Ergodic Optimization

and Related Fields

http://ergodicoptimization.ime.usp.br **December 9-13, 2013**

Book of Abstracts

The workshop ***Ergodic Optimization and Related Fields*** is a realization of the following organizations.

IME-USP
Instituto de Matemática e Estatística
www.ime.usp.br

USP
Universidade de São Paulo
www.usp.br

INCTMat
Instituto Nacional de Ciência e Tecnologia de Matemática
inctmat.impa.br

SBM
Sociedade Brasileira de Matemática
www.sbm.org.br

BREUDS
Brazilian-European partnership in Dynamical Systems
www2.imperial.ac.uk/~jswlamb/DynamIC/BREUDS

The workshop ***Ergodic Optimization and Related Fields*** is grateful to the following organizations for providing financial support.

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CAPES
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Welcome

It is a pleasure to welcome you to the Ergodic Optimization and Related Fields and to São Paulo. We wish you a pleasant stay and that you enjoy the conference.

Organizing Committee

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Ricardo Freire (IME-USP)

Scientific Committee

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Fábio Tal (IME-USP)

Address

Instituto de Matemática e Estatística, IME-USP

Rua do Matão, 1010 - Cidade Universitária,
bloco A, sala 265 (room 265 in building A)
CEP 05508-090. São Paulo/SP
Tel: (+55)(11) 3091-6136. Fax: (+55)(11) 3091-6131

e-mail: ergodicoptimization@gmail.com

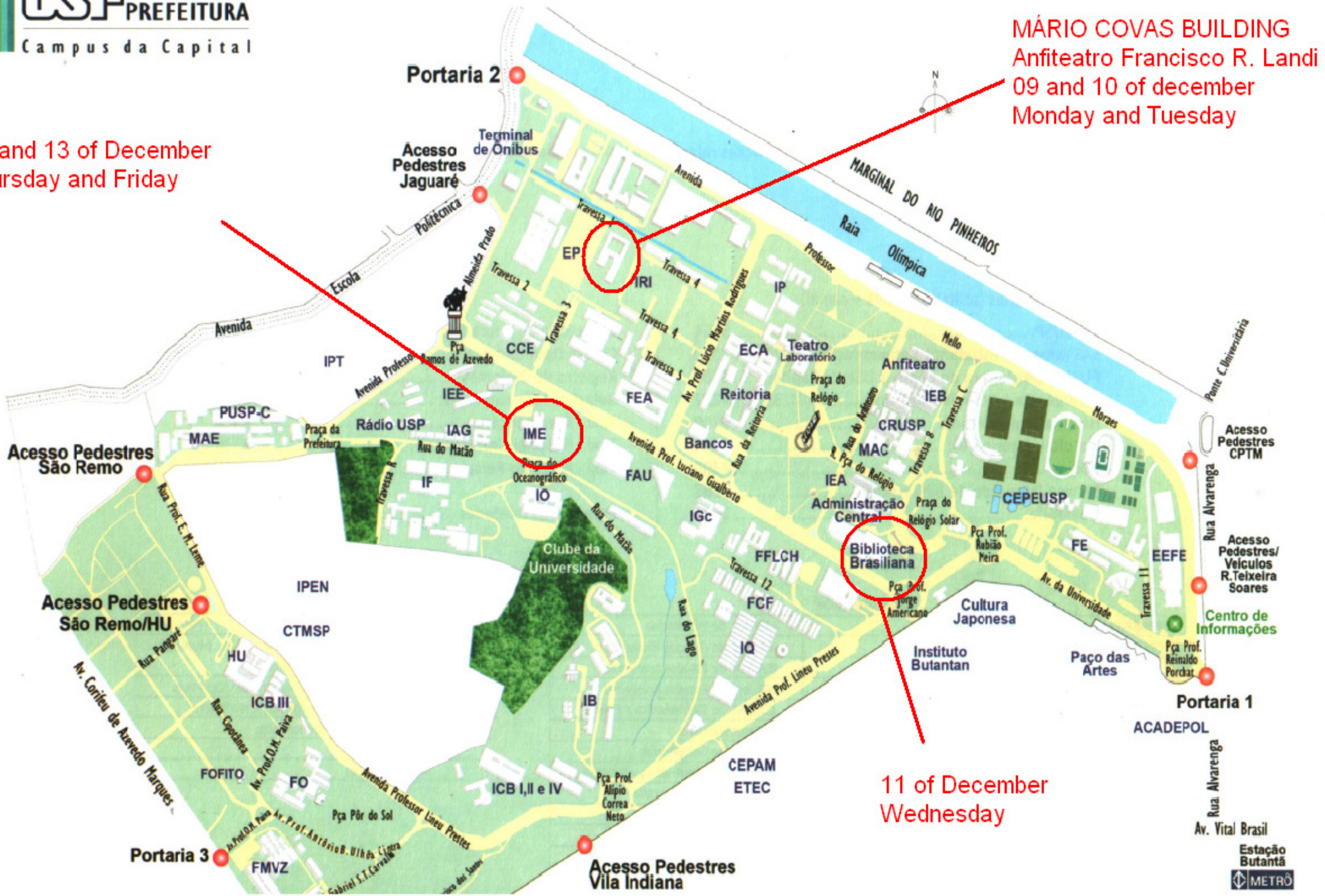
Cidade Universitária "Armando de Salles Oliveira" - CUASO

