Poster Session Titles and Abstracts [1]

Midwest Dynamical Systems Meeting
University of Illinois at Chicago – November 1-3, 2019

Benjamin Call, Ohio State University

The K Property for Some Systems with Unique Equilibrium States

We establish general conditions to show that some systems with unique equilibrium states have the K property, with an application to the geodesic flow on rank one manifolds with non-positive curvature. In particular, we show that under a few additional assumptions, any system to which one can apply the Climenhaga-Thompson machinery for uniqueness of equilibrium states, is in fact K.

Yiming Che, SUNY Binghamton

Fast Basin Stability Estimation for Dynamic Systems with Sequential Support Vector Machine

The current method, Monte Carlo method, for basin stability is inefficient, especially for high-order dynamic systems. We propose a new method to improve the efficiency of basin stability estimation by reducing the number of function evaluations. In essence, basin stability estimation is a classification problem and thus support vector machine (SVM) is a natural choice. The decision function will be sequentially updated by adding the critical training points into training set until converge. The example of numerical study regarding the dynamic of pendulum is used to demonstrate and verify the proposed method.

Ivan Cho, Indiana University Purdue University Indianapolis

Chromatic Zeros On Hierarchical Lattices And Equidistribution On Parameter Space

Associated to any finite simple graph $\Gamma = (V, E)$ is the *chromatic polynomial* $P_\Gamma(q)$, which has the property that for any integer $q \geq 0$, $P_\Gamma(q)$ is the number of ways to properly colour the vertices of Γ using q-colours. The degree of $P_\Gamma(q)$ is $|V|$. A hierarchical lattice is a sequence of graphs $\{\Gamma_n\}_{n=0}^{\infty}$ built recursively under a generating graph. For each $n \geq 0$, let μ_n be the probability measure

$$\mu_n |V_n| \sum_{q \in \mathbb{C} P_\Gamma(q)=0} \delta_n$$

We prove that if the generating graph is 2-connected, then the sequence of measures μ_n converges to some measure μ, called the *limiting measure of chromatic zeros* for $\{\Gamma_n\}_{n=0}^{\infty}$. For the Diamond Hierarchical Lattice (DHL), we show that its limiting measure has Hausdorff dimension 2.

The main techniques come from holomorphic dynamics, in particular we prove a new equidistribution result that relates the chromatic zeros of a hierarchical lattice to the bifurcation/activity current associated to a particular marked point. This is joint work with Roland Roeder.

Ethan Farber, Boston College

From expanders to pseudo-Anosovs and back again

A uniform lambda expander is a self-map of the unit interval that is piecewise linear with slope of absolute value lambda. Thurston studied these maps, and in his work gave examples of extending uniform expanders to pseudo-Anosovs on surfaces. Constructions of this kind can help one understand the dynamics of the original expander, and they also provide an avenue to generating pseudo-Anosovs or maps with similar properties. We consider this construction and give results on the relationship between the structure of these maps and their corresponding dilatations.

[1] Last updated on October 28, 2019

Khashayar Filom, Northwestern University

On the real entropy of quadratic rational maps

There is an extensive literature on the entropy behavior of polynomial interval maps as they vary in families. In particular, the monotonicity problem which asks about the connectedness of the level sets of the entropy function (the isentropes) has been of immense interest and is very well studied in the context of polynomial interval maps of full modality. In the much broader context of rational maps a real entropy function can be set up on the space of Möbius conjugacy classes of real rational maps.

The main focus of this poster is the case of degree two maps where there is an explicit description of the moduli space of real quadratic rational maps due to Milnor. This space admits a natural partition to several regions based on the modality and the degree of the restriction of ambient rational maps to the real circle. One can establish the monotonicity over some of these regions and its failure over certain another region. Both of these results are supported by experimental evidence.

Minsung Kim, University of Maryland

Effective equidistribution of nilflows

The main results of this work is to prove bounds for ergodic averages for nilflows on general higher step nilmanifolds. Under Diophantine condition on the frequency of a toral projection of the flow, we prove that almost all orbits become equidistributed at the polynomial speed. We analyze the exponent with the speed of decay which is determined by the number of steps and structure of nilpotent Lie algebras.

Anh Le, Northwestern University

Nilsequences and multiple correlations along subsequences with applications

Multiple correlation sequences of single transformation first appeared implicitly in Furstenberg's proof of Szemerédi's theorem. Bergelson, Host, and Kra proved that these sequences can be decomposed into the sum of a nilsequence and a sequence tending to zero in density. Frantzikinakis asked whether we had a similar decomposition along the sequence of primes (p_n), Hardy field sequence $([n^c])$, or (2^n).

In this poster, I will present several works of mine related to this question. First, I show the positive answer to the sequence of primes and Hardy field sequence $[n^c]$ together with an extension to correlation sequences of commuting transformations. Second, the positive answer to (2^n) follows from works in harmonic analysis under the topic of interpolation sets; I then show that an interpolation set cannot be denser than every lacunary set. Lastly, as an application, I will present a variant of Khintchine's recurrence theorem along the primes.

