

Brazilian Operator Algebras Symposium (BOAS)



The Boa Constrictor is a large, heavy-bodied species of snake. It is a member of the Boidae family found in Central America, South America and some islands in the Caribbean. (Un)fortunately it is not seen around Florianópolis often. ;-)

University of Santa Catarina

Florianópolis, Brazil

31 January – 4 February, 2011

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Workshop Organizers:
Alcides Buss, Ruy Exel
Daniel Gonçalves and Danilo Royer

Brazilian Operator Algebras Symposium

Schedule of Talks

Talks altered since schedule was printed are shown in yellow

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30AM	9:20AM	Thierry Giordano Around Orbit Equivalence	<p style="text-align: center;">Excursion to Anhatomirim Island (May be moved to Thursday in case of bad weather)</p>	Thierry Giordano Around Orbit Equivalence	Thierry Giordano Around Orbit Equivalence
9:30AM	10:20AM	Alcides Buss Proper actions of groups on C^* -algebras		Alcides Buss Proper actions of groups on C^* -algebras	Alcides Buss Proper actions of groups on C^* -algebras
10:20AM	10:50AM	Coffee		Coffee	Coffee
10:50AM	11:40AM	Gilles De Castro Iterated function systems, Ruelle operators and KMS states		Fernando Abadie Globalizations of partial actions	James Mingó A Graph of Matrices
11:40AM	1:20PM	Lunch		Lunch	Lunch
1:20PM	2:10PM	Michael Dokuchaev The interaction between partial projective representations and partial actions		Siegfried Echterhoff The classification of noncommutative 2-spheres	Nicolas Monod Littlewood and large forests
2:20PM	3:10PM	Pinhas Grossman Morita equivalences of the Hagerup fusion categories		Artur Lopes Thermodynamic formalism, entropy and transport	John Phillips TBA
3:20PM	3:50PM	Boris Novikov Total factor sets of partial projective group representation		Wadii Hajji Representation of compact inverse semigroups	Charles Starling Finite group actions on aperiodic tilings
3:50PM	4:30PM	Coffee		Coffee	Coffee
4:30PM	5:20PM	Michel Hilsum Invariance of the Gobbillon - Vey map of foliation C^* -algebras with respect to absolutely continuous foliated map		Martin Argerami Injective envelopes and local multipliers of some non-trivial continuous-trace C^* -algebras	Jean Renault When are bounded cocycles coboundaries?
5:30PM	6:00PM	Damián Ferraro C^* -Algebras Induced by Partial Actions	Laura Marti Perez A continuous Fourier algebra for a locally compact groupoid	Gerardo Morsella Locality of nets of von Neumann algebras coming from massless scattering models	

Welcome Cocktail, 7:30pm

Conference Dinner, Churrascaria Ataliba,
Av. Beira Mar Norte, 5050, 8:00pm,
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ABSTRACTS OF MINI-COURSES BY PRINCIPAL SPEAKERS

Proper actions of groups on C^* -algebras

Alcides Buss
Florianopolis

We are going to give an overview of some definitions of proper actions of groups on C^* -algebras available in the literature. Starting by recalling the classical definition of proper group actions on spaces, we can then immediately define Kasparov's notion of proper actions, which is closely related to spectrally proper actions. We also recall Thompsen's definition of K -properness and relate it to Rieffel's integrable actions via an equivariant version of Kasparov's Stabilization Theorem proved by Meyer using ideas of Mingo and Phillips for compact groups. We mainly focus on continuously integrable actions, a notion of proper action introduced by Rieffel which is slightly stronger than integrability and is exactly what one needs to define generalized fixed point algebras, a noncommutative version of the orbit space.

Around Orbit Equivalence

Thierry Giordano
Ottawa

In 1959, H. Dye introduced the notion of orbit equivalence and proved that any two ergodic finite measure preserving transformations on a Lebesgue space are orbit equivalent (OE). One year later, he also conjectured that an arbitrary ergodic action of a discrete amenable group is orbit equivalent to a \mathbb{Z} -action. This conjecture was proved by Ornstein and Weiss in 1980. The most general case was proved by Connes, Feldman and Weiss by establishing that an amenable non-singular countable equivalence relation \mathcal{R} can be generated by a single transformation, or equivalently, is hyper finite, i.e., \mathcal{R} is up to a null set a countable increasing union of finite equivalence relations.

