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Optimal control for a class of linear transport-dominated systems via the shifted proper orthogonal decomposition

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Solving optimal control problems for transport-dominated partial differential equations (PDEs) can become computationally expensive, especially when dealing with high-dimensional systems. To overcome this challenge, we focus on developing and deriving reduced-order models that can replace the full PDE when solving the optimal control problem.
Specifically, we explore the use of the shifted proper orthogonal decomposition (sPOD) as a reduced-order model, which is particularly effective for capturing high-fidelity, low-dimensional representations of transport-dominated phenomena.
Furthermore, we propose two distinct frameworks for addressing these problems: one where the reduced-order model is constructed first, followed by optimization of the reduced system, and another where the original PDE system is optimized first, with the reduced-order model subsequently applied to the optimality system. We consider a 1D linear advection equation problem and compare the computational performance of the shifted POD method against conventional methods like the standard POD when the reduced-order models are used as surrogates within a backtracking line search.

This is joint work with S. Burela and P. Schulze from TU Berlin.

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