Abstracts

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Marc Arnaudon
Université of Bordeaux, France

Couplings of Brownian Motions with Set-Valued Dual Processes on Riemannian Manifolds

The purpose of this talk is to construct a Brownian motion (X_t) taking values in a Riemannian manifold M, together with a compact set-valued process (D_t) such that, at least for small enough (D_t)-stopping time T>0 and conditioned by $D_{[0,T]}$, the law of X_T is the normalized Lebesgue measure on D_T. This intertwining result is a generalization of Pitman's theorem. We first construct regular intertwined processes related to Stokes' theorem. Then using several limiting procedures we construct synchronous intertwined, free intertwined, mirror intertwined processes. The local times of the Brownian motion on the (morphological) skeleton or the boundary of each D_t play an important role. Several examples with moving intervals, discs, annuli, symmetric convex sets are investigated.

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Theo Assiotis
University of Edinburgh, UK

Interacting particle systems, conditioned random walks and the Aztec diamond

I will talk about a general class of integrable models of interacting particles in inhomogeneous space, containing various types of inhomogeneous pushTASEPs and zero range processes, and how they are connected to determinantal point processes, random walks conditioned to never intersect and random tilings of the Aztec diamond with inhomogeneous weights.

The integrability of these models comes from a natural generalisation of Toeplitz matrices which satisfy certain intertwining relations.

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Guillaume Barraquand
CNRS, France

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Andrew Chee
Cornell University, USA

Canonical Lifting of Intertwining to Higher Dimensions and Applications

We present a theory of canonical lifting and related transformations from one-dimension to higher dimension and related spaces, e.g. the Weyl chamber, that preserve intertwining. Such constructions coincide with rich classes of intertwined complex models (1) whose connections have not previously been identified or explored and (2) have not traditionally been studied in terms of their simpler one-dimensional counterparts. These include the well studied non-intersecting Markov processes, e.g. Dyson Brownian Motion and Dyson Laguerre processes, their discrete counterparts and their associated stationary ensembles. We leverage this theory to extend results on the universality of certain scaling limits to even broader classes of models.

This work is joint with Pierre Patie (Cornell).

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Reda Chhaibi
Université Toulouse III, France

A one-parameter family of intertwinings using curvature, and Pitman's celebrated 2M-X theorem

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In this talk following joint work with François Chapon, from Toulouse, we will revisit Pitman's celebrated 2M-X theorem stating that twice the running maximum of Brownian motion minus its current value is Markov.

Moreover the law is the same as the norm of a 3 dimensional Brownian motion.

While Rogers and Pitman give a proof based on intertwining, this intertwining is nothing but a point in a natural one-parameter family.

We will explain how this classical result can be explained thanks to a one-parameter family of interwinings.

The interpolation parameter is interpreted as a curvature parameter, hence a strong geometric flavor.

These interpolate between flat curvature where one has a norm process and infinite curvature where one finds the 2M-X process.

If time allows, we shall explain how this was hidden in works by Bougerol and Jeulin, and that there are quantum manifestations of this intertwining

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Michael Choi
National University of Singapore, Singapore

A rate-distortion framework for MCMC algorithms: geometry and factorization of multivariate Markov chains

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We introduce a framework rooted in a rate distortion problem for Markov chains, and show how a suite of commonly used Markov Chain Monte Carlo (MCMC) algorithms are specific instances within it, where the target stationary distribution is controlled by the distortion function. Our approach offers a unified variational view on the optimality of algorithms such as Metropolis-Hastings, Glauber dynamics, the swapping algorithm and Feynman-Kac path models. Along the way, we analyze factorizability and geometry of multivariate Markov chains. Specifically, we demonstrate that induced chains on factors of a product space can be regarded as information projections with respect to a particular divergence. This perspective yields Han--Shearer type inequalities for Markov chains as well as applications in the context of large deviations and mixing time comparison.

This is based on joint work with Youjia Wang and Geoffrey Wolfer.

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Kolehe Coulibaly-Pasquier
Université de Lorraine, France

On the separation cut-off phenomenon for Brownian motions on high dimensional rotationally symmetric compact manifolds

Given a family of compact, rotationally symmetric manifolds indexed by the dimension and a weighted function, we will study the cut-off phenomena for the Brownian motion on this family. Our proof is based on the construction of an intertwined process, a strong stationary time, an estimation of the moments of the covering time of the dual process, and on the phenomena of concentration of the measure. We will see a phase transition concerning the existence or not of cut-off phenomena, which depend on the shape of the weighted function.