In 1976, Krieger associated to any ergodic non-singular transformation an ergodic \mathcal{R} -flow, the so-called associated flow and proved that two ergodic non-singular transformations are OE if and only if their associated flows are conjugate. Recall that there is a bijective correspondence between the OE class of ergodic non-singular transformations and approximately finite dimensional (AFD) von Neumann factors. In 1980, Connes and Woods introduced the new ergodic property of approximate transitivity (AT) and proved that the von Neumann factors associated to an ergodic non-singular transformations T is an Araki-Woods factor if and only if the associated flow of T is AT.

In my lectures, I will give an overview of these results in the measurable case and present constructions of AT-transformations, before introducing the concept of orbit equivalence in topological dynamics. In 1995, Giordano, Putnam and Skau proved that minimal \mathbb{Z} -actions on the Cantor set were orbit equivalent to approximately finite (AF) relations and their classification was given. After having defined approximately finite (AF) relations and presented their classification, I will indicate the main steps of the proof of the following result obtained in a joint effort with H. Matui, I. Putnam and C. Skau: *Minimal free actions of \mathbb{Z}_n on the Cantor set are a stable (i.e., orbit equivalent to AF- relations).*

ABSTRACTS OF INVITED LECTURES

(In order of presentation)

MON 10:50AM

Iterated Function Systems, Ruelle Operators and KMS States

Gilles de Castro

UFSC

Iterated function systems (IFS) started within the theory of fractals and many known simple examples of fractals can be constructed from such systems. To an IFS, Kajiwara and Watatani associated a C^* -algebra via a Cuntz-Pimsner construction. Later, in a joint work with Izumi, they showed how the branched points are reflected in the structure of KMS states for the gauge action. For other C^* -algebras associated with dynamical systems, it is known that the KMS states are closely related to the eigenmeasures of a Ruelle operator. In this talk, we show that the KMS states, whose action comes from a potential, of the algebra associated to an IFS comes both from the eigenmeasures of a Ruelle operator and from the branched points.

MON 01:20PM

The interaction between partial projective representations and partial actions

Michael Dokuchaev

Universidade de São Paulo

Partial representations were introduced in the theory of C^* -algebras by R. Exel [E2] and J. Quigg and I. Reaburn [QR] as an important working tool when dealing with algebras generated by partial isometries on a Hilbert space. This concept is intimately related to that of a partial action (see [E2], [ELQ] and [DEone]). Twisted partial actions of locally compact groups on C^* -algebras were introduced by R. Exel in [E1], serving the general construction of C^* -crossed products, whereas the definition of a partial action of an abstract group on a set was given by R. Exel in [E2]. Since then, several relevant classes of C^* -algebras have been described as crossed products by partial actions [ELQ], and, moreover, the algebraic study of partial actions and abstract crossed products is becoming an actively studied topic [D]. In the classical example of a crossed product the twisting is a 2-cocycle of the Galois group, so it is natural to wonder if there exists an adequate cohomological theory, which would agree with the twisting, incorporated in partial crossed products.

The first step in this direction was done in [DN]. It is a basic fact that factor sets of projective representations of groups are 2-cocycles. Taking this idea as a starting point, partial projective representations of groups were defined in [DN] and developed up to a comparison of their factor sets with the partial twistings. The interaction with partial actions came into the picture naturally. The theory was further developed in our recent preprint with B. Novikov [D], and we are going to give some details on the above mentioned interaction communicating a part of the results from [DN] and [DN2].

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- [D] M. Dokuchaev, Partial actions: a survey, *Contemp. Math.* (to appear).
- [DE1] M. Dokuchaev and R. Exel, Associativity of crossed products by partial actions, enveloping actions and partial representations, *Trans. Amer. Math. Soc.* **357**, (5), (2005), 1931-1952.
- [DN] M. Dokuchaev, B. Novikov, Partial projective representations and partial actions, *J. Pure Appl. Algebra* **214**, (2010), 251-268.
- [DN2] M. Dokuchaev, B. Novikov, Partial projective representations and partial actions II, *Preprint*.

- [E1] R. Exel, Twisted partial actions: a classification of regular C^* -algebraic bundles, *Proc. London Math. Soc.* **74** (3) (1997), 417 - 443.
- [E2] R. Exel. Partial actions of groups and actions of semigroups. *Proc. Amer. Math. Soc.*, **126**, (12), (1998), 3481-3494.
- [ELQ] R. Exel, M. Laca, J. Quigg, Partial dynamical systems and C^* -algebras generated by partial isometries, *J. Operator Theory* **47** (2002), (1), 169-186.
- [QR] J. C. Quigg, I. Raeburn, Characterizations of Crossed Products by Partial Actions, *J. Operator Theory* **37** (1997), 311–340.

