Midwest Dynamical Systems Meeting

Schedule of Talks

All events will take place in East Hall, 530 Church Street

Friday, Nov 7:

- 3:30-4:00, refreshments, common room, 2nd floor
- 4:10-5:00, Steve Smale, room 1324

Saturday, Nov 8:

- 8:30-9:00, registration and coffee, common room, 2nd floor
- 9:00-9:50, Bruce Kitchens, room 1360
- 10:00-10:50, William Gignac, room 1360
- 11:00-11:30, coffee break, common room, 2nd floor
- 11:30-12:20, Araceli Bonifant, room 1360
- 12:30-2:30, lunch
- 2:30-3:20, Giulio Tiozzo, room 1360
- 3:30-4:20, Howard Masur, room 1360
- 4:30-5:00, coffee break, common room, 2nd floor
- 5:00-5:50, Kelly Yancey, room 1360
- 6:00-7:00, poster session, 2nd floor area
- 7:00-8:30, buffet dinner, atrium, 2nd floor

Sunday, Nov 9:

- 9:00-9:50, Charles Favre, room 1360
- 10:00-10:50, Ronen Mukamel, room 1360
- 11:00-11:30, coffee break, common room, 2nd floor
- 11:30-12:20, Tim Austin, room 1360

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Abstracts of Talks

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Steve Smale's talk will be in room 1324, and all other talks will be in room 1360.

Steve Smale, City University of Hong Kong and University of California, Berkeley
Title: Dynamics of the genome
Abstract: A construction of the genome and its dynamics will be given.

Bruce Kitchens, Indiana University-Purdue University, Indianapolis
Title: Automorphisms of nonorientable surfaces
Abstract: The (well-studied) family of birational maps $f_{a,b}(x, y) = (y, \frac{y-b}{x-a})$ can be thought of as defining maps from the real projective plane to itself. Some of these maps give rise to automorphisms of nonorientable surfaces. The dynamics of these maps are interesting. Some of them are zero entropy and can be understood as piecewise rotations and translations. Others can be seen to have positive entropy because of their action on the homology but the dynamics is not easy to understand. It appears that some have contain strange atttractors and others "standard" horseshoes. This is joint work with Roland Roeder.

William Gignac, Georgia Institute of Technology
Title: On the growth of local intersection multiplicities in holomorphic dynamics
Abstract: In this talk, we will discuss a question posed by Vladimir Arnold some twenty years ago, in a subject he called "dynamics of intersections." In the simplest setting, the question is the following: given a (discrete time) holomorphic dynamical system on a complex manifold X and two holomorphic curves C and D in X which pass through a fixed point P of the system, how quickly can the local intersection multiplicies at P of C with the iterates of D grow in time? Questions like this arise naturally, for instance, when trying to count the periodic points of a dynamical system. Arnold conjectured that this sequence of intersection multiplicities can grow at most exponentially fast, and in fact we can show this conjecture is true if the curves are chosen to be suitably generic. However, as we will see, for some (even very simple) dynamical systems one can choose curves so that the intersection multiplicities grow as fast as desired. We will see how to construct such counterexamples to Arnold's conjecture, using geometric ideas going back to work of Yoshikazu Yamagishi.

Araceli Bonifant, University of Rhode Island
Title: Fjords in a Parameter Space for Antipode Preserving Cubic Maps
Abstract: This talk will describe the topological properties of the "fjords" that appear in the parameter space for antipode preserving complex cubic maps with a critical fixed point.

Giulio Tiozzo, Yale University
Title: Continuity of core entropy of quadratic polynomials
Abstract: The core entropy of polynomials, recently introduced by W. Thurston, is a dynamical invariant which can be defined purely in combinatorial terms, and provides a useful tool to study parameter spaces of polynomials. The theory of core entropy extends to complex polynomials the entropy theory for real unimodal maps: the real segment is replaced by an invariant tree, known as Hubbard tree, which lives inside the filled Julia set. We prove that

the core entropy of quadratic polynomials varies continuously as a function of the external angle, answering a question of Thurston.

Howard Masur, University of Chicago
Title: Ergodic Theory of Interval Exchange Transformations
Abstract: An interval exchange transformation (IET) is a map of an interval to itself defined by cutting the interval into d pieces and rearranging them by translations. IET arise in the study of rational billiards and translation surfaces. Once there are at least 4 pieces there exist examples of minimal, but not uniquely ergodic IET. I will give a survey of recent results about this phenomenon and talk about a new phenomenon which is that a non ergodic IET may still possess a generic point. (The Birkhoff ergodic theorem says almost every point of an ergodic IET is generic). Along the way in discussing this, I will introduce the process of Rauzy induction, which is one of the main tools in studying IET. This is joint work with Jon Chaika.

Kelly Yancey, University of Maryland
Title: Self-Similar Interval Exchange Transformations
Abstract: In this talk I will discuss dynamics on interval exchange transformations and specifically those transformations that are self-similar. A self-similar interval exchange transformation is one that is periodic under Rauzy induction. I will show that self-similar IETs on three intervals cannot be weakly mixing and rigid. This is joint work with Giovanni Forni.

Charles Favre, Ecole Polytechnique
Title: Dynamical Manin-Mumford problem
Abstract: Given a dominant rational map on a projective variety, the dynamical Manin-Mumford problem asks for a characterization of all subvarieties containing a Zariski-dense subset of periodic points. I shall review the results we have obtained with R. Dujardin in the case of a polynomial automorphism of the complex affine plane.