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Sabine Jansen
Mathematisches Institut der Universität München, Germany

Talk 1and Talk 2: Intertwining for interacting particle systems in the continuum

Several interacting particle systems on lattices have duality functions that are products of single-site duality functions. How can we generalize this structure to the continuum?

In talk 1, explain how infinite-dimensional orthogonal polynomials known in non-Gaussian white noise and chaos decompositions for Lévy random fields enter the scene and how for formulate intertwining relations.

In talk 2, I comment on relations to the algebraic approach and give two probabilistic representations of the su(1,1) current algebra. This brings in negative binomial point processes, Gamma random measures, measure-valued processes, and spatial birth-death processes.

Based on joint works with Simone Floreani, Frank Redig and Stefan Wagner.

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Aldéric Joulin
Institut de Mathématiques de Toulouse, France

On the intertwining approach for proving Poincare type functional inequalities

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In this talk, we will introduce the notion of intertwinings between (weighted) gradient and operators and see how those identities might be used to derive Poincare type functional inequalities in various situations (non uniformly convex potentiels, perturbed product measures, log-concave measures on domains, etc.). This talk is based on a series of works in collaboration with Michel Bonnefont (Institut de Mathematiques de Bordeaux, France).

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Laurent Miclo
Centre National de la Recherche Scientifique (CNRS), France

On finite interweaving relations

A faithful bi-interweaving relation is a Markovian similarity-type relation between two Markov chains, strengthening the Markovian intertwining relation and introducing warming-up times after which the time-marginal distributions of the chains can be tightly compared (for any initial distributions).

For irreducible transition kernels on the same finite state space, these relations are shown to be equivalent to the generalised isospectrality relation, but this is no longer true for non-transient transition kernels, contrary to the faithful bi-intertwining relations. Some bounds are deduced on corresponding warming-up times, when the eigenvalues are furthermore assumed to be real (but still allowing for Jordan blocks).

When the eigenvalues are non-negative, the same approach enables us to construct strong stationary times for irreducible Markov chains through interweaving relations with model absorbed Markov chains, thus extending a result due to Matthews in the reversible situation.

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Neil O'Connell
University College Dublin, Ireland

Discrete Whittaker processes

I will discuss a Markov chain on reverse plane partitions (of a given shape) which is closely related to fundamental Whittaker functions and the Toda lattice. This process has non-trivial Markovian projections and a unique entrance law starting from the reverse plane partition with all entries equal to plus infinity. I will also outline some connections with imaginary exponential functionals of Brownian motion, a semi-discrete polymer model with purely imaginary disorder, interacting corner growth processes and discrete delta-Bose gas, and hitting probabilities for some low rank examples.

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Federico Sau
University of Trieste, Italy

Mixing & scaling limits of the averaging process

The averaging process on a graph is a continuous-space Markov chain, which is commonly interpreted as an opinion dynamics, a distributed algorithm, or an interface moving through a randomized sequence of deterministic local updates. Its dynamics goes as follows. Attach i.i.d. Poisson clocks to edges, and assign real values to vertices; at the arrival times of these clocks, update the values with their average. As time runs, the averaging process converges to a flat configuration, and one major problem in the field is that of quantifying the speed of convergence to its degenerate equilibrium in terms of characteristic features of the underlying graph. In this talk, after reviewing some basic properties, intertwining relations, and recent results on mixing times for the averaging process on general graphs, we then focus on the discrete d-dimensional torus, and on some finer properties of the process in this setting. We discuss some quantitative features (e.g., limit profile, early concentration and local smoothness), and look at nonequilibrium fluctuations, a particularly interesting problem in this degenerate context lacking a non-trivial notion of local equilibrium.

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Rohan Sarkar
University of Connecticut, USA

Intertwining of some Markov semigroups on Carnot groups of step 2

We consider the hypoelliptic sub-Laplacian on Carnot groups of step 2. This operator is the generator of a Markov semigroup, which is known as the horizontal heat semigroup on the Carnot group. Using some intertwining relationships, we provide a complete description of the spectrum of these operators on $L^2(G)$, where G denotes the Carnot group of step 2. We further consider the Ornstein-Uhlenbeck operator on G and its Lèvy-type perturbations. We prove that all these perturbations are generators of some ergodic Markov semigroups on G. Moreover, under some mild conditions, all these perturbations are isospectral. Our methods rely on the Harmonic analysis on Carnot groups and some intertwining relationships.

This is a joint work with Maria Gordina (University of Connecticut).

