Long-time analysis of second-order Langevindiffusions with distribution-dependent forces

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We study the long-time behaviour of the second-order Langevindynamics, which can be understood as the probabilistic counterpart of the kinetic Fokker-Planck equation. We consider both the classical Langevindynamics and the nonlinearLangevindynamics of McKean-Vlasovtype containing distribution-dependent forces. Rather than relying on classical hypocoercivitymethods, we use a coupling approach to establish global contraction in an L^1Wassersteindistance with an explicit dimension-free rate for pairwise weak interactions. For external forces corresponding to a κ-strongly convex potential, a contraction rate of order $O(\sqrt{\kappa})$is obtained in certain cases. The contraction result is, however, not restricted to this convex setting. It extends to multi-well potentials, non-gradient-type external forces, and non-gradient-type repulsive and attractive interaction forces. The proof is based on a novel distance function which combines two contraction results for large and small distances and uses a coupling approach adjusted to the distance. By applying a componentwiseadaptation of the coupling we show uniform in time propagation of chaos bounds for the corresponding mean-field particle system. We conclude with a brief discussion of numerical discretization schemes for the dynamics.