MON 02:20PM

Morita equivalences of the Haagerup fusion categories

Pinhas Grossman

IMPA

Given a finite-index, finite depth subfactor, there are associated two unitary fusion categories and a Morita equivalence between them. It is natural to ask: what are all the unitary fusion categories that are Morita equivalent to these two, and what are all the Morita equivalences between them? We answer these and related questions in the case of the Haagerup subfactor, which is the finite depth subfactor with the smallest index strictly larger than 4. In particular, we find that there is a third unitary fusion category with the same fusion ring as the noncommutative Haagerup category but which is inequivalent as a fusion category. This is joint work with Noah Snyder.

MON 03:20PM

Total factor sets of partial projective group representations

Boris Novikov

Kharkov National University

In an joint article with M. Dokuchaev [DN] we have defined partial projective representations of groups and a Schur multiplier for them. Moreover, we have shown that the (partial) Schur multiplier of a group G is a semilattice $C(G)$ of Abelian groups where $C(G)$ consists of some subsets of $G \times G$. The component of the (partial) Schur multiplier, which corresponds to the element $G \times G \in C(G)$, is of special interest. In the talk we shall give a complete description of this component, obtained in a recent preprint [DN2].

BIBLIOGRAPHY:

- [DN] M. Dokuchaev, B. Novikov, Partial projective representations and partial actions, *J. Pure Appl. Algebra* **214**, (2010), 251–268.
- [DN2] M. Dokuchaev, B. Novikov, Partial projective representations and partial actions II, *Preprint*.

MON 04:30PM

Invariance of the Godbillon - Vey map of foliation C^* -algebras with respect to absolutely continuous foliated map

Michel Hilsum

CNRS

We shall address the topological invariance of the Godbillon-Vey map defined by A. Connes for the K-theory group of a foliation C^* -algebra, and will show the invariance for absolutely continuous map, thus solving a question of E.Ghys (1989) and extending a result of T. Natsume (1987).

MON 05:30PM

C*-Algebras Induced by Partial Actions

Damin Ferraro

Universidad de la Republica, Uruguay

In this talk we will present a generalization, to partial actions, of Raeburn's Symmetric Imprimitivity Theorem. The proof of this result is a combination of the theorem for global actions and the techniques of enveloping actions. In order to explain the interplay between these ideas, we will center our attention in the generalization of Green's theorem to partial actions.

TUE 09:30AM

Rate of escape on groupoids

Vadim Kaimanovich

University of Ottawa

This talk (based on a joint work with M. Andereg) is devoted to a discussion of the linear rate of escape for random walks on groupoids endowed with an orbitwise metric (e.g., leafwise graph metrics on graphed equivalence relations or leafwise Riemannian metrics on foliations and laminations). We generalize to this general setup recent results of Karlsson and Ledrappier obtained for random walks on groups and Brownian motion on covering manifolds.

TUE 10:50AM

Globalizations of partial actions

Fernando Abadie

Udelar, Uruguay

The restriction of a group action on a C*-algebra to a closed two-sided ideal defines a partial action of the group on that ideal. Then the former action can be thought of as a globalization of the obtained partial action. This globalization is called an enveloping action of the partial action when it satisfies a suitable condition of minimality. However, not every partial action can be described as a restriction of a global action.

In our talk we will discuss the existence and uniqueness of enveloping actions of partial actions, and the relationship between the crossed products by the partial action and its enveloping action, in case the latter does exist. The same issues will be considered for the weaker notion of Morita enveloping action. We will also indicate how the theory of enveloping actions relates to the dilations of partial group representations and to the Takai duality for partial crossed products.

TUE 01:20PM

The classification of noncommutative 2-spheres

Siegfried Echterhoff

University of Munster, Germany

The noncommutative 2-spheres are crossed products $A_\theta \rtimes F$ of the non-commutative 2-tori A_θ by finite subgroups F of $SL(2, \mathbb{Z})$. There has been quite some efforts over the last 20 years by various authors to compute the K-theory groups and give complete classification of these algebras. Now this problem has been completely solved by a combination of methods varying from the Baum-Connes conjecture for the computation of K-theory of (twisted) group algebras to the Elliott programme for the classification of simple nuclear C^* -algebras. As an outcome, we show that all non-commutative 2-spheres corresponding to irrational θ are AF-algebras (i.e., inductive limits of finite dimensional C^* -algebras). In the world of non-commutative spaces this means that irrational non-commutative spheres are totally disconnected. (Joint work with Wolfgang Luck, Chris Phillips and Sam Walters)

TUE 02:20PM

Thermodynamic Formalism, Entropy and Transport

Artur Lopes

UFRGS

In this survey talk initially we will describe briefly the main definitions and properties of Thermodynamic Formalism. We show how to define entropy without partitions. Using this approach it is possible to define entropy for a C^* -dynamical system state, to consider the Pressure problem, and to relate all this to KMS states (joint work with G. Castro).