USP PREFEITURA
Campus da Capital

MÁRIO COVAS BUILDING
Anfiteatro Francisco R. Landi
09 and 10 of december
Monday and Tuesday

12 and 13 of December
Thursday and Friday

11 of December
Wednesday



Conference's location and Internet Access

Monday 9th and Tuesday 10th at Mário Covas building

Mário Covas building at Poli-USP
Av. Prof. Luciano Gualberto, Travessa 3, nº 380.
Cidade Universitária, room Prof. Francisco Romeu Landi.
CEP 05508-010 - São Paulo/SP.
Internet Access Login and password will be given at the time of the registration in the first day.

Wednesday 11th at Brasiliana USP

Brasiliana USP
Praça da Reitoria, s/n - Cidade Universitária.
CEP 05508-050 - São Paulo/SP.
Internet Access Login: AUDITORIO. Password: bbmauditorio

Thursday 12th and Friday 13th at IME-USP

Instituto de Matemática e Estatística, IME-USP
Rua do Matão, 1010 - Cidade Universitária.
Auditório Gilioli, bloco A (Gilioli room at building A).
CEP 05508-090- São Paulo/SP.
Tel: (+55)(11) 3091-6136. Fax: (+55)(11) 3091-6131
Internet Access: We will inform you later.

PROGRAM

Ergodic Optimization and Related Fields

IME-USP, São Paulo, from 09/12 to 13/12/2013

Time	Mon, 09
09:00 - 09:50	Registration
09:50 - 10:00	Opening Cerimony
10:00 - 10:20	Coffee Break
10:20 - 11:00	**J. Aaronson**
11:00 - 11:40	**R. Leplaideur**
11:40 - 12:30	**G. Iommi**
12:30 - 14:30	Lunch
14:30 - 15:20	**MC-1**
15:20 - 16:00	**D. Coronel**
16:00 - 16:50	**MC-2**
16:50 - 17:10	Coffee Break
17:10 - 17:50	**M. Stadlbauer**
17:50 - 18:30	**T. Kucherenko**

MC-1 minicourse by O. Jenkinson

MC-2 minicourse by R.Souza and J. Mengue

MC-3 minicourse by A. Quas

Time	Tue, 10	Wed, 11	Thu, 12	Fri, 13
09:00 - 09:50	**MC-2**	**M. Denker**	**MC-3**	**MC-3**
09:50 - 10:30	**Z. Kosloff**	**C. Wolf**	**I. Rios**	**P. Varandas**
10:30 - 10:50	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10:50 - 11:30	**J. Rivera-Letelier**	**A. Lopes**	**A. Fisher**	**D. Farias**
11:30 - 12:10	**V. Pinheiro**	**E. de Faria**	**T. Kempton**	**D. Kwietniak**
12:10 - 14:30	Lunch	Lunch	Lunch	Lunch
14:30 - 15:20	**MC-1**	**G. Contreras**	**MC-1**	**MC-1**
15:20 - 16:00	**J. Bochi**	**F. Tal**	**E. Garibaldi**	**E. Vargas**
16:00 - 16:20	Coffee Break	Coffee Break	Coffee Break	Coffee Break
16:20 - 17:10	**MC-3**	**M. Pollicott**	**MC-2**	**J. Los**
17:10 - 17:50	**S. Senti**	**P. Thieullen**	**K. Oliveira**	Free
17:50 - 18:30	**A. Baraviera**	Poster Session	**B. Pires**	Free
19:00 - 23:00		Happy Hour Senzala Restaurant		

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Minicourses

Ergodic optimization, ergodic dominance, and thermodynamic formalism
by Oliver Jenkinson (Queen Mary, University of London, UK)

I will start with the History, examples, connections with thermodynamic formalism. After I will talk about the "coboundary trick", generic properties of maximizing measures, and the dual problem of finding a continuous function maximised by a given measure. At the end I will give more examples, leading to connections with stochastic dominance.

Ergodic Transport
by Jairo Mengue and Rafael Rigão Souza (Federal University of Rio Grande do Sul, Brazil)

We will present some recent results in which ideas from Classical Transport Theory are applied to Ergodic Theory. The dynamical Kantorovich duality will be one of the main topics we will describe. Some of these results are natural generalizations of the ones usually considered in Classical Ergodic Optimization.

