
Luisa Andreis (University of Padova)
Ergodicity of a system of interacting random walks with asymmetric interaction

We consider a model of interacting random walks on N introduced in [1], where an asymmetric mean-field interaction may ensure ergodicity. For a fixed $N \geq 2$, let us consider N particles evolving in N. We provide every particle with an intrinsic dynamics given by a biased random walk reflected in zero, which gives clearly a transient process. Therefore, we add an asymmetric interaction that pushes each particle towards the origin and depends only on the fraction of particles below its position. We focused on the critical interaction strength above which the N particle system and its corresponding nonlinear limit have a stationary measure, balancing the tendency of the biased random walks to escape to infinity. A similar model has been studied in the continuous with diffusive dynamics [2], where the authors consider a system of particles interacting through their cumulative distribution function. The discrete model we consider displays a peculiar difference: the particles can form large clusters on a single site and, according to our description, they cannot interact. This gives rise to non-trivial expression for the critical interaction strength, unexpected from the analysis of the continuum model. This poster is based on a joint work with Amine Asselah and Paolo Dai Pra.

References
[1] L. Andreis, A. Asselah and P. Dai Pra. Ergodicity of a system of interacting random walks with asymmetric interaction. In preparation (2017).
[2] B. Jourdain and F. Malrieu. Propagation of chaos and Poincaré inequalities for a system of particles interacting through their CDF, Annals of Applied Probability, 18(5):1706-1736, 2008.

Manon Baudel (Université d'Orléans)
Spectral theory for random Poincaré maps

We consider stochastic differential equations, obtained by adding weak Gaussian white noise to ordinary differential equations admitting N asymptotically stable periodic orbits. To quantify the rare transitions between periodic orbits, we construct a discrete-time, continuous-space Markov chain, called a random Poincaré map. We show that this process admits exactly N eigenvalues which are exponentially close to 1, and provide expressions for these eigenvalues in terms of committor functions of neighbourhoods of periodic orbits. The eigenvalues and eigenfunctions are well-approximated by principal eigenvalues and quasistationary distributions of processes killed upon hitting some of these neighbourhoods. The proofs rely on Feynman–Kac-type representation formulas for eigenfunctions, Doob's h-transform, spectral theory of compact operators, and a detailed balance property satisfied by committor functions. Joint work with Nils Berglund (Orléans).

Panagiota Birmpa (University of Sussex)

Minimal cost for the macrsoscopic motion of an interface

We study the most probable way an interface moves on a macroscopic scale from an initial to a final position within a fixed time in the context of large deviations for a stochastic microscopic lattice system of Ising spins with Kac interaction evolving in time according to Glauber dynamics. Such interfaces separate two stable phases of a ferromagnetic system and in the macroscopic scale are represented by sharp transitions. We derive quantitative estimates for the upper and the lower bound of the cost functional that penalizes all possible deviations and obtain explicit error terms which are valid also in the macroscopic scale. Furthermore, by finding the minimizers of this cost functional for the macroscopic motion of the interface in a fixed time, we prove that the probability of such events can concentrate on nucleations should the transition happen fast enough.

Francesca Collet (Delft University of Technology), **Marco Formentin**, **Daniele Tovazzi** (Università degli Studi di Padova)

Rhythmic behavior in a two-population mean field Ising model

A fundamental problem in complex systems is to understand how many interacting components organize to produce a coherent behavior at a macroscopic level. Basic examples include polarization (e.g. spin alignment) and synchronization (e.g. phase locking for rotators). A less understood phenomenon of self-organization consists in the emergence of periodic behavior in systems whose units have no tendency to evolve periodically.

In the poster we discuss some dynamical features of a two-population generalization of the mean field Ising model with the scope of investigating simple mechanisms capable to generate a rhythm in large groups of interacting individuals. In particular, we aim at understanding the role of interaction network topology and interaction delay in enhancing the creation of rhythms.

Our main finding indicates that having two groups of spins with possibly different size and different inter- and intra-population interactions suffices for the emergence of macroscopic oscillations. Moreover, delay may produce periodic behavior in interaction network configurations where otherwise absent.

Based on: Collet, Formentin and Tovazzi. Rhythmic behavior in a two-population mean field Ising model. Phys. Rev. E, 94(4): 042139, 2016.

