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Report on a short-term visit (RDSES Programme)

Synchronisation in coupled metastable systems

During the visit to the CPT in Marseille, which took place from 24 November to 5 December 2005, the collaborative research with Nils Berglund on the effect of noise on coupled dynamical systems has been continued. While previous joint work focussed on slowly driven systems, we now turned our attention to systems consisting of several identical units. As a first step we studied noise-induced transitions in a chain of bistable systems, modelled by coupled stochastic differential equations. Picturing the full system as a collection of particles, each of them living in its own double-well potential, but "feeling" the other particles' positions, we investigated the question of the synchronisation of the particles' positions due to noise for sufficiently strong coupling strength.

Bastien Fernandez (also CPT Marseille) as another expert on dynamical systems joined the team, and we set off by studying the potential landscape for the full system, thereby obtaining the necessary information enabling us to draw on the classical Wentzell–Freidlin theory to describe the most probable way for synchronisation to be achieved. This allows to determine those sequences of configurations for the particles which are most likely attained one after the other when the systems moves towards synchronisation. Depending on the crucial parameters such as coupling strength and noise intensity, these sequences can be unique (in the situation where strong coupling makes the particles move basically all at once), or there are several sequences, equivalent in terms of the large-deviation rate function.

In addition, the exponential asymptotics of the mean time needed for such transitions are obtained.

We intend to purpose this collaboration, which can be expected to lead to a series of publications over the next years. A first publication being based on the results achieved so far will be prepared in near future.