The 17th Danish-Norwegian OA Workshop

January 5-8, 2017, Lysebu

Sponsored by the Foundation for Danish-Norwegian Co-operation

Program

Thursday, January 5

11.30-12.00 – Arrival

12.00-13.00 – Lunch

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13.45-13.55 – Welcome and practical information

13.55-14.25 **Wojciech Szymanski**: *On conjugacy of MASAs in the Cuntz algebras.*

14.35-15.05 **Selçuk Barlak**: *Cartan subalgebras and the UCT problem.*

15.15-15.45 **Martin S. Christensen**: *When central sequence algebras do not admit characters.*

15.45-16.10 – Coffee/tea

16.10-16.40 **Maria Ramirez-Solano**: *Computational explorations of the Thompson group T for the amenability problem of F.*

16.50-17.20 **Juhani Koivisto**: *Non-amenability of hyperbolic cones and visual Gromov hyperbolic spaces.*

17.30-18.00 **Andreas Andersson**: *Interplay between complex differential geometry, operator theory and operator algebras.*

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19.00-21.00 – Dinner

Friday, January 6

07.00-09.00 – Breakfast

09.00-09.30 **Adam Sørensen**: *The complete classification of unital graph algebras.*

09.40-10.10 **Sara Arklint**: *The K-theoretical range of all Cuntz-Krieger algebras.*

10.10-10.40 – Coffee/tea

10.40-11.10 **Franz Luef**: *Metaplectic transformations and noncommutative tori.*

11.20-11.50 **Tron Omland**: *Rigidity theory for C^*-dynamical systems and the Pedersen rigidity problem.*

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12.00-13.00 – Lunch

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Friday, January 6 (ctd)

14.45-15.15 **David Kyed**: *L^2-Betti numbers of universal quantum groups.*

15.15-15.45 **Sara Malacarne**: *Noncommutative boundaries of random walks on $c_0(\Gamma) \rtimes C^*(K)$.*

15.45-16.10 – Coffee/tea

16.10-16.40 **Johannes Christensen**: *Diagonality of KMS weights.*

16.50-17.20 **Nicolai Stammeier**: *The role of distinguished subsemigroups for right LCM semigroups and their C^*-algebras.*

17.30-18.00 **Benjamin R. Johannesen**: *The core of C^*-algebras associated with circle maps.*

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19.00-21.00 – Dinner

Saturday, January 7

07.00-09.00 – Breakfast

09.00-09.40 **Trond Digernes**: *Physics and stochastics over local fields.*

Special Session – Remembering Ola

09.50-10.35 **George Elliott**: *Ola Bratteli—the classification legacy.*

10.35-11.05 – Coffee/tea

11.05-11.50 **Derek Robinson**: *Bratteli–Robinson 1974–2014.*

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12.00-13.00 – Lunch

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15.00-15.45 **Akitaka Kishimoto**: *Approximately inner derivations.*

15.45-16.15 – Coffee/tea

16.15-17.00 **David Evans**: *Ola and Orbifolds.*

17.10-17.55 **Palle Jorgensen**: *Representations of the Cuntz algebras, and some of their applications: Harmonic analysis of wavelets and fractals.*

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19.00-21.00 – Dinner

Sunday, January 8

07.00-09.00 – Breakfast

09.00-10.00 – Departure

Danish-Norwegian OA Workshop, Jan. 5-8, 2017 – Participants

Erik Alfsen (University of Oslo)
Andreas Andersson (University of Oslo)
Sara Arklint (University of Copenhagen)
Selçuk Barlak (University of Southern Denmark, Odense)
Erik Bédos (University of Oslo)
Kevin Aguyar Brix (University of Copenhagen)
Rasmus S. Bryder (University of Copenhagen)
Toke Meier Carlsen (University of the Faroe Islands)
Chris Cave (University of Copenhagen)
Johannes Christensen (University of Aarhus)
Martin Christensen (University of Copenhagen)
Trond Digernes (NTNU, Trondheim)
Søren Eilers (University of Copenhagen)
George Elliott (University of Toronto)
Ulrik Enstad (University of Oslo)
David E. Evans (University of Cardiff)
Olivier Gabriel (University of Copenhagen)
Jeong Hee Hong (Korea Maritime and Ocean University)
Benjamin R. Johannesen (University of Aarhus)
Palle Jorgensen (University of Iowa)
Jens Kaad (University of Southern Denmark, Odense) [1]
Akitaka and Reiko Kishimoto (Hokkaido University)
Juhani Koivisto (University of Southern Denmark, Odense)
David Kyed (University of Southern Denmark, Odense)
Nadia S. Larsen (University of Oslo)
Magnus B. Landstad (NTNU, Trondheim)
Franz Luef (NTNU, Trondheim)
Sara Malacarne (University of Oslo)
Magdalena Musat (University of Copenhagen)
Ryszard Nest (University of Copenhagen)
Petter Nyland (NTNU, Trondheim)
Tron Omland (University of Oslo)
Eduardo Ortega (NTNU, Trondheim)
Vibeke Quorning (University of Copenhagen)
Maria Ramires-Solano (University of Southern Denmark, Odense)
Gunnar Restorff (University of the Faroe Islands)
Derek Robinson (Australian National University)
Mikael Rørdam (University of Copenhagen)
Eduardo P. Scarparo (University of Copenhagen)
Christian Skau (NTNU, Trondheim)
Nicolai Stammeier (University of Oslo)
Erling Størmer (University of Oslo)
Wojciech Szymanski (University of Southern Denmark, Odense)
Adam Sørensen (University of Oslo)
Klaus Thomsen (University of Aarhus)
Steen Thorbjørnsen (University of Aarhus)
Lars Tuset (Oslo and Akershus University College)

