Carolina Dynamics Symposium 2023

Titles and Abstracts

Undergraduate Poster Session

- Josh Anecelle, Davidson College
- Douglas Deutsch, Davidson College
- John Herrmann, Christopher Newport University
- Emma Hicks, Davidson College
- Jordan Krouse, Davidson College
- Eli Lutz, Christopher Newport University
- Christopher Panko, Davidson College
- William Smith, Davidson College
- Yuxuan Zhang, Davidson College

Symposium Talks

Kitty Yang, Kenyon College

Title: Substitution subshifts and their symmetry groups

Abstract: By coding the orbits of points, we can model any dynamical system with a subshift. In this talk we will focus on substitution subshifts, which arise by iterating a finite substitution. Given a subshift, we can construct various symmetry groups, including the automorphism group and the mapping class group, which reflect dynamical properties of its subshift. We will look at various examples, and we will end the talk with a result that characterizes the mapping class group of a substitution subshift.

Shrey Sanadhya, Ben-Gurion University of the Negev, Israel

Title: Universality for $\mathbb{R}^d$ flows

Abstract: A dynamical system is called universal if any system with lower entropy can be embedded into it. In this talk, we will discuss universality for $\mathbb{R}^d$ flows ($d > 1$) both in ergodic and Borel contexts. We will discuss a specification property that implies universality for $\mathbb{R}^d$ flows and provide an example of a tiling dynamical system with this specification property. This is ongoing work with Tom Meyerovitch.

Jim Wiseman, Agnes Scott College

Title: Detecting invariant sets - the Conley index and shift equivalence

Abstract: The Conley index is a topological tool for detecting invariant sets of dynamical systems. It's well-defined for flows, but for maps it depends on the choices made in calculating it. It turns out that the right way to understand this dependence is shift equivalence, an important concept from the study of shifts of finite type. I'll talk about the ideas and examples, and some of the history. If I have time, I may talk a little about joint work with

Marian Mrozek and Mateusz Pryzbylski on shift equivalence for finite relations induced by numerical approximation of dynamical systems, but this is mostly an expository talk.

Jane Hawkins, UNC Chapel Hill

Title: Cellular Automata Problems that Everyone Can Understand and No One Can Solve

Abstract: This talk will be a survey of the dynamics of cellular automata, CAs, using only (advanced) calculus. We discuss one-dimensional CAs first with a classification, and then move to Conway's Game of Life and two-dimensional CAs. Along the way we pause to describe some open problems, applications, and basic results on surjectivity and dimension for CAs. Finally we touch on stochastic CAs and see how they can be used to study virus dynamics.

Terry Adams, USG

Title: Moving Averages

Abstract: This talk discusses moving averages for stationary ergodic processes of the form $X_i(x) = f(T^i x)$ where the function f is measurable, and T is ergodic and measure preserving. We show that universal convergence of moving averages can be characterized by complete convergence to zero of standard ergodic averages. Using a theorem of Hsu-Robbins (1947), we show for a bounded measurable function f, there is a Bernoulli transformation T with universal convergence of moving averages. Also, solutions to the coboundary equation $f(x) = g(x) - g(Tx)$ where g is integrable, yield processes with universal convergence of moving averages. We show there are integrable functions which have no universally convergent moving averages for any ergodic measure preserving T. A connection is made to defining a process which distributes resources equitably.

Jey Raymond, UNC Charlotte

Title: Shifts of Finite Type on Locally Finite Groups

Abstract: Characterizing the behavior of SFTs on the group of integers has been at the core of symbolic dynamics from its conception, and with the recent push to look at shifts on other groups, characterizing what behaviors are possible for SFTs on a general group, however this is quite difficult in general. In this talk, I will present my recent findings about SFTs on locally finite groups, which turn out to be extremely well behaved: every factor of an SFT is an SFT, every SFT is strongly irreducible, every SFT is entropy minimal, among other properties. Additionally, each of these properties is characteristic of the dynamics of shifts on locally finite groups: a group G with the property that every factor of an SFT (on G) is an SFT must be locally finite, a group G with the property that every SFT is strongly irreducible must be locally finite, and the same applies for all of the properties of SFTs on locally finite groups discussed. These results are centered around a type of shift on a group G which are built from a shift on a subgroup H, called a free extension shift. I will also discuss the construction of these shifts as well as many of the useful properties free extensions posses, and what implications these properties have about SFTs on locally finite groups.