We also introduce a new definition of "stationary" entropy for Quantum Iterated Function Systems (a generalization of the one in the Stinespring-Kraus form) acting on complex finite dimensional density matrices and we also consider the Pressure problem (joint work with A. Baraviera, C. F. Lardizabal and M. Terra Cunha). This definition of entropy generalizes the usual one for Kolmogorov entropy. Returning to the classical Thermodynamic Formalism we introduce the involution kernel for finite temperature and we consider the limit of Gibbs states when temperature goes to zero.

Finally, we describe a transport problem for the cost given by the involution kernel and we present a Kantorovich duality result (joint work with E. Oliveira and P. Thieullen).

TUE 03:20PM

Representation of compact inverse semigroups

Wadii Hajji

University of Ottawa

W. D. Munn proved that a finite dimensional representation of an inverse semigroup is equivalent to a partial unitary representation if and only if it is bounded. The first goal of this talk will be to give new analytic proof that every finite dimensional representation of a compact inverse semigroup is equivalent to a partial unitary representation.

The second goal is to parameterize all finite dimensional irreducible representations of a compact inverse semigroup in terms of maximal subgroups and order theoretic properties of the idempotent set. As a consequence, we obtain a new and simple proof of the following theorem of Shneperman: a compact inverse semigroup has enough finite dimensional irreducible representations to separate points if and only if its idempotent set is totally disconnected.

TUE 04:30PM

Injective envelopes and local multipliers of some non-trivial continuous-trace C*-algebras

Martin Argerami
University of Regina

We discuss the injective envelope and local multiplier algebra of a continuous trace C*-algebra A that arises from a continuous Hilbert bundle over an arbitrary locally compact Hausdorff space. In addition, we show that the second-order local multiplier algebra $M_{\text{loc}}^{[2]}(A)$ of any such algebra A is injective.

TUE 05:30PM

A continuous Fourier Algebra for a locally compact groupoid.

Laura Martí Pérez
University of Waterloo

If G is a locally compact groupoid, we define a continuous Fourier algebra $A(G)$. We prove that, for a class of transitive groupoids that includes the r -discrete and locally trivial ones, $A(G)$ is isometrically isomorphic to the Haagerup tensor product of spaces of continuous functions on the unit space of G and the Fourier algebra of the isotropy group of G . This allows us to consider an operator space structure on $A(G)$.

THU 10:50AM

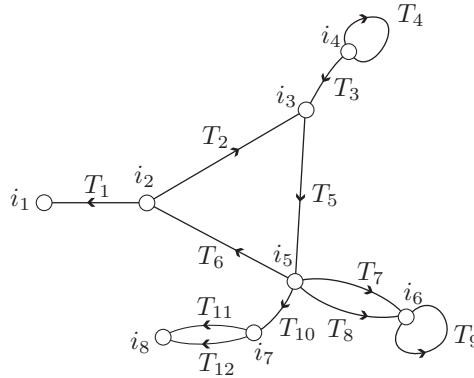
A Graph of Matrices

James A. Mingo
Queen's University

Let $G = (E, V)$ be a graph and T a map from E to the $N \times N$ matrices. We write the matrix elements of $T(e)$ as $\{t_{ij}^{(e)}\}$ and let

$$S_G(T) = \sum_{i:V \rightarrow [N]} \prod_{e \in E} t_{i_s(e) i_t(e)}^{(e)}$$

where i runs over all functions from V to $[N] = \{1, 2, 3, \dots, N\}$. For example if the graph G is



the corresponding sum is

$$S_G(T) = \sum_{i_1, i_2, \dots, i_8=1}^N t_{i_1 i_2}^{(1)} t_{i_3 i_2}^{(2)} t_{i_3 i_4}^{(3)} t_{i_4 i_4}^{(4)} t_{i_5 i_3}^{(5)} t_{i_2 i_5}^{(6)} t_{i_6 i_5}^{(7)} t_{i_6 i_5}^{(8)} t_{i_6 i_6}^{(9)} t_{i_7 i_5}^{(10)} t_{i_8 i_7}^{(11)} t_{i_8 i_7}^{(12)}$$

The question we wish to address is the dependence of $S_G(T)$ on N , which as we shall show has a surprisingly simple answer. We shall present applications to random matrices. This is joint work with Roland Speicher.

