Dynamics and Analysis Research Seminar

Spring of 2017

Department of Mathematics, the CUNY Graduate Center

Organized by Yunping Jiang, Linda Keen, Fred Gardiner, Enrique Pujals, Yun Yang, Tao Chen

Schedule: Wednesday, 2:00pm-3:30pm (Math Thesis Room, Rm. 4214-03):

February 8, Speaker: Yun Yang (CUNY Graduate Center)

Title: Hyperbolic conservative diffeomorphisms with countably many ergodic components

(We will also organize the rest of the schedule).

February 15, Class follows Monday Schedule

February 22, Speaker: Tao Chen (LaGuardia Community College)

Title: On Tangent Family

March 1 (We have two talks today)

10:30-12noon (Math thesis room 4124-03)

Speaker: Asaf Katz (The Hebrew University)

Title: Sparse equidistribution in unipotent flows.

Abstract: Equidistribution problems, originating from the classical works of Kronecker, Hardy and Weyl about equidistribution of sequences mod 1, are of major interest in modern number theory. We will discuss how some of those problems relate to unipotent flows and present a conjecture by Margulis, Sarnak and Shah regarding an analogue of those results for the case of the horocyclic flow over a Riemann surface. Moreover, we provide evidence towards this conjecture by bounding from above the Hausdorff dimension of the set of points which do not equidistribute.

2:00pm-3:30pm (Math Thesis Room, Rm. 4214-03)

Speaker: Robert L. Devaney (Boston University)

Title: Mandelpinski necklaces in the parameter plane for singularly perturbed rational maps

Abstract: In this lecture we consider rational maps of the form z^n + C/z^n where n >2. When C is small, the Julia sets for these maps are Cantor sets of circles and the corresponding region in the C-plane (the parameter plane) is the McMullen domain. We shall show that the McMullen domain is surrounded by infinitely many disjoint simple closed curves called Mandelpinski necklaces. The k^th necklace contains exactly (n-2)n^k + 1 parameters that are the centers of baby Mandelbrot sets and the same number of parameters that are centers of Sierpinski holes, i.e., disks in the parameter plane for which the corresponding Julia sets are

Sierpinski curves (sets that are homeomorphic to the Sierpinski carpet fractal). We shall also briefly describe other interesting structures in the parameter plane.

March 8, Speaker: Enrique Pujals (CUNY Graduate Center and IMPA)

Title: Dissipative surfaces diffeomorphisms in the boundary of zero entropy and renormalization

March 15, Speaker: Zhiqiang Li (Stony Brook University)

Title: Split Ruelle operators and dynamical zeta functions

Abstract: The studies of dynamical zeta functions in various dynamical contexts have led to interesting results such as decay of correlations and prime orbit theorems. The classical Ruelle operators often play important roles in such researches. In this talk, we are going to focus on prime orbit theorems in complex dynamics. We are going to discuss the main ideas used to obtain such results for hyperbolic rational maps in the works of F.~Naud, H.~Oh, and D.~Winter. In order to extend these results to a class of non-hyperbolic rational maps known as (rational) expanding Thurston maps, we have to introduce a new class of operators, which we call Ruelle operators, and study their fine properties. This is a work-in-progress joint with T.~Zheng.

March 22, No Event

March 29 (We have two talks today)

10:30-12noon (Math thesis room 4124-03)

Speaker: Jae Min Lee (CUNY Graduate Center)

Title: Geometry of the diffeomorphism group

Abstract: I will present a geometric approach towards nonlinear PDE such as Euler equation for ideal fluids in hydrodynamics. The main idea is that we can describe the Euler equation by means of geodesics on the group of volume-preserving diffeomorphisms. Thus, one can study the geometry of the diffeomorphism group to answer (or give a different context to) the problems in PDE. I will discuss infinite-dimensional manifold structure of the diffeomorphism group and show that the Euler equation arises from the energy minimizing property. Backgrounds in differential geometry and functional analysis will be useful, but I will make this talk accessible to most graduate students.

2:00pm-3:30pm (Math Thesis Room, Rm. 4214-03)

Speaker: Linda Keen (CUNY Graduate Center)

Title: Dynamically Natural Slices of Parameter Space for Meromorphic functions.

Abstract: I will discuss joint work with Nuria Fagella and Tao Chen. I will discuss fairly general families of meromorphic functions of finite type. I will show how to define a "dynamically natural" one dimensional slice if the parameter space for such functions and discuss its analytic and combinatorial properties.

April 5, (We have two talks today)

10:30-12noon (Math thesis room 4124-03)

Speaker: Jae Min Lee (CUNY Graduate Center)

Title: Geometry of the diffeomorphism group, continued

2:15pm-3:30pm (Math Thesis Room, Rm. 4214-03)

Speaker: Fred Gardiner (CUNY Graduate Center)

Title: Applications of extremal length methods to problems Riemann surface theory:

1. the uniformization theorem,
2. Slodkowsk's extension theorem for holomorphic motions,
3. plurisubharmonicity of extremal length functionals,
4. monopoles and dipoles.

April 12, Spring Recess/Passover

April 19, Speaker: Christian Wolf (City College and CUNY Graduate Center)

Title: On computability of rotation sets and their entropy

Abstract: Given a continuous dynamical system $f:X\to X$ on a compact metric space X and a m-dimensional continuous potential $\Phi = (\varphi_1, ..., \varphi_m):X\to R$, the generalized rotation set $Rot(\Phi)$ is defined as the set of all μ-integrals of Φ, where μ runs over all invariant probability measures. Analogously to the classical entropy of f, one can associate to each $w \in Rot(\Phi)$ the localized entropy H(w) at w. In this talk, we consider the question concerning the computability of rotation sets and localized entropy. We present positive results for shift maps and interior points of the rotation set. We also show that the situation is more complicated when dealing with points at the boundary of the rotation set. This is a joint work with Michael Burr and Martin Schmoll.

