KRYLOV SUBSPACE RECYCLING FOR STOCHASTIC COLLOCATION BASED UNCERTAINTY QUANTIFICATION

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Abstract

The stochastic collocation methods transform the PDE with random data to a deterministic problem by using a expansion or polynomial chaos expansion. After discretization, one is required to solve a sequence of linear systems. Krylov subspace recycling is a technique to accelerate the solution of sequences of linear systems. Typically, recycling algorithms are useful when each system in the sequence requires a large number of iterations to converge. When the underlying PDE is an elliptic diffusion equation, then linear systems converge rapidly, and hence, there is not enough "information" generated in one linear system to be recycled to the next (although recycling is needed due to the large number of linear systems in the sequence). We modify existing recycling algorithms such that the recycle space can be built even for rapidly converging linear systems. Recycling algorithms typically use an approximate invariant subspace as the recycle space. We show that another criterion works better here. Experiments show savings of up to 55 percent in time for an uncertainty quantification example.

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