Multiplicative ergodic theorems and applications
by Anthony Quas (University of Victoria, Canada)

In 1965, Oseledets proved the landmark Multiplicative Ergodic Theorem, describing the behavior of the composition of a stationary sequence of linear maps of a finite-dimensional vector space. This has immediate applications to differentiable dynamical systems, and leads directly to the study of non-uniform hyperbolicity. The Multiplicative Ergodic Theorem has a wide range of applications in other areas also. The theorem has been extended in many directions, to operators on Banach spaces and abstractly to non-expanding maps of geometric spaces. In this course, we will see the connection with the Kingman sub-additive ergodic theorem, give outlines of a proof of the MET and describe the Banach space extensions. We will also describe recent work extending the Oseledets multiplicative ergodic theorem to the semi-invertible context (where the operators are non-invertible, but the underlying base dynamics is invertible). This extension has been undertaken with a view to applying the results in collaboration with atmospheric scientists, in a way which I will talk about.

Abstracts

MONDAY, DECEMBER 09

Jon. Aaronson
Tel-Aviv University, Israel

Title: *On Multiple Recurrence and other Properties of "nice"Infinite Measure Preserving Transformations*

Abstract: A measure preserving transformation $(X, \mathcal{B}, m, T)$ is called d-recurrent ($d \in \mathcal{N}$) if $\forall\, A \in \mathcal{B}$, $m(A) > 0$ $\exists\, n \geq 1$ so that

$$m(A \cap T^{-n}A \cap T^{-2n}A \cdots \cap T^{-dn}A) > 0$$

equivalently $\forall\, A \in \mathcal{B}$, $m(A) > 0$ and for a.e. $x \in A$, the set

$$\{n \in \mathbb{N} : T^n x \in A\}$$

contains an arithmetic progression of length $d + 1$. Multiple recurrence is d-recurrence $\forall\, d \geq 1$.

Furstenberg and Szemeredi showed that probability preserving transformations are multiply recurrent.

There are conservative (i.e. 1-recurrent), ergodic measure preserving transformations which are not 2-recurrent however suitably recurrent Markov shifts are d-recurrent (A+ Nakada 2000).

We'll discuss this and the stronger multiple versions of rational ergodicity and rational weak mixing for "nice"transformations, including certain interval maps and hyperbolic geodesic.

Joint work with Hitoshi Nakada.

Renaud Leplaideur
Université de Brest, France

Title: *Renormalization, Freezing Phase Transitions and Fibonacci Quasicrystals*

Abstract: Most of the known phase transitions in Dynamical systems are freezing phase transitions, which means that the pressure in eventually linear. With respect to ergodic optimization, this means that the equilibrium reaches its ground state (or a maximizing measure) at positive temperature. One question in statistical mechanics was to construct examples of freezing phase transitions with ground states supported into a quasi-crystal. We study here the Fibonacci case.

More precisely, we examine the renormalization operator determined by the Fibonacci substitution within the full shift on two symbols $\Sigma := \{0,1\}^Z$. We exhibit a fixed point and determine its stable leaf (under iteration of the operator acting on potentials $V := \Sigma \to \mathbb{R}$, which is completely determined by the germ near the attractor of the substitution. Then we study the thermodynamic formalism for potentials in this stable leaf, and prove they have a freezing phase transition at finite temperature, with ground state supported on the attracting quasi-crystal associated to the Fibonacci substitution. Joint work with Henk Bruin.

Godofredo Iommi
PUC, Chile

Title: *Zero temperature limits of Gibbs states for almost-additive potentials*

Abstract: In this talk I will discuss ergodic optimisation problems for almost-additive sequences of functions (rather than a fixed potential) defined over countable Markov shifts (that is a non-compact space). Under certain assumptions we prove that any accumulation point of a family of Gibbs equilibrium measures is a maximising measure. Applications are given in the study of the joint spectral radius and to multifractal analysis of Lyapunov exponent of non-conformal maps. This is joint work with Yuki Yayayma.

Daniel Coronel
Universidad Andrés Bello, Chile

Title: *Lyapunov optimizing measures of quadratic maps, part I*

Abstract: We study the Lyapunov optimization problem for (quasi-)quadratic maps. We first exhibit a Misiurewicz-Thurston quadratic map having no Lyapunov minimizing measure. We show that for such a map, every sequence of measures whose Lyapunov exponents approach the infimum converges to the periodic measure on the post-critical set. We also exhibit a quasi-quadratic map whose geometric equilibrium states diverge as the temperature goes to zero. This divergence property turns out to be robust: In the space of quasi-quadratic maps, there is a codimension 2 submanifold formed by maps with this property.

