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Using ROM and adjoint-ROM for an optimal control BOLUN XU, MINGJUN WEI, Kansas State University, JOHN HRYNUK, U.S. Army Research Lab — Adjoint-based optimization allows to simultaneously optimize a large number of control parameters of a fluid problem without additional cost as the control parameters increases. The adjoint-based approaches make it possible to optimize fluid problems in a large control space where parametric study and other optimization approaches become computationally infeasible. However, typical adjoint-based approaches still involve computations as heavy as their forward computations (e.g. direct numerical simulation), the tens or hundreds of forward and adjoint computations involved in an optimization process will add up the cost quickly. Reduced order model (ROM), on the other hand, largely reduces the computational cost at the cost of lower fidelity. Though parametric study becomes possible in some cases with the much lower cost of ROMs, for a large group of problems, it is still too expensive due to the exponential increase of cost to the number of control parameters. The current study applies ROM and adjoint-ROM to provide a low-fidelity fast optimization which benefits from both the ROM's fast speed and the adjoint method's cost independence of the number of control parameters. The derivation and methodology will be first described, and then the benchmark and applications will be shown.

Mingjun Wei
Kansas State University

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