DEIM: A Method for Nonlinear Model Reduction

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A dimension reduction method called Discrete Empirical Interpolation (DEIM) is described and shown to dramatically reduce the computational complexity of the popular Proper Orthogonal Decomposition (POD) method for constructing reduced-order models for parametrized nonlinear partial differential equations (PDEs). DEIM is a technique for reducing the complexity of evaluating the reduced order nonlinear terms obtained with the standard POD-Galerkin. POD reduces dimension in the sense that far fewer variables are present, but the complexity of evaluating the nonlinear term remains that of the original problem. DEIM is a modification of POD that reduces complexity of the nonlinear term of the reduced model to a cost proportional to the number of reduced variables obtained by POD. The method applies to arbitrary systems of nonlinear ODEs, not just those arising from discretization of PDEs.

In this talk, the method will be developed along with a discussion of its approximation properties. Applications from Neural Modeling, Porous Media Flow, and shape optimization will be presented to illustrate the wide applicability of the DEIM approach.