Manuel Stadlbauer
Federal University of Bahia, Brazil

Title: Exponential decay through asymptotic coupling

Abstract: The approach through optimal transport and asymptotic coupling gives rise to very robust estimates on exponential decay of Wasserstein distances which are applicable in many situations. As an application, we present a theorem on exponential decay of correlations for a class of random shifts with respect to a countable number of states. A theorem of this type so far was out of reach since there is no fibrewise analogue of the Ionescu Tulcea-Marinescu theorem.

Tamara Kucherenko
CUNY, USA

Title: *Localized Pressure and Equilibrium States*

Abstract: We introduce the notion of localized topological pressure for continuous maps on compact metric spaces and establish a local version of the variational principle for several classes of dynamical systems and potentials. We also construct examples showing that the assumptions in the localized variational principle are fairly sharp. Next, we study localized equilibrium states and show that even in the case of subshifts of finite type and Holder continuous potentials, there are several new phenomena that do not occur in the theory of classical equilibrium states. In particular, ergodic localized equilibrium states for Holder continuous potentials are in general not unique. (joint work with C. Wolf)

TUESDAY, DECEMBER 10

Zemer Kosloff
University of Warwick, UK

Title: *Symmetric Birkhoff sums in infinite ergodic theory*

Abstract: By a Theorem of Aaronson, normalized Birkhoff sums positive integrable functions in infinite, ergodic systems either tend to 0 almost surely or there is a subsequence along which every further subsequence tends to infinity. This is not true for normalized symmetric Birkhoff sums as there are examples of infinite, ergodic systems for which the absolutely normalized symmetric Birkhoff sums of positive integrable functions may be almost surely bounded away from zero and infinity. We will talk about a joint work with Jon Aaronson and Benjamin Weiss where we showed that the absolutely normalized, symmetric Birkhoff sums of positive integrable functions in infinite, ergodic systems never converge pointwise.

Juan Rivera-Letelier
PUC, Chile

Title: *Lyapunov optimizing measures of quadratic maps, part II*

Abstract: We study the Lyapunov optimization problem for (quasi-)quadratic maps. We first exhibit a Misiurewicz-Thurston quadratic map having no Lyapunov minimizing measure. We show that for such a map, every sequence of measures whose Lyapunov exponents approach the infimum converges to the periodic measure on the post-critical set. We also exhibit a quasi-quadratic map whose geometric equilibrium states diverge as the temperature goes to zero. This divergence property turns out to be robust: In the space of quasi-quadratic maps, there is a codimension 2 submanifold formed by maps with this property.

Vilton Pinheiro
Federal University of Bahia, Brazil

Title: *Ergodicity, u-ergodicity, weak-ergodicity...*

Abstract: We will introduce some variants of the ergodicity for measures not necessarily invariant, relating them to the construct induced Markov maps. We will try to show the flexibility of these tools in the following applications:

(1) study the finiteness of the number of attractors for piecewise smooth one-dimensional maps,

(2) study the statistics of the orbits of most points for maps of the interval,

(3) study the uniqueness of the measure of maximal entropy among the expanding measure (measures with all Lyapunov exponents positives),

(4) study the finiteness of the number of attractors for $(E^{ss} \oplus E^{cu})$-partial hyperbolic with NUE center-unstable direction,

(5) construction of induced maps adapted to ergodic invariant hyperbolic probabilities of $(E^{ss} \oplus E^{cu})$-partial hyperbolic maps,

(6) study orbits with historical behavior.

Jairo Bochi
PUC-Rio, Brazil

Title: *Optimization of Lyapunov exponents of matrix cocycles*

Abstract: I will discuss the problem of optimizing (i.e., maximizing or minimizing) the upper Lyapunov exponent of a matrix cocycle. The main result to be presented, joint with Michał Rams (Warsaw), says that if a 2×2 one-step cocycle has certain hyperbolicity properties (namely, there exist strictly invariant cones whose images do not overlap) then the Lyapunov-optimizing measures have zero entropy. The proof has two steps: first, a construction in the style of Mañé lemma and second, a study of geometrical constraints between the invariant directions.

Samuel Senti
Federal University of Rio de Janeiro, Brazil

Title: *Unicity of the equilibrium measure for certain Hénon maps*

Abstract: In this collaboration with Hiroki Takahasi we study strongly dissipative Hénon maps at the first bifurcation and show that the equilibrium measure associated to the potential $-t \log |\mathrm{Jac}^u|$ is unique. This holds for arbitrarily large $t \geq 1$ provided that the dissipation is sufficiently strong.

