	William Wright
Lunch	12:30 PM	
Computational Mathematics	1:30 PM	Thomas Strohmer
Machine Learning	2:05 PM	Kirill Paramonov
Mathematical Biology	2:30 PM	Robert Guy
Combinatorics	3:05 PM	Chaim Even Zohar
Department Tea	3:30 PM	

2 Abstracts

2.1 Partial Differential Equations

Joseph Biello

Title: TBA

Abstract: TBA

2.2 Mathematical Physics

John Murray

Title: Higher Algebra and Quantum Field Theory

Abstract:

Though the experimental predictions of quantum field theories are astoundingly accurate, we are far from having a complete mathematical description of these theories. We will explore a formalism using new ideas from higher algebra to advance us toward that goal. In particular, we will describe how one deformation quantizes functions on the simplices of a derived stack. From a physical perspective, this process defines perturbation theory about classical field configurations including those that model tunneling between vacua.

2.3 Probability

TBA

Title: TBA

Abstract:

TBA

2.4 Topology

Kevin Lamb

Title: Circular Distance for Knots in the 3-Sphere

Abstract:

Knots can often be studied via their complements in the 3-manifolds in which they sit. In turn, one of the main areas of study in 3-manifold theory is their classification. One of the primary tools we use to classify 3-manifolds is a decomposition into two handlebodies; that is, a Heegaard splitting of

the 3-manifold. In 2001, Hempel showed that these splittings can be studied via Harding's curve complex. For any Heegaard splitting of a 3-manifold, we can define a combinatorial invariant for that splitting called its distance. It was then shown in 2002 by K. Hartshorn that if a 3-manifold contains an incompressible surface of genus g , then the distance of any Heegaard splitting is bounded by $2g$.

The aim of this talk is to show recent results that provide a notion of distance (the circular distance) for a class of Heegaard splittings (circular Heegaard splittings) of knot complements in the 3-sphere. In particular, we show that Hartshorn's result extends to this setting; that is, if the knot's complement in the 3-sphere contains an incompressible surface of genus g , then the circular distance of any circular Heegaard splitting of that complement is bounded by $2g$. We also state results for uniqueness of minimal genus Seifert surfaces and for circular thin position.

2.5 Number Theory

Elena Fuchs

Title: TBA

Abstract:

TBA

2.6 Optimization

William Wright

Title: An Eigenvalue Optimization Method for Phase Retrieval

Abstract:

Phase retrieval is the process of recovering the phase of an unknown signal using only the magnitudes of some signal observations. Some common applications are X-ray crystallography, electron microscopy, speech processing, and astronomical imaging. A wide variety of methods exist for retrieving phase, yet most do not allow for much noise in the observations. A phase retrieval method was recently developed [Friedlander, 2016] which handles noise, leading to an eigenvalue optimization problem. This underlying eigenvalue problem has a unique structure which we exploit using modern eigenvalue methods to increase the efficiency of the phase retrieval process.

2.7 Computational Mathematics

Thomas Strohmer

Title: Mathematics of Data Science

Abstract:

I will talk about some recent research my collaborators and I have conducted in the field of data science. Topics include blind deconvolution, convex and nonconvex optimization, data clustering, and deep learning.

2.8 Machine Learning

Kirill Paramonov

Title: TBA

Abstract:

TBA

2.9 Mathematical Biology

Robert Guy

Title: TBA

Abstract:

TBA

2.10 Combinatorics

Chaim Even Zohar

Title: Patterns in Random Permutations

Abstract:

Every k entries in a permutation of order n can have one of $k!$ different relative orders, called *patterns*. How many times does each pattern occur in a large random permutation? We analyze the distribution of pattern densities, using representations of the symmetric group.