[1] Jens Kaad ble dessverre syk; han ble erstattet av **Dorte Olesen** (Denmark's Techn. Univ.) som kom på fredag.

Danish-Norwegian Workshop Jan. 5-8, 2017 – Speakers, titles and abstracts

Andreas Andersson (University of Oslo):

Interplay between complex differential geometry, operator theory and operator algebras.

Operator theory on bounded domains in the unit ball of $\mathbb{C}^n$ is known to be related to projective algebraic geometry. Here we extend this connection to complex differential geometry by involving $*$-structures and we use operators on Fock space to construct useful operator algebras. It has been known for a long time that the C^*-algebra $C(M)$ of continuous functions on a projective complex-analytic manifold M can be quantized in an approximate sense. We show how to obtain $C(M)$ exactly as a C^*-algebra using generalized inductive and projective limits, in a way which depends on the complex-analytic structure and some additional geometric data. Similarly, vector bundles over M have been known to be approximately quantizable, but we observe that there is an obstruction to quantizing them exactly as projective modules over the algebra $C(M)$. Quantization works to different extents depending on the stability properties of the vector bundle. We observe that slope-stable vector bundles are those which come from Hilbert modules over a type II_1 von Neumann algebra constructed in the above-mentioned operator-theoretic setting.

Sara Arklint (University of Copenhagen):

The K-theoretical range of all Cuntz-Krieger algebras.

In 2006, Restorff showed that the class of purely infinite Cuntz-Krieger algebras are classified by reduced filtered K-theory, and Eilers-Restorff-Ruiz-Sørensen have now extended the result to all Cuntz-Krieger algebras (even all unital graph C^*-algebras) by augmenting the order of the K_0-groups to Restorff's invariant.

I will describe the range of Cuntz-Krieger algebras (and unital graph C^*-algebras) under these invariants, thus completing the classification, and will note how in the purely infinite case this gives a new characterization of the Cuntz-Krieger algebras.

This is joint work with Bentmann and Katsura.

Selçuk Barlak (University of Southern Denmark, Odense):

Cartan subalgebras and the UCT problem.

The question whether every separable, nuclear C^*-algebra satisfies Rosenberg-Schochet's UCT is a major open problem in C^*-algebra theory. Currently, renewed interest arises from the recent breakthrough results in the classification program for separable, simple, nuclear C^*-algebras, where the UCT plays a rather mysterious role. This talk deals with the connection between the UCT problem and Cartan subalgebras, that is, MASAs admitting a conditional faithful expectation and generating the ambient C^*-algebra in a suitable sense. Using remarkable results of Renault and Tu, separable, nuclear C^*-algebras with Cartan subalgebras are shown to satisfy the UCT. By combining this with Izumi's seminal work on finite group actions with the Rokhlin property on the Cuntz algebra $\mathcal{O}_2$, the UCT problem turns out to be linked to Cartan subalgebras and finite order automorphisms of $\mathcal{O}_2$. This is joint work with Xin Li.

Martin S. Christensen (University of Copenhagen):

When central sequence algebras do not admit characters.

In a recently published paper, Kirchberg and Rørdam asked whether a unital, separable C^*-algebra A absorbs the Jiang-Su algebra tensorially if and only if the central sequence algebra of A does not admit characters. In this talk I will motivate this question, and explain how it connects to questions posed by Dadarlat–Toms and Ozawa. Furthermore, I will explain

how the central sequence algebra of A relates to the Cuntz semigroup $\mathrm{Cu}(A)$ and how this relation can be used to show that many of the known examples of C^*-algebras which do not absorb the Jiang-Su algebra tensorially do in fact admit characters on their central sequence algebras. Time permitting, I will also discuss permanence properties of the class of separable C^*-algebras A whose central sequence algebra does not admit characters.

