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Adaptive space-time model order reduction with dual-weighted residual (MORe DWR) error control for poroelasticity

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Abstract In this work, the space-time MORe DWR (M odel O rder Re duction with D ual- W eighted R esidual error estimates) framework is extended and further developed for single-phase flow problems in porous media. Specifically, our problem statement is the Biot system which consists of vector↓alued displacements (geomechanics) coupled to a Darcy flow pressure equation. The MORe DWR method introduces a goal-oriented adaptive incremental proper orthogonal decomposition (POD) based-reduced-order model (ROM). The error in the reduced goal functional is estimated during the simulation, and the POD basis is enriched on-the-fly if the estimate exceeds a given threshold. This results in a reduction of the total number of full-order-model solves for the simulation of the porous medium, a robust estimation of the quantity of interest and well-suited reduced bases for the problem at hand. We apply a space-time Galerkin discretization with Taylor-Hood elements in space and a discontinuous Galerkin method with piecewise constant functions in time. The latter is well-known to be similar to the backward Euler scheme. We demonstrate the efficiency of our method on the well-known two-dimensional Mandel benchmark and a three-dimensional footing problem.