Reduced-Order Modeling

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One of the most current research goals in computational sciences is to solve very large scale PDE problems coming from real-life applications in real time. Model-Order Reduction (MOR) is one of the most popular approaches to achieving this. MOR aims to project the original large problem into a subspace in a way that yields good approximate solutions in real computational time. Standard approaches are based on Proper Orthogonal Decomposition (POD) using snapshots of the original system. In our presentation, we will motivate and describe our ongoing research and our results, built on the idea that it is not necessary to invest time in computing snapshots to get a reduced base and later obtain good approximate solutions.

In particular, the approach we will be describing consists in solving the problem on a coarser discretization mesh of the original solving space. We show that even when we coarsen the mesh by going, e.g., from a 400-dimensional space to a 100-dimensional space, we are able to retain the quadratic convergence rate of the Newton method when applied to solving the square nonlinear problems associated to the problem.

We ran experiments using cubic splines to interpolate the rest of the spacial mesh. Our preliminary numerical results are promising, including competitive accuracy (when compared against the original models) and much improved computational time.