Johannes Christensen (University of Aarhus):

Diagonality of KMS weights.

For the C^*-algebra of a locally compact groupoid we can obtain a one-parameter action from a continuous real-valued groupoid homomorphism using a canonical procedure introduced by Renault. We call these one-parameter actions *diagonal*. It follows from a result of Neshveyev that when a KMS state exists for a diagonal action there will in many cases also be one which is given by a measure on the unit space. If a state or a weight is given like this we call it *diagonal*. In this talk I will prove that in many cases a diagonal KMS weight exists for a one-parameter action if and only if the action is diagonal. This is joint work with Klaus Thomsen.

Trond Digernes (NTNU, Trondheim):

Physics and stochastics over local fields.

We will give a brief review of physical models over local fields, and illustrate the use of non-Archimedean stochastics in connection with finite approximations of such models.

George Elliott (University of Toronto):

Ola Bratteli—the classification legacy.

Glimm and Dixmier had discovered the exciting phenomenon of (stably) UHF classification (smooth in Glimm's case, non-smooth in Dixmier's non-unital case), but it was Bratteli who threw open the whole panoply of AF algebra behaviour, a microcosm of the operator algebra world—soon to be reflected in the amazing development of the classification of AF (= amenable) von Neumann algebras—and, over the next half century, in the emergence of an almost mirror classification of (non-AF!) amenable (= nuclear) C*-algebras—so far, just the well-behaved case of finite nuclear dimension, and mainly simple C*-algebras.

David E. Evans (University of Cardiff):

Ola and Orbifolds.

Orbifolds are now ubiquitous in operator algebras. I will discuss the early work in the late 1980's on non-commutative spheres or toroidal orbifolds with Aki, Ola and George, following the breakthrough of Bruce Blackadar of the discovery of a symmetry on the Fermion algebra with non AF fixed point algebra. This has led to orbifold phenomenona across operator algebras including subfactors and applications in conformal quantum field theory and underlying statistical mechanics.

Benjamin R. Johannesen (University of Aarhus):

The core of C-algebras associated with circle maps.*

We consider a sub-C*-algebra of the C*-algebra of an amended transformation groupoid of a continuous self-map on the unit circle which is not necessarily a local homeomorphism. This is quite a mouthful, but all the individual components will be explained. I will present some of the main results obtained for these C*-algebras and emphasise their impact through certain examples. The talk will be focused on a class of circle maps for which we can take the complete journey. This is based on joint work with Thomas Schmidt and Klaus Thomsen.

Palle Jorgensen (University of Iowa):

Representations of the Cuntz algebras, and some of their applications: Harmonic analysis of wavelets and fractals.

We study systems of non-commuting operators and representation theory arising in certain applications, in particular in the theory of sub-band filters from signal processing. The reported developments initiate with work by the speaker and Ola Bratteli, and starting with families of representations of the Cuntz algebras $\mathcal{O}_N$. We further give an account of new research dealing with applications to a class of filter problems (including the study of fractals, and geometric measure theory). By their nature, these representations reflect intrinsic selfsimilar features inherent in the problems at hand; for example, similarity up to scale. Thus they serve ideally to encode iterated function systems (IFSs), their dynamics, and their measures, as they arise in the theory of non-linear dynamics. At the same time, the $\mathcal{O}_N$-representations offer new insights into analysis of signals and signal processing: these families of representation have now found powerful uses in such applied problems as wavelet theory, and in fractal analysis.

A case in point: Wavelets on fractals. The fractals in question are generated by certain (fixed) finite systems of affine transformations and their iterations (hence IFS). They include standard Cantor spaces such as the middle third, and the planar Sierpinski-caskets in various forms, and their corresponding selfsimilar (maximal entropy) measures, supported on fractals and realized in $\mathbb{R}^d$. We outline a construction by the speaker and Dorin Dutkay to the effect that all these affine systems do have wavelet bases; this entails what we call thin Cantor spaces.

Akitaka Kishimoto (Hokkaido University):

Approximately inner derivations.

The first paper Ola and I wrote was on generation results pertinent to approximately inner derivations; the last we did with Derek Robinson was still on approximately inner derivations addressing a difficulty surrounding them 30 years later in 2008. I will explain them and talk on how we stuck for these years.

Juhani Koivisto (University of Southern Denmark, Odense):

Non-amenability of hyperbolic cones and visual Gromov hyperbolic spaces.

Følner's condition for amenability can be extended to all uniformly coarsely proper metric spaces. In 2000 Cao proved that a complete geodesic hyperbolic Riemannian manifold or metric graph with bounded local geometry and quasi-pole is non-amenable if its Gromov boundary consists of finitely many connected components with strictly positive diameter. We will discuss a large-scale variant of this, stating that a uniformly coarsely proper hyperbolic cone over a bounded metric space with finitely many uniformly coarsely connected components each containing at least two points is non-amenable. Using the functorial relationship between the Gromov boundary and its hyperbolisation this generalises Cao's result to all uniformly coarsely proper visual Gromov hyperbolic spaces. Time permitting, we will mention some further applications to metric measure spaces and locally compact compactly generated groups.

