An Adaptive Gaussian-Based Time Integrator for Fokker–Planck Equations

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In this talk, we present a numerical solver for Fokker–Planck equations based on linear combinations of Gaussian functions. This class of functions provides a natural representation of probability densities and therefore offers a convenient framework for approximating the evolution of solutions to Fokker–Planck equations.

Our approach relies on an operator-splitting strategy. The transport step is handled by approximating the action of the characteristic flow on each Gaussian component, while the diffusion step is treated analytically. During the computation, the method adaptively adjusts the number of Gaussian components according to a prescribed error tolerance.

We provide a convergence analysis of the proposed scheme and illustrate its performance through numerical experiments. Beyond Fokker–Planck equations, this Gaussian-based approximation opens the door to new classes of numerical solvers for mean field games, where the evolution of a probability density is coupled with a Hamilton–Jacobi–Bellman equation.