The 5th Northeast Mathematics Undergraduate Research Mini-Symposium

August 3rd, 2017

University of Connecticut

Scientific Program & Book of Abstracts

Organizers

Luke G. Rogers, Phanuel Mariano & Gamal Mograby

The 5th Northeast Mathematics Undergraduate Research Mini-Symposium

University of Connecticut, August 3rd, 2017

Full schedule

Time	Agenda & Location
10:00∼10:30	**Registration** *Monteith 4th Floor Lobby*
10:40∼11:55	**Student Talks: Morning Session** *Monteith Room 420*
11:55∼12:10	**Photo-op**
12:10∼1:05	**Lunch & Poster Session** *Monteith 4th Floor Lobby*
1:05∼1:40	**Panel on applying to graduate schools** *Monteith Room 420*
1:40∼3:20	**Student Talks: Afternoon Session** *Monteith Room 420*
3:20∼	Departure

Participating schools

Amherst · Smith · UConn · UMass

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Schedule of Talks

Morning Session (10:40∼11:55)

Monteith Room 420 (Session Chair: Phanuel Mariano)	
Time	Title & Presenters
10:40∼11:05	**Study of solitary wave propagation in woodpile chains** Sydney Hauver *(UMass Amherst)*
11:05∼11:30	**A Numerical Study of the Multiplicative Law of Large Numbers and Central Limit Theorem for Random Matrices** Anthony Sisti, Lowen Peng, Rajeshwari Majumdar *(UConn)*
11:30∼11:55	**The game of tipsy cops and robber on cycles and hypercubes** Ezra Alexander, Joshua Campbell,Obi Daniel Ezegou[1], Chirag Malkani, Charles Smith *(Amherst)*

Afternoon Session (1:40∼3:20)

Monteith Room 420 (Session Chair: Gamal Mograby)	
Time	Title & Presenters
1:40∼2:05	**Splines on Cycles with Degree-2 Polynomial Edge Labels** Cleo Roberts *(Smith)*
2:05∼2:30	**Splines on Graphs with Two Distinct Degree-2 Polynomial Edge Labels** Portia Anderson *(Smith)*
2:30∼2:55	**Spectral Analysis on Graphs Related to the Basilica Julia Set.** Courtney George and Samantha Jarvis *(UConn)*
2:55∼3:20	**Gradients on Higher Dimensional Sierpinski Gaskets** Luke Brown ,Giovanni E Ferrer Suarez, and Karuna Sangam*(UConn)*

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List of oral presentations

Study of solitary wave propagation in woodpile chains

(UMass Amherst)

Sydney Hauver

Abstract

In this project we studied the formation of solitons in woodpile chains by considering a variety of different theoretical scenarios. We looked at the case of having a single defect and multiple defects as well as linear and nonlinear defects. We did so in order to gain a well rounded perspective into how solitary waves can be formed in such woodpile chains. At first, our motivation was the work of P. G. Kevrekidis, A. Vainchtein, M. Serra Garcia, and C. Daraio. After completing an introductory study on the numerical methods needed, we developed Matlab codes to not only corroborate the numerical findings in the aforementioned work but also obtain the numerical results of interest in our present setting. This was done for our understanding and to ensure the accuracy and duplicability of the paper's graphs and figures.

A Numerical Study of the Multiplicative Law of Large Numbers and Central Limit Theorem for Random Matrices

(UConn)

Rajeshwari Majumdar

Lowen Peng

Anthony Sisti

Abstract

In the study of random matrices, there are analogues to the Law of Large Numbers and the Central Limit Theorem. We examine the numerics of these analogues and approximate the related mean (Lyapunov exponent) and variance for systems where $GL(2, R)$ acts on the projective space P^2. In one specific model, we can prove analytic estimates for the Lyapunov exponent in terms of a limit involving Fibonacci like sequences.

The game of tipsy cops and robber on cycles and hypercubes (UConn)

Ezra Alexander
Joshua Campbell
Obi Daniel Ezegou
Chirag Malkani and Charles Smith

Abstract

The original game of cops and robbers is a type of pursuit/evasion game played on graphs concerned with minimizing the number of cops needed to capture a robber under a certain set of rules. The game assumes both the cops and the robber possess perfect information about the other's location.

In the tipsy cop and robber version of the game a female cop is trying to capture a male robber and there is a probability p (q) that the cop (resp. the robber) will not know the robber (res. the cop)'s location before a move forcing her (him) to move randomly. The purpose is then to investigate the expected length of the game bases on the variables p, q and the shapre of the graph. In our case we study the problem for cycles and hyper graphs.

Splines on Cycles with Degree-2 Polynomial Edge Labels (Smith)

Cleo Roberts

Abstract

Consider a cycle graph C with fixed edge labels. A spline on C is a set of vertex labels such that the labels of any two adjacent vertices are congruent modulo the edge label between them. All splines on C can be formed by a linear combination of the minimal generating set of splines, which forms a basis. Our research focuses on cycles whose edges are labeled by homogeneous degree-2 polynomials. We explore the characteristics of the minimal generating set, with special attention to its degree sequence. Furthermore, we characterize the determinant of the minimal generating set.

Splines on Graphs with Two Distinct Degree-2 Polynomial Edge Labels (Smith)

Portia Anderson

Abstract

Given a graph with fixed edge labels, a spline is a set of vertex labels such that the labels of any two adjacent vertices are congruent modulo the edge label between them. A minimal generating set is a set of splines that, via linear combination, can generate any arbitrary spline on a given graph. Our focus is studying the minimal generating sets of graphs whose edges are labeled with degree-2 homogeneous polynomials. In particular, we are interested in the degree sequence, which counts how many splines of each degree appear in a minimal generating set. Our goal is to develop an algorithm for characterizing the minimal generating set of an arbitrary planar graph with exactly two edge distinct labels by relating it to simpler graphs.

Spectral Analysis on Graphs Related to the Basilica Julia Set. (UConn)

Courtney George
Samantha Jarvis

Abstract

We analyze the spectra of a sequence of graphs constructed from the Schreier graphs of the Basilica group. Our analysis differs from earlier work of Grigorchuk and Zuk in that it is based on a macroscopic decomposition of the graphs. This method gives precise information about the multiplicities of eigenvalues and, consequently, good information about the spectral measures of large graphs. It also permits a proof of the existence of gaps in the spectrum of limiting graphs.

Gradients on Higher Dimensional Sierpinski Gaskets (UConn)

Luke Brown
Giovanni E Ferrer Suarez
Karuna Sangam

Abstract

Laplacians have been well studied on post-critically finite (PCF) fractals. However, less is known about gradients on such fractals. Building on work by Teplyaev (1998, Teplyaev), we generalize results regarding the existence and continuity of the gradient on the standard Sierpinski Gasket to higher dimensional Sierpinski Gaskets. In particular, we find that, for functions with a continuous Laplacian, the gradient must be defined almost everywhere, and specify a set of points for which it is defined. Furthermore, we provide a counterexample on higher-dimensional Sierpinski gaskets where the Laplacian is continuous but the gradient is not defined everywhere. We conjecture that Holder continuity of the Laplacian is a condition strong enough to guarantee that the gradient exists at each point.