Alexandre Tavares Baraviera
Federal University of Rio Grande do Sul, Brazil

Title: *Selection of measures: some recent results*

Abstract: Given a dynamical system define on the Bernoulli space (with a finite alphabet) and a potential A we can define its Gibbs measure for any given temperature. Then a natural question is the behavior of the family of Gibbs measures as function of this parameter, and specially what happens when the temperature goes to zero. We say that a measure is selected when it is the limit of a sequence of Gibbs measures. In this talk I would like to present some recent results in this field, showing some examples where selection is obtained and also discussing some cases where there is no selection.

WEDNESDAY, DECEMBER 11

Manfred Denker
Penn State University, USA

Title: *Selforganized criticality for neuronal dynamics*

Abstract: Abstract: This talk is a report on the dissertation of Anna Levina in 2008 dealing with a model of random dynamics for avalanche dynamics in neuronal networks. The results concern the asymptotic distribution of avalanche sizes in terms of branching processes, existence of invariant measures and topological transitivity for the associated skew product.

Christian Wolf
CUNY, USA

Title: *Variation of topological pressure and dimension: From polynomials to complex Hénon maps*

Abstract: We study the topological pressure and dimension theory of complex Hénon maps which are small perturbations of one-dimensional polynomials. In particular, we derive regularity results for the generalized pressure function in a neighborhood of the degenerate map (i.e. the polynomial). This unifies results concerning the regularity of the pressure function for polynomials by Ruelle and for complex Hénon maps by Verjovsky and Wu. We then apply this regularity to show that the Hausdorff dimension of the Julia set is a continuous non-differentiable function in a neighborhood of the polynomial. Furthermore, we establish uniqueness of the measure of maximal dimension and show that the Hausdorff dimension of the Julia set of a complex Hénon map is discontinuous at the boundary of the hyperbolicity locus.

Artur O. Lopes
Federal University of Rio Grande do Sul, Brazil

Title: *Limit of eigenfunctions of the Ruelle Operator when temperature goes to zero, piecewise analytic subactions and Transport*

Abstract: We consider a piecewise real analytic expanding map $f : [0,1] \to [0,1]$ of degree d which preserves orientation and a real analytic positive potential $g : [0,1] \to \mathbb{R}$.

An important result in Complex Dynamics is the following: under the above hypothesis, for a given real analytic potential $\beta \log g$, where $\beta \geq 0$ is a real constant, there exists a real analytic positive eigenfunction ϕ_β defined on $[0,1]$ for the real Ruelle operator $P_{\beta \log g}$ of the potential $\beta \log g$. There exists a complex analytic extension of $\log \phi_\beta$ to a neighborhood O_β of the interval $[0,1]$. The set O_β changes with β when $\beta \to \infty$.

It is known that any convergent subsequence of the equicontinuous family of real functions $\frac{1}{\beta} \log \phi_\beta$, $\beta \to \infty$, is a calibrated subaction for $\log g$.

There are examples where there is no real analytic calibrated subaction for $\log g$. Under some suitable conditions we show that it is possible to get in the limit of $\frac{1}{\beta} \log \phi_\beta$, $\beta \to \infty$, a real piecewise analytic calibrated subaction. Ideas of Transport Theory related to the involution kernel helps to show the main result.

Our theory can be applied when $\log g(x) = -\log f'(x)$. In that case we relate the involution kernel to the so called scaling function.

Joint work with Elismar Oliveira and Daniel Smania.

References:

[1] *Negative Entropy, Pressure and Zero temperature: a L.D.P. for stationary Markov Chains on* $[0,1]$, A. Lopes, J. Mohr, R. R. Souza and Ph. Thieullen, *Bull. Soc. Bras. Math.* Vol 40 n 1, (2009), 1-52.

[2] *On the general one dimensional XY Model: positive and zero temperature, selection and non-selection*, A. T. Baraviera, L. M. Cioletti, A. Lopes, J. Mohr, R. R. Souza, Reviews in Math. Physics. Vol. 23, N. 10, pp 1063-1113 (2011).

[3] *A Thermodynamic Formalism for continuous time Markov chains with values on the Bernoulli Space: entropy, pressure and large deviations*, A. Lopes, A. Neumann and Ph. Thieullen.

[4] *A Ruelle Operator for continuous time Markov Chains*, A. Baraviera, R. Exel and A. Lopes, Sao Paulo Journal of Mathematical Sciences, vol 4 n. 1, pp 1-16 (2010).

Edson de Faria
University of São Paulo, Brazil

Title: *On Sloane's persistence problem*

Abstract: We investigate the so-called persistence problem of Sloane, exploiting connections with the dynamics of circle maps and the ergodic theory of free abelian actions. We also formulate a conjecture, concerning the asymptotic distribution of digits in long products of primes chosen from a given finite set, whose truth would in particular solve the persistence problem. We provide computational evidence and an heuristic argument in favor of our conjecture. Such heuristics can be thought in terms of a simple model in statistical mechanics. This talk is based on joint work with Charles Tresser (IBM).