Ronen Mukamel, University of Chicago
Title: Billiards, the square root of 11 and a Teichmuller curve of genus one
Abstract: A Teichmuller curve is an algebraic curve which is isometrically immersed in the moduli space of Riemann surfaces. The study of such complex geodesics in moduli space has celebrated applications to the dynamics of mapping classes, rational maps and polygonal billiards. We will present explicit topological, hyperbolic and algebraic models of a particular Teichmuller curve of genus one.

Tim Austin, Courant Institute
Title: Scenery entropy and the asymptotic geometry of marginals
Abstract: Simple models of random walks in random sceneries can be turned into examples of probability-preserving dynamical systems with interesting ergodic theoretic properties. In particular, they provide some of the few known 'natural' examples of systems with the K property that are not measure theoretically isomorphic to Bernoulli shifts.

The construction gives a large family of these examples, and it is natural to ask whether they are all really distinct up to isomorphism. This talk will sketch a new invariant for probability-preserving systems which can be used to recover the entropy rate of the scenery as an isomorphism-invariant of these models. This implies that they form continuum-many

distinct examples. In general, this new invariant of systems is defined by viewing the sequence of finite-dimensional marginals of a stationary stochastic process as a sequence of probability measures on the appropriate Hamming metric spaces, and then considering asymptotic features of the metric geometry of those spaces.

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Abstracts of Posters

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Yanxia Deng, Northwestern University
Title: Transitivity of Symplectic Diffeomorphisms
Abstract: We consider a class of partially hyperbolic symplectic diffeomorphisms. We show that for a generic C^r $(r = 1, 2, ...)$ symplectic diffeomorphism with a two-dimensional center and close to a product map, there is a normally hyperbolic submanifold which is normally transitive.

Jessica Dyer, University of Illinois, Chicago
Title: Bratteli diagrams for weak solenoids
Abstract: A weak solenoid, in the sense of McCord and Schori, induces a minimal equicontinuous action of a finitely generated group G on a Cantor space X. We use the coding method for such actions, as developed in the paper "Homogeneous matchbox manifolds" in Transactions AMS, 2013 by Clark and Hurder, to construct an "almost finite presentation" representing (X, G). We then use this presentation to construct a Bratteli diagram with group actions that captures the partially homogeneous dynamics of weak solenoids.

This work is joint with Steven Hurder and Olga Lukina.

Jesse Feller, University of Wisconsin Milwaukee
Title: Random Iteration of Rational Maps
Abstract: We present some results on iteration of rational functions when the parameters of the function vary with each composition. This gives rise to what is known as Random Iteration when the sequence of parameters are random variables. We can examine the probability $P(z)$ that z tends towards a neighborhood of a given attracting cycle. An early result in this area says that under certain conditions, these probabilities, $P(z)$, are continuous in z. Furthermore, every point in the complex plane will converge towards some attracting cycle with probability one. Our main result is a generalization of this idea.

Kenneth Jacobs, University of Georgia
Title: An Equidistribution Result for Non-Archimedean Dynamical Systems
Abstract: Let K be a complete, algebraically close non-Archimedean valued field. Recently Rumely introduced a function $\mathrm{ordRes}_\phi(x)$ on the Berkovich projective line, along with a canonical probability measure ν_ϕ supported on Berkovich hyperbolic space. This poster will

present two recent results on the convergence of the corresponding functions $\{\mathrm{ordRes}_{\phi^n}(x)\}$ attached to the iterates and the equidistribution of the family of measures $\{\nu_{\phi^n}\}$.

Cara Mullen, University of Illinois, Chicago
Title: The Critical Orbit Structure of $f_c(z) = z^2 + c$ over $\mathbb{C}_p$
Abstract: Fix a prime $p > 2$ and consider $f_c(z) = z^2 + c$ with $c \in \mathbb{C}_p$. What are the different possibilities for the structure of the orbit of 0, under iteration of f? A full classification of finite critical orbit trees is known in the complex setting; we will examine some of the variations over $\mathbb{C}_p$ by looking at the critical portrait of the reduction map $\bar{f}_c$ (over the residue field $\overline{\mathbb{F}}_p$).

Phil Mummert, Butler University
Title: A Path Lifting Algorithm for the Julia set of a Complex Hénon Map
Abstract: The preimages of a large circle converge to the Julia set of a quadratic map. Can we lift tori in a similar way to approximate the Julia set of a quadratic complex Hénon map? By "lengthening orbits," we create more than pretty pictures; the algorithm forms a tinker-toy model of J that should tell us something about solenoidal external rays and connectivity. This idea is work in progress.

Anna Siffert, University of Pennsylvania
Title: New equivariant harmonic maps between cohomogeneity one manifolds
Abstract: I explain how to construct new equivariant harmonic self-maps of cohomogeneity one manifolds. The problem of constructing such harmonic self-maps is reduced to solving non-standard singular boundary value problems for non-linear ordinary differential equations. I present new techniques to construct solutions to these boundary value problems. Furthermore, new interesting examples of harmonic are discussed.

Pengfei Zhang, University of Houston
Title: Homiclinic points for convex billiards
Abstract: Suppose there is a homoclinic point of a hyperbolic periodic point of a planar billiard system. Then a local deformation of the billiard table could make the intersection of the stable and unstable manifolds transversal. However, the local perturbation technique may not be enough to create a homoclinic intersection. We showed that for a C^r $(r = 2, 3, ...)$ generic convex billiard, there do exist homoclinic points for every hyperbolic periodic point.