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Mladen Savov
Sofia University and Bulgarian Academy of Sciences, Bulgari

Intertwining of non-self-adjoint Markov semigroups

In this talk we will discuss question related to the intertwining of non-self-adjoint Markov semigroups. First, we are going to discuss the intertwining between minimal semigroups and how this is preserved for any Itô's recurrent extension of these semigroups. When one of the semigroups is a quasi-diffusion then we extend Krein theory of strings and offer some spectral decompositions. In this talk we will also present results concerning the spectral theory of generalized Laguerre semigroups the results on which have been the motivation for many further studies.

The results are based on joint works with P. Patie and Y. Zhao

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Dario Spano
Warwick University, UK

Dualities and intertwinings in population genetics diffusions and beyond

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Mathematical population genetics has been an incredible culture broth for the recent developments of the modern theory of stochastic duality. Duality in genetics clarifies the intrinsic link between forward-in-time dynamics of a population's allele frequencies evolution and backward-in-time dynamics of the same population's ancestry. It has yielded a probabilistic insight into the spectral properties of both processes, and helped significantly the tractability of such processes for simulation and inference. I will review some aspects of stochastic duality - and related intertwining operators - playing a key role in the analysis of Wright-Fisher diffusion processes of population genetics and in some of their (not necessarily diffusive) generalisations, for which some open problems will be discussed.

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Filip Stojanovic
Cornell University, USA

An algebraic perspective for scaling limits of non-self-adjoint operators

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Many scaling limits in the random matrix theory literature can be fruitfully studied in terms of limits of a scaling action on the spectral projections of a self-adjoint operator, with the corresponding limiting operator itself being a projection of another self-adjoint operator. This perspective led to a novel approach proposed by P. Patie to study the universality phenomenon for these limiting self-adjoint operators, making use of ideas from operator algebras, representation theory, and spectral theory. In this talk, we describe this approach to self-adjoint scaling limits, and we present some results and techniques, based on intertwining relations, towards obtaining the domain of attraction of some non-self-adjoint operators.

This is based on ongoing work with P. Patie.

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Jan Swart
Czech Academy of Sciences, Czech Republic

A numerical search for intertwining relations

I will be interested in relations of the form PK=KQ where P,Q, and K are n by n matrices that are probability kernels. Such a relation is called an intertwining relation and K is called the intertwiner. To stress the different roles of P and Q, I will say that Q is intertwined on top of P. I am interested in the case that P is a given and one is looking for K and Q. In particular, the aim may be to understand the slow and fast modes of the Markov chain with transition kernel P by intertwining it with a Markov chain with a simpler transition kernel Q. Motivated by known results for birth-and-death processes, I will present a numerical method that aims to find K and Q with certain desirable properties given P. Most of this is nonrigorous, and work in progress.

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Matthias Winkel
Oxford University, UK

Projections of the Aldous chain on binary trees: Intertwining and consistency

Consider the Aldous Markov chain on the space of rooted binary trees with n labelled leaves in which at each transition a uniform random leaf is deleted and reattached to a uniform random edge. Now, fix $1 \leqslant k < n$ and project the leaf mass onto the subtree spanned by the first k leaves. This yields a binary tree with edge weights that we call a "decorated k-tree with total mass n". We introduce label swapping dynamics for the Aldous chain so that, when it runs in stationarity, the decorated k-trees evolve as Markov chains themselves, and are projectively consistent over k. The construction of projectively consistent chains is a crucial step in our construction of the Aldous diffusion on continuum trees, which is the $n \to \infty$ continuum analog of the Aldous chain.

This is joint work with Noah Forman, Soumik Pal and Douglas Rizzolo.

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Ali Zahra
Instituto Superior Técnico, Portugal

Single impurity in a step initial profile of the Totally Asymmetric Simple Exclusion Process

We study the behavior of a single impurity particle embedded at the interface separating two density regions of the Totally Asymmetric Simple Exclusion Process (TASEP). By analyzing the impurity's dynamics, characterized by two arbitrary hopping parameters α and β, we explore its macroscopic impact on the overall system as well as its own trajectory, offering new insights into the interplay between the impurity and the TASEP environment. We systematically classify the induced hydrodynamic limit shapes based on the initial left and right densities, as well as the values of α, β. We conceive a novel coupling tool that allows to describe the behavior of the impurity particle in an arbitrary density field, generalizing the basic coupling technique conventionally used for secondclass particles. Thanks to this new tool, we extend under certain parameter conditions, Ferrari and Kipnis's known results on the asymptotic speed of a second-class particle in the rarefaction fan to the context of the impurity. We report numerical evidence of a departure from the uniform distribution of speeds under different parameter sets. As a by-product of our formalism, we provide a new simple proof of the expression of the speed of the impurity in a uniform environment, obtained by K. Mallick and B. Derrida using integrable techniques.

This is a joint work with Luigi Cantini.

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