Gonzalo Contreras
CIMAT, Mexico

Title: *Ground states are generically a periodic orbit*

Abstract: We prove that for an expanding transformation, the maximizing measures of a generic Lipschitz function are supported on a single periodic orbit.

Fábio Tal
University of São Paulo, Brazil

Title: *Rotationally extremal measures and hamiltonian homeomorphisms of* $\mathbb{T}^2$

Abstract: Given a homeomorphisms $f : \mathbb{T}^2 \to \mathbb{T}^2$ homotopic to the identity, a f-invariant measure μ is called *rotationally extremal* if here exists a lift of f to the universal covering $\hat{f}$ and a direction $v \in \mathbb{R}^{2*}$ such that $\int_{\mathbb{T}^2} \langle \hat{f}(\hat{x}) - \hat{x}); v \rangle d\mu$ is maximal. These measures are intrinsically associated with extremal points of the rotation set of $\hat{f}$, describing the homotopical behavior that orbits of f may display. In this talk we discuss what are the restrictions for the support of these extremal measures. We show that, in many situations, the support of these extremal measures must be topologically small, in the sense that it may be continuously deformed into a point. As an important application, we show that if f is an hamiltonian diffeomorphisms of $\mathbb{T}^2$ (the time 1 map of a 1-periodic hamiltonian flow) with finitely many fixed points, then either there exists an invariant open essential annulus or there exists linear diffusion in every direction for the lifted dynamics, proving a conjecture by P. Boyland.

Mark Pollicott
University of Warwick, UK

Title: *Joint spectral radius and maximizing measures*

Abstract: We relate the construction of counterexamples to the joint spectral radius conjecture to maximizing measures and sturmian measures associated to actions of 2×2 matrices on the projective line.

This is work in progress with Oliver Jenkinson.

Philippe Thieullen
Université de Bordeaux, France

Title: *Discrete weak-KAM methods for quasicrystal models*

Abstract: A quasicrystal model is given by a 1D chain of atoms in short range interaction between themselves and in interaction with an almost periodic environment which is uniquely ergodic. Weak-KAM theory corresponds to a set of tool that enable to describe the minimizing configurations of the chain. In a joint work with E. Garibaldi and S. Petite we show that minimizing configurations (and more precisely calibrated configurations) do exist for any quasicrystal models.

Posters Section

Juliano S. Gonschorowski
UTFPR, Brazil

Title: *Density of the set of endomorphisms with maximizing measures supported on a periodic orbit*

Abstract: Let M be a compact n-dimensional Riemanian manifold, $\mathrm{End}(M)$ the set of the endomorphisms of M with the usual $\mathcal{C}^0$ topology and $\phi : M \to \mathbb{R}$ continuous.

We prove, extending the main result of [1], that there exists a dense subset of $\mathcal{A}$ of $\mathrm{End}(M)$ such that, if $f \in \mathcal{A}$, there exists a f invariant measure $\mu_{\max}$ supported on a periodic orbit that maximizes the integral of ϕ among all f invariant Borel probability measures. Jointly with Tatiane C. Batista and Fábio A. Tal.

Ricardo Ribeiro
University of São Paulo, Brazil

Title: *Mean field games with logistic population dynamics: One dimensional example*

Abstract: In its standard form, a mean-field game can be defined by a coupled system of equations, one Hamilton-Jacobi equation for the value function of agents and one Fokker-Planck equation for the density of agents. Traditionally, the latter equation is adjoint to the linearization of the former. Since the Fokker-Planck equation models a population dynamic, we introduce natural features such as immigration, birth, and non-linear death rates. Here we analyze a stationary mean-field game in one dimension, illustrating various techniques to obtain regularity of solutions in this class of systems. In particular we consider a logistic-type model for birth and death of the agents which is natural in problems where crowding affects the death rate of the agents. The introduction of these new terms requires a number of new ideas to obtain well posedness. In a forthcoming publication we will address higher dimensional models.

Tatiane Batista
UTFPR, Brazil

Title: *Density of the set of symbolic dynamics with all ergodic measures supported on periodic orbits*

Abstract: Let K be a Cantor set. In this thesis we present two theorems related to the density of symbolic dynamics. We prove that given an endomorphism $T : K \to K$ then there exists an endomorphism $\tilde{T} : K \to K$ close to T such that every orbit is finally periodic. We also prove that given a homeomorphism $T : K \to K$ then there exists a homeomorphism $\tilde{T} : K \to K$ close to T such that every orbit converges to a periodic orbit. In particular, we have shown, in both cases, that all ergodic measures have support on periodic orbits.