April 26, Speaker: Yunping Jiang (Queens College and CUNY Graduate Center)

Title: Period doubling and period merging and renormalization in the tangent family.

Abstract: In this talk, I will discuss a period doubling and period merging diagram in the tangent family $T_{t}(x)=i t\tan x$ $0<t<\pi$. This new bifurcation diagram leads to a renormalization on tangent-like maps which are piecewise continuous functions on the real line. We will discuss this renormalization and the attractor for an infinitely renormalizable tangent-like map. This is an on-going joint work with Linda Keen and Tao Chen.

May 3, Speaker: Khayutin Ilya **(Institute for Advanced Study and Princeton Univ.)**

Title: Geometric Expansion of Entropy for Periodic Torus Orbits

Abstract: In this talk we will discuss the asymptotic distribution of packets of maximal flats in higher rank spaces of Euclidean lattices PGLn(Z)\PGLn(R). Packets of maximal flats are natural collections of periodic torus orbits which are closely related to Arakelov class groups of totally real number fields. The special case of a packet of maximal flats in rank-1 corresponds to the collection of all periodic geodesics on PGL2(Z)\PGL2(R) with a fixed discriminant. The

distribution of packets of periodic torus orbits has been studied using dynamical methods in the pioneering work of Linnik in the rank 1 case. Recently Einsiedler, Lindenstrauss, Michel and Venkatesh have shown that Linnik's "ergodic method" is closely related to metric entropy. Inspired by Linnik's ideas for bounding the separation of integral points on the sphere I will present a geometric expansion for the collision probability of torus packets. This expansion is related to the double quotient of the ambient group by a maximal torus. Studying the arithmetic geometry of the double quotient of PGLn by a maximal torus allows us to significantly strengthen results towards the equidistribution of packets of periodic torus orbits. The results apply in greater generality, they hold for a general S-arithmetic quotient of any inner form of PGLn or SLn and for packets of periodic orbits of maximal tori which are only partially split at a fixed place.

May 10 (We have two talks today)

10:30-12noon (Math thesis room 4124-03)

Speaker: Milena Cuellar **(LaGuardia Community College)**

Title: Identifying Dynamical Coherent Behaviors for parameter estimation for Chaotic Models: prediction of the Solar Cycle

Abstract: The process of selecting model parameter values allows to test our understanding of physical systems by evaluating the mathematical structures we use to model what we observe. The estimation of the model parameter values that best represent the observations poses many challenges from the limitation of the information contained in observations available and the likely nonlinearity of the model class selected to represent the observed behaviour. In one hand, traditional methods for parameter estimation, e.g. least-squares, underperformed when forecast errors are non-Gaussian, even if the noise present in the observations are normally distributed. On the other hand, when the observed system is represented by a model class which does not admit an empirical adequate model, the idea of "true" parameter value is blurred. We present a recently developed method of data assimilation known Pseudo-orbit data assimilation, used to estimate parameters of a model of the Solar Cycle. In this nonlinear chaotic 5D model, variations of the solar activity are represented as the result of the coupling of two oscillators, one a regular nonlinear oscillator and the other a chaotic system. The quality of the estimations of system state and parameters is based on the ability of the model to shadow the observations and probabilistic skill scores, i.e. ignorance, of the model, in terms of its predictability potential. We will also mention other applications of the pseudo-orbit data assimilation method to reconstruct of the dynamic of chaotic dynamical system from partial observations. This worked is done with E.A. Spiegel and A. Svedin.

2:15pm-3:30pm (Math Thesis Room, Rm. 4214-03)

Speaker: Enrique Pujals (CUNY Graduate Center and IMPA)

Title: Dissipative surfaces diffeomorphisms in the boundary of zero entropy and renormalization II.

May 17, **(We have two talks today)**

10:30-12noon (Math thesis room 4124-03)

Speaker: Dyi-Shing Ou **(Stony Brook University)**

Title: Nonexistence of Wandering Domains for Infinite Renormalizable Henon Maps

Abstract: Nonexistence of wandering domains for strongly dissipative infinite renormalizable Henon-like maps of period doubling type is proved. The result answers the question asked by van Strien (2010) and Lyubich (2011) and produces a positive answer for the absences of wandering domain which is still widely open in higher dimension. Phenomena in dimension two occur in the model and produce both obstruction and solution toward the proof. The theorem also helps to understand the topological structure of the homoclinic web for such kind of maps: the union of the stable manifolds for all periodic points is dense.

2:15pm-3:30pm (Math Thesis Room, Rm. 4214-03)

Speaker: Sudeb Mitra (Queens College and CUNY Graduate Center)

Title: Variation of moduli under continuous motions

Abstract: The topic of "quasiconformal motions" was first introduced in a paper of Sullivan and Thurston. In our talk, we will show that a continuous motion of a finite set E in the Riemann sphere $\hatC$ over a simply connected parameter space V can be extended to a quasiconformal motion of $\hatC$ over V, with some additional analytic properties; furthermore, such an extension is unique up to isotopy rel E. (This is rather surprising because "continuous motion" is a purely topological notion.) This fact leads to results on continuity for the extremal length of a general family of curves, and in particular for modulus of annuli and lengths of closed Poincare geodesics. We will discuss these geometrical applications. This is a joint work with Yunping Jiang.