THU 01:20PM

Littlewood and large forests

Nicolas Monod
EPFL, Switzerland

Motivated by a classical result of Sz.-Nagy in functional analysis, Dixmier asked in 1950 which group representations can be made unitary. This question is still open, but I will report on some progress obtained with Epstein and Ozawa. We approach the question with ideas borrowed from XIXth century electricity theory as well as from contemporary percolation theory. As a result, we obtain notably non-unitarizable representations for Burnside groups and a new characterization of amenability. The talk will be expository.

THU 02:20PM

Title to be announced

John Phillips
Victoria

Abstract to be announced.

THU 03:20PM

Finite group actions on Aperiodic Tilings

Charles Starling
University of Ottawa

Putnam, Kellendonk and others have studied the C^* -algebras arising from aperiodic tilings, for example the Penrose tiling. Such tilings usually exhibit some rotational symmetries. We examine the actions finite symmetry groups on these algebras and contrast the cases where the action is more or less free to when it is not.

THU 04:30PM

When are bounded cocycles coboundaries?

Jean Renault
Université de Orleans

There are a number of results which say that, under suitable hypotheses, cocycles which are bounded are necessarily coboundaries. One of the earliest such result in topological dynamics is the Gottschalk-Hedlund theorem. One of the most recent is due to Bader-Gelander-Monod. I shall review these results in the framework of continuous cocycles on locally compact groupoids.

THU 05:30PM

Locality of nets of von Neumann algebras coming from massless scattering models

Gerardo Morsella
Mathematics Department, Tor Vergata University of Rome

We discuss the construction of 2d chiral nets of von Neumann algebras associated to models of massless particles with a factorizing S-matrix. The existence of local observables in these models amounts to the question whether certain relative commutants are trivial or not. We show that this question can be solved through the study of the analytic properties of suitable matrix elements ("form factors") of such local observables. (Joint work with H. Bostelmann, C. D'Antoni and G. Lechner)

FRI 10:50AM

Purely infinite C*-algebras arising as crossed products by exact non-amenable groups

Mikael Rordam

University of Copenhagen

We discuss conditions that will ensure that a crossed product of a C*-algebra by a discrete exact group is purely infinite (simple or non-simple). We are particularly interested in the case of a discrete non-amenable exact group acting on a commutative C*-algebra, where our sufficient conditions for example can be phrased in terms of paradoxicality of subsets of the spectrum of the abelian C*-algebra. As an application of our results we show that every discrete countable non-amenable exact group admits a free amenable minimal action on the Cantor set such that the corresponding crossed product C*-algebra is a Kirchberg algebra in the UCT class. (Joint work with Adam Sierakowski.)

FRI 01:20PM

Toeplitz flows and their K-theory

Christian Skau

Norwegian University of Science & Technology(NTNU)

Toeplitz flows are a family of Cantor minimal dynamical systems that have been extensively studied in topological dynamics. They are in a sense the simplest Cantor minimal systems beyond the odometer systems, to which they are related in an explicit way. By looking at the associated C*-crossed products and their K-theory, a new and fruitful approach was introduced in the study of Toeplitz flows. Besides giving new proofs of earlier results known about these systems, the K-theoretic approach brought about an entirely new perspective, which in turn led to new results. We will give a survey of all this.

FRI 02:20PM

Spectral triples associated with hyperbolic dynamical systems

Michael Whittaker

University of Wollongong

In this talk I will define spectral triples on hyperbolic dynamical systems known as Smale spaces. The summability of one of these spectral triples is shown to recover the topological entropy of the Smale space itself.

I will give an introduction to Smale Spaces and their associated C*-algebras. I plan to concentrate on a specific example and no background in dynamics is necessary. Spectral triples will be introduced along with some accompanying definitions and examples. Finally, a type of metric on equivalence classes of a Smale space is defined, which gives rise to spectral triples.

FRI 03:20PM

Amenability and property (T) for non locally compact topological groups

Vladimir Pestov

University of Ottawa

This is a survey of the two major properties mentioned in the title beyond the locally compact case, including recent results and open problems.