Vicent Pit
UNICAMP, Brazil

Title: *Ruelle operator duality for smooth coupled Markov maps of the circle*

Abstract: We present how one can construct an explicit duality between eigenfunctions and eigendistributions of the Ruelle operators associated with two smooth expanding Markov maps of the circle coupled by a Baker-like map. This setting has been inspired by the left and right Bowen-Series maps associated with even corners fundamental domains for hyperbolic surfaces of finite volume.

Isabel Lugão Rios
Fluminense Federal University, Brazil

Title: *Uniqueness of equilibrium states for a family of partially hyperbolic systems*

Abstract: In this work we study a family of partially hyperbolic horseshoes introduced in [1]. In [2], the authors proved the existence of equilibrium states for the diffeomorphisms F in this family, associated to continuous potentials. They also proved the existence of a spectral gap associated to the central Lyapunov exponents, and that, for a positive value of t_0, the smooth potencial $t_0 \log ||DF|_{E^c}||$ admits at least two equilibrium states. Here we prove the uniqueness of equilibrium states for the class of Holder-continuous potentials with small variation, which includes $t_0 \log ||DF|_{E^c}||$, for small values of t. Jointly with Jaqueline Siqueira Rocha.

References:
[1] L. J. Díaz, V. Horita, M. Sambarino and I. Rios. *Destroying horseshoes via heterodimensional cycles: generating bifurcations inside homoclinic classes.* Ergod. Th. and Dynamical Systems. **29**, (2009) 433-474.
[2] R. Leplaideur, K. Oliveira and I.Rios. *Equilibrium States for partially hyperbolic horseshoes.* Ergod. Th. and Dynamical Systems. **31** (2011)1 79-195.

Albert Fisher
University of São Paulo, Brazil

Title: *Finite and infinite invariant measures for adic transformations*

Abstract: We study invariant Borel measures for nonstationary adic transformations with bounded alphabets. First we reduce to the well-understood primitive case by means of a nonstationary version of the Frobenius decomposition into communicating states. We next find an appropriate notion of distinguished eigenvector sequence and prove a nonstationary Frobenius-Victory theorem. Lastly we classify the measures which are finite positive on the path space of some sub-Bratteli diagram: we give necessary and sufficient criteria for the measures to be finite, infinite but finite on some open set, and infinite on every nonempty open set. These results extend work of Bezuglyi, Kwiatkowski, Medynets and Solomyak.

We apply this analysis to a naturally occurring example: nested circle rotations. This is joint with Marina Talet of the University Aix-Provence.

Tom Kempton
Utrecht University, Holanda

Title: *Zero Temperature Limits for Countable Markov Shifts*

Abstract: An effective way of doing ergodic optimization is the so called 'zero temperature limits' approach. In this talk we discuss zero temperature limits of Gibbs measures associated to Markov locally constant potentials over countable alphabet Markov shifts. We prove that the sequence of Gibbs measures converges as temperature goes to zero, generalising work of Bremont which dealt with the finite alphabet case.

Eduardo Garibaldi
UNICAMP, Brazil

Title: *Minimizing measures and minimizing configurations on lattice spin systems*

Abstract: For bounded spin systems with long-range translation-invariant interactions, we show that translation-invariant probability measures that minimize the average of the contribution to energy from the neighborhood of the origin are exactly those whose support lies on the set of minimizing configurations (or ground states). This is a joint work with Philippe Thiuellen (Université de Bordeaux).

Krerley Oliveira
Federal University of Alagoas, Brazil

Title: *Uniqueness of Non-lacunary Gibbs Measures: the non-uniformly expanding case*

Abstract: General conditions to obtain existence and uniqueness of equilibrium states and Gibbs measures are not known beyond uniform expanding/hyperbolic setting. In this talk, we discuss a point of view to treat maps such that equilibrium states are hyperbolic measures. One could ask if under reasonable conditions, among hyperbolic measures with the same number of positive and negative Lyapunov exponents, there exists an unique equilibrium measure?

We give an affirmative answer for the previous question for the case of measures with only positive Lyapunov exponents. For a continuous map f and potential f with total pressure of the set of points with infinitely many hyperbolic times admits at most one equilibrium measure, provided that f has some expanding conformal measure. Moreover, to prove this, we develop an non-uniform version of the Ruelle-Perron-Frobenius Theorem and we show that if, in addition, f is transitive and f has a conformal measure with infinitely many hyperbolic times, then there exists at most one unique equilibrium measure, which is absolutely continuous with respect to a non-lacunary Gibbs measure. Finally, we obtain the existence of this equilibrium measure, assuming that the pressure of the points with infinitely many times is bigger than the pressure of its complement.

