Model reduction for stochastic processes exhibiting multiple scales

We consider stochastic processes as they appear in modelling molecular and cellular dynamics. Such processes exhibit a rich hierarchy of scales that easily span 15 orders of magnitude in time and several more in space. However, understanding biological function typically requires information about the dynamical behavior on the longest timescales and often also on large spatial scales.

Simulation of the processes on such scales is not feasible today, not even on the fastest and largest supercomputers. Therefore mathematical strategies are required that allow for a massive reduction of complexity but still lead to good approximation of the dynamical behavior on the largest scales. The talk will review the progress that has been made in this direction in recent years along the lines of metastable process and transfer operator analysis but will also discuss open problems and main challenges for future research. It will start with a detailed introduction into the biological background.

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