Workshop Surfaces in São Paulo
Titles and abstracts of talks

São Sebastião, SP, Brasil - April 7 to 11, 2014

François Béguin (Université Paris Nord, France)

Title: *Building Anosov vector fields in dimension 3*

Abstract: Whereas Anosov diffeomorphisms on surfaces are very simple (at least from the topological viewpoint), Anosov flows in dimension 3 remain quite mysterious. The two basic examples of such flows are the suspension of a linear Anosov automorphism of $\mathbb{T}^2$, and the geodesic flow on the unit tangent bundle of a hyperbolic surface. Some rigidity results by Plante and Ghys tend to suggest that every Anosov flow in dimension 3 is almost equivalent to one of these two canonical examples (for example, every Anosov flow in dimension 3 with C^2 stable and unstable foliations is topologically equivalent to a finite cover of one of the two examples above). Nevertheless, several exotic Anosov flows (by Franks-Williams, Handel-Thurston, Goodman, Bonatti-Langevin) have been known for many years.

I will present a result which allows to "glue hyperbolic pieces together, and get a transitive Anosov vector field". This gluing result gives rise to a kind of "brick building game" which allows to construct many new examples of Anosov vector fields. We obtain several corollaries, such as the existence of manifolds supporting arbitrarily many transitive Anosov vector fields, or the possibility to embed any simple hyperbolic set in a Anosov vector field. This is a joint work with Christian Bonatti and Yu Bin.

Jason Behrstock (City University of New York, USA)

Title: *Higher dimensional isoperimetric and divergence functions for mapping class groups*

Abstract: We will discuss the higher dimensional filling functions for mapping class groups of surfaces. We will establish bounds for these families of functions and show they exhibit phase transitions at the rank (as measured by 3 genus+number of punctures-3); this phase transition is analogous to a corresponding result for symmetric spaces which results from the combined work of Brady–Farb, Hindawi, Leuzinger, and Wenger. This is joint work with Cornelia Drutu.

Marc Bonino (Université Paris Nord, France)

Title: *Homeomorphisms of the annulus rotating the points slowly*

Abstract: In relation with the Poincare-Birkhoff theorem, we will discuss the property for a homeomorphism of the compact annulus to rotate the points only with sublinear speed.

Jan Boronski (IRAFM, Ostrava, Czech Republic)

Title: *On strange attractors, rotational chaos and the pseudo-circle*

Abstract: An attractor in the 2-torus is called strange if it admits two orbits with distinct rotation vectors. The associated dynamics is then referred to as rotational chaos. Strange attractors were discovered by George D. Birkhoff in 1932 for dissipative maps with a twist, and then studied by P. Le Calvez, M. Casdagli, and others. We shall present a method of constructing examples of connected strange attractors, as inverse limits of circles. Using this approach we shall show that R.H. Bing's pseudo-circle can appear as a strange attractor on the 2-torus and discuss topological entropy and differentiability of this example. We conclude with some open questions related to the study. Among them, we wonder if uncountably many topologically distinct strange attractors could be produced this way. This is joint work with Piotr Oprocha (Krakow).

Philip Boyland (University of Florida, USA)

Title: *New rotation sets in a family of torus homeomorphisms*

Abstract: Jointly with de Carvalho and Hall we study the rotation sets, $\rho(f_t)$, of a family of two-torus homeomorphisms. We show that there is a full measure collection of non-trivial closed intervals on each of which $\rho(f_t)$ mode locks to a constant polygon with rational vertices and that the generic rotation set in the Hausdorff topology has infinitely many extreme points, accumulating on a single non-rational extreme point whose components are rationally independent. The family also yields examples of rotation sets for which an extreme point is not represented by any minimal set or any directional ergodic measure. In addition, at some parameters t the set of extreme points of $\rho(f_t)$ does not vary continuously in the Hausdorff topology. Each homeomorphism in the family has its rotation set carried by an embedded inverse limit of a symbolic β-shift. The analysis of digit frequency sets of the family of β-shifts which will be described in Toby Hall's talk.

Sylvain Crovisier (Université Paris Sud, France)

Title: *Unlinked fixed points on surface*

Abstract: We compare the various notions of linking for the fixed points of a surface homeomorphism. In particular we prove the existence of maximal unlinked sets, a property that is required in the a foliated equivariant version of Brouwers plane translation theorem proved by Le Calvez. This is a joint work with F. Béguin and F. Le Roux.