Maximilian Engel (Imperial College London)
Synchronisation and Chaos in Stochastic Hopf Bifurcation

We consider the two-dimensional normal form of a Hopf bifurcation with additive white noise and phase-amplitude coupling (shear) and investigate the bifurcation behaviour of the stochastic system. The most relevant observable is the first Lyapunov exponent with respect to the stationary measure of the stochastic process. We determine the sign of this exponent depending on the bifurcation parameter, the noise intensity and the shear parameter. We find negative top Lyapunov exponents if the shear is small enough and conclude that the random attractor consists of singletons implying synchronisation.
However, for certain big enough values of shear, we observe positivity of the first Lyapunov exponent corresponding with chaotic random attractors. This leads to a new dynamical bifurcation scenario from order to chaos. We encounter difficulties in showing positive Lyapunov exponents that we tackle by considering similar slightly simpler models.

Pierre-Yves Louis, Meghdad Mirebrahimi (University of Poitiers)
Interacting stochastic processes with competing local/global reinforcement schemes

The Polya urn is a well known reinforcement stochastic process leading to a random (beta-distributed) time-asymptotics. The Friedman urn is a modification whose time-limit is not random anymore. We consider a (finite-) system of interacting reinforced stochastic processes mixing these two schemes with different strength. Individual components are updated through a competition between a local reinforcement rule and a global one, defined as transformation of the average state (mean field). We study the time-asymptotics and synchronisation phenomenon according to the different parameter regimes.

Lara Neureither (FU Berlin)
Analysis of entropy production rates for linear SDEs

Working with stochastic processes one of the key quantities of interest is the relaxation behaviour of the process to its equilibrium distribution. We investigate this behaviour in terms of relative entropy. For linear systems there exist bounds on the entropy production rates which are given by the minimum real part of the spectrum of the drift matrix. When simulating and observing the process the resulting entropy production curve often differs a lot from the theoretic bounds. We analyse these observations with respect to multiple parameters such as initial conditions, temperature but also parameters in the system which correspond to a time scale seperation between degrees of freedom in the system. Trying to make use of what we have learned about the relaxation behaviour we look for methods extracting fast and slow degrees of freedom from the system.

Atul Kumar Verma, Arvind Kumar Gupta (Department of Mathematics, Indian Institute of Technology Ropar)

Modelling of Driven Stochastic Transport Problems using out of equilibrium systems

Many natural systems exhibit complex behavior under stationary state when either driven by some external field or self driven. Such driven diffusive systems reveal very rich nonequilibrium phenomena in physics, chemistry and biology such as kinetics of bio-polymerization dynamics of motor proteins in biological cells, gel electrophoresis, vehicular traffic and modeling of ant-trails [1]. In biological systems, molecular motors are motor proteins that consume chemical energy and move along polymer filaments of the cytoskeleton, which act as macromolecular tracks [2]. Their collective dynamics plays a major role in various intracellular processes/functions such as cellular trafficking, protein synthesis, cell division etc. In order to analyze the collective properties of interacting molecular motors and other driven stochastic transport problems, totally asymmetrically simple exclusion process (TASEP) model that is an out of equilibrium system is found to be a paradigmatic model to study such problems in the last decade [3]. TASEP model comprises of single species of particles performing biased hopping with uniform rate in a preferred direction along a 1D lattice. The particles obey certain preassigned rules under hard-core exclusion principle, due to which a lattice site cannot have more than one particle.

In this presentation, I will begin with some beautiful theoretical results on single channel exclusion process followed by results on coupled as well as uncoupled two channel exclusion process. Effect of an important nonconserving dynamics known as Langmuir Kinetics on single as well as two channel open system will be presented. Additionally, to mimic some stochastic transport problems more realistically, we extend two channel system into three-channel systems in presence of the attachment - detachment process with open boundary conditions. To understand the collective dynamics of system, we derive various phase diagrams and density profiles using mean-field theory along with singular perturbation technique, for different values of binding constant which is the ratio of attachment and detachment rates. Monte-Carlo simulations are carried out for verifying our theoretical findings, which are in good agreement with simulation results. We have found that binding constant affects system dynamics significantly and many new phases are observed. It is also noticed that number of steady-state phases vary non-monotonically with an increase in binding constant.

References

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