Martin Schmoll, Clemson University

Title: Ergodic Theory for Coded Shifts

Abstract: We discuss coded shifts from the viewpoint of ergodic theory. That is we investigate measures of maximal entropy and equilibrium measures. Besides the results, if time permits, we will present examples and sketches of proofs. (joint with Tamara Kucherenko, Christian Wolf and Yun Yang)

Robert Bland, UNC Charlotte

Title: An embedding theorem for subshifts over countable amenable groups with the comparison property

Abstract: The 1982 embedding theorem of Krieger gives necessary and sufficient conditions for a subshift X over $\mathbb{Z}$ to embed into a mixing SFT Y when $h(X) < h(Y)$. In 2003, Lightwood gave sufficient conditions for a strongly aperiodic subshift over $\mathbb{Z}^d$ to embed into a square mixing SFT, thus providing a partial extension of the theorem of Krieger to a wider class of groups. In this talk, I will present sufficient conditions for a strongly aperiodic subshift X over an amenable group G to embed into a strongly irreducible SFT Y when G has the "comparison property". The main construction relies on recent developments in the theory of tilings of amenable groups due to Downarowicz and Zhang.

Chris Johnson, Western Carolina University

Title: Oblivious Points on Translation Surfaces

Abstract: The well-known illumination problem asks whether or not it is possible that light emitted from a single point can illuminate an entire room where every wall is a mirror, or equivalently, if each point in the room is visible from every other point. Restricting to the case of polygonal rooms, Lelièvre, Monteil and Weiss used results from the theory of translation surfaces to show that at most only finitely-many points are not visible from any given point in the room. In this talk I will discuss joint work with Chris Judge where we consider a similar question of whether or not every point on a translation surface is contained in a closed, unidirectional geodesic. This could be rephrased as asking whether or not there could exist a polygonal room with mirrored walls you can not see your own reflection when standing at specific points.

Michelle LeMasurier, Hamilton College

Title: Bratteli diagrams for bounded topological speedups

Abstract: A bounded topological speedup of a Cantor minimal system (X, T) is a minimal system (X, S), where $S(x) = T^{p(x)}(x)$ for some bounded function $p : X \to \mathbb{Z}^+$, or any system topologically conjugate to such an (X, S). Assuming the system (X, T) is represented by a properly ordered Bratteli diagram $\mathcal{B}$, we provide a method for constructing a new, perfectly ordered Bratteli diagram $\widetilde{\mathcal{B}}$ that represents the sped-up system (X, S). The diagram $\widetilde{\mathcal{B}}$ relates back to $\mathcal{B}$ in a manner that enables us to see how certain dynamical properties are preserved under speedup. As an application, in the case that (X, T) is a substitution minimal system, we show how to use $\widetilde{\mathcal{B}}$ to write an explicit substitution rule that generates the sped-up system (X, S), answering an open question from *Bounded topological speedups* by Alvin, Ash and Ormes (2018).

David McClendon, Ferris State University

Title: Rank one $\mathbb{Z}^d$-actions conjugate to odometers

Abstract: In this talk, we give explicit criteria that specify (1) whether a given rank one action of $\mathbb{Z}^d$ factors onto a given $\mathbb{Z}^d$-odometer, (2) whether a given rank one action of $\mathbb{Z}^d$ is conjugate to a given $\mathbb{Z}^d$-odometer, and (3) whether a given rank one action of $\mathbb{Z}^d$ is conjugate to some (unspecified) $\mathbb{Z}^d$-odometer. These criteria are based on parameters describing how a rank one $\mathbb{Z}^d$-action is constructed via cutting and stacking.

This is joint work with Aimee Johnson (Swarthmore) and extends results of Foreman, Gao, Hill, Silva and Weiss, who laid out similar criteria in the case d=1.