Pablo Dávalos (ITESO, Mexico)

Title: *On irrotational homeomorphisms of the annulus*

Abstract: A conjecture by Fabio Tal in [http://arxiv.org/pdf/1307.1664.pdf] states that for an irrotational, area preserving homeomorphism on a compact surface M, either the orbits are uniformly bounded (in the lift to the universal cover), or the set of fixed points is "big" (not contained on a topological disk). We study such conjecture in the particular case that M is the annulus, and we prove it to be true under the additional hypothesis that there exist orbits going from one boundary component to the other.

John Franks (Northwestern University, USA)

Title: *Symplectic Surface Diffeomorphisms and the Tits Alternative*

Abstract: TBA

Nancy Guelman (IMERL - UdelaR, Uruguay)

Title: *Burnside Problem for groups of homeomorphism on surfaces*

Abstract: A group G is said to be periodic if for every $g \in G$ there exists a positive integer n with $g^n = \mathrm{Id}$. We give conditions that guarantee that any finitely generated periodic group G is finite, when G is a group of homeomorphisms on some surfaces.

Toby Hall (University of Liverpool, England)

Title: *Lexicographic infimax sequences*

Abstract: In this talk I will discuss the main tool used in the results presented by Phil Boyland about rotation sets in a family of torus homeomorphisms.

Let Σ_k be the space of sequences with entries in $\{1, 2, \ldots, k\}$, ordered lexicographically. An element of Σ_k is *maximal* if it is the maximum of its orbit under the shift map.

Given $\alpha \in \mathbb{R}^k_{\geq 0}$ with entries summing to 1, consider the set $M(\alpha)$ of all maximal elements of Σ_k for which the proportion of entries equal to each i is α_i. The infimum of $M(\alpha)$ is called the *α-infimax sequence*, or the *α-minimax sequence* if the infimum is a minimum.

I will explain how these infimaxes can be determined, and show that whether or not the infimax is a minimax depends on the growth rate of an itinerary associated with α; and I will explain their connection with rotation sets of torus homeomorphisms and digit frequency sets of beta expansions.

This is joint work with Phil Boyland (Florida) and André de Carvalho (USP) - arXiv:1301.0458.

Luis Hernandez-Corbato (IMPA, Brasil)

Title: *Fixed point indices via Conley theory*

Abstract: In this talk we will explain how fixed point indices of fixed points of maps behave in some low-dimensional cases (dimensions 2 and 3) assuming isolation of the fixed point as an invariant set. The indices will be computed once we obtain a description of the first homological (discrete) Conley index of the fixed point, which codifies essentially how the branches of the unstable set are permuted by the dynamics. A careful geometric study of index pairs (or isolating blocks) proves that the first Conley index is represented by a permutation. As a consequence we obtain a characterization of fixed point indices for fixed points (satisfying the isolation hypothesis) of continuous maps in the plane and orientation–reversing homeomorphisms in $\mathbb{R}^3$. This is joint work with Patrice Le Calvez and Francisco R. Ruiz del Portal.

Tobias Jäger (TU Dresden, Germany)

Title: *Rotation sets of almost periodic sequences*

Abstract: Abstract: A result by Misiurewicz and Ziemian states that if the rotation set of a torus homeomorphism has non-empty interior, then every point in the interior is realised as the unique rotation vector on some minimal set. We investigate the question whether more complex rotational behaviour can occur as well. It turns out that for the rotation set associated to a minimal set there are no restrictions besides connectedness. In particular, it can be a non-convex or even plane-separating continuum, or any line segment. For the proof, a construction of Kwapisz allows to transfer the problem to the symbolic level, where the crucial technical issue is to implement the desired rotational behaviour by using suitable Toeplitz sequences.

Patrice Le Calvez (Institut de Mathemátiques de Jussieu, France)

Title: *A finite dimensional approach to Bramham's approximation theorem*

Abstract: Using pseudo-holomorphic curves techniques from symplectic geometry, Barney Bramham proved recently that every smooth irrational pseudo-rotation of the unit disk is the limit, for the C^0 topology, of a sequence of smooth periodic diffeomorphisms. We exhibit a finite dimensional proof of this result that works in the case where the pseudo-rotation is smoothly conjugate to a rotation on the boundary circle. The proof extends to C^1 pseudo rotations and is based on the dynamical study of the gradient flow associate to a generating function.

