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Embedded Ensemble Propagation for Improving Performance, Portability and Scalability of Uncertainty Quantification on Emerging Computational Architectures

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Typical approaches for forward uncertainty propagation involve sampling of computational simulations over the range of uncertain input data. Often simulation processes from sample to sample are similar. We explore a rearrangement of sampling methods to simultaneously propagate ensembles of samples in an embedded fashion. We demonstrate this enables reuse between samples, reduces computation and communication costs, and improves opportunities for fine-grained parallelization, resulting in improved performance on a variety of contemporary computer architectures. Building on these techniques, we explore strategies for grouping samples into ensembles for adaptive stochastic collocation methods applied to anisotropic diffusion problems.