Aperiodic Order
Ordre apériodique
(Org: **Elaine Beltaos** and/et **Nicolae Strungaru** (Grant MacEwan))

JAMES CURRIE, University of Winnipeg
A decision procedure for morphisms avoiding Abelian k-powers

Words avoiding repetitions are fundamental objects, used to build counter-examples in group theory, formal language theory, universal algebra and other areas. The concept of words avoiding *Abelian* repetitions is 50 years younger, and correspondingly less well-understood. I will present a decision procedure for testing whether the fixed point of a morphism avoids Abelian k-powers, and illustrate the use of this procedure on several classic morphisms.

GEORGE ELLIOTT, University of Toronto
The role of C-algebra K-theory in the study of the Hofstadter spectrum*

The famous Hofstadter butterfly is in fact, when viewed as a vertically moving horizontal section, a moving picture—not only of the spectrum of the Peierls operator from solid state physics, as the parameter, the magnetic field strength, varies, but also of the ordered K_0-group of the continuously varying C*-algebra naturally containing this operator. This C*-algebra, known, variously, as the rotation algebra and as the non-commutative torus, underlies the result, based on over thirty years of work—beginning with Hofstadter's discovery of the phenomenon in 1979, and ending with the recent Annals paper of Avila and Jitomirskaya—, that for all irrational values of the parameter the spectrum is a Cantor set. A very brief survey of this work will be attempted.

NATALIE FRANK, Vassar College
Fusion: a general framework for hierarchical tilings

We introduce a formalism for handling general spaces of hierarchical tilings, a category that includes substitution tilings, Bratteli-Vershik systems, S-adic transformations, and multi- dimensional cut-and-stack transformations. We explore ergodic, spectral and topological proper- ties of these spaces. Familiar properties of substitution tilings carry over under appropriate assumptions, but can fail where these assump- tions are not met. For instance, there is a 2-dimensional tiling space that has pure point measure-theoretic spectrum but is topologically weakly mixing. This is joint work with Lorenzo Sadun of the University of Texas at Austin.

JEONG-YUP LEE, Kwandong University
Algorithm for determining pure point spectrum on substitution tilings

There has been considerable interest in understanding the structures of substitution tilings which have pure point dynamical spectrum. There are a number of equivalent properties to the pure point dynamical spectrum in the setting of substitution tilings. One of the properties is "overlap coincidence" which was first introduced by Solomyak '97. In this talk, we give a computable algorithm to check the overlap coincidence and show a few interesting examples which are computed using this algorithm. This algorithm has been applied to the einstein tiling which was recently introduced by Socolar and Taylor. We present a result on dynamical spectrum of this tiling as well. This is a joint-work with Shigeki Akiyama.

ROBERT MOODY, University of Victoria
Spatial stochastic processes and the inverse problem in pure point diffraction.

The fundamental problem in the theory of diffraction is the inverse problem of finding all the solutions to a given diffraction pattern. This talk is about new class of mathematical structures, which we call spatial stochastic processes, that provide a good setting for this type of problem. We indicate how this works in the case of pure point diffraction to classify all solutions to the inverse problem. The work is joint with Daniel Lenz.

IAN PUTNAM, University of Victoria
Some conjectures on tiling cohomology

Tiling cohomology (that is, the cohomology of the hull of an aperiodic material) has been studied quite intensely over the past fifteen years. Overall, its role as a quantification of aperiodic order remains unclear. In particular, there are some very basic questions concerning the first cohomology group which remain open. I will discuss a couple of these and some other related open problems.

NARAD RAMPERSAD, University of Liege
Decidable properties of automatic sequences

We discuss some decidable properties of automatic sequences. An automatic sequence is a sequence generated by first iterating a uniform substitution and then possibly relabelling some of the alphabet symbols. In 1986, Honkala showed that the problem of determining if an automatic sequence is ultimately periodic is algorithmically decidable. Several different proofs of this result have been given since then, including one by Allouche, Rampersad, and Shallit. In fact, the approach proposed by Allouche et al. can be presented in a more general framework based on a logical characterization of automatic sequences. This approach allows one to show very easily that certain properties (those expressible in a certain formal logic) of automatic sequences are algorithmically decidable. Such properties include periodicity, squarefreeness, recurrence, and many others. This is joint work with Emilie Charlier and Jeffrey Shallit.

CHRISTOPH RICHARD, Universität Erlangen
Ergodic properties of randomly coloured point sets

In order to analyse properties of an aperiodically ordered point set such as the vertex set of the Penrose tiling, it has proven useful to consider the closure of the collection of all translates of the given point set, with respect to a suitable topology. In particular, there is a geometric characterisation of unique ergodicity in terms of uniform pattern frequencies for point sets of finite local complexity. We give such a characterisation within a generalised setup, where we allow for a uniformly discrete point set in a locally compact metric space with a continuous and proper action of a locally compact, second countable, unimodular group, which admits suitable averaging sequences. We will discuss applications of our setup to random colourings and graphs. This is joint work with Peter Müller, Munich, see also http://arxiv.org/pdf/1005.4884.

LORENZO SADUN, University of Texas
A relative cohomology theory for tiling dynamical systems

Relative homology is based on inclusions of spaces, but factor maps between dynamical systems are typically surjective, not injective. I will present a variant of relative cohomology, called "quotient cohomology", that is adapted to this case, and show how it can be used to better understand dynamical systems with R^d actions, such as tiling spaces. Examples include variations on the chair tiling, and finite matching rules tilings that model substitution tilings. This is joint work with Marcy Barge