Noncommutative Workshop 24-27 January,

Department of Mathematics, (Huxley Building), Imperial College London.

Organizers : M. Ottobre, M. Alrashed, B. Zegarlinski

Minicourses : Raffaella Carbone, Nilanjana Datta, Anna Jencova

Talks by : Koenraad M.R. Audenaert, Madalin Guta, Myungshik Kim, Martin Lindsay, Martin B Plenio, Joachim Zacharias

Minicourses

Raffaella Carbone (Pavia) : Quantum Markov semigroups and hypercontractivity.

Abstract: The course will start with a brief introduction to quantum Markov semigroups, infinitesimal generators and invariant states. Contractive and asymptotic properties of the quantum semigroups will be discussed, considering the p-norms induced by the invariant states. Finally we will concentrate on hypercontractivity and its relation with logarithmic Sobolev inequalities. Some examples of quantum hypercontractive semigroups will also be described.

Nilanjana Datta (Cambridge) : Quantum Information, Entropy and Entanglement.

Abstract: Quantum Information Theory is an exciting, young field which lies at the intersection of Mathematics, Physics and Computer Science. It was born out of Classical Information Theory, which is the mathematical theory of acquisition, storage, transmission and processing of information. It is the study of how these tasks can be accomplished, using quantum-mechanical systems. The underlying quantum mechanics leads to some distinctively new features which have no classical analogues. These new features can be exploited, not only to improve the performance of certain information-processing tasks, but also to accomplish tasks which are impossible or intractable in the classical realm. The optimal rates of these tasks are usually quantified in terms of entropic quantities. Many of the important differences between Classical and Quantum Information Theory can be attributed to the presence of entanglement in quantum mechanics. In this mini-course I will give a very brief introduction to Quantum Information Theory, with particular focus on entropy and entanglement.

Anna Jencova (Slovak Acad. Sci.): Basic structures of quantum information geometry.

Abstract: An information manifold is a family of states of a classical or quantum system with the structure of a differentiable manifold. The manifold is endowed with a Riemannian metric and an affine connection, which are required to be invariant with respect to statistical (Markov) maps. An important feature of classical information geometry is that for probability distributions, this condition singles out a unique Riemannian metric (the Fisher metric) and a one-parameter family of connections. We study several possibilities to introduce similar structures for quantum states, for which such uniqueness no longer holds. As it turns out, the structures become unique if a further condition of dual flatness is imposed. Dually flat manifolds are closely related to Bregman divergences, for which generalized Pythagorean relation and projection theorems hold. We deal with these questions for states on matrix algebras, as well as general von Neumann algebras.

Talks

Koenraad M.R. Audenaert (Univ. London): Asymptotic error rates in symmetric quantum multi-hypothesis testing
Abstract: The problem to determine a closed form expression for the optimal asymptotic error rate in binary quantum hypothesis tests has been solved recently, giving rise to a quantum generalisation of the Chernoff information. For multi-hypothesis testing, however, this problem has only been solved for pure states and is still open for mixed states. We discuss recent progress on this matter by Tyson, Szkola and Nussbaum, Mosonyi and the speaker, and show how the problem would be solved by a conjectured inequality about positive definite matrices.

Madalin Guta (Nottingham): Asymptotic inference in system identification for the atom maser.

Abstract: System identification is an integrant part of control theory and plays an increasing role in quantum engineering. In the quantum set-up, system identification is usually equated to process tomography, i.e. estimating a channel by probing it repeatedly with different input states. However for quantum dynamical systems like quantum Markov processes, it is more natural to consider the estimation based on continuous measurements of the output, with a given input which may be stationary. We address this problem using asymptotic statistics tools, for the specific example of estimating the Rabi frequency of an atom maser. We compute the Fisher information of different measurement processes as well as the quantum Fisher information of the atom maser, and establish the local asymptotic normality of these statistical models. The statistical notions can be expressed in terms of spectral properties of certain deformed Markov generators and the connection to large deviations is briefly discussed.

Myungshik Kim (Imperial College London):

Martin Lindsay (Lancaster) : Tensoring an operator space with a dual operator space.

Abstract: An asymmetric tensor product,for an operator spaceV and a dual operator space Y, has been introduced. It is injective and contains the spatial tensor product, and also the normal spatial tensor product when V is a dual operator space too. It has been found to be effective in quantum stochastic analysis where one is interested in marrying the topology of a noncommutative state space, encoded in a C_*-algebra A, to the measure- theoretic noise, encoded in a filtration of von Neumann algebras, in order to construct stochastic flows on A. In this talk I shall outline the key features of this tensor product, in particular, the facility with which it permits ampliation of maps via its connection to mapping spaces, its restriction to the case where V is also a dual operator space (where symmetry is restored), and the connection to other tensor products and matrix spaces over operator spaces. The latter throws light on Neufang's recent treatment of ampliations of non-normal completely bounded operators between dual operator spaces which, for the case of functionals, goes back to early work of Tomiyama on Fubini tensor products and slice maps. The first part is partly joint work with Orawan Tripak.

Martin B Plenio (Universität Ulm & Imperial College London) : Exact mapping between system-reservoir quantum models and semi-infinite discrete chains using orthogonal polynomials with applications to non-Markovian dynamics.

Abstract: Multi-component quantum systems in strong interaction with their environment are receiving increasing attention due to their importance in a variety of contexts, ranging from solid state quantum information processing to the quantum dynamics of bio-molecular aggregates. Unfortunately, these systems are difficult to simulate as the system-bath interactions cannot be treated perturbatively and standard approaches are invalid or inefficient. Here we present the TEDOPA approach which is a combination of the time dependent density matrix renormalization group methods with techniques from the theory of orthogonal polynomials to provide an efficient method for simulating open quantum systems, including spin-boson models and their generalisations to multi-component systems.

Joachim Zacharias (Nottingham) : Title: On noncommutative topological entropy

Abstract: We review Voiculescu's approximation approach to noncommutative topological entropy and present and discuss several examples and some open problems. Most of the examples we discuss are endomorphisms on Cuntz algebras and their generalisations, which we have studied in collaboration with Adam Skalski.

Tue 24/01/12	Wed 25/01/12	Thu 26/01/12	Fri 27/01/12
Room 343 – 12.30-6pm	*Room 342 – 12.30-6pm*	*Room 343 – 12.30-2pm* *Room 342 – 2-3pm* *Room 139 – 3-6pm*	*Room 139 – 12.30-3pm* *Room 341 – 3-6pm*
Lec I_ND	**Lec I_AJ**	**Lec II_ND**	**Lec III_AJ**
TLKS: Martin Plenio, Myungshik Kim	**TLKS: Joachim Zacharias, Madalin Guta**	**TLKS: Martin Lindsay, Koenraad Audenaert**	**Lec III_RC**
Lec I_RC	**Lec II_RC**	**Lec II_AJ**	**Lec III_ND**