Frédéric Le Roux (Institut de Mathemátiques de Jussieu, France)

Title: *The displaced disks problem, spectral norm and unlinked sets*

Abstract: Consider the following "displaced disks problem": prove that an area preserving homeomorphism of the 2-sphere, close enough to the identity, cannot displace a disk of area 1/10. The recent solution by Sobhan Seyfaddini makes use of his results from symplectic topology. We will discuss the solution, the wonderful topological properties of the mysterious "spectral norm", and a conjectural formula by Patrice Le Calvez expressing the spectral norm in terms of the action of unlinked sets.

Emmanuel Militon (Ecole Polytechnique, France)

Title: *Conjugacy class of pseudo-rotations and distortion elements in groups of homeomorphisms*

Abstract: The notion of distortion elements give rigidity results on the action of some groups on manifolds. In this talk, we will explore links between the rotation sets of homeomorphisms of surfaces and distortion elements in groups of homeomorphisms of surfaces. This study leads to some questions about pseudo-rotations.

Meysam Nassiri (Institute for Research in Fundamental Sciences - IPM, Iran)

Title: *Prime ends rotation numbers and periodic points*

Abstract: Given an orientation-preserving homeomorphism of a surface leaving invariant an open simply connected set U, one may define its rotation number using Carathéodory's prime ends compactification. I will talk about the relationship between this rotation number and the existence of periodic orbits in the boundary of U. As an application of the main results, we show that any periodic complementary domain U which is invariant by a generic area-preserving diffeomorphism has no periodic points in its boundary, and this allows us to provide topological information about the boundary of U. This is a joint work with Andrés Koropecki and Patrice Le Calvez.

Alejandro Passeggi (IMERL - UdelaR, Uruguay)

Title: *On extensions of irrational rotations to the two torus.*

Abstract: We study the Franks-Misiurewicz conjecture on the family of those toral homeomorphisms that are semiconjugate to an irrational rotation of the cirlce. We prove that the existence of a possible counterexample is associated to a complicated topological structure (given by the fibers of the semiconjugacy).

Mario Ponce (Pontificia Universidad Catlica de Chile, Chile)

Title: *Midsets in hyperbolic spaces*

Abstract: We study the metric properties of midsets in hyperbolic spaces. The asymptotic properties of these sets depend on the geometric properties of the horocyclic foliations. We illustrate that "in the hyperbolic plane there are no parabolas".

Javier Ribón (Universidade Federal Fluminense - UFF, Brasil)

Title: *Rotational properties of nilpotent groups of diffeomorphisms of surfaces*

Abstract: Brouwer translation theorem implies that any orientation preserving homeomorphism of the plane that preserves a Borel probability measure has a fixed point. We show partial generalizations of this result in the context of nilpotent groups of diffeomorphisms of the plane. We will also discuss existence of global fixed points of nilpotent groups of diffeomorphisms in compact surfaces and the connection of this problem with the rotational properties of elements in the group.

Sonja Stimac (University of Zagreb, Croatia)

Title: *Horseshoe-like maps of plane and symbolic dynamics*

Abstract: I will present a possible approach to coding of attractors of horseshoe-like maps of plane (such as the Hénon and Lozi maps). I will also discuss some techniques which can be used if an attractor is characterized by an appropriate countable collection of sequences of 0s and 1s (which play role of "kneading sequences" of "critical point").

Juliana Xavier (IMERL - UdelaR, Uruguay)

Title: *Periodic points for annulus endomorphisms*

Abstract: Let f be a degree $d > 1$ covering map of the open annulus $A = S^1 \times (0, 1)$ preserving an essential (i.e not contained in a disk of A) compact subset. We show that for each n, f^n has at least $d^n - 1$ fixed points. Moreover, for each n, f has a periodic point of period exactly n. If $f : A \to A$ is not assumed to be a covering but just any continuous map of degree $d > 1$, we obtain the same result provided that the ends of the annulus are both attracting.

Comments: This is a joint work with Jorge Iglesias, Aldo Portela and Álvaro Rovella.