Mengda Lei, Indiana University

The spectrum of a solenoid

Given a sequence of regular finite coverings of complete Riemannian manifolds, we consider the covering solenoid associated with the sequence. We study the leaf-wise Laplacian on the covering solenoid. The main result is that the spectrum of the Laplacian on the covering solenoid equals the closure of the union of the spectra of the manifolds in the sequence. We offer an equivalent statement of Selberg's 1/4 conjecture.

Shrey Sanadhya, University of Iowa

Commuting Borel Automorphisms

We present a Kakutani Rokhlin tower construction for Borel automorphism group generated by two commuting Borel transformations of a standard Borel space. Using this $\mathbb{Z}^2$ Kakutani Rokhlin lemma we show that two commuting Borel automorphisms have same set of real coboundaries if and only if either they are same or inverse of each other.

Vijay Kumar Shukla, Shivharsh Kisan P.G. College

Study of synchronization and stability analysis between fractional order chaotic systems

In this article, the synchronization and stability analysis between fractional order chaotic systems have been discussed. During synchronization the Simple chaotic system is taken as master system and Lu chaotic systems is considered as slave systems. Nonlinear control method has been used to analyse the synchronization. New lemmas which are based on Lyapunov stability and Caputo derivative theory are used. For numerical simulations Adams-Bashforth-Moulton method has used and results are presented graphically.

Margaret Stawiska-Friedland, AMS Math Reviews

Equilibrium measures in holomorphic dynamics and a characterization of polynomials on the Riemann sphere

In 1960's Hans Brolin initiated systematic application of potential-theoretic methods in the dynamics of holomorphic polynomials. Among other things, he proved the now-famous equidistribution theorem: for a polynomial f of degree greater than 1 the preimages, under successive iterates of f, of a Dirac measure at an arbitrary point of the complex plane (except at most two so-called exceptional points) converge weakly to the equilibrium measure ν_∞ (defined in the sense of classical logarithmic potential theory) of the Julia set for f. In 1980's a similar result (about convergence of preimages of quite general probabilistic measures) was proved (by M. Lyubich and independently by A. Freire, A. O. Lopes and R. Mañe) for a rational map f of degree greater than 1. The limit measure μ_f obtained in this case (called the balanced measure) is also supported on the Julia set for f, but does not have to be its equilibrium measure. In fact, under some assumptions on f, A.O. Lopes proved (using dynamical properties of Julia sets) that equality of these two measures implies that f is a polynomial. In this poster I present a recent (2018) proof of the following strengthening of Lopes's theorem: Let f be a rational function on the Riemann sphere of degree $d > 1$ whose Julia set J_f does not contain the point ∞. Then the following are equivalent: (i) $f \circ f$ is a polynomial; (ii) the measures μ_f and ν_∞ are equal. This is joint work with Yûsuke Okuyama from Kyoto Institute of Technology.

Victor Vilaça Da Rocha, Georgia Tech

Construction of unstable quasi periodic solutions for a system of coupled NLS equations

The systems of coupled NLS equations occur in some physical problems, in particular in nonlinear optics (coupling between two optical waveguides, pulses or polarized components...). From the mathematical point of view, the coupling effects can lead to truly nonlinear behaviors, such as the beating effect (solutions with Fourier modes exchanging energy) of Grébert, Paturel and Thomann (2013).

In this poster, I will present a method to use the coupling between two NLS equations on the 1D torus in order to construct a family of linearly unstable tori, and therefore unstable quasi periodic solutions.

The idea is to take profit of the Hamiltonian structure of the system via the construction of a Birkhoff normal form and the application of a KAM theorem. In particular, the idea is to highlight the links between this surprising behavior (this is the first example of unstable tori for a 1D PDE) and the existence of beating solutions. This is a work in collaboration with Benoît Grébert (Université de Nantes, France).

Tianyu Wang, Ohio State University

Unique Equilibrium States, Large Deviations and Lyapunov Spectra for the Katok Map

We study the thermodynamical formalism of a smooth non-uniformly hyperbolic diffeomorphism on 2-torus, known as the Katok Map. We prove for Hölder continuous potential with one additional condition and geometric t-potential with $t < 1$, the equilibrium state exists and is unique. We derive the level-2 large deviation principle for the equilibrium states above. We study the multifractal spectra of the Katok map concerning entropy and dimension of level sets of Lyapunov exponents.

Kitty Yang, Northwestern University

Mapping class groups for minimal zero-entropy subshifts

Let (X, σ) be a subshift. A flow equivalence of two spaces is an orientation-preserving homeomorphism of the suspension spaces. The mapping class group of a subshift is the group of self-flow equivalences up to isotopy. We compute the mapping class group for various classes of minimal zero-entropy subshifts.