Harmonic oscillator in heat bath: Exact simulation of time-lapse-recorded data and exact analytical benchmark statistics - DTU Orbit (28/12/2018)

Harmonic oscillator in heat bath: Exact simulation of time-lapse-recorded data and exact analytical benchmark statistics

The stochastic dynamics of the damped harmonic oscillator in a heat bath is simulated with an algorithm that is exact for time steps of arbitrary size. Exact analytical results are given for correlation functions and power spectra in the form they acquire when computed from experimental time-lapse recordings. Three applications are discussed: (i) The effects of finite sampling rate and time, described exactly here, are similar for other stochastic dynamical systems e.g., motile microorganisms and their time-lapse-recorded trajectories. (ii) The same statistics is satisfied by any experimental system to the extent that it is interpreted as a damped harmonic oscillator at finite temperature such as an AFM cantilever. (iii) Three other models of fundamental interest are limiting cases of the damped harmonic oscillator at finite temperature; it consequently bridges their differences and describes the effects of finite sampling rate and sampling time for these models as well.

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