

# Projection formalisms for dimensional reduction and multiscale sampling

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Title: Statistical projections for dimensional reduction and for multiscale sampling.

Abstract: Given a set of equations that describe the time evolution of a dynamical system, the Mori-Zwanzig formalism of statistical mechanics generates the exact equations of motion for a subset of the variables given an initial probability density for all the variables. The complexity of the formalism can be tamed by approximation, in the well-known case of scale separation, but also in the interesting case of long memory, as for example in hydrodynamics. The analysis also shows the perils in averaging equations, and the need to take into account noise and memory effects in the reduction of nonlinear systems. Examples will be given.

A different limit of this formalism produces marginals for subsets of variables in sampling problems, and leads to interesting Monte Carlo sampling methods that require no Markov chains. An application to a spin glass problem will be exhibited.

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