ANALYSIS OF ACCURACY IN FORMATION OF REDUCED ORDER MODEL

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We examine the effects of basis vectors solved with loose tolerance on performance of a reduced order model. Our method builds a reduced order model from a set of solutions $h*$ and the sensitivity of those solutions to the parameters κi. We then use Proper Orthogonal Decomposition (POD) to orthogonalize the basis and select only the most significant basis vectors. The sensitivity vectors are solved with a linear system that utilizes the matrix construction and factorization of the full model. For large scale problems, it is untenable to solve the system directly and we use iterative methods. The user must define a tolerance to terminate iteration for these methods, and we explore how that tolerance affects the efficiency of the reduced order model.
A low-accuracy set of basis vectors poses several difficulties in the optimization algorithm. Primarily, any reduction of error in the reduced order model does not necessarily translate into a similar convergence of the full model. The optimization process must also be tuned to avoid overanalyzing the results of the low- accuracy reduced order model. Rather than completely explore the parameter space the optimizer should find a suitable local minimum and query the full model again.
Our method explores the effects of several tolerances for both the solution and the solution sensitivities on three 3-D domains. Our applications are large-scale saturated groundwater models. We show that a low accuracy solve for the full model solution always causes poor convergence for the optimizer. However, in some cases a low accuracy solve for the sensitivities can be overcome by high accuracy solves in the solution. Our results compare total computation time, final error in the full model solution, and error in parameter values.