Benito Pires
University of São Paulo, Brazil

Title: *Asymptotically periodic piecewise contractions of the interval*

Abstract: We study the asymptotical behavior of iterates of piecewise contractive maps of the interval. We say that a map $f : [0,1) \to [0,1)$ is a *piecewise contraction* (*PC*) *of* n *intervals* if there exist $0 \leq \lambda < 1$ and a partition of $[0,1)$ into n intervals $I_1, I_2, \ldots, I_n$ such that $f|_{I_i}$ is λ-Lipschitz for every $1 \leq i \leq n$. We prove that for a generic injective PC f of n intervals, there exist at least one and at most n stable periodic orbits $\gamma_1, \gamma_2, \ldots, \gamma_r$ of f such that $\omega(x) \in \{\gamma_1, \gamma_2, \ldots, \gamma_r\}$ for every $x \in [0,1)$, where $\omega(x)$ denotes the ω-limit set of x. In particular, a generic injective PC of n intervals is asymptotically periodic.

Piecewise contractions arise as Poincaré maps of many systems such as: traffic control systems, queueing theory, outer billiards and Cherry flows.

Joint work with Arnaldo Nogueira and Rafael Rosales.

FRIDAY, DECEMBER 13

Paulo Varandas
University of Bahia, Brazil

Title: *Decay of correlations for flows and limit theorems for time-1 maps*

Abstract: The study of the decay of correlations for flows and the statistical properties of the time-1 map turned out to be much harder than the corresponding ones for discrete time dynamical systems. In fact,even in the uniformly hyperbolic setting, it is known not only that Axiom A flows may have arbitrary slow decay of correlations as the time-1 maps are (strongly) partially hyperbolic, a class of maps for which the ergodic theory is not completely known. Other important class of flows are given by the geometric Lorenz attractor where there regular and singular behavior coexists. In this talk we describe that every geometric Lorenz attractor has superpolynomial decay of correlations with respect to the unique SRB measure and that the Central Limit Theorem and Almost Sure Invariance Principle for the time-1 map of the flow of geometric Lorenz attractors does hold. If the time permits we will also discuss some future perspectives. This will be based on joint works with V. Araujo, O. Butterley and I. Melbourne.

Diego Marcon Farias
Federal University of Rio Grande do Sul, Brazil

Title: *Weak KAM and Aubry-Mather theories for optimal switching problems*

Abstract: There is a deep connection between the classical calculus of variations problem and aspects of weak KAM and Aubry-Mather theories. Such formulation is a combination of results that have been introduced by P.L. Lions, G. Papanicolaou, S.R.S. Varadhan, A. Fathi, J. Mather, R. Mañé, among others. We extend a number of concepts of this known theory to the case where an optimal switching system is considered. Roughly speaking, an optimal switching problem consists of finding trajectories of a system whose dynamics can be conveniently modified by switching between different settings or "modes", in order to minimize an action functional. We mainly consider two issues: the analysis of the calculus of variations problem and the study of a generalized weak KAM-type theorem for solutions of a weakly coupled systems of Hamilton–Jacobi equations. Our results include the existence and regularity of action minimizers as well as necessary conditions for minimality, and an extension of Fathi's weak KAM theorem. These can be applied to obtain the long time behavior of solutions of the time-dependent system.

Dominik Kwietniak
Jagiellonian University in Krakow, Poland

Title: *When is a simplex of invariant measures the Poulsen simplex?*

Abstract: We introduce two topological conditions sufficient for the set of invariant measures of a compact dynamical system to be the Poulsen simplex. These conditions generalize the periodic specification property used previously to obtain the same conclusion. They are fulfilled for example by all beta-shifts, all S-gap shifts and many other systems. They also imply that every invariant measure has a generic point. Time permitting some examples illustrating our methods will be included. These will allow a comparison with other specification-like properties introduced recently. This is a joint work with Katrin Gelfert (UFRJ).

Edson Vargas
University of São Paulo, Brazil

Title: *Invariant measures for Cherry flows*

Abstract: We investigate the invariant probability measures for Cherry flows, i.e. flows on the two-torus which have a saddle, a source, and no other fixed points, closed orbits or homoclinic orbits. In the case when the saddle is dissipative or conservative we show that the only invariant probability measures are the Dirac measures at the two fixed points, and the Dirac measure at the saddle is the physical measure. In the other case we prove that there exists also an invariant probability measure supported on the quasi-minimal set, we discuss some situations when this other invariant measure is the physical measure, and conjecture that this is always the case. The main techniques used are the study of the integrability of the return time with respect to the invariant measure of the return map to a closed transversal to the flow, and the study of the close returns near the saddle.

Jérôme Los
Aix Marseille Université, France

Title: *Markov partitions for geometric presentations of surface groups*

Abstract: The talk will describe a new construction of Markov partitions for surface groups for each presentation in a natural class called geometric and does not use the structure of the hyperbolic plan. The idea that such maps exist goes back to Bowen and Series, the construction uses only the presentation. As a consequence of the construction the volume entropy of such presentations becomes computable.