Minisymposium 2 - Numerics for PDE-Constrained Control Problems

Improved construction and application of reduced-order models

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The approximate solution of optimization and control problems constrained by nonlinear partial differential equations is often a formidable task. At the least, it requires multiple state solutions or, in the feedback control setting, real-time state solutions. These tasks are difficult or even impossible to accomplish without using some sort of model reduction technique. We discuss some recent developments in the construction and application of reduced-order models for reducing the cost of state solutions. We focus on two issues: the generation of snapshots upon which reduced-order models are built and the incorporation of a parallelism-in-time methodology into reduced-order solution strategies. In the first case, we discuss some novel techniques developed by several authors (notably Antony Patera and co-workers and Omar Ghattas, Karen Willcox, and co- workers) for adaptively sampling parameter space during the snapshot generation process. We also show the results of some computational experiments that test the ability of reduced-order models to remain useful as the dynamical nature of the state solution changes during the optimization process. We close by describing some recent work (by Janet Peterson and co-workers) on combining the parareal algorithm for time parallelism with reduced-order modeling, showing that the combination results in significant speedups compared to using only reduced-order modeling.