David Kyed (University of Southern Denmark, Odense):

L^2-Betti numbers of universal quantum groups.

I will report on a joint work with Sven Raum (EPFL) revolving around the computation of L^2-Betti numbers for universal quantum groups. We prove that the first L^2-Betti number of the discrete quantum groups dual to the free unitary quantum groups is one, and that all L^2-Betti numbers vanish for the duals of the quantum automorphism groups of full matrix algebras. All objects mentioned in the abstract will be defined (more or less rigorously) during the talk.

Franz Luef (NTNU, Trondheim):

Metaplectic transformations and noncommutative tori.

In this talk I describe extensions of the K-theory classes of Heisenberg modules over higher-dimensional noncommutative tori to projective modules over crossed products of noncommutative tori by finite cyclic groups, aka noncommutative orbifolds. The two dimensional case was treated by Echterhoff, Lueck, Phillips and Walters. The approach is based on the theory of metaplectic transformations of the representation theory of the Heisenberg group. This is joint work with Sayan Chakraborty.

Sara Malacarne (University of Oslo):

Noncommutative boundaries of random walks on $c_0(\Gamma) \bowtie C^*(K)$.

I will discuss both the Poisson and Martin boundary of random walks on the discrete quantum group $c_0(\Gamma) \bowtie C^*(K)$, for a finitely generated discrete group Γ and a finite group K, which is a simple example of the bicrossed product construction introduced by S. Majid. As the Martin boundary is defined only for random walks with Markov operator associated to a generating state, it will be shown that under this assumption both boundaries are classical not being affected by the action of the finite group K. These results are extended also to the case of Γ being a discrete quantum group.

Tron Omland (University of Oslo):

Rigidity theory for C^*-dynamical systems and the Pedersen rigidity problem.

Given a C^*-dynamical system (A, G, α), there is a dual coaction $\widehat{\alpha}$ of G on the crossed product $A \rtimes_\alpha G$. We discuss how to recover a C^*-dynamical system up to outer conjugacy from its dual coaction. Mostly, we will focus on the case where G is abelian, so that the dual coaction is just an action by the dual group $\widehat{G}$. The talk is based on joint work with Steve Kaliszewski and John Quigg.

Maria Ramirez-Solano (University of Southern Denmark, Odense):

Computational explorations of the Thompson group T for the amenability problem of F.

I will discuss how we can estimate the norm of a certain element in the complex group ring of T, considered as an operator via the left regular representation of T. By a result of U. Haagerup and K. Olesen, it follows that the value of this norm is closely related to the amenability problem of the Thompson group F. This is joint work with Uffe Haagerup and Sren Haagerup, which is a continuation of the work started in "A computational approach to the Thompson group F ", by the same authors.

Derek Robinson (Australian National University):

Bratteli–Robinson 1974–2014.

I will give some personal reflections on 40 years of collaboration with Ola with particular emphasis on the conception, writing and revision of our book on Operator Algebras and Quantum Statistical Mechanics.

Nicolai Stammeier (University of Oslo):

The role of distinguished subsemigroups for right LCM semigroups and their C^*-algebras.

I will summarize recent developments in the study of equilibrium states and K-theory for C^*-algebras associated to right LCM semigroups. The aim of this talk is to draw contours of the landscape as we currently perceive it. This will lead to a number of questions revolving around spots of uncertainty. The talk is based on joint work with Zahra Afsar, Nathan Brownlowe, and Nadia S. Larsen, and also with Selcuk Barlak and Tron Omland.

Wojciech Szymanski (University of Southern Denmark, Odense):

On conjugacy of MASAs in the Cuntz algebras.

We discuss recent results pertaining classification of MASAs in the Cuntz algebras (or, more generally, purely infinite and simple graph C*-algebras) up to inner conjugacy. The key question we are interested in is for what automorphisms α of O_n is $\alpha(D_n)$ inner conjugate to D_n, where D_n denotes the standard MASA of O_n. This in turn has bearing on the structure of the outer automorphism group of O_n. The talk is based on joint work with Roberto Conti, Tomohiro Hayashi and Jeong Hee Hong.

Adam Sørensen (University of Oslo):

The complete classification of unital graph algebras.

I will discuss recent joint work with Eilers, Restorff, and Ruiz that gives a complete classification of unital graph algebras. I will explain the progression that brought us from purely infinite Cuntz-Krieger algebras to all unital graph algebras, and the new ideas we needed for the final push.